Academic Regulations, Curriculum and Syllabi 2021

B. Tech.
Civil Engineering

(Duration of Study : 4 years)

Department of Civil Engineering
GMR Institute of Technology
Rajam, Andhra Pradesh
(An Autonomous Institute, Affiliated to JNTUGV, Vizianagaram, AP)
NBA Accredited and NAAC Accredited



Academic Rules and Regulations

2021

Undergraduate Programs



GMR Institute of Technology
Rajam 532 127, Andhra Pradesh
(An Autonomous Institute, Affiliated to JNTUGV, Vizianagaram, AP)
Accredited by NAAC & NBA

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Academic Regulations
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Undergraduate Programs
Version 2



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The Vision of GMRIT

- To be among the most preferred institutions for engineering and technological education in the country
- An institution that will bring out the best from its students, faculty and staff – to learn, to achieve, to compete and to grow – among the very best
- An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture

The Mission of GMRIT

- To turnout disciplined and competent engineers with sound work and life ethics
- To implement outcome based education in an IT-enabled environment
- To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty and staff
- To develop teaching, research and consulting environment in collaboration with industry and other institutions

Academic Regulations for B. Tech. Program

(For all the candidates admitted from the Academic Year 2021 onwards)

1. Eligibility for Admission

The total seats available as per the approved intake are grouped into two categories viz. category A and Category B with a ratio of 70:30 as per the state government guidelines.

a. The admissions for category A and B seats shall be as per the guidelines of Andhra Pradesh State Council for Higher Education (APSCHE) in consonance with government reservation policy

b. Admission eligibility-Under Lateral Entry Scheme

Students with diploma qualification have an option of direct admission into 2nd year B. Tech. (Lateral entry scheme). Under this scheme 10% seats of sanctioned intake will be available in each course as supernumerary seats. Admissions to this three-year B Tech later entry Programme will be through APECET. The maximum period to complete B. Tech. under lateral entry scheme is six consecutive academic years from the date of joining

2. Duration of the Programme

The course duration for the award of the Degree in **Bachelor of Technology** will be four academic years, with two semesters in each year. However, if a student is unable to complete the course within 4 years, he/she can do so by giving more attempts but within 8 consecutive academic years from the date of admission.

2.1 Academic Calendar

For all the eight semesters a common academic calendar shall be followed in each semester by having sixteen weeks of instruction, one week for the conduct of practical exams and with three weeks for theory examinations and evaluation. Dates for registration, sessional and end semester examinations shall be notified in the academic calendar of every semester. The schedule for the conduct of all the curricular, co-curricular and extra-curricular activities shall be notified in the semester planner.

3. Award of the Degree

A student will be declared eligible for the award of B. Tech. degree if he/she fulfills the following:

1. Pursues a course of study in not less than four and not more than eight academic years
2. After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech. course and their admission stands cancelled
3. Registers for 160 credits and must secure all the **160** credits
4. A student shall be eligible for the award of B.Tech degree with Honours or Minors if he/she earns 20 credits in addition to the 160 credits
5. A student shall be permitted to register for Honors or Minors and not for both.

4. Branches of Study

B. Tech. Programmes

I. Chemical Engineering (CH)
II. Civil Engineering (CE)
III. Computer Science and Engineering (CSE)
IV. CSE (Artificial Intelligence & Data Science)
V. CSE (Artificial Intelligence & Machine Learning)
VI. Electrical and Electronics Engineering (EEE)
VII. Electronics and Communication Engineering (ECE)
VIII. Information Technology (IT)
IX. Mechanical Engineering (ME)

5. **Program Structure & Curriculum Framework**

The curriculum of B. Tech. program has different categories of courses. For a total of 160 credits the indicative credit distribution among these categories is listed in table below for all the programs.

No.	Categories of Courses	Credits
1	Basic Science & Humanities	26.5
2	Engineering Science	21
3	Professional Core	37.5
4	Professional Core Electives	12
5	Open Electives	12
6	Skill Oriented	31.5
7	Internships and Project	19.5
8	Audit Courses	Non-Credit

The curriculum and its structure is designed based on the philosophy of Outcome Based Education with a composition of courses spread out in the various categories listed above and syllabi is prescribed by the respective Boards of Studies from time to time. The students have an option of taking nine electives based on their interest/career path spanned across 5th to 8th semesters from the list of electives prescribed in the curriculum. Under Choice Based Credit System (CBCS) the students also have the flexibility to choose one elective from the list of open electives offered by the other programs of study in consultation with their respective department. Following are some of the distinct courses that are being offered in the curriculum.

a. **Skill Oriented Courses:** Skill Oriented Courses are offered in the form of Integrated courses that are exclusively designed to provide a unique learning experience of layered learning where in the students have the chances to practice while learning. These courses are designed by blending both theory and laboratory components one over the other
b. **Mini project:** The curriculum offers Mini Project for the students during 6th semester. They will be divided into batches and the report will be evaluated by a committee as nominated by CoE constituted with internal and external members
c. **Term paper:** The term paper is a self-study report with an objective enhancing the students' written technical-communication and shall be carried out in 5th semester. Every student will take up this either individually or as a batch of maximum four members and submit a report. The scope of the term paper could be an exhaustive literature review choosing any engineering concept with reference to standard research papers or an extension of the concept of earlier course work in consultation with the term paper supervisor.

   The report will be evaluated by a committee nominated by HoD with the approval of the Controller of Examinations (CoE)
d. **Project work**: The final year project work shall be carried out during the 7th or 8th semester based on the interest of the students. Students shall take up the capstone project at the industries along with the full semester internship (FSI) in the same industry. However, students should take prior permission if he/she is interested to take up both the

above said courses and shall submit separate report. Projects shall be taken up either as a team or as an individual.

Internal evaluation will be done by the Project Review Committee (PRC), comprising of HOD and two senior members of faculty along with the project supervisor. Semester end evaluation will be done by Project Evaluation Committee (PEC) comprising of three members including HOD, project guide and an external examiner nominated by the office of the CoE.

e. **Audit courses**: Audit courses are those courses which do not carry any credits and are not accounted for the calculation of CGPA. Students shall take three audit courses in the beginning of **3rd semester** and shall complete those courses in self-study mode. One of the audit courses will be by the choice of the students from the list of the courses notified at the beginning of the third semester. The second and third audit course is common to all the students and is viz. "Environmental Studies" and "Professional Ethics and Human values". All the students (regular and lateral entry students) shall complete the audit course before the announcement of 6th semester results by taking all the chances provided along with the regular/supplementary examinations scheduled. Multiple attempts to clear the audit courses before the 6th semester will not affect the eligibility for the award of distinction. The results will be indicated with "Satisfactory" (40% of the total marks) or "Not Satisfactory" performance and will be reflected in the 6th Semester Grade Memo.

f. **MOOCs and Self-Study Courses**: Massive Open Online Courses (MOOCs) are free online courses available for anyone to enroll. MOOCs provide an affordable and flexible way to learn new skills in self-learning mode. The Curriculum provides adequate flexibility for the students to take up MOOCs through self-study mode enabling them to learn the courses on independent mode with minimal guidance of faculty mentor to earn credits for the award of the degreeB. Tech. (Regular) and B. Tech. (Honours) and B. Tech. (Minors).

Elective Courses are offered in two modes

1) Self Learning through MOOCs. 2) Direct Teaching as like Regular Courses

If the students opted for Elective Courses through NPTEL/SWAYAM: Each BoS, for its UG program, shall approve a list of around 2 to 15 (number as per their suitability) courses with minimum 8-weeks (45 Hours) duration and shall be announced in the beginning of the 3rd semester. These courses shall be offered as an alternative to "Elective Courses" of the respective branch offered in any semester from 5th to 8th semesters. Courses offered through NPTEL should not have similar or overlapping contents vis-à-vis the core subjects offered in the department in any of the semesters. Students opted for Elective Courses in self-learning mode (NPTEL/SWAYAM /MOOCs) need not attend the regular classes in the respective subject.

Students opting for Elective Courses through NPTEL/SWAYAM, shall submit the certificate before the beginning of the respective offering semester for the award of credits equal to Elective Courses. The conversion from percentage of marks given by NPTEL to the corresponding grades shall be similar to regular courses. If the student fails to submit the NPTEL certificate, he/she will have an option to choose either "self-learning through MOOCS with proctored assessment" or "a regular Elective Course".

The evaluation and assessment pattern for such courses which are part of the curriculum for the B. Tech. (Regular) Degree shall be carried out as similar to other regular theory courses. However, for B. Tech. (Honours) and B. Tech. (Minors) the grade/marks offered by the NPTEL-SWAYAM is considered for the calculation of grade point.

g. Summer Internships (I and II)

Summer Internship-I: As a part of curriculum in all UG programmes, it is mandatory for all students to undergo summer internship-I at industries (core or allied) / R & D organization to get practical insight of their subject domain or community engagement during summer break after the 4th semester. This summer internship programme shall be for a period of 6 weeks duration and the assessment shall be carried out during the 5th semester and the credits will be reflected along with grade point in the 5th semester Grade memo. The student can also choose Community engagement to take field related Projects.

In case of any functional challenges in taking up of the summer Internship-I in the physical mode, the respective BoS may suggest substitute online courses (MOOCS)/Online internship as approved by AICTE.

Further, in case of students who could not successfully complete the allotted Summer Internship-I in the specified duration, he/she will be given substitute online courses (MOOCs)/Online internship as suggested by BoS chairman and schedule notified by the CoE and will be treated as second attempt.

Summer Internship-II: Will be deployed in the form of skill bridge training for a duration of 6 weeks during summer break after the 6th semester, wherein the students will be trained on Problem Solving and Computer Coding Skills to enhance the employability skills. The assessment shall be carried out during the 7th semester and the credits will be reflected along with grade point in the 7th semester Grade memo.

In case students fails to attend the Summer Internship-II or could not secure the required percentage of attendance he/she will be allowed to take the assessment only after attending the make-up classes and will be treated as second attempt.

h. Co-Curricular and Extra Curricular (CCEC) Activities:

Students shall acquire 1 credit each in 2nd and 3rd years based on the various activities conducted in all the four semesters (3rd & 4th; 5th & 6th) as per the schedule notified. Assessment will be based on the level of participation/performance of the students in the various activities

i. Employability Skills: It is mandatory for all students to take a course on Employability Skills from 3rd Semester to 6th Semester. The Employability Skills are covered under three broad streams viz. **Aptitude Skills, Soft Skills and Domain Specific Knowledge**. The credits earned through these courses will be indicated in the grade memos of 4th and 6th semester and will be taken into account for CGPA calculation. The End semester assessment for all the four semesters will be done independently by an internal examiner(s) nominated by CoE.

j. Industry Driven One Credit Courses (IDC): Meeting with the industry requirements/research organizations as well as to reduce the gap between industry-academia-research organizations, the one credit (15 hours.) course has been introduced. The credits earned through these courses will be indicated in the grade memo over and above the graduation requirements and will not be considered for CGPA calculation.

k. Full Semester Internship (FSI): Students shall undergo mandatory FSI programme at industries/R&D Institutions/Premier Institutions during 7th or 8th semester to get practical insights relevant to their core branch of engineering or in allied branches of study under the guidance of expert members from the institution and at industries.

All the students shall register their choice of interest either in 7th or 8th semester for FSI in the beginning of 5th semester with Career Development Cell. However, the Institute shall allow the students to pursue FSI during the 7th semester or 8th semesters based on the availability of the opportunities.

The curriculum in 7th and 8th semesters is bundled with FSI and Project work. The students opting for FSI in 7th semester should take up the respective bundled theory courses offered on self-study mode during the internship period.

Those who undergo FSI in 8th semester shall take up the Project work during the 7th semester along with the respective theory courses.

In case of those students who could not appear/fail in the semester end assessment, he/she will be given chance to appear during the immediate supply exam conducted and will be treated as second attempt.

l. Semester Away Programme (SAP): Interested students can have the option of undergoing Semester Away Programme during 7th or 8th semester with Higher Learning Institutions at Foreign Countries or Institutions of National Repute or Research Organizations in India, by earning necessary credits as per the curriculum subject to the terms and conditions as prescribed by the respective host organization. The student shall acquire 8 credits at the host institution (either by taking project work or suitable courses) to compensate for the 8 credits required for the Project and take up the other three courses in self-study mode as per the curriculum. The students who are interested to opt for SAP shall register at the beginning of 6th semester and initiate the process with the host institute.

m. Career Path Electives (CPE):

- The curriculum provides opportunities to the students to gain expertise in the emerging technologies in the form of Career path with expertise by offering elective courses in a sequential mode from 5th semester onwards. The students can choose any one of these career paths during the 5th semester and shall continue in the same career path by selecting specific electives in the 6th and 7th semesters in a sequence and finally leading to a Capstone project aligning with the career path in the 7th /8th semester.
- All the students who successfully complete the elective course aligned as per the CPE will have their Consolidated Grade Memos mentioning the title of the career path. Further, they will also receive a certificate/citation issued by the college.
- After choosing CPE during 5th semester and if any student fails to take up the specific electives courses as per the sequence in the subsequent semesters and select the electives from the general pool of electives, the student will be automatically gets out of the CPE. All those students who don't take up the Capstone project in the CPE domain will also get out the CPE
- In case of the students who are going for FSI/SAP in 7th semester shall take the respective elective course on self-study mode and further, complete the Capstone project in the 8th semester on campus
- In case of the students who are going for FSI in 8th semester shall take the respective elective course on self-study mode and further, complete the Capstone project in the 7th semester itself
- In case of the students going for FSI as a preplacement offer during 8th semester, he/she shall take up the elective courses on self-study mode and complete the Capstone project in the industry. The assessment pattern pertaining to the career path courses will be similar to those of other theory and integrated courses.
- The students who are not interested in any of these career paths can choose any of the other core electives as furnished in the respective list of the electives in the curriculum

n. Language Electives:

To enable the students to take up foreign languages as a language elective during the 2nd semester, students are provided with an option of selecting any of the foreign languages Viz. French, Spanish, Japanese and German apart from the national language Hindi. All these courses are offered as a language elective during the 2nd semester to prepare them for higher education and compete in the global market. All these courses are offered in Synchronous Online mode of delivery and the assessment will be done in line with the regular theory courses.

5.1. Basis for Credit Allotment for Courses Offered

No	Course	L	T	P	Credits
1	Theory Course (Regular)	1	0	0	1.0
2	Integrated Course (Theory +Lab)	1	0	1	1+0.5
3	Laboratory/Drawing Course	0	0	1	0.5
4	Elective Courses	1	0	0	1
5	Elective Courses (Integrated)	1	0	1	1+0.5
6	Term Paper	0	0	1	0.5
7	Mini Project	0	0	1	0.5
8	Project work	0	0	1	0.5
9	Co- and Extra-curricular Activities (CCEC)	0	0	1	0.5
10	Employability Skills (ES)	0	0	1	0.5
11	Audit /Mandatory Courses	0	0	0	0
12	Theory Course (Honours/Minors)	1	0	0	1
13	MOOCs/ Industry Driven courses /Self Study (For every 15hrs of Duration)				1
14	Summer Internship (6 Weeks: Offline/Online)				1
15	Full Semester Internship (16 Weeks)				8

5.2. Semester-wise Curriculum Structure

Course Pattern for Four Year Regular and Three-Year Lateral Entry Programme

Sem.	No. of Theory Courses	No. of Lab Courses, Internship, Term Paper, Project	Total Credits
I	5 Theory /4 Theory	4 Labs/4Labs	20/17
II	4 Theory/ 5 Theory	4 Labs/4Labs	17/20
III	6 (4 Theory + 2 Integrated)	2 Labs + Employability Skills - I+ CCEC-I	23
IV	5 (4 Theory + 1 Integrated)	2 Labs + Employability Skills - I + CCEC-I	22
V	6 (2 Theory + 2 Integrated + 1 Professional Elective +1 Open Elective)	1 Lab + Term Paper + Employability Skills-II + CCEC-II + Summer Internship -I	24
VI	8 (3 Theory + 1 Professional Integrated Elective +1 Open Elective + 3Audit Course)	1 Lab + Mini Project + Employability Skills -II + CCEC-II	22
VII	3 (2 Professional Elective + 1 Open Elective)/ 2 (1 Professional Elective + 1 Open Elective)	Project/FSI+ Summer Internship-II	18/15
VIII	2 (1 Professional Elective + 1 Open Elective)/ 3 (2 Professional Elective + 1 Open Elective)	FSI/ Project	14/17
		Total Credits	**160**

The credit requirement for three-year programme i.e. students admitted through lateral entry will be as per the sum of credits from third semester through eighth semester as above i.e. 123.

5.3 Credit Break-up for Various Category of Courses

For Four Year/Three Year Regular Programme

S. No.	Category	Total No. of Credits and Courses					
		Four Years			Three Years		
		Credits	Courses	Total Credits	Credits	Courses	Total Credits
1	Theory courses	3/2	20/2(22)	64	3	13	39
2	Integrated course	4	5	20	4	5	20
3	Laboratory course	1.5	14	21	1.5	6	9
4	Professional elective	3/4	4/1 (5)	16	3/4	4/1 (5)	16
5	Open Elective	3	4	12	3	4	12
6	Employability Skills	2	2	4	2	2	4
7	CC EC activities	1	2	2	1	2	2
8	Internship (Summer Internship/FSI)	1/8	2/1 (3)	10	1/8	2/1 (3)	10
9	Term paper	1.5	1	1.5	1.5	1	1.5
10	Mini Project	1.5	1	1.5	1.5	1	1.5
11	Project	8	1	8	8	1	8
Total		**-**	**60**	**160**	**-**	**43**	**123**

5.4 Division of Marks for Continuous and Semester End Assessment

Course	Marks Continuous Assessment	Marks for Semester end Assessment
Theory	30	70
Integrated Course	40 (30T+10L)	90 (70T+20L)
Drawing Courses	25	50
Laboratory	25	50
Term Paper	25	50
Audit Courses	--	50
Mini Project	25	50
Industry Driven Courses (IDC)	--	25
CCEC	20	30
Employability Skills (AS+SS+DSS)	20+20+20	30+30+30
Summer Internship	20	30
Full Semester Internship	100	100
Project Work	100	100

6. Evaluation Methodology

a. The assessment will be based on the performance in the semester-end examinations and /or continuous assessment, carrying marks as specified
b. At the end of each semester, final examinations will normally be conducted during October/November and during April / May of each year. Supplementary examinations shall be conducted as per the schedule announced
c. Continuous Assessment Marks will be awarded based on Continuous Evaluation made during the semester as per the scheme
d. The letter grade and the grade points are awarded based on the absolute grading system having earned grades based on the marks scored. Grading is done based on the

percentage of marks secured by a candidate in individual course (Theory & Laboratory) as detailed below:

Range of Percentage of Marks -Theory	Range of Percentage of Marks-Lab	Qualitative Meaning	Letter Grade	Grade Point
90 to 100	90 to 100	Outstanding	A+	10
80 to 89	80 to 89	Excellent	A	9
70 to 79	70 to 79	Very Good	B	8
60 to 69	60 to 69	Good	C	7
50 to 59	50 to 59	Fair	D	6
40 to 49	---	Satisfactory	E	5
< 40	---	Fail	F	0
---	<50	Fail	F	0
		Absent	AB	0

e. After completion of the programme, the Cumulative Grade Point Average (CGPA) from the I Semester to VIII Semester (from III to VIII semester for lateral entry) is calculated using the formula:

$$CGPA = \frac{\sum_{i=1}^{n}(c_i \times g_i)}{\sum_{i=1}^{n} c_i}$$

Where n is the number of courses registered for, 'c_i' is the credits allotted to the given course and 'g_i' is the grade point secured in the corresponding course

f. In view that grading system is adopted for the award of the grade points in each of courses, for the benefit of the students and other stack holders who wish to have an equivalence for the CGPA secured for the graduation, the following empirical relation is provided.
Equivalent Percentage: (CGPA-0.75) x 10

6.1 Continuous Assessment Pattern for all courses

a. Theory Course:

Out of 30 marks allotted for continuous assessment 20 marks will be awarded based on two tests (Each test will be conducted for 40 marks and scale down to 20 marks) conducted and 10 marks shall be awarded based on Open book examination/ Assignment test enabling to assess Higher Order Thinking skills (HOT)

For finalization of the 20 marks, 80 % of marks secured in 1st best internal tests and 20% marks secured in 2nd best internal test will considered

- The duration of each internal test will be 90 minutes addressing predominantly on lower order thinking skills and shall cover two units of syllabus in each test
- All the students will be notified with the marks secured within one week after the completion of the sessional exams
- Students are permitted for reconciliation within a period of two working days after the notification of marks
- The evaluation methodology of Design and Drawing courses coming under theory will be given in their respective course handouts which will be approved by the respective chairperson of the BoS

Open book Examination: Is an assessment process providing the students a realistic environment to assess the higher order learning/thinking skills with the questions that mimic professional ability to demonstrate Creating, analyzing, and evaluating skills. Open Book Examination carries 1/3rd weightage in the continuous assessment and the exam will be conducted for 30 marks at the end of every semester and will be scaled down to 10 marks. The duration of each test will be 120 minutes predominantly focusing on Higher Order Thinking Skills.

In case, the course has limited scope of HOTs, the assessment shall be carried out with LOTs. In this assessment, the students are allowed to carry any printed and handwritten material of their choice.
In case of the course that have limited scope for Open Book Examinations, Assignment Test is preferred. However, BoS chairmen shall ensure that OBE system is followed for a min of 50% of the courses in each of the semesters.
Four questions will be given to the students covering all the six COs and all four units one week before the commencement of examination. Out of 4 questions 2 will be selected by the HOD for the conduct of assignment test.

b. Integrated Course:

40 marks are allotted for continuous assessment as given below:

Theory part:

30 marks will be awarded based on two tests conducted similar to theory. Each Test will be conducted for 40 marks and scale down to 30 marks. 80 % of marks secured in 1st best internal test and 20% marks secured in 2nd best internal test for the final award of the marks

Laboratory Part:

10 marks are awarded for continuous assessment and following is the pattern for the award of 10 marks

Preparation, Observation & Result and Record: 05 Marks
Internal Test : 05 Marks

c. Laboratory Course:

25 marks are awarded for continuous assessment and following is the pattern for the award of 25 marks

Preparation, Observation & Result	: 05 Marks
Record	: 05 Marks
Internal Test	: 05 Marks
Viva – Voce	: 05 Marks
Augmented Experiment	: 05 Marks (Laboratory Mini Project)

Engineering drawing course is evaluated in line with lab courses and the Pattern of awarding 25 marks for continuous evaluation is as follows

Day-to-day work	: 15 marks
Internal test	: 10 marks

There shall be two internal tests for 10 marks each during the semester and the average shall be considered

d. Term Paper:

Continuous Assessment	: 25 Marks
Distribution	
Literature Survey	: 05 Marks
Review 1	: 05 Marks
Review 2	: 05 Marks
Publication/Presentation of Paper	: 05 Marks
Presentation	: 05 Marks

e. Audit Courses:

Online Objective Test	: 50 Marks

f. Mini Project:

Continuous Assessment	: 25 Marks
Distribution	
Review 1	: 05 Marks
Review 2	: 05 Marks
Literature Survey	: 05 Marks
Internal Vivo-Voce	: 10 Marks

g. Project:

Continuous Assessment	: 100 Marks
Distribution	
Innovativeness of the Project	: 05 Marks
Literature Survey	: 10 Marks
Experimentation / Simulation	: 15 Marks
Result Analysis	: 05 Marks
Review 1	: 10 Marks
Review 2	: 10 Marks
Product development	: 25 Marks
Publication/Presentation of Paper	: 05 Marks
Final Presentation	: 05 Marks
Project Report	: 10 Marks

h. Full Semester Internship:

Continuous Assessment	: 100 Marks
Distribution	
Internship Progress Report	: 10 Marks
On Site Assessment	: 15 Marks
Assessment by Industry	: 50 Marks (Intern Assessment Tool)
Final Assessment on Campus	: 25 Marks

i. Co-Curricular and Extra Curricular (CCEC) Activities:

Students shall acquire 1 credit each in 2nd and 3rd years with the following scheme:
Scheme of evaluation for the CCEC activities:

- No. of slots in each Semester @ 1 slot every week : 16
- No of activities per slot : 1
- No. of Streams [1 CC + 1 (EC+ Community Engagement)] : 2
- No. of minimum activities to be conducted in each stream : 6
- Students shall secure an overall attendance of 65% in all activities put together
- Students need to perform a minimum of one activity in each stream
- Students who did not maintain 65% of attendance in all activities put together and not performed in a minimum of two activities are not eligible for semester end summative assessment

Assessment for CCEC activities is done based on the participation and performance of the students in any of the two CCEC activities for the award of 20marks.

j. Employability Skills (ES):

Students shall take this course during from 3rd – 6th semesters and will have three components 1) Aptitude Skills AS 2) Soft Skills_SS and 3) Domain Specific Skills_DSS having equal weightage. The course content for AS and SS will be common for all the programs whereas the course content for DSS will be program specific and shall be notified before the commencement of every semester based on the demand and need.

The students will be assessed in all the three components in each of the semesters with equal weightage. For the two components AS & DSS the students are assessed based on the marks secured in continuous assessment. For SS, the students are assessed based on the attendance for the various activities scheduled. A minimum of 16 periods shall be allotted for each stream per semester.

Assessment for Aptitude Skills
Continuous assessment : 20 Marks
For continuous assessment, tests will be conducted along with midterm examinations. 20 marks will be awarded by taking into account 80% of marks secured in 1st best assessment test and 20% marks secured in 2nd best assessment test

Assessment of Soft Skills
Minimum of six activities are conducted for SS training in a semester. Assessment for Soft Skills is done based on the participation and performance of the students under different SS activities. Students are expected to perform in at least four activities to get qualified in each semester out of six activities.
Continuous Assessment : 20 Marks
Under continuous assessment, the students will be assessed for the four activities based on this performance for 20M.

Assessment of Domain Specific Skills
The Domain specific skill training will be preferably a training program on branch specific Application Software tool. For continuous assessment, tests will be conducted along with midterm examinations. 20 marks will be evaluated by taking into account 80% of marks secured in 1st best assessment test and 20% marks secured in 2nd best assessment test
Continuous Assessment : 20 Marks

For the continuous assessment of this course, the average of the marks scored in all the three components put together is considered.

k. Industry Driven One Credit Courses:

Online Objective Test : 25 Marks
Grading:

Marks ≥ 20	: Very Good (A grade)
Marks < 20 and ≥ 15	: Good (B grade)
Marks < 15 and ≥ 10	: Satisfactory (C grade)
Marks < 10	: Course registration gets cancelled

l. Summer Internship -I:

Total Assessment	**:** 50 marks
Onsite Assessment	: 20 Marks (Once in 3 weeks-Mode of Assessment Rubrics)
Final Assessment	: 30 Marks
Distribution	
Technical Knowledge	:10 Marks
Internship report	:10 Marks
Presentation &Viva Voce	:10 Marks

In case of the students who have taken MOOCS/Online internship as a substitute to summer internship-I, the assessment will be based on the marks/Grade secured in the courses/Online Internship. In case the students fail to clear the summer internship-I, the student shall appear for the subsequent supplementary examinations

m. Summer Internship-II:

Total Assessment	**:** 50 marks
Continuous assessment	: 20 Marks (Once in 2 weeks by online test MCQ)
Final Assessment	: 30 Marks (MCQs/Coding/Project)

In case the students fail to clear the summer internship-II, the student shall appear for the subsequent supplementary examinations.
For both summer internships I & II, the students shall clear the course by securing min of 25 marks (50% of 50 Marks) and acquire credits. These credits will be reflected in 5th and 7th semester grade memos.

6.2 Semester End Assessment

After the completion of the course work as per the academic calendar, semester assessment will be done for all courses as per the curriculum. A common schedule will be notified by the controller of examinations for all the semester end examinations. All the students who fulfill the attendance requirements shall be eligible to appear for the semester end examinations.

All the students who could not clear the semester end examinations for those courses that carry credits will be given an opportunity to appear for the supplementary examinations conducted subsequently.

a. Theory Course:

For all the theory courses students shall appear for subjective examination of three hours duration and the assessment will be done for Max of 70 Marks. Students shall score a min of 28 marks (40% of 70 Marks) and score a min of 40% marks in continuous and end semester assessment both put together to clear the course and acquire the credits.

b. Integrated Course

Theory part:

For the theory part students shall appear for a subjective examination of three hours duration and the assessment will be done for Max of 70 Marks.

Laboratory Part:

For Laboratory part students shall appear for the examination of three hours duration and the assessment will be done for Max of 20 Marks.

Students shall score a min of 40% marks in theory and also both theory and Lab put together in the semester end examination. And students shall score a min of 40% marks in continuous and end semester assessment both put together to clear the course and acquire the credits.
The students who fails to secure min of 40% marks in the semester end theory part examination, he/she shall appear for both theory and lab supplementary examinations.

c. Laboratory Course:

Students are assessed for a Max of 50 marks during the semester end assessment and the assessment will be done by an internal and external examiner appointed by CoE. Students shall score min of 25 marks (50% of 50 marks) and score a min of 50% marks in continuous and end semester assessment both put together to clear the course and acquire the credits.

d. Engineering drawing courses

Students are assessed for a Max of 50 marks during the semester end assessment and the assessment will be done along with theory examination as per the schedule. Students shall score min of 25 marks (50% of 50 marks) and score a min of 50% marks in continuous and end semester assessment both put together to clear the course and acquire the credits.

e. Term Paper:

Students are assessed for a Max of 50 marks during the semester end assessment and the assessment will be done by an internal and external examiner appointed by CoE. Students shall score min of 25 marks (50% of 50 marks) and score a min of 50% marks in continuous and end semester assessment both put together to clear the course and acquire the credits.

f. Audit Courses:

Students are assessed for a Max of 50 marks by an MCQ test conducted on Moodles platform and score a min of 40% marks in to clear the course. The assessment will be conducted along with semester end examinations from 3rd semester onwards for both the opted and common audit courses. The students shall clear the course by the end of 6th semester.

g. Mini Project:

Students are assessed for a Max of 50 marks during the semester end assessment and the assessment will be done by an internal and external examiner appointed by CoE. Students shall score min of 25 marks (50% of 50 marks) and score a min of 50% marks in continuous and end semester assessment both put together to clear the course and acquire the credits.

h. Project:

Students are assessed for a Max of 100 marks during the semester end assessment and the assessment will be done by project evaluation committee appointed by Chief controller of examination. Assessment will be based on the project report submitted and presentation given by the project team.

Students shall score a min of 50 marks (50% of 100 Marks) in the end semester assessment and score a min of 100 marks in continuous and end semester assessment both put together to clear the course and acquire the credits.

i. Full Semester Internship:

Students are assessed for a Max of 100 marks during the semester end assessment and the assessment will be done by evaluation committee appointed by Chief controller of examination. Assessment will be based on the internship report submitted and presentation given by the students.

Students shall score a min of 50 marks (50% of 100 Marks) in the end semester assessment and score a min of 100 marks in continuous and end semester assessment both put together to clear the course and acquire the credits.

j. Co-Curricular and Extra Curricular (CCEC) Activities:

Students need to appear for the final summative assessment at the end of 3rd, 4th, 5th and 6th semesters. During the assessment student will perform in any one of the activities offered by the department and grades will be awarded based on the marks secured as per the rubric.

The credits earned through these courses will be indicated in the grade memo of 4th and 6th semesters and will be taken into account for CGPA calculation. If any student fails to attend summative assessment or failed in the summative assessment, he/she will not be eligible for the award of Distinction.

Students shall score a min average of 12 marks (40% of 30 Marks) in the end semester assessment and score a min of 20 marks in continuous and end semester assessment both put together to clear the course.

Students who clear the courses put together in 3rd and 4th semesters will acquire credits and will be reflected in 4th semester grade memo. Similarly, the credits are reflected in the 6th semester grade memo by clearing the courses put together in 5th and 6th semesters. The student who fails to clear the semester end examination shall appear for the subsequent supply exams and will not be eligible for the distinction

k. Employability Skills (ES):

The students will be assessed in all the three components i.e 1) Aptitude Skills-AS 2) Soft Skills-SS and 3) Domain Specific Skills-DSS at the end of 3rd, 4th, 5th and 6th semesters with equal score of 30 marks each. Assessment will be by an MCQ based question paper having 90 questions with equal weightage to the three components.

Students shall score a min 36 marks in the MCQ test (40% of 90 Marks) in the end semester assessment and score a min of 60 marks in continuous and end semester assessment both put together to clear the course. The student who fails to clear the semester end examination shall appear for the subsequent supply exams and will not be eligible for the distinction

The total marks secured by the student in both 3rd and 4th semesters will be scaled down to 100 marks for the calculation of the overall grade point and will be reflected in the 4th semester grade memo. Similarly, the grade point for the 5th and 6th semesters will be reflected in the 6th semester grade memo.

6.3 Performance Audit Committee

The Performance Audit Committee is constituted by Internal Quality Assurance Cell (IQAC) comprising of the course coordinators/instructors and programme coordinator. This committee shall review the attainment of Course Outcomes and Program Outcomes, progress and progress of the students twice in a semester. The committee may take feedback from the faculty mentors and students and suggest appropriate solutions to ensure continuous improvement in the leaning outcomes across all semesters.

7. Attendance Requirements

If his/ her academic progress and conduct have been satisfactory…

a. It is desirable for a candidate to put on 100% attendance in all the subjects. However, a candidate shall be permitted to appear for the semester end examination by maintaining at least 75% of attendance on an average in all the courses in that semester put together
b. The shortage of attendance on medical grounds can be condoned to an extent of 10% provided a medical certificate is submitted to the Head of the Department when the candidate reports back to the classes immediately after the leave. Certificates submitted afterwards shall not be entertained. Upon the payment of the Condonation fee as fixed by the college, students who put on attendance between ≥ 65% and <75% shall be permitted to appear for the semester end examinations. Attendance may also be condoned as per the State Government rules for those who participate in sports, co-curricular and extra-curricular activities provided their attendance is in the minimum prescribed limits for the purpose and recommended by the concerned authority
c. In case of the students having overall attendance less than 65% after condonation shall be declared detained and has to repeat semester again
d. During the Summer Internship -I, Summer internship-II and Full semester Internship it is required for the candidate to put on 90% of attendance. The shortage of attendance on medical grounds can be condoned to an extent of 15% and permitted to appear for the final assessment by maintaining at least 75% of attendance.
e. If the candidate failed to maintain 75% of attendance during FSI he /she shall be declared detained and has to repeat FSI, however the student will be allowed to appear for semester end examinations of two self-study courses.
f. If the candidate detained in FSI in the 8th semester, he/she will be allowed to repeat the FSI immediately after completing the 8th semester. If the candidate could not complete FSI in the 7th semester, he/she will be allowed to continue in the 8th semester course work and needs to repeat the FSI, with immediately after completing the 8th semester.

g. For the students repeating the FSI, with regard to two self-study courses, student have an option of taking the continuous and end semester assessments together either in the regular slot or while dong with FSI.
h. In case of the student having less than 65% of attendance in any of the theory/lab courses/CCEC activities/Employability skills during a particular semester and less than 75% in Summer Internship-I/Summer Internship-II, he/she will not be permitted to appear for the semester end examination in the that particular course.
i. In all such cases, the students need to register for the makeup classes which will be notified by the CoE office at appropriate time. The students shall secure 90% of the attendance in the make-up classes to appear for the semester end assessment and will be treated as a second attempt. The number of makeup classes to be conducted will be at least 35% of the regular class work taken in a particular course

8. Promotion Policies

a) In four year B. Tech. Programme, a student shall be promoted from 2nd year to 3rd year only if he/she fulfills the academic requirements and earning of minimum 50% of credits up to 2nd year
b) In four year B. Tech. Programme, a student shall be promoted from 3rd year to 4th year only if he/she fulfills the academic requirements and earning of minimum 50% credits up to 3rd year
c) In three year lateral entry B. Tech. Programme, a student shall be promoted from 3rd year to 4th year only if he/she fulfills the academic requirements and earning of minimum 50% credits up to 3rd year

9. Graduation Requirements

9.1 Academic Requirements:

The following academic requirements shall be met for the award of the B. Tech. degree:

- Student shall secure 160 credits for regular B. Tech. Programme and 123 credits for the students who entered in second year through lateral entry scheme and CGPA is calculated accordingly for the award of Grade/Class/Division.
- A student of a regular Programme who fails to earn 160 credits within eight consecutive academic years from the year of his/her admission shall forfeit his/her degree and his/her admission stands cancelled.
- A student of a lateral entry Programme who fails to earn 123 credits within six consecutive academic years from the year of his/her admission shall forfeit his/her Degree and his/her admission stands cancelled.

9.2 Award of degree:

Classification of degree will be as follows:

I. CGPA ≥ 8.0 + No history of arrears +20 addl. Credits : Degree with Honours
(20 credits shall be earned through core domain courses)
II. CGPA ≥ 8.0 + No history of arrears +20 addl. Credits : Degree with Minor
(20 credits shall be earned through inter-disciplinary courses)
III. CGPA ≥ 7.75 : First class with Distinction
IV. CGPA ≥6.75 and < 7.75 : First Class
V. CGPA ≥5.75 and < 6.75 : Second Class
VI. CGPA ≥5.0 and < 5.75 : Pass Class

- **First Class with Distinction:** A candidate who acquires credits for the award of the Degree (vide clause 9 (a)) having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) in the first attempt (without appearing for supplementary exams), within eight consecutive semesters (six consecutive semesters for lateral entry candidates) after the commencement of his/her study and securing a CGPA of 7.75 and above shall be declared to have passed in **First Class with Distinction**.

- **First Class**: A candidate who acquires credits for the award of the Degree (vide clause 9 (a)) having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) and securing a CGPA of 6.75 and above shall be declared to have passed in **First Class**
- **Second Class**: A candidate who acquires credits for the award of the Degree (vide clause 9 (a)) having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) and securing a CGPA of 5.75 and above shall be declared to have passed in **Second Class**
- **Pass Class**: A candidate who acquires credits for the award of the Degree (vide clause 9 (a)) having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) and securing a CGPA of 5.00 and above shall be declared to have passed in **Pass Class**
- **Degree with Honours/Minors**: The students can register for Honours Degree or Degree with Minors by earning additional 20 credits over and above the credit requirement of B. Tech. (Regular) Degree Programme and also maintain minimum of 8 CGPA at the time of graduation clearing the courses in single attempt.

9.3 Grafting: In order to extend the benefit to the students with one/ two backlogs after either 6th semester or 8th semester, GRAFTING option is provided to the students enabling their placements and fulfilling graduation requirements. Following are the guidelines for the Grafting:

- Grafting of the marks will be done among the courses within the semester. A maximum of 10% of max marks in semester end examinations shall be drawn from any one of the cleared courses in the semester and will be grafted to the maximum of any two failed courses in the same semester
- Students shall be given a choice of grafting only once in the 4 years Programme, either after 6th semester (Option#1) or after 8th semester (Option#2)
- Option#1: Applicable to students who have maximum of TWO theory courses in 5th and/or 6th semesters
- Option#2: Applicable to students who have maximum of TWO theory courses in 7th and/or 8th semesters
- Students can use Option#1or Option#2 for grafting only after declaration of the results for regular examinations conducted for 6th or 8th semesters respectively.

- Eligibility for grafting:
  i. He/she must appear in all regular or supplementary examinations as per the provisions laid down in regulations for the courses, he/she appeals for grafting
  ii. The marks obtained by her/him in latest attempt shall be taken into account for grafting of marks in the failed course(s)
  iii. Grafting is applicable only for the theory courses
  iv. The subject which has the highest marks in the respective semester will be considered for grafting, preferably without change in grade.

9.4 Betterment Chance: Student who clears all the subjects up to 6th semester and wish to improve their CGPA can register and appear for one betterment chance for maximum of any five theory courses up to 6th semester. Betterment chance can be availed along with 7th and 8th semester examinations by paying the registration and examination fee.

9.5 Quick Supplementary Examination: The supplementary examinations for the 8th semester will be conducted as a Quick Supplementary Examination (immediately after the completion of 8th semester) to clear the failed courses of 8th semester.

9.6 Memorandum of Marks: All the candidates who register for the semester end examination will be issued a memorandum of marks by the Institute. Apart from the semester wise grade memos, the institute will issue the consolidate grade memo subject to the fulfillment of all the academic requirements.

10. Flexibility to Add / Drop Self Study Courses (SSC) over and above the curriculum

a. It is mandatory that all the students need to earn the minimum number of credits (as per clause 9) for the award of B. Tech. degree in their respective disciplines. However, a student can earn more number of credits if he/she opt, by registering one additional course, from the suggested list of courses for all disciplines, over and above to the existing courses from 4th semester to 6th semester. Assessment will be done upon the payment of the registration fee.

b. The student shall be permitted to drop any SSC at any point of time and registration for such courses will gets cancelled and it will not be reflected Cumulative Grade Memo (CGM)

c. All the courses registered and cleared by a student in this mode will be mentioned in the CGM as additional acquired. However, the CGPA is calculated for the 160/123 credits only (as mentioned in the clause 9)

d. In case of the students who registers for B.Tech (Honour and Minors degree) and gets disqualified for the award of the Honours/Minors degree, the credits secured if any can be reflected under SSC in the grade memo by the choice of the student

11. Withdrawal from the Examination

a. A candidate may, for valid reasons which could be due to the overlap of the schedule of the events (Participation in state/national/international sports and games events; NSS or NCC camps; National/international competitions of high repute) with the semester end examination schedule, may be granted permission with prior approval to withdraw from appearing for the examination in any course or courses of only one semester examination during the entire duration of the Degree Programme.

b. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination and if it is made two weeks prior to the commencement of the examination in that course or courses and recommended by a committee nominated by the principal.

c. The candidate opting out of examinations shall appear for all the courses in the next immediate examinations that are scheduled (regular/supply) and will be treated as first attempt.

12. Transitory Regulations: To enable the students to get into GMRIT either by Re-admission, Admission, or Transfer from other Autonomous and Non-Autonomous Engineering colleges affiliated to JNTUK/Academic regulation within GMRIT, the following transitory regulations will be applicable based on the situation and the case of transfer following are possible cases that may arise in transitory regulations

- Transfer of a student from a Non-Autonomous engineering college affiliated to JNTUK
- Transfer of a student from an Autonomous engineering college affiliated to JNTUK
- A student within the Institution gets transferred from one regulation to the other regulation

a. Transfer of candidates from Non-Autonomous Engineering College affiliated to JNTUK:
A student who wishes to transfer from a Non-Autonomous engineering college affiliated to JNTUK either in the 3rd semester or thereafter, shall acquire the credits required for graduation as per the GMRIT regulations and the following two cases may arise:

- Students getting admission into 3rd semester shall be treated at par with the lateral entry students and shall complete all the courses works in the 1st & 2nd semester before joining as per the JNTUK regulations. The credits acquired per course during 1st & 2nd semester will be calculated as per the GMRIT regulations. In case of any credit mismatch for the 1st & 2nd semester when compared with JNTUK regulations, the student shall take the additional courses approved by the concern Board of Studies and Academic council during 3rd semester at GMRIT.
- Students getting admission into 5th or 7th semesters, the students shall clear all the earlier courses under JNTUK regulations and curriculum before joining and acquiring the required credits. The credits acquired per course at JNTUK regulations will be calculated as per the JNTUK regulations. After joining GMRIT the students shall follow the GMRIT curriculum, however, the credits for the subjects will be awarded at par with JNTUK regulations. In case of credits mismatch, students will take up additional courses approved by the concern Board of Studies and Academic council at GMRIT.

After taking necessary approvals from the concern Board of Studies & Academic council the details of the transferred students will be forwarded to the University.

b. Transfer of candidates from an Autonomous college affiliated to JNTUK:
A student who wishes to transfer from an Autonomous engineering college affiliated to JNTUK either in the 3rd semester or thereafter, shall acquire the credits required for graduation as per the GMRIT regulations and the following two cases may arise:

- Students getting admission into 3rd semester shall be treated at par with the lateral entry students and shall complete all the courses works in the 1st & 2nd semester before joining as per the other Autonomous regulations of the earlier college. The credits acquired per course at the earlier autonomous college will be calculated as per the GMRIT regulations. In case of any credit mismatch for the 1st & 2nd semester when compared with the previous Autonomous college regulations, the student shall take the additional courses approved by the concern Board of Studies and Academic council during from 3rd semester at GMRIT.
- Students getting admission into 5th or 7th semesters, the students shall clear all the earlier courses under the earlier college regulations and curriculum before joining and acquire the required credits. The credits acquired per course at the earlier autonomous college will be calculated as per the autonomous college regulations. After joining GMRIT the students shall follow the GMRIT curriculum, however, the credits for the subjects will be awarded at par with autonomous college regulations. In case of credits mismatch, students will take up additional courses approved by the concern Board of Studies and Academic council at GMRIT.

After taking necessary approvals from the concern Board of Studies & Academic council the details of the transferred students will be forwarded to the University.

c. Students getting readmitted within GMRIT moving from one regulation to another regulation. A student gets admission into one regulation in the first year shall continue with the same graduation requirements in terms of total credits required for the award of Degree. However,

- In case the students getting readmitted into a subsequent new regulation, and if the readmission is in the 1st semester, the student shall follow the new regulations and secure the required number credits in the new regulations.
- In case the students getting readmitted into a subsequent new regulation, and if the readmission is into any of the semesters from 2nd to 4th semester, the student shall follow the regulations applicable to the ongoing batch to which he/she gets admitted and continue in the same regulation till graduation. The substitute courses will be offered, and number of credits/ semesters shall be compensated and balanced

between the old and new regulations on case to case basis. Necessary approvals from the concern Board of Studies and Academic council shall be taken

- In case the students getting readmitted into a subsequent new regulation, and if the readmission is into any of the semesters from 5th to 8th semester, the student shall follow the regulations applicable as per the regulations existing at the time of his/her admission and will clear all the subjects and acquire the credits for graduation. For all the common courses he/she will continue along with the students in the new regulations. Necessary approvals from the concern Board of Studies and Academic council shall be taken

After taking necessary approvals from the concern Board of Studies & Academic council the details of the transferred students will be forwarded to the University.

13. Eligibility for Degree with Honours or Degree with Minors

a. The curriculum provides flexibility to enable the competent students to register for B. Tech. degree with Honours or B.Tech Degree with Minors by earning additional 20 credits which are over and above 160 credits for the award of B. Tech. (Regular) degree. He/She shall register Honours/Minors by paying registration fee during the 4th semester provided he/she secures ≥ 8 CGPA clearing all the courses in single attempt till 3rd semester. In case of students admitted through lateral entry, the CGPA compliance will be considered from 3rd semester performance and diploma CGPA.

b. The students shall have scope to earn these additional 20 credits from 4th semester onwards and at any point of time if he/she wishes to withdraw from B. Tech. (Honours) program, the additional credits acquired till that time will get lapsed and cannot be used to compensate with those 160 credits needed for the award of the degree. A separate grade sheet will be issued to the students who register for the Honours and minors degree program indicating the domain name for Honours and Minor degree title name for Minors along with the GPA.

c. All the students who maintain ≥ 8 CGPA are eligible to enrollment for B. Tech. with Honours, However, registration for Minors degree will be limited to maximum of 35% of the total intake in a particular batch of students.

d. These additional courses offered by the program may change from time to time based on the demand and resources availability. The courses may be offered in different modes i.e. guided learning/taught courses/Blended mode or combination.

e. To acquire 20 additional credits, the students shall register for four 4-credit courses under the list of the courses offered by the respective departments and acquire the balance 4 credits by taking two 2-credit MOOCs of 30 hours/6 weeks duration or one 4-credit MOOCs of 60 hours/12 weeks duration on self-study mode as per the prescribed syllabus.

f. For the award of **B. Tech. degree with Honours** the additional 20 credits shall be earned by taking the courses offered by the respective department of study in one domain. A set of four courses are offered under each of the four different domains preferably from the new emerging areas as recommended by the BoS

g. For the award of **B. Tech degree with Minors** the additional 20 credits shall be earned by taking the inter-disciplinary courses offered preferably from the new emerging areas by the other departments. Minors degree will be awarded with a Title among the pool of titles recommended by the various BoS.

h. The students who acquire 20 additional credits and maintain 8.0 CGPA at the time of registration and graduation clearing all the courses in single attempt and acquiring 160 credits will be awarded the B.Tech degree Honours or Minors.

i. The students shall register for the courses related to additional 20 credits as per the calendar released by the respective departments and clear them in a single attempt. All the students who maintain 8.0 CGPA at the time of registration and graduation in regular B.Tech courses and acquire GPA of minimum of 6.75.in Honour/Minor courses are eligible for the award of B. Tech. (Honours)/B.Tech (Minors) . Any student who fails to full fill these conditions will automatically get deregistered for B. Tech.

(Honours)/B.Tech (Minors) without any notification. A separate grade memo will be issued for B. Tech. (Honours)/B.Tech (Minors) along with the CGM.

14 Gap Year: The curriculum provides flexibility for the students having ≥9 CGPA shall take a break of one year at any time after the end of I/II/III year of study to pursue entrepreneurship full time. This period of gap shall be counted for the maximum time of graduation. A committee approved by the Academic Council shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

15 Curriculum of all the UG Programmes

The curriculum of the UG programmes mentioned below is provided by the respective BoS

I. Chemical Engineering (CH)
II. Civil Engineering (CE)
III. Computer Science and Engineering (CSE)
IV. CSE (Artificial Intelligence & Data Science)
V. CSE (Artificial Intelligence & Machine Learning)
VI. Electrical and Electronics Engineering (EEE)
VII. Electronics and Communication Engineering (ECE)
VIII. Information Technology (IT)
IX. Mechanical Engineering (ME)

General

a. He/she represents “he” and “she” both
b. Where the words ‘he’, ‘him’, ‘his’, occur, they imply ‘she’, ‘her’, ‘hers’ also
c. The academic regulations should be read as a whole for the purpose of any interpretation
d. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman, Academic Council will be final.

The Vision of GMRIT

- To be among the most preferred institutions for engineering and technological education in the country.
- An institution that will bring out the best from its students, faculty, and staff – to learn, to achieve, to compete and to grow – among the very best.
- An institution where ethics, excellence and excitement will be the work religion, while research, innovation and impact, the work culture.

The Mission of GMRIT

- To turnout disciplined and competent engineers with sound work and life ethics.
- To implement outcome-based education in an IT-enabled environment.
- To encourage all-round rigor and instill a spirit of enquiry and critical thinking among students, faculty, and staff.
- To develop teaching, research, and consulting environment in collaboration with industry and other institutions.

Department Vision

- To be a preferred department of learning for students and teachers alike, with a commitment towards Academics & Research, serving the students in an atmosphere of innovation, critical thinking and making them Industry ready.

Department Mission

M1: To provide adaptable education in a collaborative and innovative environment in skilling the graduates to solve real world problems in the field of Civil Engineering

M2: To prepare the students as critical thinking professionals with multidisciplinary research orientation and Innovation

M3: To instil ethical values and nurture the graduates who will be able to contribute to society.

Program Educational Objectives (PEOs)

PEO 1: Employ logical and analytical skills in solving complex real-world engineering problems in the areas of civil engineering.

PEO 2: Adaptable to emerging technologies with enhanced professional skills and ability towards continuous learning, facilitating higher studies and research.

PEO 3: Demonstrate professional ethics, leadership qualities and promote inclusive and collaborative growth with human values towards societal interest.

Program Outcomes (POs):

Engineering graduate will be able to:

PO 1: Apply the knowledge of basic sciences and fundamental engineering concepts in solving civil engineering problems (**Engineering knowledge**)

PO 2: Identify and define civil engineering problems and investigate to analyze and interpret data to arrive at substantial conclusions. (**Problem analysis**)

PO 3: Propose appropriate solutions for engineering problems complying with functional constraints such as economic, environmental, societal, ethical, safety and sustainability in accordance with Indian standard codes of practices. (**Design/development of solutions**)

PO 4: Perform investigations, design and conduct experiments, analyze and interpret the results to provide valid conclusions. (**Conduct investigations of complex problems**)

PO 5: Select/develop and apply appropriate techniques and IT tools to analyze, design and scheduling of activities with an understanding of the limitations and successfully implement and adopt to technological changes in civil engineering with intervention of IT industries (**Modern tool usage**)

PO 6: Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practice. (**The engineer and society**)

PO 7: Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development. (**Environment and sustainability**)

PO 8: Demonstrate knowledge of professional and ethical practices. (**Ethics**)

PO 9: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations. (**Individual and team work**)

PO 10: Communicate effectively with respect to oral, written and graphical communication (**Communication**)

PO 11: Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment. (**Project management and finance**)

PO 12: Recognize the need for, and have the ability to engage in independent and lifelong learning. (**Life-long learning**)

Program Specific Outcomes (PSOs):

Engineering graduate will be able to:

PSO 1: Demonstrate the quality and suitability of construction materials (**Program Specific**)

PSO 2: Ability to apply the practical aspect of analysis, design and safe construction practices (**Program Specific**)

Department of Civil Engineering

Minimum Credits to be earned: 160 (for Regular students)
123 (for Lateral Entry Students)

No	Course Code	Course	POs	Contact Hours			
				L	T	P	C
First Semester							
1	21HSX01	Communicative English	10, 12	2	-	-	2
2	21MAX01	Engineering Mathematics I	1	3	-	-	3
3	21PYX01 21CYX01	Engineering Physics / Engineering Chemistry	1 / 1	3/3	-	-	3/3
4	21BEX01 21BEX06	Basics of Engineering / IT Workshop	1,12/1,12	3/ -	-	-/ 3	3/1.5
5	21BEX02	Problem Solving and Programming Skills	1, 12	3	-	-	3
6	21BEX03	Problem Solving and Programming Skills Lab	4	-	-	3	1.5
7	21BEX04/ 21BEX05	Engineering Drawing / Engineering Workshop	1,5,10/1, 9,10	-	-	3/3	1.5/1.5
8	21PYX02/ 21CYX02	Engineering Physics Lab /Engineering Chemistry Lab	4/4	-	-	3/3	1.5/1.5
9	21HSX02/-	Communicative English Lab/-	10,12	-	-	3/-	1.5/-
Total				**14/ 11**	**-**	**12/ 12**	**20/17**
Second Semester							
1		Language Elective	10,12	2	-	-	2
2	21MAX02	Engineering Mathematics II	1	3	-	-	3
3	21CYX01/ 21PYX01	Engineering Chemistry /Engineering Physics	1/1	3/3	-	-	3/3
4	21BEX01/ 21BEX06	Basics of Engineering/ IT Workshop	1,12/1,12	-/3	-	3/-	1.5/3
5	21BEX07	Python Programming	1,12	3	-	-	3
6	21BEX08	Python Programming Lab	4	-	-	3	1.5
7	21BEX05/ 21BEX04	Engineering Workshop / Engineering Drawing	1,9,10/ 1,5,10	-	-	3/3	1.5/1.5
8	21CYX02/ 21PYX02	Engineering Chemistry Lab/Engineering Physics Lab	4/4	-	-	3/3	1.5/1.5
9	-/21HSX02	-/Communicative English Lab	-/10,12	-	-	-/3	-/1.5
Total				**11/ 14**	-	**12/ 12**	**17/20**
Third Semester							
1	21MA303	Numerical Methods	1, 12	3	-	-	3
2	21CE302	Building Materials and Concrete Technology	2,4,8, 12, PSO1	3	-	2	4
3	21CE303	Building Planning and Drawing	5, 10, 12	3	-	2	4
4	21CE304	Fluid Mechanics	1, 12	3	-	-	3
5	21CE305	Solid Mechanics I	1, 12	3	-	-	3
6	21CE306	Surveying	1, 2, 10, 12	3	-	-	3
7	21CE307	Solid Mechanics Laboratory	1, 4	-	-	3	1.5
8	21CE308	Surveying Laboratory	1, 4	-	-	3	1.5
9	21ESX01	Employability Skills I	1,2,5,8,10, 12	1	-	1	-
10	21HSX11	CC & EC Activities I	6,7,9,10	-	-	1	-
Total				**19**	-	**12**	**23**
Fourth Semester							
1	21CE401	Hydraulics and Hydraulic Machinery	1, 12	3	-	-	3
2	21CE402	Soil Mechanics	1, 2, 12, PSO1	3	-	-	3

3	21CE403	Solid Mechanics II	1, 12	3	-	-	3
4	21CE404	Structural Analysis	1, 12	3	-	-	3
5	21CE405	Transportation Engineering	3, 12, PSO2	3	-	2	4
6	21CE406	Fluid Mechanics and Hydraulic Machinery Laboratory	1, 4	-	-	3	1.5
7	21CE407	Soil Mechanics Laboratory	1, 4	-	-	3	1.5
8	21ESX01	Employability Skills I	1,2,5,8,10, 12	1	-	1	2
9	21HSX11	CC & EC Activities I	6,7,9,10	-	-	1	1
Total				**16**	**-**	**10**	**22**
Fifth Semester							
1	21CE501	Design and Detailing of RC Structures	3, 10, 12,PSO2	3	-	2	4
2	21CE502	Environmental Engineering	3, 6, 7, 12	3	-	-	3
3	21CE503	Foundation Engineering	2, 3, 8, 12,PSO2	3	-	-	3
4	21CE504	Hydrology	2, 3, 12	3	-	2	4
5		Elective I (Professional Elective)		3	-	-	3
6		Elective II (Open Elective I)		3	-	-	3
7	21CE505	Environmental Engineering Laboratory	3, 6, 7, 12	-	-	3	1.5
8	21TPX01	Term Paper	1,4,10,12	-	-	3	1.5
9	21ESX02	Employability Skills II	1,2,5,8,10, 12	1	-	1	-
10	21HSX12	CC & EC Activities II	6,7,9,10	-	-	1	-
11	21SIX01	Summer Internship I	1,2,8,10, 12	-	-	-	1
Total				**19**	**-**	**12**	**24**
Sixth Semester							
1	21CE601	Problem solving using OOPS	1, 5, 12	3	-	-	3
2	21CE602	Design of Steel Structures	3, 5, 10, 12,PSO2	3	-	-	3
3	21CE603	Estimation and costing	1,12	3	-	-	3
4		Elective III (Professional Elective)		3	-	2	4
5		Elective IV (Open Elective II)		3	-	-	3
6	21CE604	Programming Language Laboratory	1,2,3,5	-	-	3	1.5
7	21MPX01	Mini Project	1,2,3,4,5,6, 7,8,9,10, 11,12,PSO1 , PSO2	-	-	3	1.5
8	21ESX02	Employability Skills II	1,2,5,8,10, 12	1	-	1	2
9	21HSX12	CC & EC Activities II	6,7,9,10	-	-	1	1
10	21ATX01	Environmental Studies	1,3,6,7	-	-	-	-
11	21ATX02	Professional Ethics and Human Values	---	-	-	-	-
12	21ATX---	Audit Course	---	-	-	-	-
Total				**16**	**-**	**10**	**22**
Seventh Semester							
1		Elective V (Professional Elective)		3	-	-	3
2		Elective VI (Professional Elective)		3	-	-	3
3		Elective VII (Open Elective III)		3	-	-	3
4	21PWX01	Project Work	1,2,3,4,5,6, 7,8,9,10,11 ,12, PSO1, PSO2	-	-	16	8
5	21SIX02	Summer Internship II	1,2,5,6,10, 12	-	-	-	1
Total				**9**	**-**	**16**	**18**

Eighth Semester							
1		Elective VIII (Professional Elective)		-	-	-	3
2		Elective IX (Open Elective IV)		-	-	-	3
3	21FIX01	Full semester Internship (FSI)	1,2,5,8,9, 10,PSO1, PSO2	-	-	-	8
Total				**-**	**-**	**-**	**14**
Language Electives							
No.	**Course Code**	**Course**	**POs**	**Contact Hours**			
				L	**T**	**P**	**C**
1	21HSX03	Advanced Communicative English	10,12	3	-	-	3
2	21HSX04	Communicative German		3	-	-	3
3	21HSX05	Communicative French		3	-	-	3
4	21HSX06	Communicative Japanese		3	-	-	3
5	21HSX07	Communicative Spanish		3	-	-	3
6	21HSX08	Communicative Korean		3	-	-	3
7	21HSX09	Communicative Hindi		3	-	-	3
Elective I **Career Path I, II, III, IV and Other Core Electives**							
1	21CEC11	Principles of Building Architecture	1,3,PSO1, PSO2	3	-	-	3
2	21CEC21	Geometric Design and Highway Materials	1,3,PSO2	3	-	-	3
3	21CEC31	Prefabricated Structures	3, PSO2	3	-	-	3
4	21CEC41	Data Analysis and Visualization Using Python	1,2,5,12	3	-	-	3
5	21CE004	Construction Techniques	4,5,11, PSO2	3	-	-	3
6	21CE005	Airport, Railways and Harbour Engineering	1,3,12	3	-	-	3
7	21CE006	Construction Economics and Finance	3,10,11	3	-	-	3
Elective III **Career Path I, II, III,IV and Other Core Electives**							
1	21CEC12	Building Services	3,7,12 PSO2	3	-	2	4
2	21CEC22	Highway Design and Simulation	1,3,PSO2	3	-	2	4
3	21CEC32	Pre Engineered Buildings	3,11	3	-	2	4
4	21CEC42	ML for Civil Engineering	1,2,4,5,12	3	-	2	4
5	21CE007	Engineering Geology	1,2,4, PSO1	3	-	2	4
6	21CE008	Irrigation and Water Resources Engineering	3, 5, 10, 12	3	-	2	4
Elective V **Career Path I, II, III,IV and Other Core Electives**							
1	21CEC13	Building Information Modeling	3,5,10, PSO2	3	-	-	3
2	21CEC23	Highway Project Formulation and Economics	2,5,10, PSO2	3	-	-	3
3	21CEC33	BIM for Pre-Engineered Building	3,5,10, PSO2	3	-	-	3
4	21CEC43	AI for Civil Engineering	1,2,4,5,12	3	-	-	3
5	21CE010	Ground Improvement Techniques	2, 12, PSO1, PSO2	3	-	-	3
6	21CE011	Advanced Reinforced Concrete Design	2,3,10,12,PSO2	3	-	-	3
7	21CE012	Construction Methods and Equipment	2,7,12	3	-	-	3
Elective VI							
1	21CE013	Basics of Dynamics and Earthquake Engineering	1,2,3,12, PSO2	3	-	-	3

2	21CE014	Pavement Analysis and Design	3,12,PSO2	3	-	-	3
3	21CE015	Prestressed Concrete Structures	3,10,12, PSO2	3	-	-	3
Elective VIII							
1	21CE016	Repair and Rehabilitation of Structures	2,7,12, PSO2	-	-	-	3
2	21CE017	Spatial Analysis Techniques in Remote Sensing and GIS	1,2,5	-	-	-	3
3	21CE018	Pavement Management System	5,12	-	-	-	3
Open Elective I, II, III, and IV (Elective II, IV, VII, and IX)							
1	21CE001	Disaster Management	2,7	3	-	-	3
2	21EE001	Electrical Installation, Safety and Auditing	2,3,6,8	3	-	-	3
3	21ME001	Fundamentals of Optimization Techniques	1,2,3,5	3	-	-	3
4	21EC001	Sensors for Engineering Applications	1	3	-	-	3
5	21CS001	Fundamentals of Artificial Intelligence	1,2,3	3	-	-	3
6	21CH001	Energy Conversion and Storage Devices	1,3,6,7	3	-	-	3
7	21IT001	Fundamentals of Multimedia	3,5,7	3	-	-	3
8	21BS001	Nano Materials and Technology	1,12	3	-	-	3
9	21DS001	Fundamentals of Data Science	1,2	3	-	-	3
10	21CE002	Air Pollution and Environmental Impact Assessment	6,7,12	3	-	-	3
11	21EE002	Renewable Energy Sources	2,7	3	-	-	3
12	21ME002	Principles of Entrepreneurship	1,5,8,11	3	-	-	3
13	21EC002	Electronics for Agriculture	1,2	3	-	-	3
14	21CS002	Fundamentals of Machine Learning	2,5	3	-	-	3
15	21CH002	Industrial Safety and Hazard Management	1,2,3,6,8	3	-	-	3
16	21IT002	Fundamentals of Cloud Computing	2,6,7,8,12	3	-	-	3
17	21BS002	Advanced Numerical Techniques	1,2	3	-	-	3
18	21BS003	Functional Materials and Applications	1,7	3	-	-	3
19	21CE003	Solid Waste Management	3,7,12	3	-	-	3
20	21EE003	Fundamentals of Electrical Vehicle Technology	2,3,12	3	-	-	3
21	21ME003	Industrial Engineering and Management	1,11	3	-	-	3
22	21EC003	Interfacing and Programming with Arduino	1,2	3	-	-	3
21	21CS003	Data Science for Engineering Applications	2,3,4	3	-	-	3
24	21CH003	Industrial Ecology for Sustainable Development	2,6,7	3	-	-	3
25	21IT003	Fundamentals of Mobile Computing	1,7	3	-	-	3
26	21BS004	Advanced Materials of Renewable Energy	1,7	3	-	-	3
27	21BS005	Applied Linear Algebra for Engineers	1,12	3	-	-	3
28	21CE019	Green Buildings	1,7,12	3	-	-	3
29	21EE017	Sustainable Energy	2,3,12	3	-	-	3
30	21ME019	Total Quality Management	1,11	3	-	-	3
31	21EC011	Communication Technologies	1,2	3	-	-	3
32	21CS020	Applications of Artificial Intelligence	2,3,6,7	3	-	-	3
33	21CH016	Green Technologies	2,6,7	3	-	-	3
34	21IT015	Human Computer Interaction	1,7	3	-	-	3
35	21BS006	Handling of Industrial waste and waste water	1,7	3	-	-	3
36	21OE001	Robotics and Automation	5,6,7	3	-	-	3
37	21OE002	Introduction to IoT	1,2	3	-	-	3
38	21OE003	Fundamentals of Image processing	1,2	3	-	-	3
39	21OE004	Fundamentals of Data Acquisition systems	1,2	3	-	-	3
40	21OE005	Airport Operations Management	2,4,11,12	3	-	-	3
41	21OE006	Fundamentals of Embedded Systems	1,2	3	-	-	3
42	21OE007	Remote Sensing and GIS	1,2,5,7,10	3	-	-	3
43	21OE008	Big Data Analytics	1,7	3	-	-	3
44	21OE009	Fundamentals of Cyber Security	3,6,8	3	-	-	3

45	21OE010	Smart Cities	7,12	3	-	-	3
46	21OE011	Nano Materials and Thin Film Technology	1,12	3	-	-	3
47	21CSMC1	Cloud computing	2,3	3	-	-	3
48	21CSMC2	Ethical Hacking	1,2,3	3	-	-	3
49	21CSMC3	Fundamentals of Web Development	2,3,5	4	-	-	4
50	21OE012	Business Intelligence & Analytics	2,3,5	3	-	-	3
51	21OE013	Introduction To Industry 4.0 And Industrial IoT	2,3	3	-	-	3
52	21OE014	Natural Language Processing	2,3	3	-	-	3
Audit Course							
1	21AT001	Communication Etiquette in Workplaces					
2	21AT002	Contemporary India: Economy, Policy and Society					
3	21AT003	Design The Thinking					
4	21AT004	Ethics and Integrity					
5	21AT005	Indian Heritage and Culture					
6	21AT006	Intellectual Property Rights and Patents					
7	21AT007	Introduction to Journalism					
8	21AT008	Mass Media Communication					
9	21AT009	Science, Technology and Development					
10	21AT010	Social Responsibility					
11	21AT011	The Art of Photography and Film Making					
12	21AT012	Gender Equality for Sustainability					
13	21AT013	Women in Leadership					
14	21AT014	Introduction to Research Methodology					
15	21AT015	Climate Change and Circular Economy					
B. Tech. (Honors)							
Domain I: Structural Engineering							
01	21CEH11	Advanced Concrete Technology	1,12	4	-	-	4
02	21CEH12	Advanced Structural Analysis	1,12	4	-	-	4
03	21CEH13	Design of Industrial Structures	3,5,12, PSO2	4	-	-	4
04	21CEH14	Bridge Engineering	1,12,PSO2	4	-	-	4
Domain II: Transportation Engineering							
01	21CEH21	Rural Road Technology	2,3,PSO1	4	-	-	4
02	21CEH22	Evaluation and Strengthening of Pavements	3,12,PSO2	4	-	-	4
03	21CEH23	Traffic Engineering and Management	3,12	4	-	-	4
04	21CEH24	Planning and Design of Airport	3,12,PSO2	4	-	-	4
Domain III: Geotechnical Engineering							
01	21CEH31	Elements of Rock Mechanics	2,12,PSO1	4	-	-	4
02	21CEH32	Construction in Expansive Soils	2,12,PSO2	4	-	-	4
03	21CEH33	Geosynthetics in Soil Structures	2,3,12, PSO1	4	-	-	4
04	21CEH34	Soil dynamics	2,3,12	4	-	-	4
Domain IV: Construction Management							
01	21CEH41	Modern Construction Material	1,7,12	4	-	-	4
02	21CEH42	Construction Planning and Project Management	1,12	4	-	-	4
03	21CEH43	Quality Control and Assurance in Construction	1,3,12, PSO1	4	-	-	4
04	21CEH44	Safety in Construction	2,11, PSO2	4	-	-	4
B. Tech. (Minors)							
Energy Science & Technology							
01	21CHM11	Foundation of Energy Science and Technology	1,2,3,5,7, 12	4	-	-	4

02	21CHM12	Energy Generation from Waste	1,2,3,4,5	4	-	-	4
03	21CHM13	Energy Storage Systems	1,2,3,6,7	4	-	-	4
04	21CHM14	Hydrogen Energy and Fuel Cells	1,2,3,7	4	-	-	4
Nano Science & Technology							
01	21CHM21	Introduction and Characterization of Nano-Materials	1,2,3,7	4	-	-	4
02	21CHM22	Carbon Nano-Structures and Applications	1,3,4,5	4	-	-	4
03	21CHM23	Energy, Environmental and Biomedical Nanotechnology	1,2,3,7	4	-	-	4
04	21CHM24	Industrial Application of Nanotechnology	2,3,5,7	4	-	-	4
Environment Engineering							
01	21CEM11	Watershed Management	6,7	4	-	-	4
02	21CEM12	Industrial Pollution Control and Engineering	3,6,7,12	4	-	-	4
03	21CEM13	Solid and Hazardous Waste Management	1,3,6,7	4	-	-	4
04	21CEM14	Ecology and Environmental Assessment	1,3,6,7	4	-	-	4
05	21CEM15	Environmental Pollution	2,3,6	4	-	-	4
Artificial Intelligence & Machine Leaning							
01	21CSM11	Fundamentals of AI & Machine Learning	1,12	4	-	-	4
02	21CSM12	Feature Engineering for Machine Learning	1,2,3	4	-	-	4
03	21CSM13	Exploratory Data Analytics	1,4	4	-	-	4
04	21CSM14	Deep Learning	1,2,4	4	-	-	4
Cyber Security							
01	21CSM21	Fundamentals of Security	1,2	4	-	-	4
02	21CSM22	Management of Information Security	3,6,7	4	-	-	4
03	21CSM23	Cyber Security	1,3,4	4	-	-	4
04	21CSM24	Cloud Security	2,3	4	-	-	4
Data Science & Analytics							
01	21CSM31	Data Cleaning	2,3,4	4	-	-	4
02	21CSM32	Data Engineering	1,2,3,4	4	-	-	4
03	21CSM33	Text Analytics	1,2,4	4	-	-	4
04	21CSM34	Social Network Semantic Analysis	2,4	4	-	-	4
Computer Systems Programming							
01	21CSM41	Programming Fundamentals	1,2,3	4	-	-	4
02	21CSM42	Data Structures & Algorithms	1,2,3,4	4	-	-	4
03	21CSM43	Fundamentals of Databases	1,4	4	-	-	4
04	21CSM44	Fundamentals of Computer Networks & Operating Systems	1,2,3	4	-	-	4
Digital IC Design							
01	21ECM11	Fundamentals of VLSI Design	1,2,3	4	-	-	4
02	21ECM12	Digital Design using HDL	1,2,3	4	-	-	4
03	21ECM13	FPGA Technology	1,2	4	-	-	4
04	21ECM14	Analog and Mixed Signal Design	1,2	4	-	-	4
Industrial Automation							
01	21ECM21	Microcontrollers and Interfacing	1,2,3	4	-	-	4
02	21ECM22	Sensors and Data Acquisition System	1,2	4	-	-	4
03	21ECM23	Fundamentals of Lab view	1,2	4	-	-	4
04	21ECM24	Medical Robotics	1,2,3	4	-	-	4
Communications and Networking							
01	21ECM31	Principles of Communications	1,2	4	-	-	4
02	21ECM32	Coding Theory and Practice	1,2	4	-	-	4
03	21ECM33	Ad-hoc and Wireless Sensor Networks	1,2,3	4	-	-	4
04	21ECM34	Fundamentals of Multimedia Networking	1,2,3	4	-	-	4
Avionics							
01	21ECM41	Principles of Aerodynamics	1,2	4	-	-	4
02	21ECM42	Aircraft Electrical Systems	1,2	4	-	-	4
03	21ECM43	Aircraft Instrument Systems	1,2	4	-	-	4
04	21ECM44	Aircraft Communication and Navigation	1,2	4	-	-	4

		Systems					
Geographic Information System							
01	21ECM51	Sensors and Sensing Technology	1,2	4	-	-	4
02	21ECM52	Geographic Information Systems	1,2	4	-	-	4
03	21ECM53	Digital Image Processing	1,2	4	-	-	4
04	21ECM54	Lidar Systems	1,2	4	-	-	4
Electric Vehicles Technology							
01	21EEM11	Introduction to Electric Vehicles Technologies	2,3	4	-	-	4
02	21EEM12	Electrical Drives and Controllers for Electric Vehicles	2,3	4	-	-	4
03	21EEM13	Charging Technology in Electric Vehicles	2,3	4	-	-	4
04	21EEM14	Computer Vision in Electric Vehicles	2,3	4	-	-	4
Smart City Management							
01	21EEM21	Fundamentals of Smart City	2,3	4	-	-	4
02	21EEM22	Smart City Infrastructure	2,3,5,6,7, 11	4	-	-	4
03	21EEM23	Computational Methods for Smart City Management	3,5	4	-	-	4
04	21EEM24	Communication Technologies and Mobility for Smart City	2,3	4	-	-	4
Industrial Applications and Control							
01	21EEM31	Modelling and Simulations of Industrial Applications	2,3	4	-	-	4
02	21EEM32	Industrial Sensors and Actuators	2,3	4	-	-	4
03	21EEM33	Programmable Logic Controllers	2,3	4	-	-	4
04	21EEM34	Control Design for Industrial Applications	2,3	4	-	-	4
Cloud Application Development							
01	21ITM11	Introduction to Cloud Computing	6,7,12	4	-	-	4
02	21ITM12	Introduction to Web Development with HTML, CSS, JavaScript	1,2,3,9,12	4	-	-	4
03	21ITM13	Developing Cloud Native Applications	5,8,10	4	-	-	4
04	21ITM14	Developing Cloud Apps with Node.js and React	5,8,10	4	-	-	4
Robotics and Automation							
01	21MEM11	Introduction to Robotics	1,2,3	4	-	-	4
02	21MEM12	Drives and Sensors	1,2,3,4	4	-	-	4
03	21MEM13	Control Systems for Robotics	1,2,3,4	4	-	-	4
04	21MEM14	Machine Learning for Robotics	2,5	4	-	-	4
Industrial Systems Engineering							
01	21MEM21	Industrial Engineering	1,10,11,12	4	-	-	4
02	21MEM22	Fundamentals of Operations Research	1,2,3,5	4	-	-	4
03	21MEM23	Enterprise Resource Planning	1,2,3,5,11, 12	4	-	-	4
04	21MEM24	Production Planning and Control	1,2,3,5,11, 12	4	-	-	4

21HSX01 Communicative English

(Common to all B Tech Programmes)

2 0 0 2

Course Outcomes

1. Develop effective listening skills for better comprehension of English spoken in different social and workplace contexts
2. Compose speech clearly on a specific topic using appropriate language in informal discussions
3. Understand the implicit and explicit meanings of a text while reading.
4. Summarize the texts of reading and listening based on comprehension
5. Construct sentences using proper grammatical sentence structures
6. Chose and use the appropriate vocabulary, phrases in different contexts

COs – POs Mapping

COs	PO1	PO9	PO10	PO11	PO12
l	1	1	3	1	2
2	1	1	3	1	2
3	1	1	3	1	1
4	1	1	3	1	2
5	1	1	3	1	1
6	1	1	3	1	1

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions about main idea and supporting ideas.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.

Grammar and Vocabulary: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural; basic sentence structures; simple question - wh-questions; word order in sentences.

Poem: Once upon a time by Gabriel Okara

15 Hours

Unit II

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together

Writing: Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.

Grammar and Vocabulary: Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

Short-story: Next Sunday by R.K. Narayan

15 Hours

Unit III

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for reading comprehension

Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions; introducing the structure of essay writing.

Grammar and Vocabulary: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes

Speech: The fringe benefits of failure (Harvard inaugural address) by J. K. Rowlings

15 Hours

Unit IV

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts -without the use of PPT slides.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables.

Grammar and Vocabulary: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms; Editing short texts identifying and correcting common errors in grammar and usage.

Essay: How to read a book? by Virginia Woolf

15 Hours

Total: 60 Hours

Textbook (s)

1. *English All Round: Communication Skills for Undergraduate learners*, Vol.1,Published by Orient Black Swan, 2019

Reference (s)

1. Chase, Becky Tarver. *Pathways:Listening, Speaking and Critical Thinking.*Heinley ELT; 2nd Edition, 2018.
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) MacmillanEducational.
3. Hewings, Martin.*Cambridge Academic English (B2)*. CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
4. Bailey, Stephen. *Academicwriting: A handbook for international students*.Routledge, 2014
5. Dhanavel.S.P. *English and Communication Skills for Students of Science and Engineering.* Orient Blackswan, 2009.

Web resource(s)

Grammar/Listening/Writing

1. 1-language.com
2. www.5minuteenglish.com
3. www.englishpractice.com

Grammar/Vocabulary

4. English Language Learning online
5. www.bbc.co.uk/learningenglish
6. www.better-english.com
7. www.nonstopenglish.com
8. www.vocabulary.com

Reading

9. www.usingenglish.com
10. www.englishclub.com
11. www.english-online.at

Listening

12. learningenglish.voanews.com
13. www.englishmedialab.com

Speaking

14. www.talkenglish.com
15. BBC Learning English – Pronunciation tips
16. Merriam-Webster – Perfect pronunciation Exercises

All Skills

17. www.englishclub.com
18. www.world-english.org
19. learnenglish.britishcouncil.org

Online Dictionaries

20. Cambridge dictionary online
21. MacMillan dictionary
22. Oxford learner's dictionaries

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment Test (%)
Remember	25	25	
Understand	25	25	
Application	50	50	40
Analysis	-	-	30
Evaluate	-	-	
Create	-	-	30
Total (%)	100	100	100

Sample question (s)

Remember

1. Write plural forms of the following nouns**.**
   i. ox ii. radius
2. Find an adjective form of the following verbs
   i. Interact ii. communicate

Understand

1. What do you understand by skimming and scanning?
2. Differentiate summarizing and paraphrasing.

Apply

1. Construct a dialogue between students about organizing music club activities in their college.
2. Punctuate the following sentences.
   a. does he speak english well
   b. mount everest is the highest peak in the world
   c. rama a son of dasaradha is a great king of ayodhya
3. A) Imagine that you are Jack Ma and you are going to speak to the students of first semester B.Tech. students of GMR Institute of Technology about your life and future course of action. Use the information given in the passage below to create a 3-minute speech. You must answer all the questions in the order as follows:
   a. Identify 8 keywords from the passage below.
   b. Mention minimum 4 headings under which you will organize your speech. Refer to page No. 17 of English All Round to identify the prompts you need. You can also create your own prompts.
   c. Introduce Jack Ma in a single sentence of not more than 12 words.
   d. Refer to page no 39 to use signpost language to write a speech imagining that you are Jack Ma speaking to the students of first semester B.Tech. students of GMR Institute of Technology about your life and future course of action.

1. B) Which title given below is the best in your view? Justify your decision. You may suggest a new title and justify that your choice is better than the given options. (For Open Book Examination and not for semester end examination)

21MAX01 Engineering Mathematics I

(Common to all B. Tech. Programmes)

3 0 0 3

Course Outcomes

1. Find the solution of system of linear equations, eigen values and eigen vectors
2. Identify the nature of the quadratic form using matrix theory
3. Classify and solve first and higher order ordinary differential equations with constant coefficients
4. Apply the knowledge of Mean value theorems, Maxima and Minima of functions of several variables
5. Analyze the characteristics to trace the curve
6. Adapt methods for measuring lengths, volumes, surface area of an object and also the procedure to transform change of variables and order of integration

COs – POs Mappings

COs	PO1	PO2	PO3	PO4	PO12
1	3	3	2	2	1
2	3	2	3	3	1
3	3	3	3	2	1
4	3	2	2	1	1
5	3	3	2	1	1
6	3	3	3	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Matrices

Rank-Echelon form, Normal form, Solution of Linear System of equations –Gauss Elimination Method and Gauss Jordan Method

Eigen values and Eigen vectors – Properties (without proofs), Cayley-Hamilton Theorem (without proof) - Inverse and powers of a matrix

Quadratic forms- Reduction of quadratic form to canonical form using orthogonal transformation – Rank, index and signature, Nature of Quadratic form

LU-Decomposition Method

15 Hours

Unit II

Differential Equations

Differential equations of first order and first degree–exact and reducible to exact, Newton's Law of cooling, Law of natural growth and decay, orthogonal trajectories

Linear differential equations of higher order with constant coefficients with RHS term of the type e^{ax}, $\sin ax$, $\cos ax$ polynomials in x, $e^{ax}V(x)$, $x^mV(x)$

Problems related to LCR circuits

15 Hours

Unit III

Curve tracing and Functions of Several Variables

Curve tracing-Cartesian, Polar and Parametric curves

Functions of several variables-Partial differentiation, Taylor's theorem (generalized Mean Value theorem-without proof), Jacobian, Functional dependence, Maxima and Minima of functions of two variables with and without constraints

Applications of Mean value theorems

15 Hours

Unit IV

Applications of Integration

Lengths, Volumes and Surface areas of revolution in Cartesian and Polar Coordinates

Multiple integrals-Double integrals, Change of order of Integration, change of variables (Cartesian and Polar coordinates) and evaluation of triple integrals

Problems related to Centroid and Mass

15 Hours

Total: 60 Hours

Textbook (s)

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publishers, New Delhi, 2012
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Ed., Wiley, 2012
3. R. K. Jain, S. R. K.Iyengar, Advanced Engineering Mathematics, 4th Ed., Narosa Publishing House, New Delhi, 2014

Reference (s)

1. B. V. Ramana, Engineering Mathematics, 4th Ed., Tata McGraw Hill, New Delhi, 2009
2. D. S. Chandrashekharaiah, Engineering Mathematics, Volume 1, Prism Publishers, 2010
3. T. K. V. Iyengar, B. Krishna Ghandhi, S. Ranganathan and M.V. S.S.N. Prasad, Engineering Mathematics, Volume-I, 12th Ed., S. Chand Publishers, 2014
4. U. M. Swamy, P. VijayaLaxmi, K. L. Sai Prasad and M. Phani Krishna Kishore, A Text Book of Engineering Mathematics–I, Excel Books, New Delhi, 2010

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Int. Test 3[1] (%)
Remember	10	10	-
Understand	30	30	25
Apply	60	60	75
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. State Cayley-Hamilton theorem.
2. What is Bernoulli's equation?

Understand

1. Represent $x^2y + 3y - z$ in powers of $(x - 1)$ using Taylor's theorem.
2. Show that $3y^4z^2\hat{\imath} + 4x^3z^2\hat{\jmath} + 3x^2y^2\hat{k}$ is solenoidal.

Apply

1. Make use of the properties, to compute the sum and the product of the Eigen values of $A = \begin{pmatrix} 1 & 2 & 3 \\ 0 & 5 & 1 \\ 0 & 0 & 2 \end{pmatrix}$.
2. Solve $(D^3 - 3D^2 + 4)y = e^{2x} + 6 + 80\cos 2x$
3. Gowtham invests a total of Rs. 10,000 in three accounts, one paying 5% interest, another paying 8% interest, and the third paying 9% interest. The annual interest earned on the three investments last year was Rs. 770. The amount invested at 9% was twice the amount invested at 5%. (For Open Book Examination and not for semester end examination)
   a) Express the given data in system of equations. (U/C)
   b) Use the knowledge of matrices to evaluate the amounts invested in three accounts. Justify your method. (An/P)
   c) If the amount invested at 9% was Rs. 200 more than that of the twice the amount invested at 8%. How much amounts would be gowtham invested in this case. (An/P)

21PYX01 Engineering Physics

(Common to all B.Tech. Programmes)

3 0 0 3

Course Outcomes

1. Interpret the concepts of mechanics to understand the conservative principles
2. Outline the principles of electrostatics, magnetostatics and able to explain electromagnetism.
3. Illustrate the concepts of Interference, Diffraction, Polarization and their applications
4. Summarize the fundamental concepts of quantum theory and identify the applications of quantum theory in various contexts
5. Classify solids into conductors, insulators and semiconductors and understand conductivity in intrinsic and extrinsic semiconductors
6. Demonstrate the emission of laser light and their applications in various engineering fields. Interpret and classify optical fibers and their applications in modern communication systems.

COs – POs Mapping

COs	PO_1	PO_2	PO_{12}
1	3	2	1
2	3	2	1
3	3	2	1
4	3	2	1
5	3	2	1
6	3	2	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Mechanics, Electrostatics and Magnetostatics

Scalar and Vector fields, – Gradient, divergence and curl – Gravitational potential energy – Work Energy theorem – Central forces – Conservative forces– Angular momentum - Kepler's laws of planetary motion (qualitative)

Electric flux - Gauss's law (electrostatics) – Applications of Gauss law: Coulomb's law from Gauss law, Spherically distributed charge (Non conducting sphere) - Ampere's law, application of Ampere's law - Biot-Savart's law, Applications of Biot-Savart's law: B due to current carrying straight conductor and a circular loop – Faraday's law – Lenz's law - Maxwell's equations.

Electric field due to infinite sheet of charge and infinite line of charge

17 Hours

Unit II

Wave Optics

Principle of Superposition-Interference of light - Conditions for sustained Interference –Young's double slit interference-Interference in thin films (reflected light) - Newton's Rings, Determination of Wavelength, applications of Interference

Diffraction - Fraunhofer Diffraction at Single slit - Diffraction Grating – Grating Spectrum - Determination of Wavelength - applications of Diffraction.

Polarization - Types of polarization - Polarization by double refraction - Nicol's Prism - Half wave and Quarter wave plates - applications of Polarization.

Wedge shaped film - Polariods - Rayleigh criterion in resolution

14 Hours

Unit III

Quantum theory and semiconductors

Dual nature of matter - de-Broglie Hypothesis - Properties of matter waves – Uncertainty Principle - Physical significance of wave function - Schrödinger's wave equation – Particle in infinite potential well (one dimensional box) - Free electron theory of metals, electrical conductivity - Fermi Dirac Distribution function (qualitative) - Kronig - Penney model (qualitative) - Classification of materials into conductors, semiconductors and insulators.

Intrinsic semiconductors - Density of charge carriers (qualitative) - Fermi energy level – Electrical conductivity - Extrinsic semiconductors (P-type & N-type) - Density of charge carriers (qualitative) - Dependence of Fermi energy on carrier concentration and temperature - Hall effect - Applications of Hall effect - Drift and Diffusion currents

Tunneling effect

17 Hours

Unit IV

Lasers and Optical Fiber

Characteristics of laser – Stimulated absorption – Spontaneous emission - Stimulated emission – Population inversion – Pumping mechanism – Active medium –Laser systems: Ruby laser, He-Ne laser, Semiconductor laser – Applications of Lasers

Introduction to Optical Fibers-Total Internal Reflection and Critical angle of propagation - Acceptance angle - Numerical Aperture-Classification of fibers based on Refractive index profile and modes – Applications of optical fibers - Block Diagram of Fiber optic Communication system

Fiber optic sensors - Holography.

12 Hours

Total: 60 Hours

Textbook (s)

1. Halliday, Resnick and Krane, Physics Part-II, Wiley India Pvt. Ltd, 2014
2. D Kleppner and Robert Kolenkow, An Introduction to Mechanics –II, Cambridge University Press, 2015.
3. David J Griffiths, Introduction to Electrodynamics, Printice Hall of India, 2012.
4. R.K. Gour and S.L. Gupta, Engineering Physics, Dhanpath rai Publications, New Delhi, 2014
5. S. O. Pillai, Solid State Physics, 6th Ed., Newage International Publishers, 2015
6. A. S. Vasudeva, Modern Engineering Physics, S. Chand and Company, New Delhi, 2006

Reference (s)

1. V. Rajendran, Engineering Physics, McGraw Hill Education (India) Private LTD, 2010
2. M. Armugam, Engineering Physics, Anuradha Agencies, 2007
3. P.K. Palanisamy, Engineering Physics – I, II, Scitech Publications (India) Pvt. Ltd, 2011.
4. M.R. Srinivasan, Engineering Physics, New age International Publishers, 2nd Edition, 2014.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Int. Test 3 [i](%)
Remember	40	40	-
Understand	40	40	25
Apply	20	20	75
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

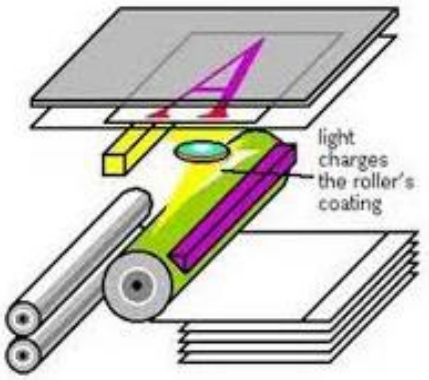
1. Define Principle of Superposition.
2. State Faraday's law of electromagnetic induction and Lenz's law.
3. Recall vector and scalar fields.

Understand

1. Explain the construction and working principle of Nicole's prism.
2. Illustrate Ruby laser and explain its working principle with energy level diagram.
3. Outline fermi dirac distribution function.

Apply

1. Demonstrate any four applications of lasers with reference to their characteristics**.**
2. Apply Biot-Savart's law, and calculate the Magnetic field induction along the infinite length of a straight conductor at points close to the conductor.
3. Calculate electric field intensity due to infinite line of charge by applying Gauss law**)**
4. Electric field just above the surface of the charged drum of a photocopying machine as a magnitude of E = 2.3 x 10^5 N/Coulomb. **(For Open Book Examination and not for semester end examination)**



a) What is the surface charge density on the drum if it is a conductor?
b) Calculate the total charge on the drum if it has a length of 42 cm and diameter of 12 cm.
c) The manufacturer wishes to produce a desktop version of the machine, this requires reducing the size of the drum to a length of 28 cm and diameter of 8 cm. The electric field at the drum surface must remain unchanged. What must be charge on this new drum?

21CYX01 Engineering Chemistry

(Common to all B.Tech. Programmes)

3 0 0 3

Course Outcomes

1. Illustrate the different types of polymers and their applications
2. Interpret the Nernst equation for electrode potential and construct various types of energy storage devices
3. Describe corrosion factors and implement prevention measures
4. Estimate the calorific value of a fuel and select a suitable fuel as an energy resource
5. Describe the important renewable energy sources and their usage
6. Explain bonding, colour and magnetic properties of molecules

COs – POs Mapping

COs	PO1	PO2	PO6	PO7	PO12
1	3	1	1	3	1
2	3	1	1	2	1
3	3	1	1	3	1
4	3	1	1	2	1
5	3	1	1	3	1
6	3	1	1	2	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples of polymer formation.

Plastics - Thermoplastics and Thermosettings; Compounding of plastics; Preparation, properties and engineering applications of – Teflon, Bakelite, polycarbonate; Fibre reinforced plastics (FRP), Elastomers: Processing of natural rubber, Vulcanization of rubber–Engineering applications of rubber

Conducting polymers: mechanism of conduction in polyacetylene and applications of conducting polymers, Bio-degradable polymers: Poly hydrohy alkanoates (PHA), Poly caprolactum (PCL)

Molecular imprinting polymers (MIP)

15 Hours

Unit II

Electrochemistry and Corrosion

Concept of Electrode potential, electrochemical cell, Nernst equation, cell potential calculations

Primary cells – Fuel cells, hydrogen-oxygen fuel cells, working of the cells

Secondary cells – lead acid and lithium ion batteries- working of the batteries including cell reactions

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, environmental factors (pH, temperature, DO) affecting corrosion rate, protection methods – corrosion inhibitors with specific examples, cathodic and anodic protection.

Organic coatings

15 Hours

Unit III

Fuel Chemistry

Fuels **–** Types of fuels, calorific value - HCV, LCV, numerical problems based on calorific value; Working and calorific value determination using Bomb calorimeter & Junkers Calorimeter, Characteristics of a good fuel, Analysis of coal - Proximate analysis & Ultimate analysis, refining of petroleum, liquid fuels, knocking and anti-knock agents, Octane and Cetane values, cracking of oils-Catalytic cracking, Synthetic petrol-polymerization, Fischer Tropsch & Bergius Process

Renewable Energy Resources: Energy scenario in India, Solar energy- Harnessing of solar energy in the form of Photo-voltaic cells, Bio-energy: Biodiesel

Rocket Fuels

15 Hours

Unit IV

Structure and Bonding Models

Molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2, N_2, NO and CO, etc. π-molecular orbitals of butadiene and benzene, calculation of bond order

Crystal field theory – salient features – energy level diagrams for transition metal ions – splitting in octahedral and tetrahedral environments, Magnetic properties and colour of complexes

Band theory of solids – band diagrams for conductors, semiconductors and insulators, role of doping on band structures.

Planck's quantum theory, Schrodinger equation (qualitative treatment only)

15 Hours

Total: 60 Hours

Textbook (s)

1. P. C. Jain and Monica Jain, Engineering Chemistry, 16th Ed., Dhanpat Rai Publishing Company, New Delhi, 2015
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference (s)

1. S. Chawla, A Textbook of Engineering Chemistry, 3rd Ed., Dhanpat Rai& Co (Pvt) Ltd, New Delhi, 2012
2. P. Murthy, C. V. Agarwal, A. Naidu, Textbook of Engineering Chemistry, B. S. Publications, Hyderabad, 2006
3. S. S. Dara, A Textbook of Engineering Chemistry, S. Chand and Company Limited, New Delhi, 1994

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Int. Test 3[1] (%)
Remember	20	20	-
Understand	60	60	25
Apply	20	20	75
Analyze	-	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. Define polymer. Which are the different types of polymerization?
2. Differentiate between polymer and plastic? List out the differences between thermoplastics and thermosetting plastics?
3. Define calorific value, HCV and LCV

Understand

1. What is meant by vulcanization of rubber? Explain the advantages of vulcanization.
2. What is compounding of plastics? Explain the role of Fillers and Stabilizers with examples in compounding of plastics.
3. How a photo-voltaic cell is constructed and what is the working mechanism of it?

Apply

1. By which methods, the underground pipelines are protected from corrosion? Explain the involved mechanisms.
2. Illustrate the Molecular orbital diagram of NO molecule by applying the MOT.
3. When a metal X (of reduction potential = 0.337V at 25^0C) is connected to another metal Y (of reduction potential = -0.140V at 25^0C) and this structure is exposed continuously to sea water, which type of corrosion would take place? Explain with suitable mechanism
4. Starch is digested by humans as well as animals but cellulose is digested by animals only. (For Open Book Examination and not for semester end examination)
   a) Draw and identify the differences in structures of starch and cellulose
   b) Comment on the bio-degradability of them, giving possible by products if bio degradable
   c) Is it possible to make plates with starch so that they can be eaten too at the end? What precautions should be taken while making plates with starch so that they have all the necessary properties like cellulose plate?
   d) List few suitable/bio-compatible/edible ingredients to such a 'starch' plate
   e) What would be the situation if humans were given the ability to digest cellulose as well, by God?

21BEX01 Basics of Engineering

(Common to all B.Tech. Programmes)

3 0 0 3

Course Outcomes

1. Understand the principles of surveying and building materials and components
2. Understand the working principle of steam, Gas, Diesel, Hydro-electric, Nuclear Power plants and IC Engines
3. Understand the working principle of vapour compression & vapour absorption refrigeration systems, Window and Split type AC systems
4. Illustrate the behavior of basic electric circuit elements for both DC and AC excitation
5. Outline the construction and working principle of DC machines with appropriate safety measures
6. Understand the operation of sensors for engineering applications.

COs – POs Mapping

COs	PO1	PO3	PO6	PO7	PO9	PO11	PO12
1	3	2	1	1	1	1	1
2	3	2	1	1	1	1	1
3	3	2	1	1	1	1	1
4	3	2	1	1	1	1	1
5	3	2	1	1	1	1	1
6	3	2	1	1	1	1	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Surveying, building materials and components

Surveying principles, measurements of distances and areas. Building Materials: Bricks, stones, sand, cement, steel and concrete. Substructure: safe bearing capacity, foundations and types. Superstructure: stone and brick masonry, beams, columns, lintels, roofs, floors, plastering.

Layout of building (Plan and Elevation)

15 Hours

Unit II

Power Plant, IC Engines, Refrigeration and Air Conditioning System

Power plant – Classification, Working principle - steam, Gas, Diesel, Hydro-electric and Nuclear Power plants. IC Engines - Working principle of Petrol and Diesel Engines, Four stroke and two stroke cycles, Comparison. Refrigeration and Air Conditioning System – Simple and practical vapour absorption system, Window and Split type room Air conditioner.

Layout of typical domestic refrigerator

15 Hours

Unit III

Fundamentals of Electrical Engineering

Voltage, Current, Ohm‘s law, Kirchhoff’s laws, Faraday‘s Laws, Basic circuit elements–R, L and C-series and parallel circuits, mesh and nodal analysis, Generation of alternating current, basic definitions, RMS and average values of periodic waveforms-form factor and peak factor, Principle of operation and construction-DC machines, Electric shock and its prevention, Methods of earthing.

Indian electricity safety rules.

15 Hours

Unit IV

Sensors & Consumer Electronics

Sensors and Applications: Resistive Sensors, Inductive Sensors, Capacitive Sensors, Optical Sensors, Electro Magnetic Sensors, Thermal Sensors. Electronic Appliances: Photo Copier, Digital Camera, Mobile Phone, Television, Washing Machine.

Ultrasonic sensors and applications

15 Hours

Total: 60 Hours

Textbook(s):

1. G. Shanmugam and M.S. Palanichamy, Basic Civil and Mechanical Engineering, 3rd Ed., Tata. McGraw. Hill Publishing Co., New Delhi, 2000.
2. Ramamrutham S., Basic Civil Engineering, 3rd Ed., Dhanpat Rai Publishing Co. (P) Ltd. 2013.
3. Ganeshan.V, IC Engines, Tata McGraw-Hill Education Pvt. Ltd, 3rd Ed., 2013.
4. C.P.Arora, Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Limited, 3rd Ed., 2009.
5. P.K.Nag, Power Plant Engineering,Tata McGraw Hill Publishing Company, India, 4th Ed., 2014.

6. R.K.Rajput, Power Plant Engineering, 5th Ed., Lakshmi Publications, 2016.
7. D. P. Kothari and I. J. Nagrath, Theory and Problems of Basic Electrical Engineering, 4th Ed., PHI Learning Private limited, 2013.
8. Ramana Pilla, M. Surya Kalavathi and G.T.Chandra Sekhar, Basics of Electrical Engineering, 1st Ed., S. Chand & Company Ltd., 2018
9. D. Patranabhis, Sensors and transducers, 2nd Ed., PHI publication, 2013.
10. Principles of Electrical Engineering by V. K. Mehta and Rohit Mehta, S Chand and company Ltd, 5th Edition, 2012
11. 11. Basic Electrical Engineering Theory and Problems by D.P. Kothari and I.J. Nagrath, Prentice Hall, India, 4 th Edition, 2013.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Int. Test 3[1] (%)
Remember	20	40	-
Understand	55	60	25
Apply	25	-	75
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. Define Surveying.
2. Define Plane surveying.
3. Define Geodetic Surveying.
4. Define Bearing capacity, Ultimate bearing capacity, Gross safe bearing capacity and Net bearing capacity?
5. What are the different types of foundations and explain with neat sketches.
6. What is the standard Size of brick?
7. Why is gypsum needed in cement?
8. Define a cantilever beam.
9. What is D.P.C?
10. What is plastering?
11. Classify the power plant
12. Lable the components of IC engine
13. State Faradays laws of Electro-magnetic Induction.
14. Define Kirchhoff's laws
15. List out five Indian electricity safety rules
16. Define RMS and average values,form factor and peak factor, of a periodic waveform
17. Define resolution of a sensor.
18. List any two applications of a electro magmetic sensor.
19. State the purpose of a sensor?
20. List any two applications of a capacitive sensor.
21. Define Slew rate of sensor.

Understand

1. Explain Chain surveying with its accessories.
2. Explain different types of ranging methods.
3. Explain in detail about principle of Surveying
4. What are the factors effecting safe bearing capacity
5. What are the qualities of a good brick?
6. How are rocks classified? Briefly discuss the different classification of rocks.
7. What are the general principles of brick masonry?
8. Distinguish between short column and long column.
9. Differentiate between truss and a roof.
10. Compare the two stroke and four stroke engines.
11. Explan the working of split type air conditioner
12. Outline the expression for RMS and Average values of a sinusoidal voltage wave form

13. Outline the construction and working of DC generator.
14. Explain various methods of earthing.
15. Explain the preventive method of avo9iding electric shock
16. Explain the principle behind the operation of thermal sensors.
17. Explain sensitivity and repeatability with reference to a sensor.
18. Explain the working principle of photo copier.
19. Explain the operating principle of a washing machine.
20. Discuss the evolution of mobile phone technology.

Apply

1. The following perpendicular offsets were taken at 10 meters intervals from a survey line to an irregular boundary line: 3.25, 5.60, 4.20, 6.65, 8.75, 6.20, 3.25, 4.20, 5.65
2. Calculate the area enclosed between the survey line, the irregular boundary line, and first and last offsets, by the application of a) average ordinate rule b) trapezoidal rule and C) Simpsons rule.
3. The following figure shows the typical cross section of a Flexible Pavement or Bituminous Pavement:



City A Municipal Corporation intends to use the following cross section detailed in Figure No. 2 for preparation of pavement which is spanning 20 km in length and 14 m wide. Camber slope (transverse slope) provided on top of the pavement surface is 1 in 45. Cost of excavation of Earthwork based on Standard Scheduled Rate (SSR) report prepared by governing body of city is ₹ 252.20/1 m^3. Traditional Materials that can be used in flexible pavement construction include: Bitumen (Viscous substance), Granular Soil, Binders (limited use only), Crushed Stone and Bricks. Amount of traffic expected to ply on the road surface after it is finished and open to service is 30 commercial vehicles/4 hours. Each commercial vehicle is approximately weighing 8 tonnes to 12 tonnes. Flexible pavement is expected to serve 7.50 msa (million standard axle) load repetitions throughout its 15 years (design life or minimum serviceability life). 1 standard axle is equal to 80 kN. Alternative road construction forms: Plain Cement Concrete (PCC), Reinforced Cement Concrete (RCC). Alternative road construction materials: Dressed Stone Blocks (Igneous Type), Pre-casted Paver Blocks (with Concrete), Plastic Lamina.

a) Calculate the cross-section area of the pavement in m^2 if pavement sections are constructed:
   - To preserve economy
   - To use abundant materials
   - To use average quantity of resources

b) Calculate the following details based on traffic data provided:
   - Earliest time of failure of pavement (in years)
   - Time gap between earliest failure of pavement and design life (in years)

c) What is the cost incurred in excavation of earth work for preparing road cross section, for a mentioned length; if cross section is prepared with abundant pavement material resources?

d) Apex council of city A have relaxed the choice of materials used in pavement construction w. r. t. traditional materials; what are the different materials that you suggest for each layer of the pavement among alternative materials mentioned in question statement. Justify your preferences made for each layer of the pavement.

Mention significant pavement damage causing elements other than traffic plying on it. Create a pavement design strategy (in the form of flow chart) which can be tested in laboratory before it is implemented in form of full-scale construction. **(For Open Book Examination and not for semester end examination)**

21BEX02 Problem Solving and Programming Skills

(Common to all B.Tech. Programmes)

3 0 0 3

Course Outcomes

1. Explain and illustrate aspects of the problem solving using algorithm, flowchart
2. Demonstrate conditional and iterative statements to write programs
3. Understand and apply the concepts of arrays and user defined functions
4. Describe and apply the concepts of pointers and structures
5. Understand and apply the file manipulation functions to handle data files
6. Solve problems of varying complexity by developing programs in C

COs – POs Mapping

COs	PO1	PO2	PO3	PO12
1	3	2	2	2
2	3	2	2	2
3	3	2	2	2
4	3	2	2	2
5	2	2	2	2
6	2	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Problem Solving and Fundamentals of C

Problem solving basics: Introduction to computers, the problem-solving Aspect, Top-down Design, Algorithms, Flowcharts/Pseudo codes, Implementation of algorithms, Types of Programming Languages, Program development steps, The compilation process, Syntax and Semantic errors.

Fundamentals of C: C Fundamentals: C Character set, Token, Data types, variables, Declarations, Operators and Expressions: Different types of operators, expressions, Type Conversions, Precedence and Order of Evaluation, Data input and output statements.

Control Flow Statements: Branching: if, if-else, nested if, else-if ladder, Looping: while, do-while, for, Break, Continue, goto, Switch statement

Comma and size of operators, bitwise operators, escape sequences

19 Hours

Unit II

Arrays and Functions

Arrays: definition, declaration, accessing elements, storing elements, 2-D arrays, Multidimensional arrays Strings and string manipulations

Functions: Built-in functions, User-defined Functions: Function prototyping, Function Definition, Passing arguments to function, call by value, Recursion, Passing arrays to function, Storage classes, Scope and life time of variables.

Preprocessor commands, *enumerations*

15 Hours

Unit III

Pointers and Structures

Pointers: Fundamentals, declarations, passing pointers as argument to function (Call by reference), arrays and pointers, Operations on pointers, dynamic memory management functions

Structures: Definition, declaration, Structures and Functions, Arrays of Structures, Pointers to Structures, Self-referential Structures, typedef, Unions

Dangling pointers, variable length arguments

14 Hours

Unit IV

Data Files and Introduction to Data Structures

File manipulation: Creation of Files, Opening and Closing a File, Processing a File, Unformatted Files

Introduction to Data Structures: Definitions, Classification of data structures: Linear, Non-Linear, Operations on Linked lists, Stack, Queue.

Command line arguments, Macros, error handling functions.

12 Hours

Total: 60 Hours

Textbook (s)

1. Byron Gottfried, Programming with C, 3rd Ed., Tata McGraw Hill, 2017.
2. R. G. Dromey, How to solve it by Computer, Pearson Education India, 2008

Reference (s)

1. Y. Kanetkar, Let us C, 8th Ed., BPB Publication, 2004
2. ISRD Group, "Programming and Problem Solving Using C", Tata McGraw Hill, 2008.
3. F. E. V. Prasad, C Programming: A Problem-Solving Approach, Giliberg, Cengage, 2010
4. A. S. Tenenbaum, Y. Langsam and M. J. Augenstein,Data Structures using C, Pearson Education, 2009
5. Ellis Horowitz, Anderson-Freed, S Sahni, Fundamentals of Data Structures in C, 2nd Ed., Universities Press, 2008

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment Test [5] (%)
Remember	25	20	-
Understand	35	40	25
Apply	40	40	75
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. Define Algorithm
2. List any four types of operators of C - Language
3. What is dangling pointer?

Understand

1. What is Structured programming?
2. Differentiate linear and nonlinear data structures
3. List any four string handling functions

Apply

1. Write a program for matrix multiplication using arrays
2. Solve Towers of Hanoi problem using recursion
3. Identify the suitable file mode for adding new data in to the existing file
4. Compare structure and union
5. Differentiate logical and relational operators
6. Distinguish between Recursive and non-recursive functions

In a class of 50 students of 30 boys and 20 girls, develop programs that help a teacher to

a) to enroll their names to a particular course according to an alphabetical order

b) different ways to form a team of 17 students for coding sessions that consists of 7 boys and 10 girls

c) wants to know the no. of groups in which the students are grouped according to their length of names

d) wants students to form 2 groups: a palindromic group and a non-palindromic group

21BEX03 Problem Solving and Programming Skills Lab

(Common to all B.Tech. Programmes)

0 0 3 1.5

Course Outcomes

1. Implement, execute the programs in C language for solving a problem
2. Exercise conditional and iterative statements to Write C programs
3. Implement programs to develop applications using functions
4. Apply Arrays and structures to solve real world problems
5. Make use of pointers to design applications with efficient use of memory
6. Solve problems using files concept

COs – POs Mapping

COs	PO2	PO3	PO4	PO12
1	2	2	3	2
2	2	2	3	2
3	2	2	3	2
4	2	2	3	2
5	2	2	3	2
6	2	2	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

List of Experiments

1. Draw the Flow charts using Raptor tool (Minimum 2)

2. Mr. John takes a loan to buy a truck at the rate of some interest. Help John to calculate the simple interest to be paid for the loan amount for a time.

   For example:
   Given P=15000 amount at the rate of 5% interest annually (T=12 months).find SI?

   Functional Description:
   Complete the task using C editor and the output of the program is to display a float value.

   Constraints:
   - P>10,000
   - T>0
   - 2<=R<=5

   Sample Test case:
   15000
   11
   3
   4950.00
   The first integer indicates Principal amount
   Second integer indicates Time
   Third integer indicates Rate of interest
   Forth value indicates the interest to be paid by John.

3. A person brought a new house and want to paint his house. He is having following details: Length, Height, Breadth and cost for square feet to paint a single wall. Help him out to calculate the cost for painting work.
   For example:
   Given L=5, B=3, H=10, C=1000 and find total cost of house for painting

   Functional Description:
   Complete the task using C editor and the output of the program is to display a value.

   Constraints:
   - 0<L<100
   - 0<B<100

- 1<=H<=10
- C>100

Sample Test case:
5
3
10
1000
150000
The first integer indicates Length
Second integer indicates Breadth
Third integer indicates Height
Fourth integer indicates Cost
Fifth value indicates total cost.

4. Government wants implement new pension scheme to people of the country based on the following criteria

Age	Amount to be paid monthly	Pension after 60 Years
Below 18	---	Not Eligible
18-22	210	5000
23-27	310	5000
28-35	410	5000
35-45	510	5000

Help the citizens to know how much amount need to be paid based on age criteria

Functional Description:
Complete the task using C editor and the output of the program is to display a value.

Sample Test case:
20
210
5000
The first integer indicates Age
Second integer indicates amount to be paid
Third integer indicates pension amount

5. There are n students attempted a competitive exam. The college wants to allocate the section to a student based on their rank. Use an appropriate logic to order the students according to their rank.

Functional Description:
Complete the task using C editor by reading set of integer values into 1-D array and display them in sorted order.

Constraints:
- n>4
- All values should be in integer

Sample Test case:
5
3
2
1
4
10
1 2 3 4 10

6. Consider a country with n states. Read capital income from n states and find the highest , lowest capital income

Functional Description:

Complete the task using C editor by reading set of integer values into 1-D array and display highest and lowest values.

Constraints:

- n>=2
- All values should be in integer

Sample Test case:

5
3
2
1
4
10
1 10

7. 2 colleges with 3 teams each participating in a technical quiz. Each team should consists of students from IT, ECE, CSE. Find the total number of students participated from each branch in both colleges.

Functional Description:
Complete the task using C editor by reading set of integer values into 2-D array and display the output.

Constraints:

- All values should be in integer

Sample Test case:

College1 College2

2	3	4	1	2	5
3	4	5	5	6	3
4	2	1	6	2	4

21 19 22

8. Divya is teaching her student Amit about palindromes. A palindrome is a word, phrase, number, or other sequence of characters which reads the same backward or forward.

For example
The string "MALAYALAM" is a palindrome. Help Divya to check whether Amit identified palindromes correctly or not.

Functional Description:
Complete the task using C editor and the output of the program is to display a value.

9. A box contains 'n' distinct color balls. A person has to take 'r' balls at a time. Find the arrangements and selections of balls.

Functional Description:
Complete the task using C editor and the output of the program is to display the output.

Constraints:

- n>0
- r>=0

Sample Test case:

5
3
10
60
The first integer indicates n
Second integer indicates r

Third integer indicates number of arrangements
Forth value indicates number of arrangements

10. a. Bob wants to store some information regarding his research work later he wants to see Whenever necessary. Suggest him how efficiently he can do this work.
    b. An Organization has several branches which maintain information regarding company one Of Sub branches wants some information from main branch. Help them in effective way

    Functional Description:
    Complete the task using C editor and the output of the program is to display its content.

11. Determine all positive integer values that evenly divide into a number, its factors. Return the pth element of your list, sorted ascending. If there is no pth element, return 0.
    For example, given the number n = 20, its factors are {1,2,4,5,10,20}. Using 1-based indexing if p = 3, return 4. If p > 6, return 0.
    Function Description
    Complete the function pthFactor in the editor below. The function should return a long integer value of the pth integer factor of n.
    pth Factor has the following parameter(s):
    n: an integer
    p: an integer
    Constraints
    - 1 ≤ n ≤ 1015
    - 1 ≤ p ≤ 109

    Input Format for Custom Testing
    Input from stdin will be processed as follows and passed to the function.
    The first line contains an integer n, the number to factor.
    The second line contains an integer p, the 1-based index of the factor to return.
    Sample Case 0
    Sample Input 0
    10
    3
    Sample Output 0
    5
    Explanation 0
    Factoring n = 10 we get {1, 2, 5, 10}. We then return the p = 3rd factor as our answer.
    Sample Case 1
    Sample Input 1
    10
    5
    Sample Output 1
    0
    Explanation 1
    Factoring n = 10 we get {1, 2, 5, 10}. There are only 4 factors and p = 5.
    We return 0 as our answer.
    Sample Case 2
    Sample Input 2
    1
    1
    Sample Output 2
    1
    Explanation 2
    Factoring n = 1 we get {1}. We then return the p = 1st factor as our answer.

12. Alex wants to paint a picture. In one stroke, Alex can only paint the same colored cells which are joined via some edge.Given the painting, determine the minimum number of strokes to completely paint the picture.Take for example, the canvas with height given by h = 3 and width given by w = 5 is to be painted with picture picture=["aabba", "aabba", "aaaca"], the diagram below shows the 4 strokes needed to paint the canvas.

    Strokes
    Canvas 1 2 3 4
    aabba aa bb a

aabba aa bb a
aaaca aaa c a

Function Description

Complete the function strokesRequired in the editor below. The function must return an integer, the minimum number of strokes required to paint the canvas.

strokesRequired has the following parameter(s):
picture[picture[0],...picture[h-1]]: an array of strings where each string represents one row of the picture to be painted

Constraints

- $1 \le h \le 105$
- $1 \le w \le 105$
- $1 \le h*w \le 105$
- len(picture[i]) = w (where $0 \le i < h$)
- picture[i][j] ∈ {'a', 'b', 'c'} (where $0 \le i < h$ and $0 \le j < w$)

Input Format For Custom Testing
The first line contains an integer, h, that denotes the height of the picture and the number of elements in picture.
Each line i of the h subsequent lines (where $0 \le i < h$) contains a string that describes picture[i].
Sample Case 0
Sample Input For Custom Testing
3
aaaba
ababa
aaaca
Sample Output
5
Explanation
The 'a's can be painted in 2 strokes, 'b's in 2 strokes and 'c' in 1 stroke, for a total of 5.

Strokes
Canvas 1 2 3 4 5
aaaba aaa b a
ababa a a b b a
aaaca aaa c a

Sample Case 1
Sample Input For Custom Testing
4
bbba
abba
acaa
aaac
Sample Output
4
Explanation
The 'a's can be painted in 1 stroke, the 'b's in 1 stroke and each 'c' requires 1 stroke.

Strokes
Canvas 1 2 3 4
bbba bbb a
abba bb a a
acaa a aa c
aaac aaa c

13. We define the following:
A binary string is a string consisting only of 0's and/or 1's. For example, 01011, 1111, and 00 are all binary strings.
The prefix of a string is any substring of the string that includes the beginning of the string. For example, the prefixes of 11010 are 1, 11, 110, 1101, and 11010.

We consider a non-empty binary string to be magical if the following two conditions are true:
The number of 0's is equal to the number of 1's.

For every prefix of the binary string, the number of 1's should not be less than the number of 0's.

For example, 11010 is not magical because it doesn't have an equal number of 0's and 1's, but 110100 is magical because it satisfies both of the above conditions.

A magical string can contain multiple magical substrings. If two consecutive substrings are magical, then we can swap the substrings as long as the resulting string is still a magical string. Given a magical binary string, binString, perform zero or more swap operations on its consecutive magical substrings such that the resulting string is as lexicographically large as possible. Two substrings are considered to be consecutive if the last character of the first substring occurs exactly one index before the first character of the second substring.

For example, if we look at the magical binary string binString = 1010111000, we see two magical binary substrings, 1010 and 111000 among others. If we swap these two substrings we get a larger value: 1110001010. This is the largest possible magical substring that can be formed.

Function Description
Complete the function largestMagical in the editor below. The function must return a string denoting the lexicographically largest possible magical string that can be formed by performing zero or more swap operations on consecutive magical substrings of binString.
largestMagical has the following parameter(s):
binString: a string

Constraints
Each character of binString ∈ {01}.
1 ≤ |binString| ≤ 50
binString is a magical string.

Input Format For Custom Testing
The only line of input contains the string binString.
Sample Case 0
Sample Input 0
11011000
Sample Output 0
11100100
Explanation 0
Given the magical string binString = 11011000, we can choose two consecutive magical substrings, 10 and 1100, to swap such that the resultant string, str = 11100100, is the lexicographically largest magical string possible.
Sample Case 1
Sample Input 1
1100
Explanation
The only consecutive magical substrings of binString are 110100 and 1100. Note that 100 is not a magical substring because it contains more zeroes than ones. If we were to swap them, it would result in a lexicographically smaller string. Thus, binString is already the lexicographically largest magical string that can be formed.

List of Augmented Experiments

1. Employee's Management System
2. Library management system
3. Automation of department store
4. Personal Dairy Management
5. Telecom Billing Management
6. Bank Management System
7. Contacts Management

Reading Material (s)

1. C Programming Lab manual–Department of CSE-GMRIT Rajam, 2019

21HSX02 Communicative English Lab

(Common to all B Tech Programmes)

0 0 3 1.5

Course Outcomes

1. Develop effective listening skills for better comprehension of English spoken in different social and workplace contexts
2. Compose speech clearly on a specific topic using appropriate language in informal discussions
3. Understand the implicit and explicit meanings of a text while reading.
4. Summarize the texts of reading and listening based on comprehension
5. Construct sentences using proper grammatical sentence structures
6. Chose and use the appropriate vocabulary, phrases in different contexts

COs – POs Mapping

COs	PO1	PO9	PO10	PO11	PO12
l	1	1	3	1	2
2	1	1	3	1	2
3	1	1	3	1	1
4	1	1	3	1	2
5	1	1	3	1	1
6	1	1	3	1	1

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

List of Experiments

Module-1: Letters and Sounds of English **(2) sessions**
Letters and sounds, Speech Organs

Module -2: Interaction-1: **(1) session**
Greeting and taking leave, introducing oneself to others.

Module -3: The Sounds of English: **(1) session**
Consonants, consonant clusters and Vowels

Module -4: Pronouncing Words:
Silent letters, Plural markers and past tense markers **(1) session**

Module -5: Interaction-2: **(1) session**
Making request and response to them ask for and give/refuse permission,
Ask for and give directions, thank and respond

Module -6: Stress and Intonation **(1) session**

Module -7: Interaction-3: **(1) session**
Invite, accept, and declining invitations, Make complaints and respond to them, Express sympathy

Module -8: Presentation Skills: **(2) sessions**
Oral and PPT Presentations

Module -9: Interaction-4: **(1) session**
Apologize and respond, advice and suggest, Telephone Skills

Module -10: Group Discussions **(1) Session**

List of Augmented Experiments

1. Common Errors in English
2. Listening Skills
3. Writing Skills
4. Reading Skills
5. Public Speaking
6. Interview Skills
7. Business Communication
8. Functional English
9. Preparation for GRE/TOEFL
10. Preparation for IELTS/CAT/GMAT

Reading Material (s)

1. K. Nirupa Rani, Jayashree Mohanraj and B. Indira, Strengthen Your Steps-Maruthi publications, 2012
2. K. Nirupa Rani, Jayashree Mohan Raj, B. Indira, (Ed) Speak Well (C.D) Orient Black Swan Pvt Ltd, Hyderabad, 2012
3. D. Jones, English Pronouncing Dictionary (Software)*CUP, Ver.1.0, 2003*
4. *J. Sethi, S. Kamlesh, D. V. Jindal. A Practical Course in English Pronunciation, Prentice-hall of India, New*

Delhi, 2007
5. T. Balasubramanian, A Textbook of English Phonetics for Indian students, McMillan, 1981
6. K. Mohan and M. Raman, Effective English Communication, 1st Ed., Tata McGraHills, 2000
7. R. K. Bansal and J. B. Harrison, Spoken English, 3rd Ed., Orient Black Swan, Hyderabad, 1983

21BEX04 Engineering Drawing

(Common to all B.Tech. Programmes)

0 0 3 1.5

Course Outcomes

1. Apply the Principles of engineering drawing for the construction of various geometric shapes
2. Construct various curves which include ellipse, parabola and hyperbola
3. Develop Orthographic projections of Points, Lines and Planes
4. Develop Orthographic projections of Solids using basic drafting software
5. Construct Isometric projections using basic drafting software
6. Construct Orthographic projections from given isometric projections of an object and vice versa

COs – POs Mapping

CO	PO1	PO5	PO10	PO12
1	3	-	3	3
2	3	-	3	3
3	3	-	3	3
4	3	3	3	3
5	3	3	3	3
6	3	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

Unit I

Conic Sections-Introduction to Orthographic Projections

Construction of conics using general method and other special methods

Orthographic Projections of Points, Straight Lines parallel to both planes, parallel to one plane and inclined to other plane

9 Hours

Unit II

Orthographic Projections of Straight Lines and Planes

Projections of Straight Lines inclined to both planes; Projections of Planes; Regular Planes Perpendicular Parallel to one Reference Plane and inclined to other Reference Plane; inclined to both the Reference Planes

Practice the following topics by using any one 2D drafting software

9 Hours

Unit III

Projections of Solids &Isometric Projections

Projections of Prisms, Cylinders, Pyramids and Cones with the axis inclined to one Principal Plane and Parallel to the other, Projections of Prisms, Cylinders, Pyramids and Cones inclined to both the Principal Planes Introduction to Isometric Projections, Isometric axes, angles, Isometric views, Construction of Isometric views of Simple planes and Solids in various positions

15 Hours

Unit IV

Conversion of Engineering Views

Conversion of Orthographic Views of Simple Solid objects into Isometric View, Conversion of Isometric View of Simple Solid objects into Orthographic Views

9 Hours

Total: 42 Hours

List of Drawing Sheets

1. Conics by General Method
2. Conics by using Special Methods
3. Projections of Points and Straight lines in Simple Positions
4. Projections of Lines inclined to both planes
5. Projections of Planes in Simple positions
6. Projections of Planes inclined to both planes
7. Projections of Solids
8. Projections of Solids inclined to both planes
9. Isometric Projections
10. Conversion of Orthographic views into Isometric views
11. Conversion of Isometric views into Orthographic views

List of Augmented Experiments

1. Draw the Knuckle Pin and fork end of the knuckle joint
2. Draw the Socket and spigot cotter joint
3. Draw the Tommy bar and body of the Screw jack
4. Draw the Cup and Big and Small screws of screw jack
5. Draw the Connecting rod of IC Engine using CAD
6. Draw the Pipe spool with flanges and a valve
7. Draw a sample pipe line construction design in oil and gas industries using CAD
8. Draw the Pipe truss design using AutoCAD
9. Draw a 3-D bolt and nut with Threads using CAD
10. Draw a 3-D Cross head pattern using CAD
11. Draw the sample Bridge using CAD
12. Draw the pipe vice using CAD
13. Draw the Ni-Cd Battery zapper circuit diagram using CAD
14. Draw the circuit diagram of battery charger with automatic cutoff using CAD
15. Draw the satellite dish and Antenna using CAD

Reading Material (s)

Textbook (s)

1. N.D. Bhatt, V. M. Panchal, Pramod R. Ingle, Engineering drawing, Charotar Publications, 54th Edition, 2014
2. D. M. Kulkarni, A.P. Rastogi, Ashoke K. Sarkar, Engineering Graphics with Auto CAD, Prentice Hall of India, 2nd Edition, 2010

Reference (s)

2. K. C. John, Engineering Graphics for Degree, PHI Publications, 2nd Edition, 2009
3. M. B. Shah and B. C. Rana, Engineering Drawing, Pearson Publishers, 2nd Edition, 2009
4. D. A. Jolhe, Engineering Drawing, Tata McGraw-Hill Education, 1st Edition, 2008

21BEX05 Engineering Workshop

(Common to all B.Tech. Programmes)

0 0 3 1.5

Course Outcomes

1. Make use of basic hand tools of carpentry, fitting, tin smithy and house wiring
2. Develop simple wooden prototypes using carpentry practice
3. Develop simple house hold items using sheet metal
4. Develop different mild steel joints using Fitting practice
5. Understand simple house wiring circuits
6. Create various prototypes using the basic principles of all workshop trades

COs – POs Mapping

CO	PO1	PO9	PO10	PO12
1	3	2	2	2
2	3	3	2	2
3	3	3	2	2
4	3	3	2	2
5	3	3	2	2
6	3	3	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of experiments

Trades

Carpentry : 1. Cross Lap joint
2. T-Lap joint
3. Dovetail Joint
4. Mortise and Tennon Joint

Fitting : 1. Square Fit
2. V- Fit
3. Half Round Fit
4. Dovetail Fit

Tin Smithy : 1. Square Box without lid
2. Taper Tray
3. Open Scoop
4. Funnel

House wiring : 1. Parallel/Series connection of three bulbs
2. Florescent Lamp Wiring
3. Stair Case Wiring
4. Godown Wiring

Total: 45 Hours

List of Augmented Experiments

1. Prepare Tee–bridle joint
2. Prepare Corner dovetail joint
3. Make Corner bridge joint
4. Make Dovetail lap joint
5. Prepare 90^0 round elbow pipe
6. Prepare Ellipse using GI sheet
7. Make cylindrical pipe
8. Make Round T-pipe
9. Prepare hexagonal fitting
10. Prepare diagonal dovetail fitting
11. Prepare universal fitting
12. Make square fitting
13. Set the general house wring
14. Set the dim & bright lighting
15. Set the test lamping

Reading Material (s)

1. Engineering workshop Lab manual, Department of Mechanical Engineering, GMRIT Rajam.

21BEX06 IT Workshop

(Common to all B.Tech. Programmes)

0 0 3 1.5

Course Outcomes

1. Apply knowledge for computer assembling and Operating System installation
2. Understand trouble shooting of various problems of Hardware
3. Construct residential wiring and various types of wiring schemes
4. Demonstrate the working and troubleshooting of various electrical gadgets
5. Understand the applications of various sensors and transducers
6. Demonstrate the working principle of top loaded washing machine

CO-PO Mapping

CO	PO1	PO12
1	3	2
2	3	2
3	3	2
4	3	2
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

List of Experiments

1. Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral.
2. Disassemble and assemble the PC back to working condition.
3. Installation of MS Windows (2010 or Latest Version) on the personal computer.Word Orientation: Introduction to MS Word, Accessing, overview of toolbars, saving files, Using help and resources, rulers, Font, Colors, format painter, creating custom tabs.
4. Creating a Scheduler: Introduction to MS Excel, Gridlines, Format Cells, Summation, auto fill, FormattingText, is creating custom tabs.
5. Creating Power Point Slides: Basic power point utilities and tools, PPT Orientation, Slide Layouts, InsertingText, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Master Layouts,Types of views.
6. Interactive Presentations: Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts, Rehearsals.
   Two lamps control using two 2-way switches: Design of electrical circuit to control two lamps connected in series and parallel using two two-way switches.
7. Wiring of living room: Development of socket connections consisting one-way and two-way switches forliving room.
8. Tube-light wiring: To do the installation and connection of tub-light wiring.
9. Electrical wiring circuit incorporated with fuse cut-out, energy meter and main switch.
10. Godown wiring: Preparing a godown wiring circuit with PVC conduit system.
11. Resistance, Current and Voltage Measurements using Digital Multimeter.
12. Temperature measurement using thermocouple sensors and understand the working principle of relay.
13. Detection of smoke using smoke sensor and measuring the speed of DC motor using Speed sensor.
14. Distance measurement using Linear Voltage Differential Transducer.
15. Identification of Fault detection in top loaded / front loaded washing machine

Reference Books

1. Faithe Wempen & Rosemary Hattersley & Richard Millett & Kate Shoup , Computing fundamentals:digital literacy edition, Wiley, 2014.
2. Clements & Alan, Principles of Computer Hardware, Oxford press, fourth edition,2006.

1PYX02 Engineering Physics Lab

(Common to all B.Tech. Programs)

0 0 3 1.5

Course Outcomes

1. Infer the knowledge from the scientific methods and learn the process of measuring different physical parameters
2. Develop the laboratory skills in handling of electrical and Optical instruments
3. Demonstrate the interference and diffraction phenomena of light
4. Inspect and experience physical principles of Magnetic fields and optical fiber communications
5. Apply the principles of physics and measure the solid state properties of materials
6. Design and analyze experiment based on physics concepts

COs – POs Mapping

COs	PO4	PO9	PO11
1	3	2	2
2	3	2	2
3	3	2	2
4	3	2	2
5	3	2	2
6	3	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

List of Experiments

1. Variation of magnetic field along the axis of current-carrying circular coil-Stewart and Gee's Method
2. Determination of wavelengths of spectral line of mercury spectrum using diffraction grating
3. Determination of radius of curvature of convex lens by forming Newton's rings
4. LCR circuit- Study of parallel and series Resonance
5. Measurement of thickness of a thin paper using wedge method
6. Fiber optics-Numerical aperture of a given fiber and study of bendig losses
7. Meldie's Experiment–Transverse and longitudinal modes
8. Determination of wave length of Laser by diffraction grating
9. Determination of Hall Coefficient and charge carrier density of semi-conductor
10. Determination of Band gap of a semiconductor

List of Augmented Experiments

1.To study the magnetization (M) of a ferromagnetic material in the presence of a magnetic field B and to plot the hysteresis curve (M vs. B)
2. Study the Thermoemf of the thermo couple
3. LCR Series and Parallel–Design of circuit for various resonance frequencies
4. Determination of characteristics of Laser beam
5. Determination of Horizontal component of earth's magnetic field
6. Study of double refraction in calcite crystals
7. Dispersive power of various liquids using spectrometer
8. Photo cell–Characteristics and determination of Planks constant
9. Michelson's interferometer.

Reading Material (s)

1. Physics Lab manual–Department of Physics, BS & H, GMRIT, Rajam, 2019
2. S. Balasubramanian , M.N. Srinivasan " A Text book of Practical Physics"- S Chand Publishers, 2017
3. Y. Aparna and K. Venkateswararao, Engineering Physics–I and II, VGS Techno series, 2010
4. S. Panigrahi and B. Mallick, Engineering Practical Physics, Cengage leaning, Delhi, 2015
5. http://www.amrita.vlab.co.in Virtual Labs, Amrita University.
6. http:/www./iitk.vlab.co.in

21CYX02 Engineering Chemistry Lab

(Common to all B.Tech. Programmes)

0 0 3 1.5

Course outcomes:

1. Utilize different Analytical tools and execute experiments involving estimation of raw materials, finished products and environmental samples etc.
2. Utilize modern instruments like ion analyzer, UV Vis spectrophotometer for characterization of materials used in industry & environment
3. Determine the amount of fluoride present in water for its quality in drinking purpose
4. Estimate the acid number of oil and assess its suitability as a lubricant.
5. Prepare a cross-linked & thermosetting polymer - Bakelite
6. Identify the adulteration of food items such as milk, honey, tea, coffee

COs – POs Mapping

COs	PO1	PO6	PO7	PO9	PO12
1	3	1	3	1	1
2	3	1	3	1	1
3	3	1	3	1	1
4	3	1	2	1	1
5	3	1	3	1	1
6	3	1	3	1	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

List of Experiments

1. Introduction to Quantitative Analysis - Demonstration
2. Determination of Acid number of a lubricating oil [titration of weak acid vs. strong base]
3. Estimation of Strength of an acid in Pb-Acid battery by pH metry
4. Conductometry - Determination of cell constant and conductance of solutions
5. Potentiometry - Determination of redox potentials and emfs using Weston cell
6. Preparation of a polymer - Bakelite
7. Determination of molecular weight of a polymer using viscometer
8. Verify Lambert-Beer's law - ε calculation or conc. estimation
9. Assessment of quality of water – Fluoride content
10. Detection of adulteration of food in Honey/Milk/Tea
11. Making and using a blue printing paper
12. Measurement of 10Dq by spectrophotometric method
13. Determination of corrosion of metal in the presence/absence of inhibitor

List of Augmented Experiments

1. Assessment of ground water quality of your village/Mandal (by taking min. 6 locations and determining min. 4 parameters – Fluoride, Chloride, Hardness, TDS etc.
2. Preparation of desired quality of Viscosity Index lubricating oil
3. Studies on the effect of various factors on corrosion
4. Making a battery of required potential
5. Energy scenario in India- Various sources, % consumption, solutions to meet future demand etc.

Reading Material (s)

1. K. Gouru Naidu, Engineering Chemistry Lab Manual, 1st Ed., 2014
2. G. Svehla, Vogel's Qualitative Inorganic Analysis, 7th Ed., Pearson Education, New Delhi, 2003

21HSX03 Advanced Communicative English

(Language Elective for all B Tech Programmes)

2 0 0 2

Course Outcomes

1. Develop effective listening skills for better comprehension of English spoken in different social and workplace contexts
2. Compose speech clearly on a specific topic using appropriate language in informal discussions
3. Understand the implicit and explicit meanings of a text while reading.
4. Summarize the texts of reading and listening based on comprehension
5. Construct sentences using proper grammatical sentence structures
6. Chose and use the appropriate vocabulary, phrases in different contexts

COs – POs Mapping

COs	PO1	PO9	PO10	PO11	PO12
l	1	1	3	1	2
2	1	1	3	1	2
3	1	1	3	1	1
4	1	1	3	1	2
5	1	1	3	1	1
6	1	1	3	1	1

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Listening:Listening for presentation strategies and answering questions on the speaker, audience, and key points.

Speaking: Formal presentations using PPT slides without graphic elements and with graphic elements.

Reading: Reading for presenting – strategies to select, compile and synthesize information for presentation; reading to recognize academic style.

Writing: Paraphrasing; using quotations in writing; using academic style - avoiding colloquial words and phrases. Writing structured persuasive/argumentative essays on topics of general interest using suitable claims, examples and evidences for presenting views, opinions and position.

Grammarand Vocabulary: Formal/academic words and phrases; Phrasalprepositions; phrasal verbs

Novel: *Time Machine* by H G wells

15 Hours

Unit II

Listening: Following an argument/ logical flow of thought; answering questions on key concepts after listening to extended passages of spoken academic discourse.

Speaking: Group discussion on general topics; agreeing and disagreeing, using claims

Reading: Understand formal and informal styles; recognize the difference between facts and opinions.

Writing: Formal letter writing and e-mail writing (enquiry, complaints, seeking permission, seeking internship); structure, conventions and etiquette.

Grammar and Vocabulary: Language for different functions such as stating a point, expressing opinion, agreeing/disagreeing, adding information to what someone has stated, and asking for clarification.

Drama: Hayavadana by Girlish karnad

15 Hours

Unit III

Listening: Identifying views and opinions expressed by different speakers while listening todiscussions.

Speaking: Group discussion; reaching consensus in group work (academic context).

Reading: Identifying claims, evidences, views, opinions and stance/ position.

Writing: Applying for internship/ job **-** Writing one's CV/Resumeand cover letter.

Grammarand **Vocabulary:** Active and passive voice – use of passive verbs in academic writing.

Autobiography: Wings of Fire by Abdul Kalam

15 Hours

Unit IV

Listening: Understanding inferences; processing of information using specific context clues and processing of explicit and implicit information inferable from the text or from previous /back ground knowledge.

Speaking: Formal team presentations on academic/ general topics using PPT slides.

Reading: Reading for inferential comprehension.

Writing: Structure and contents of a Project Report; identifying sections in project reports; understanding the purpose of each section; significance of references.

Grammarand Vocabulary: Reinforcing learning; editing short texts; correcting common errors in grammar

and usage.
Travelogue: Butter Chicken in Ludhiyana by Pankaj Mishra

15 Hours
Total: 60 Hours

Textbook (s)

1. *English All Round: Communication Skills for Undergraduate Learners*, vol.2, Published by Orient Black Swan, 2019.

Reference (s)

1. Chase, Becky Tarver. *Pathways:Listening, Speaking and Critical Thinking.*Heinley ELT; 2nd Edition, 2018.
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) MacmillanEducational.
3. Hewings, Martin.*Cambridge Academic English (B2)*. CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
4. Bailey, Stephen. *Academicwriting: A handbook for international students*.Routledge, 2014
5. Dhanavel,S.P. *English And Communication Skills For Students Of Science And Engineering.* Orient Blackswan, 2009.

Web resource(s)

Grammar/Listening/Writing

1. 1-language.com
2. www.5minuteenglish.com
3. www.englishpractice.com

Grammar/Vocabulary

4. English Language Learning online
5. www.bbc.co.uk/learningenglish
6. www.better-english.com
7. www.nonstopenglish.com
8. www.vocabulary.com

Reading

9. www.usingenglish.com
10. www.englishclub.com
11. www.english-online.at

Listening

12. learningenglish.voanews.com
13. www.englishmedialab.com

Speaking

14. www.talkenglish.com
15. BBC Learning English – Pronunciation tips
16. Merriam-Webster – Perfect pronunciation Exercises

All Skills

17. www.englishclub.com
18. www.world-english.org
19. learnenglish.britishcouncil.org

Online Dictionaries

20. Cambridge dictionary online
21. MacMillan dictionary
22. Oxford learner's dictionaries

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment Test (%)
Remember	25	25	
Understand	25	25	
Application	50	50	40
Analysis	-	-	30
Evaluate	-	-	
Create	-	-	30
Total (%)	100	100	100

Sample question (s)

Remember

1. Write the meanings for the following phrasal verbs**.**
   i. look for ii. Break down
2. Use the following verbs in your own sentences
   i. Assess ii. Instruct

Understand

1. What are the steps that one should follow while preparing a PPT presentation.

2. Discuss the role of body language in group discussion.

Apply

1. Convert the following sentence into passive voice:
   a. The result surprises me. b. People speak English all over the world
2. Correct the following sentence:
   a. the tree is cut by man by an axe. b. he discussed about phonetics at length.
3. Write a formal letter to the Chief District Medical Officer of your district requesting him to utilize the NSS units of colleges to carry out public campaign to help people to stay safe from Covid-19. Use the clues below to write your letter:
   (For Open Book Examination and not for semester end examination)
   a) Stay home
   (b) Face mask
   (c) Sanitizer
   (d) Social distancing
   (e) Wash hands
   (f) Do not shake hands
   (g) Get medical check-ups

21MAX02 Engineering Mathematics II

(Common to all B. Tech. Programmes)

3 0 0 3

Course Outcomes

1. Solve problems related to engineering applications using integral transform techniques.
2. Make use of Laplace transforms in solving the differential equations with the initial and boundary conditions.
3. Utilize basic knowledge of conservative field, potential function and work done and also identify the relationships between line, surface and volume integrals in engineering problems
4. Find the Fourier series of periodic functions and expand a function in sine and cosine series.
5. Solve problems related to basic linear and non-linear partial differential equations.
6. Formulate and solve some of the physical problems of engineering using partial differential equations.

COs – POs Mappings

COs	PO1	PO2	PO3	PO4	PO12
1	3	3	2	2	1
2	3	2	3	3	1
3	3	3	3	2	1
4	3	2	2	1	1
5	3	3	2	1	1
6	3	3	3	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Laplace Transforms

Laplace transforms of standard functions, Shifting Theorems, Transforms of derivatives and integrals (Properties-without proofs), Unit step function, Dirac delta function, evaluation of definite integrals

Inverse Laplace transforms, Convolution theorem (without proof), Application of Laplace transforms toordinary differential equations with constant coefficients

Laplace transforms of Periodic functions

15 Hours

Unit II

Vector Calculus

Vector Differentiation-Gradient, Divergence, Curl and Vector Identities (without proofs)

Vector Integration - Line integral, work done, Scalar Potential function, surface and volume integrals, Vector integral theorems- Green's, Stokes and Gauss Divergence Theorems (Theorems without proof) and related problems

Proofs of Vector Identities

15 Hours

Unit III

Fourier Series and Transformations

Fourier series– even and odd functions, Half-range sine and cosine series, Fourier integral theorem (without proof)

Fourier transforms – sine and cosine transforms, properties (without proofs), inverse Fourier transforms.

Fourier Transform of convolution products

15 Hours

Unit IV

Partial Differential Equations and Applications

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange) equations and non-linear equations (four standard types)

Method of Separation of Variables, Applications to wave equation, one dimensional heat conduction equation and two-dimensional Laplace equation (Cartesian form)

Charpit's method

15 Hours

Total: 60 Hours

Textbook (s)

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, New Delhi, 2012
2. S. R. K. Iyengar, R. K. Jain,Advanced Engineering Mathematics, Narosa Publishing House, 4th Edition, New Delhi, 2014
3. B. V. Ramana , Engineering Mathematics, Tata McGraw Hill, New Delhi, 4th Edition,2009

Reference book (s)

1. T. K. V. Iyengar*et.al,* Engineering Mathematics, 12th Edition,Volume -II, S. Chand Publishers, 2014
2. U. M. Swamy*et.al,*A Text Book of Engineering Mathematics – I, Excel Books, New Delhi, 2010
3. D.S.Chandrashekharaiah, Engineering Mathematics, Vol- 1, Prism Publishers, 2010
4. Erwin Kreyszig Advanced Engineering Mathematics, Wiley Student Edition,9th Edition, 2012

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Int. Test 3[1] (%)
Remember	10	10	-
Understand	30	30	25
Apply	60	60	75
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. Define unit step function.
2. Solve the PDE. $\sqrt{p}+\sqrt{q}=2x$.

Understand

1. Interpret Laplace transform technique $y^{11}-3y^1+2y=e^{3t}$ given $y(0)=1 \ \ and \ y^1(0)=0$.
2. Show that the vector $(x^2-yz)I-(y^2-zx)\,J-(z^2-xy)\,K$ is Irrotational.

Apply

1. Verify Gauss divergence theorem $F=(x^3-yz)I-2x^2y\,J-z\,K$taken over the surface of the cube formed by the planes $x=y=z=a$ and coordinate planes.
2. A tightly stretched string with fixed end points $x=0\ and\ x=l$is initially in a position given by $y=y_0 sin^3\frac{\pi x}{l}$.If it is released from rest from this position, find the displacement $y(x,t)$.
3. Using Laplace transform to evaluate $\int_0^\infty \frac{\cos at-\cos bt}{t}\,dt$
4. Evaluate $f(x)=x^2$as a fourier series in $-\pi<x<\pi$.
5. Examine whether $F=(y^2cosx+z^3)I+(2ysinx-4)J+(3xz^2+2)K$ is a conservative vector field ? If so find the scalar potential?
6. The population of a city grows at a rate proportional to the number of people presently living in the city. After two years, the population has doubled, and after three years the population is twenty thousands.
   a) State the suitable law to construct the differential equation
   b) Apply Transform techniques to solve the equation
   c) Estimate the number of people initially living in the city and interpret your result
   d) Justify the advantage of Laplace transform technique over conventional techniques

   (For Open Book Examination and not for semester end examination)

21BEX07 PYTHON PROGRAMMING

3 0 0 3

Course Outcomes

1. Understand the fundamentals of Python , syntax and semantics
2. Understand the concepts of control flow statements
3. Understand and apply the concepts of strings, dictionaries, sets, list, and tuples.
4. Demonstrate and apply the concepts of Functions and Modules
5. Understand and apply the concepts of searching and sorting
6. Understand exception handling in Python and standard library

CO – PO Mapping

COs	PO1	PO2	PO3	PO12
1	3	2	2	2
2	3	2	2	2
3	3	2	2	2
4	3	2	2	2
5	2	2	2	2
6	2	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I **16 Hours**

Introduction: History of Python, Need of Python Programming, Running Python Scripts, Identifiers, Statements, Variables, Keywords, Input-Output statements, Indentation, command line arguments

Types, Operators and Expressions: Types - Integers, Strings, Booleans; Operators-Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Precedence and Associativity

Control Flow Statements: if Statement, if…else Statement, elif Statement, Nested if Statement, while Loop, for Loop, continue and break Statements.

Applications of Python, REPL

Unit II **15 Hours**

Strings: initialization, modifying, concatenation, slicing, formatting and string methods, lists with strings.

Python Data structures:

Lists: Creating Lists, Basic List Operations, List Methods.

Introduction to Tuple: Tuple Operations and methods, Dictionary, dictionary operations and dictionary methods, Sets, set operations.

Comprehension on list, tuple and dictionary

Unit III **15 Hours**

Functions- Defining Functions, Calling Functions, Types of Arguments, Anonymous Functions, Scope of the Variables in a Function - Global and Local Variables.

Modules: Creating modules, import statement, from. Import statement.

Object Oriented Programming OOP in Python: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Encapsulation, Inheritance, Polymorphism.

Filters, Lambda function

Unit IV **14 Hours**

Files: Creating files, operations on files (open, close, read, write)

Searching and Sorting: Searching techniques-linear search and binary search. Sorting techniques-bubble sort, selection sort, insertion sort, merge sort.

Exception Handling: Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exception.

Regular Expressions

Total: 60 Hours

Textbook (s)

1. Fundamentals of Python Programming ,Richard L. Halterman 2019
2. Kenneth A. Lambert. "Fundamentals of Python: First Programs", 2nd Edition, Publisher: Cengage Learning 2018 3. Python Programming: A Modern Approach, VamsiKurama, Pearson 2017 Learning Python, Mark Lutz, Orielly, 5th Edition.

Reference(s)

1. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	--
Understand	50	40	--
Apply	20	30	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. What are the benefits of using Python?
2. What is an Interpreted language?

Understand

1. List any four string handling functions
2. What are lists and tuples? What is the key difference between the two?
3. What are Dict and List comprehensions?

Apply

1. Explain user defined exception
2. Justify multiple inheritance is supported in python?
3. Design a simple GUI page using Tkinter

Open Book Exam Questions

1. Write a program which accepts a sequence of comma-separated numbers from console and generate a list and a tuple which contains every number. Suppose the following input is supplied to the program: 34, 67, 55, 33, 12, 98.
   Then, the output should be:
   ['34', '67', '55', '33', '12', '98']
   ('34', '67', '55', '33', '12', '98')
2. A website requires the users to input username and password to register. Write a program to check the validity of password input by users. Following are the criteria for checking the password:
   At least 1 letter between [a-z]
   At least 1 number between [0-9]
   At least 1 letter between [A-Z]
   At least 1 character from [$#@]
   Minimum length of transaction password: 6
   Maximum length of transaction password: 12
   Your program should accept a sequence of comma separated passwords and will check them according to the above criteria. Passwords that match the criteria are to be printed, each separated by a comma.
   Example: If the following passwords are given as input to the program:
   ABd1234@1,a F1#,2w3E*,2We3345
   Then, the output of the program should be:
   ABd1234@1

21BEX08 PYTHON PROGRAMMING LABORATORY

0 0 3 1.5

Course Outcomes

1. Understand various programming platforms available for problem solving
2. Understand mathematical and logical methods which improve critical thinking
3. Understand and apply Python programs with conditionals and loops.
4. Understand and develop Python programs step-wise by defining functions and calling them.
5. Understand and apply Python lists, tuples, and dictionaries for representing compound data.
6. Analyze various searching and sorting techniques using python and apply exception handling.

Co-Po Mapping

COs	PO2	PO3	PO4	PO5	PO12
1	2	2	3	3	2
2	2	2	3	3	2
3	2	2	3	3	2
4	2	2	3	3	2
5	2	2	3	3	2
6	2	2	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

List of Experiments

1. a) Write a python program to add two numbers.
   b) Write a python program to print a number is positive/negative using if-else.
   c) Write a python program to find largest number among three numbers.
2. a) Write a python program to check whether the given string is palindrome or not.
   b) Write a python program to check whether the given number is even or odd.
   c) Write a python program using while loop that asks the user for a number and prints a countdown from that number to 0
3. a) Write a python program that takes two numbers as command line arguments and prints its sum.
   b) Write a python program to implement various operators available in python language.
4. a) Write a program to count the numbers of characters in the string and store them in a dictionary data structure
   b) Write a Python function that takes two lists and returns true if they are equal otherwise false
5. a) Create a list and perform the following methods 1) insert() 2) remove() 3) append() 4) len() 5) pop() 6) clear()
   b) Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) use get() 4)change values 5) use len()
6. a) Write a python program to find factorial of a given number using functions
   b) Write function to compute gcd, lcm of two numbers. Each function shouldn't exceed one line.
7. a) Write a program to double a given number and add two numbers using lambda()?
   b) Write a program for filter() to filter only even numbers from a given list
8. a) Write a python program to display a particular month of a year using calendar module
   b) Write a program to find sum of two numbers using class and methods.
9. Write a program to read 3 subject marks and display pass or failed using class and object.
10. a) Write a python program to open and write "hello world" into a file?
    b) Write a python program to write the content "hi python programming" for the existing file.
11. Write a python program to compute 5/0 and use try/except to catch the exceptions.
12. Write a python program for binary search to search an item in a sorted list and to return the index of element to be searched in the list.

List of Augmented Experiments

1. Flames Game
2. 2048 Game
3. Automated Trading
4. GUI Applications

21HSX04 Communicative German

(Language Elective for all B Tech Programmes)

2 0 0 2

Course Outcomes

1. Demonstrate an awareness of the relevance of foreign languages and understanding of the foreign culture
2. Show a basic level of proficiency necessary in an environment where German is used professions and careers exclusively
3. Make use of German language in description, narration, asking/answering questions and short statements for the variety of topics and situations
4. Build familiar vocabulary, everyday expressions and very simple sentences, which relate to the satisfying of concrete needs
5. Comprehend the foreign language with sufficient ability to grasp the main idea and some supporting details in short conversations
6. Write sentences and short paragraphs in German language

COs – POs Mapping

COs	PO10	PO12
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit-1

Grammar:

1) Nouns 2) Indefinite articles 3) Definite articles 4) Prepositions 5) Negation 6) Interrogatives 7) Conjugation of verbs in present perfect 8) Conjugation of verbs in present tense

15 Hours

Unit-2

Vocabulary:

1) Alphabet 2) Transport 3) Hobby4) Birthday 5) Colors 6) Numbers 0 to 100 (Ordinal, cardinal) 7) Parts of the face and body 8) Clothes 9) Fruits and vegetables 10) Time, Days, Months, Seasons

15 Hours

Unit-3

Communicative skills:

1) How to greet 2) Locating objects and places 3) How to ask and answer questions 1) How to introduce oneself4) How to talk about the weather5) How to talk over the telephone

Grammar:

1) Personal Pronoun 2) Imperative mood 3) Nominative and Accusative cases 4) Dative case 5) Adjectives 6) Separable and Inseparable verbs 7) Modal verbs 8) Conjunctions 9) Plurals

15 hours

Unit-4

Civilization:

1) Greetings2) Etiquettes3) Facts about Germany4) German customs and traditions5) Food culture in Germany

Vocabulary:

1) Food and Drinking 2) Family and Friends 3) Names of Country, its Citizens & Language 4) Vacation 5) Home 6) Furniture 7) Office 8) Directions 9) Shopping 10) Contacts 11) Daily routine 12) Games/Sports 13) Medical Equipment

15 hours

Total: 60 hours

Recommended study material:

1. Netzwerk A1 Kursbuch by Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber
2. Netzwerk A1 Arbeitsbuch by Stefanie Dengler , T Mayr-Sieber, Paul Rusch

21HSX05 Communicative French

(Language Elective for all B Tech Programmes)

2 0 0 2

Course Outcomes

1. Demonstrate an awareness of the relevance of foreign languages and understanding of the foreign culture
2. Show a basic level of proficiency necessary in an environment where French is used professions and careers exclusively
3. Make use of French language in description, narration, asking/answering questions and short statements for the variety of topics and situations
4. Build familiar, everyday expressions and very simple sentences, which relate to the satisfying of concrete needs
5. Comprehend the foreign language with sufficient ability to grasp the main idea and some supporting details in short conversations
6. Write sentences and short paragraphs in French language

COs – POs Mapping

Cos	PO_{10}	PO_{12}
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit-1

Grammar: 1) Nouns2)Indefinite articles3) Definite articles4) Prepositions5) Negation6) Interrogatives7) Irregular verbs (Present tense) : être8) Regular verbs (Present tense): -er 9) Expressions : c'est, cesont, il y a. 10) Imperative mood

15 Hours

Unit-2

Vocabulary: 1) Alphabet 2) Geography of France 3) Days4) Months5) Colours 6) Numbers 0 to 100 (Ordinal, cardinal) 7) Parts of the face and body

15 Hours

Unit-3

Communicative skills: 1) How to greet2) Locating objects and places3) How to ask and answer questions4) How to introduce oneself 5) How to talk about the weather6) How to talk over the telephone

Grammar: 1) Contracted Articles 2) Irregular verbs (present tense): avoir, aller, faire, venir, écrire, lire, recevoir. 3) Adjectives 4) Verbs: -ir (present tense) 5) Tense: futurproche 6) Impersonal verbs: pleuvoir ; neiger.

7) Possessive adjectives

15 hours

Unit-4

Civilization: 1)Greetings 2) Etiquettes3) Facts about France4) French customs and traditions5) Food culture

Vocabulary: 1) Clothes 2) Fruits and vegetables 3) Festivals

15 hours

Total: 60 hours

Recommended study material

1. **Sans frontieres 1**by Michèle Verdelhan-Bourgad

21HSX09 Communicative Hindi

(Language Elective for all B Tech Programmes)

2 0 0 2

Course Outcomes

1. Build confidence to speak Hindi language and demonstrate an awareness and relevance of Hindi language
2. Show a basic level of proficiency in speaking in meaningful conversations in careers
3. Make use of good vocabulary in description, narration, asking/answering questions and short statements for the variety of topics and situations
4. Practice familiar, everyday expressions and sentence structures, which relate to the satisfying of concrete needs
5. Comprehend the language and grasp the main idea and some supporting details in short conversations.
6. Write simple sentences and short paragraphs in Hindi language

COs – POs Mapping

Cos	PO10	PO12
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Writing: Introduction to Alphabet (phonology) –classification; Mathra
Vocabulary: Useful words- home, animals, birds, vegetables, flowers, fruits, relationships, days, months
Grammar Noun, Pronoun, verb, adjective, adverb, post position, conjunction, interjection.

15hours

Unit II

Vocabulary: Antonyms, synonyms, gender, vachan, suffix, prefix
Speaking:. Simple sentences, comparative sentences, Sentence structures, use of want, not, don't, must, so-that, aa-ee-ye
Grammar: Tense, Usage of lag-sak-chuck-Degrees of comparison

15hours

Unit III

Writing: Official, Formal and informal letters
Speaking: Self- introduction, Conversations (at bank, post office, etc.)
Grammar and Vocabulary: Translations - words; sentences, paragraphs.

15hours

Unit IV

Writing: Short notes/stories, Essay writing
Speaking: Short talk and Conversations in travel, market etc
Vocabulary: Names of numerals, business vocabulary, time and scales of measurement etc.

15hours

Total: 60hours

Recommended Study material:

1.MeenuKaturia. *Saral Hindi Vyakaran tatha Rachana. Kumar publications Delhi.*
2. N.RajeshRakhade & G.kanaka Durga*. Hindi Speaking course,* Mudra Books. 2014

21MA303 Numerical Methods

3 0 0 3

Course Outcomes

1. Utilize numerical techniques to find approximate solutions of Algebraic and Transcendental Equations.
2. Apply method of least squares to fit a best curve for the given data.
3. Make use of the concepts of interpolation to estimate the unknown functional values.
4. Examine the technique of numerical methods to find the derivative of a function.
5. Evaluate the definite integrals using numerical methods.
6. Solve ordinary differential equations using numerical methods.

COs – POs Mappings

COs	PO1	PO12
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Solution of Algebraic and Transcendental Equations, Curve fitting

Introduction, Bisection method, Regula-Falsi method, Newton-Raphson method, Iterative method, Curve fitting- Fitting a straight line, Second degree curve, Exponential curve, Power curve by method of least squares

Geometrical interpretation - Bisection Method, Regula- Falsi method, Newton-Raphson Method

12 Hours

Unit II

Interpolation

Introduction, Finite differences, Symbolic relations, Newton's- forward and backward differences, Gauss's forward and backward differences, Lagrange's interpolation method

Newton's divided differences

12 Hours

Unit III

Numerical differentiation and Integration

Numerical differentiation- First and Second order derivatives using forward, backward and Stirling's difference formulas

Numerical Integration-Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle's rule

Boole's rule of integration

12 Hours

Unit IV

Numerical solutions of Ordinary Differential Equations

Taylor's series Method, Euler's and Modified Euler's Methods, Runge-Kutta Methods, Milne's Predictor-Corrector Method

Adams Bashforth Predictor-Corrector Method

12 Hours

Total: 48 Hours

Textbook (s)

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publishers, New Delhi, 2012
2. B. V. Ramana, Engineering Mathematics, 4th Ed., Tata Mc Graw Hill, 2009

Reference (s)

1. T.KV.Iyengar, S.Ranganatham, B.Krishna Gandhi, Mathematical Methods, 2nd Ed., S.Chand Co., New Delhi, 2006.
2. Ervin Kreyszig, Advanced Engineering Mathematics, 9th Ed., Wiley India Pvt. Ltd., 2012
3. S. S. Sastry, Introductory methods of Numerical Analysis, 4th Ed., Prentice Hall of India Pvt. Ltd., 2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	10	10	-
Understand	30	30	-
Apply	60	60	70
Analyze	-	-	20
Evaluate	-	-	10
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Find the root of the equation $x^3 - 5x + 1 = 0$ using Bisection method.
2. What is the Newton's forward difference formula?

Understand

1. Explain method of least squares to fit a straight line.
2. Show that $\mu = \frac{1}{2}(E^{\frac{1}{2}} + E^{-\frac{1}{2}})$.

Apply

1. Apply Euler's method to find $y(0.1)$ for $y' = x^2 - y$, $y(0) = 1$.
2. Choose an appropriate interpolation formula to find $e^{1.75}$ from the following data

X	1.7	1.8	1.9	2.0
$y=e^x$	5.474	6.050	6.686	7.389

21CE302 Building Materials and Concrete Technology

3 0 2 4

Course Outcomes

1. Illustrate the various characteristics of building materials and their applications in the construction industry.
2. Interpret the procedures and results of testing for various construction materials.
3. Identify suitable finishing materials for various building elements.
4. Design concrete mix proportions as per the IS code.
5. Apply testing methods for fresh concrete to prepare workable concrete.
6. Evaluate and infer the properties of hardened concrete.

COs-POs Mapping

COs	PO2	PO4	PO8	PO12	PSO1
1	3	1	1	2	3
2	3	1	1	2	3
3	3	1	1	2	3
4	3	1	1	2	3
5	3	1	1	2	3
6	3	3	3	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Building Materials

Stones- Tests on stones; Bricks – Classification, Manufacturing of clay bricks, Tests on bricks, Bricks for special use - Refractory bricks, Cement Concrete blocks, Lightweight concrete blocks; Timber - Classification of timber, structure of timber, seasoning of timber, Defects on timber. Modern materials: Glass, Aluminum, Ceramics, Sealants for joints, Geosynthetics.

Practical Components

1. Determination of water absorption of clay bricks
2. Determination of compressive strength of clay bricks

12+4 Hours

Unit II

Construction Materials and Building Finishes

Construction Materials: Constituents of cement and their significance, Manufacturing of Cement, Heat of hydration, types of cement. Aggregates- size and shape, gradation, fineness modulus, bulking of sand. Mortar - mix proportions and compressive strength of mortars for masonry.

Building Finishes: Plastering –Types; Painting –constituents- Types– characteristics, Varnish, Damp proofing - causes and effects of dampness, methods of damp proofing.

Practical Components

1. Determination of fineness and consistency of cement
2. Determination of Initial and Final setting time of cement
3. Determination of compressive strength of mortar
4. Determination of specific gravity of fine aggregate
5. Determination of specific gravity of coarse aggregate
6. Determination of bulking of sand

12 + 12 Hours

Unit III

Concrete Mix Design and Fresh Concrete

Ingredients, Manufacturing process, Properties of fresh concrete –Workability- slump test, compaction factor, Vee Bee Consistometer, segregation, bleeding; Mix Design - Concrete mix design by I.S. method.

Practical Components

1. Develop a Python programme to design concrete mix as per IS 10269 2019
2. Determine the workability of concrete using slump cone
3. Determine the workability of concrete using compaction factor
4. Determine the workability of concrete using Vee Bee Consistometer

12 +8 Hours

Unit IV

Hardened Concrete

Hardened Concrete: Water / Cement ratio – Abram's Law –Gel space ratio. Properties of hardened concrete-Factors affecting strength of concrete– Strength in compression, tension and flexure. Relation between compression, tensile, flexural strength and modulus of elasticity of concrete .Shrinkage and creep of concrete.

Practical Components

1. Determine the compressive strength of concrete
2. Determine the Split tensile strength of concrete
3. Determine the flexural strength of concrete
4. Determine the modulus of elasticity of concrete

12 +8 Hours

Total: 48 + 32 Hours

Textbook (s)

1. S. K. Duggal, Building Material, 5th Ed, New Age International Publishers, 2019
2. Rangwala "Engineering Materials (Material science)" Charotar Publishing House Pvt. ltd., Edition-2017
3. M.S. Shetty, "Concrete Technology" S. Chand & Co., Ltd., Revised Edition - New Delhi, 2018
4. A.M. Neville, Properties of Concrete, 5th Ed., Low Priced Edition, Prentice Hall Publishers, 2012

Reference (s)

1. P.C. Varghese, Building materials, 2nd Ed., Prentice-Hall of India private Ltd, New Delhi. 2015
2. R.K. Rajput "Engineering Materials (Including construction materials)", 4th Ed., S. Chand Publications. 2014
3. Rofat Siddique "Special structural Concrete" Galgotia Publishing Pvt. Ltd., New Delhi, 2000
4. Code book: IS 10262-2019 "Concrete Mix Proportioning-Guidelines", Second Revision.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the standard brick size?
2. List out any four types of cements.
3. Define seasoning of timber.
4. What is the most common pozzolana used in the cement?

Understand

1. Explain the formation of metamorphic rocks.
2. Describe various functions of Geosynthetics.
3. Explain the process of Hardening in cement.
4. Illustrate the expansive property of expansive cements.

Apply

1. Design a concrete mix for characteristic strength of 25 MPa at 28 days with a standard deviation of 4MPa.The specific gravity of FA and CA are 2.64 and 2.74 respectively. A slump of 40mm is necessary. The specific gravity of cement is 3.15. Assuming the necessary data design the mix as per IS code method
2. Design mix proportions with the following data using IS code method. Characteristic compressive strength of concrete 30 MPa. 20mm Maximum size of round aggregate. Moderate degree of workability. Specific gravity of cement is 3.15. Specific gravity of coarse and fine aggregates is 2.65. Sand Conforms to Zone III . Good quality control.

21CE303 Building Planning and Drawing

3 0 2 4

Course Outcomes

1. Utilize building byelaws effectively in diverse building scenarios, ensuring compliance with regulatory standards and legal requirements.
2. Apply the concepts of FAR and FSI in different building types.
3. Evaluate and analyze the preliminary prerequisites for residential buildings.
4. Examine and elucidate the specific planning requisites applicable to different types of buildings.
5. Determine the minimum project duration by applying the principles of critical path methods.
6. Analyze the project durations and examine the probability of project completion using the PERT technique.

COs – POs Mapping

COs	PO5	PO10	PO12
1	1	2	3
2	3	2	2
3	1	2	3
4	3	3	3
5	3	3	3
6	1	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Building Byelaws and Regulations

Introduction – Terminology – Objectives of building byelaws. Principles underlying building byelaws. Classification of buildings. Floor Area Ratio (FAR). Floor Space Index (FSI). Open space requirements. Built up area limitations. Height of Buildings. Wall thickness. Lighting and ventilation requirement.

Practical components

1. Conventional signs and symbols used in civil Engineering
2. English bond and Flemish bonds
3. Panelled Doors
4. Panelled Windows

12+8 Hours

Unit II

Components of Residential Buildings

Minimum standards for various parts of buildings. Requirements of different rooms and their grouping. Characteristics of various types of residential buildings.

Practical components

1. King Post Truss
2. Queen Post Truss
3. Dog Legged Stairs
4. Load Bearing wall

12+8 Hours

Unit III

Planning of Residential and Public Buildings

Planning of Educational institutions, hospitals, dispensaries, office buildings, banks, industrial buildings, hotels and motels, buildings for recreation.

Practical components

1. Plan and section of a residential building
2. Plan and Section of office building
3. Plan, elevation and section of a two storied residential building
4. Plan, elevation and section of a secondary school

12+8 Hours

Unit IV

Planning and scheduling of Construction Projects

Planning scheduling and monitoring of building construction projects, Bar chart, CPM and PERT Network planning. Computation of times and floats – their significance.

Practical components

1. Constructing a Network Diagram and Identifying Critical Path
2. CPM Network Scheduling
3. PERT Analysis for Project Duration
4. Resource-Constrained PERT Analysis

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. N.Kumaraswamy, A.Kameswara Rao, building planning and drawing, 7th Ed, Charotar Publishing House, 2019
2. R.L. Peurifoyetal, Construction Planning, Equipment and Methods, 7th Ed., Tata Mc. Graw Hill Publications, 2010.
3. B.C.Punmia&Khandelwal, Project Planning and Control with PERT and CPM, 4th Ed., Laxmi publications, 2009.
4. 'A' Series & 'B' Series of JNTU Engineering College, Anantapur.

Reference (s)

1. Building Byelaws by State and Central Governments and Municipal Corporations.
2. Gurucharan Singh & Jagadish Singh, Building Planning, Designing and Scheduling, 5th Ed., Standard Publishers Distributors, 2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	50	60	50
Understand	50	40	50
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the objectives of building byelaws?
2. What are the planning factors to be considered in the design of educational institutions?
3. Define CPM and PERT. Explain the difference between both.
4. What are the components of a building used for recreation?
5. Write the various requirements for residential building.

Understand

1. What is FAR and also in what way it is use full to a Civil Engineer?
2. Classify the buildings based on the i) occupancy ii) Fire Resistance
3. Write the various requirements for designing
   i)Verandah ii)Drawing room iii)Bedroom iv)Sanitary units of a residential buildings
4. Write the usefulness of specifying the minimum standards in buildings.
5. Write the significance of Scheduling and monitoring of construction projects.

21CE304 Fluid Mechanics

3 0 0 3

Course Outcomes

1. Understand the importance of fluid properties and their influence on fluid motion.
2. Apply the principles of total pressure, center of pressure and buoyancy in the design of different components in hydraulic structures.
3. Explain the principles of fluid kinematics and dynamics in different fluid flow problem.
4. Understand the concepts of laminar flow, turbulent flow and boundary layer theory.
5. Solve various problems related to fluid flow through pipes.
6. Explain the fundamental principles of fluid motion in the measurement of flow.

COs–POs Mapping

COs	PO1	PO12
1	3	2
2	3	3
3	3	2
4	3	2
5	3	3
6	3	3

3–Strongly linked |2–Moderately linked|1–Weakly linked

Unit I

Fluid Properties - Hydro Static Forces on Surfaces – Buoyancy and Floatation

Fluid Properties: Mass Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Surface Tension and Capillarity, Vapour Pressure and Cavitations, Pressure at a point, Pascal's law, Hydrostatic law, Atmospheric, Gauge and Vacuum pressure; Measurement of Pressure, Manometers.

Hydrostatic forces on Surfaces: Derivations of Total and Centre of Pressure for Horizontal, Vertical, Inclined and Curved surfaces.

Buoyancy and Floatation: Centre of Buoyancy, Meta Centre and Metacentric Height, Stability of Submerged and Floating bodies, Determination of Metacentric Height.

Metacentric Height for Floating bodies containing liquid, Time period of transverse oscillation of a floating body

12 Hours

Unit II

Fluid Kinematics and Fluid Dynamics

Fluid Kinematics: Velocity of Fluid Particles, Types of Fluid Flow, Description of the Flow Pattern, Basic Principles of Fluid Flow, Equation of Continuity, Acceleration of Fluid Particle, Stream Function and Velocity Potential functions, Flow Net Analysis.

Fluid Dynamics: Forces acting on Fluid in Motion, Euler's Equation of Motion and Bernoulli's Equation, Impulse Momentum Equation and its Application in forces on pipe bend. Angular Momentum Principle – Moment of Momentum Equation

Kinetic Energy Correction Factor

12 Hours

Unit III

Laminar and Turbulent Flows and Boundary Layer Flow

Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer-displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation , velocity distribution for both laminar and turbulent flow.

Methods of Controlling Boundary Layer, Friction in Non -Circular Conduits

12 Hours

Unit IV

Flow through Pipes and Measurement of Flow

Flow through Pipes: Reynolds's Experiment, Laws of Fluid friction, Froud's Experiments, Darcy – Weisbach equation, Chezy's Formula, Mannin's Formula, Hazen William's Formula, Minor losses, Pipes in Series, Pipes in Parallel, Total Energy Line and Hydraulic Gradient Line, Flow through long pipes , Compound Pipe, Equivalent Pipe.

Measurement of Flow: Pitot-tube, Venturi Meter, Flow through Orifices and Mouthpieces, Flow over Notches and Weirs.

Water Hammer in Pipes-Submerged Weirs

12 Hours

Total: 48 Hours

Textbook (s)

1. R.K.Bansal, A Fluid Mechanics and Hydraulic Machines, 9th Ed., Laxmi Publications(P) Ltd.,NewDelhi,2017
2. Modiand Seth, Hydraulics & Fluid Mechanics, 20th Ed., Standard Book House, New Delhi, 2014
3. S.K.Som & G.Biswas, Introduction to Fluid Machines, 3rd Ed., Tata McGraw-Hill Publishers Pvt.Ltd., 2013.

Refernce (s)

1. J.F.Douglas, J.M.Gaserek and J.A.Swaffirld, Fluid Mechanics, 6th Ed., Longman Scientific & Technical, New York,2011
2. Frank.M.White, FluidMechanics, 5th Ed., Tata Mc.Grawhill Pvt.Ltd, 2003
3. A.K.Mohanty, Fluid Mehanics,2nd Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2006
4. Edward J. Shaughnessy, Jr, Ira M.Katzand James, Introduction to Fluid Machines, P.Schaffer, Oxford University Press, New Delhi, 2005

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	35	25	-
Understand	35	25	-
Apply	30	50	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define total pressure.
2. What is Pitot tube?
3. Define hydraulic gradient line
4. Define friction factor.
5. List out all the types of weir sand notches

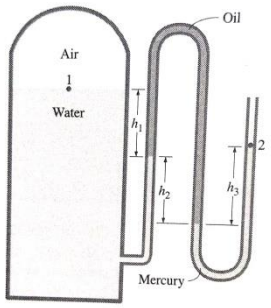
Understand

1. Explain the terms: Dynamic viscosity & kinematic Viscosity. Give their dimensions.
2. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in liquid.
3. Derive an expression for meta-centre height of floating body.
4. Derive an expression for Von Karman Momentum integral equation
5. Mention any four advantages of triangular notch or weir over rectangular notch or weir.

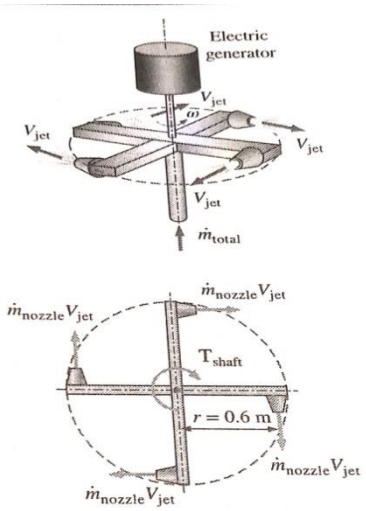
Apply

1. Find the discharge over a triangular notch of angle 60° when the head over the notch is 0.3in. Assume C_d=0.6.
2. A weir 36 m long is divided into 12 equal bays by vertical posts, each 60 cm wide. Determine the discharge over the weir if the head over the crest is 1.20 m and velocity of approach is 2m per second.

3. Determine the rate of flow of water through a pipe of diameter 20 cm and length 50 m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4 m above the centre of the pipe. Consider all minor losses and take f=0.009.
4. A tank has two identical orifices on one of its vertical sides. The upper orifice is 3 m below the water surface and lower one is 5 in below the water surface. If the value of C_V for each orifice is 0.96. Find the point of intersection of the two jets.
5. A block of wood of specific gravity 0.8 floats in water. Determine meta-centric height of the block if its size is 3mx2mx1m
6. The water in a tank is pressurised by air, and the pressure is measured by a multi fluid manometer as shown in figure below. The tank is located on a mountain at an altitude of 1400 m where the atmospheric pressure is 85.6Kpa. Determine the air pressure in the tank if h_1 = 0.1m, h_2 =0.2m, and h_3 = 0.35m.Take the densities of water, oil, and mercury to be 1000 Kg/m^3, 850 Kg/m^3, and 13600 Kg/m^3 respectively.



7. A large lawn sprinkler with four identical arms is to be converted into a turbine to generate electric power by attaching a generator to its rotating head as shown in figure. Water enters the sprinkler from the base along the axis of rotation at a rate of 20L/s and leaves the nozzles in the tangential direction. The sprinkler rotates at a rate of 300rpm in a horizontal plane. The diameter of each jet is 1cm, and the normal distance between the axis of rotation and the centre of each nozzle is 0.6m. Estimate the electric power produced.



21CE305 Solid Mechanics I

3 0 0 3

Course Outcomes

1. Sketch the free body diagram and compute the resultant of a given system of forces
2. Estimate the centroid of composite figures and bodies
3. Estimate the moment of inertia of composite figures and bodies
4. Contrast between normal, shear stresses and various elastic constants
5. Examine the variation of bending moment and shear force at every cross section of a beam under all practical loading cases
6. Examine the variation of flexural stress for various cross section of a beam under all practical loading cases.

COs–POs Mapping

COs	PO1	PO12
1	3	3
2	3	3
3	3	3
4	3	3
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

System of forces-Equilibrium of system of forces

System of forces, Resultant–Moment of a force and its application, free body diagrams, equations of equilibrium of force systems, Lami's theorem, and resolution of a force

Varignons theorem

12 Hours

Unit II

Centroid-Centre of Gravity- Moments of Inertia

Centroids of simple figures and Composite figures, Centre of gravity of simple body and composite bodies, Moments of Inertia of simple figures and composite figures

Mass Moment of Inertia

12 Hours

Unit III

Simple Stresses, Strains and Strain Energy

Elasticity and plasticity – Types of stresses and strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic modulus and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Resilience – Gradual, sudden, impact loadings – simple applications

Principle of superposition, Resilience

12 Hours

Unit IV

Shear Force, Bending Moment and Flexural Stresses

Definition of beam – Types of beams – Concept of shear force and bending moment – Relation between S.F., B.M and rate of loading at a section of a beam, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads – Point of contra flexure Theory of simple bending – Assumptions – Derivation of bending equation-Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections

S.F and B.M diagrams for simply supported beam subjected to couple

12 Hours

Total: 48 Hours

Textbook (s)

1. S. S. Bhavikatti, Engineering Mechanics,6th Ed New Age International, 2018
2. S. Timoshenko & D. H. Young, and JV Rao, Engineering Mechanics, 4th Ed., TMH Education, 2006
3. R. Subramanian, Strength of Materials, 2nd Ed., Oxford University Press, New Delhi, 2010
4. Ferdinand P Beer, E. Russell, Johnston, Jr, John T Dewolf, Mechanics of Materials, 6th Ed., Tata McGraw-Hill Publications, 2012

Reference (s)

1. R. K. Bansal, Engineering Mechanics, Laxmi Publications, 3rd Ed, 2004
2. R.K.Rajput, Strength of Materials, 4th Ed, S.Chand & Co, New Delhi, 2007
3. U.C. Jindal, Introduction to Strength of Materials, 5th Ed, Galgotia Publications, 2001

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	10	10	-
Understand	10	10	-
Apply	80	80	100
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define centroid
2. Define stress
3. Define beam
4. Define the term torsional rigidity
5. Recall the polar moment of inertia expression for a circular shaft

Understand

1. Explain Lami's theorem
2. Obtain an expression for shear stress distribution for a rectangular beam of cross-Section
3. What is the ratio between the maximum horizontal shear stress to the mean stress in a circularbeam?
4. Derive the shear stress expression in a beam of rectangular cross-section
5. The internal diameter of a hollow shaft is two-third of its external diameter. Compare its resistance to torsion with that of a solid shaft of the same weight and material

Apply

1. A rectangular steel bar, 15 mm wide by 30 mm high and 6 m long, is simply supported at its ends. If the density of steel is 7850 kg/m^3, determine the maximum bending stress caused by the weight of the bar.
2. A beam of I section 50 cm deep and 20 cm wide has equal flanges 2 cm thick and web 1cm thick. It carries at a cross-section a shear force of 200kN. Determine the shear stress distribution in thebeam and the ratio of maximum shear to mean shear
3. What diameter of shaft will be required to transmit 80kW at 80 R.P.M., if the maximum torque is 30 percent greater than the mean and the limit of torsional stress is to be 56 MPa?
4. Find the maximum stress if the diameter of the solid shaft is 30cm and also compute the ratio between polar moment of inertia for hollow shaft to circular shaft
5. A steel ladder 1m long and weighing 1 N/m is resting against a smooth vertical wall and the bottom end is resting on rough ground. If a man weighing 1N stands midway on the ladder draw the Bending moment and shear force diagrams and determine the maximum bending moment in the ladder. Take the inclination of the ladder to the horizontal equal to 45^0.
6. A mass falling from a particular height 'h' strikes a simply supported wooden beam at mid span and the highest bending stress developed is 1 MPa. The same mass falling from a height 'h/3', on a steel beam of identical dimensions and support conditions produces a max bending stress of 2 MPa. Determine what will be the max bending stress if the same mass is placed suddenly, gradually on the (a) steel beam, (b)wooden beam. Assume $E_{Steel} = 20E_{wood}$.

21CE306 Surveying

3 0 0 3

Course Outcome

1. Explain the conventional methods of surveying.
2. Apply the concept of levelling to prepare the contour maps. Interpret survey data and compute areas and volumes.
3. Apply the concept of theodolite in angular measurement and tacheometer in elevation and distance between an object.
4. Classify different types of curves in road and railway surveying.
5. Understand the objectives,equipments and methods for Hydrographic Surveying.
6. Make use of advanced equipment to conduct a survey works.

COs–POs Mapping

COs	PO1	PO2	PO10	PO12
1	3	1	1	1
2	3	1	3	1
3	3	1	3	1
4	3	1	1	1
5	3	1	1	1
6	3	1	1	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Basic Surveying and Levelling

Chain and Compass Surveying: Principles, Linear measurements, Conversions, Chain, Tape, Ranging. Compass surveying – types – Error Corrections.

Levelling: Introduction to Leveling, Contours, Areas and volume calculation.

Corrections for Tape, Errors, Scale usage in plotting.

12 Hours

Unit II

Theodolite and Tacheometric Surveying

Theodolite survey: Measurement of horizontal angle, vertical angle and distance and adjustments- temporary;

Tacheometric surveying: Stadia and tangential methods of Tachometry, Distance and Elevation formulae for Staff vertical position, Horizontal and vertical control, Triangulation, Signals & towers, Baseline and Satellite Stations.

Distance and Elevation Formulae in Tacheometry When Staff is in Inclined Position

12 Hours

Unit III

Curves and Hydrographic Surveying

Curves: Elements of simple curve, compound curve, Reverse curve and Vertical curves, Methods of setting out of simple curve.

Hydrographic Surveying: Introduction to hydrographic surveying, Tides, MSL Sounding methods, Three-point problem.

Transition Curves

12 Hours

Unit IV

Advanced Surveying

Total Station: Principle of Electronic distance measurement, Modulation, types of EDM instruments, Accessories of a Total Station, Advantages and Applications, Field procedure for total station survey, Errors in Total Station Survey, Care and maintenance of Total Station instruments.

GPS Survey: Basic concepts – Different segments- space, control and user segments, errors in GPS Survey.

Fundamentals of Photogrammetry and Remote sensing.

12 Hours
Total: 48 Hours

Textbook (s)

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying (Vol–1), 18th Ed., Laxmi Publications (P) Ltd., New Delhi, 2016

Reference (s)

1. Chandra A M, Higher Surveying, 3rd Ed., New age International Pvt. Ltd., Publishers, New Delhi, 2015
2. Dr. K. R. Arora, Surveying (Vol-1), 11th Ed, Rajsons Publications Pvt. Ltd., 2010
3. Arthur R Benton and Philip J Taety, Elements of Plane Surveying, 8th Ed., McGraw Hill, 2000

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	--
Understand	30	20	--
Apply	50	60	100
Analyze	-	-	-
Evaluate	--	--	-
Create	--	--	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Surveying
2. List out all the fundamental lines of theodolite
3. Write an expression to calculate horizontal and vertical distances in tacheometry when the line of sight is inclined
4. Define plane and geodetic surveying.
5. Define magnetic declination and its types.
6. Define Change point.
7. Define contour interval.
8. List any four tape corrections
9. Define Triangulation and Trilateration.
10. Define eccentricity of a signal.

Understand

1. Explain the different classifications of surveying
2. Describe the principle involved in surveying
3. Compare the advantages and disadvantages of plane table surveying with those of chain surveying
4. Explain in detail about obstacles with different cases.
5. Explain in detail about uses of Contours.
6. Explain in detail about characteristics of Contours.
7. Explain setting out procedure for Rankine's method and two theodolite method.
8. Explain merits and demerits of total station

Apply

1. A 30m chain was found to be 10 cm too long, after chaining a distance of 1800 meter, it was found to be 18 cm too long at the end of day's work, after chaining a total distance of 3300 meter. Find the true distance if the chain was correct before the commencement of work.
2. A survey line BAC crosses a river, A and C on the near and distant banks respectively standing at D, a point 50 meter perpendicular to AB from A, the bearing of C & B are 320^0 and 230^0 respectively. AB being 25

meter. Find the width of the river.

3. A railway embankment is 20 m wide with a side slope of 2:1. Assuming the ground to be level in a direction traverse to the center line, calculate the volume contained in a length of 120 meters, the center height at 20 m interval being in meters 2.2, 3.7, 3.8, 4.0, 3.8, 2.8, 2.5.
4. Area enclosed by a contour of a hill and a lake situated side by side are as under. If the lake is to be filled up to 100 m level with the excavated earth from the hill ascertain whether the excavated earth is sufficient or in excess. If excess up to what level the excavation is done to just fill up the lake.

HILL	Contour(m)	100	110	120	130	140	150
	Area (m^2)	5500	4000	2750	1500	500	0
LAKE	Contour(m)	100	90	80	70	60	50
	Area (m^2)	5000	3750	2500	1750	550	0

5. The following perpendicular offsets were taken at 10 m intervals from a survey line to an irregular boundary line 3.25, 5.60, 4.20, 6.65, 8.75, 6.20, 3.25, 4.20, 5.65. Calculate the area enclosed by the application of trapezoidal rule and Simpson rule.
6. Demonstrate how do you measure the horizontal angle by using the repetition method
7. The following are the bearings taken on a closed compass traverse. Compute the interior angles and correct the for observational errors

Line	**Fore Bearing**
AB	$80^o10'$
BC	$120^o20'$
CD	$170^o50'$
DE	$230^o10'$
EA	$310^o20'$

8. Compare between prismatic compass and surveyors' compass
9. Following readings were observed successively with a leveling instrument. 0.585, 1.010, 1.735, 3.295, 3.775, 0.350, 1.300, 1.795, 2.575, 3.375, 3.895, 1.745, 0.635, and 1.605. Draw up a page of level book and determine the RL of various points, if RL of first point is 134.00 m. (use rise and gall method or height of collimation method).
10. The chainage of the intersection point of two straights is 1060 m, and the angle of intersection is 120°. If radius of a circular curve to be set out is 570 m, and peg interval is 30 m, determine the tangent length, the length of the curve, the chainage at the beginning and end of the curve, the length of the long chord, the lengths of the sub-chords, and the total number of chords.

21CE307 Solid Mechanics Laboratory

0 0 3 1.5

Course Outcomes

1. Demonstrate the basic knowledge of the mechanical properties of materials
2. Estimate compressive strength of wood, concrete, brick materials and decide their suitability for the construction purpose
3. Evaluate the tensile strength and comment on their usage in reinforced concrete structures
4. Determine the impact resistance of steel used in construction works
5. Determine the young's modulus of wood/steel materials
6. Determine shear modulus of rigidity for helical spring

COs – POs Mapping

COs	PO1	PO4
1	3	2
2	3	2
3	3	2
4	3	2
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

List of Experiments

1. Determine the tensile strength of Mild steel rod
2. Determine the young's modulus of elasticity for wooden cantilever beam
3. Determine the young's modulus of elasticity for wooden simple supported beam
4. Determine the young's modulus of elasticity for a mild steel continuous beam
5. Determine the Rockwell's Hardness number for the specimen
6. Determine the shear modulus of rigidity for helical spring
7. Determine the Compression strength of concrete cube
8. Determine the energy absorption of given specimen by using Izod
9. Determine the energy absorption of given specimen by using charpy
10. Determine the Shear strength of given specimen
11. Verification of Maxwell's Reciprocal theorem for beams
12. Determine the Compression strength of wood (along and across the grains)
13. Bend/Rebend Test on steel specimens
14. Determine the stress strain curve for HYSD bars
15. Determine the strain by use of electrical resistance strain gauge
16. Determine the torsional resistance of a given specimen

List of Augmented Experiments[1]

1. Determination of compressive strength of different wood and brick specimens which are locally available
2. Determination of tensile strength on different grades of steel
3. Determination of hardness of different metals
4. Verify Maxwell's Reciprocal theorem on a straight beam.
5. Impact resistance of aluminum and wood
6. Determine the rigidity modulus of open coil helical spring

Text Book(s)

1. U.C. Jindal, Introduction to Strength of Materials, Golgotha publications, 2010
2. R. Subramanian, Strength of Materials, 2nd Ed. Oxford university press, New Delhi, 2011

Reading Material (s)

1. Strength of Materials Lab Manual – Civil Engineering – GMR Institute of Technology, Rajam

21CE308 Surveying Laboratory

0 0 3 1.5

Course Outcomes

1. Utilize conventional survey equipment to measure distance and bearings.
2. Utilize theodolite to find horizontal angles, vertical angles, heights and distances using trigonometric levelling.
3. Utilize theodolite to find vertical angle and find distance and elevation using tacheometric surveying.
4. Evaluate differences in elevation, draw profiles & sections further to draw contour plots using levelling instrument.
5. Take part in calculation of area, missing measurements and elevation using Total station
6. Plot the hand-held Global Positioning System global coordinate in google earth software.

COs – POs Mapping

COs	PO1	PO4
1	3	2
2	3	2
3	3	2
4	3	2
5	3	2
6	3	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

1. Survey of an area by chain survey (Closed traverse) & Plotting.
2. Surveying past obstacles using Chain and Prismatic Compass.
3. Distance between inaccessible points using a compass survey.
4. Surveying of a given area by Prismatic compass (closed traverse) and plotting after adjustment.
5. Horizontal angle measurement between two points using Theodolite.
6. Vertical angle measurement using two points using Theodolite.
7. Trigonometric Levelling-When the base is accessible.
8. Trigonometric Levelling- When the base is inaccessible.
9. Fly leveling (differential leveling).
10. Plotting of the Longitudinal section of a given road.
11. Plotting of Cross-sections of a given road.
12. Distance and elevation computations from tacheometric surveying principles.
13. Determination of the area of the ground using a total station.
14. Determination of remote height using a total station.
15. Determination of the Gradient of the line between two inaccessible points using a total station.
16. Exercise on plotting ground points in Google Earth using Hand Held G.P.S

List of Augmented Experiments[1]

1. Determination of the horizontal distance between two inaccessible points using a theodolite.
2. Plot the contour map of a given area using the Grid method.
3. Plotting of existing road details using Total Station traverse.
4. Draw the layout plan of the existing campus.

Text Book (s)

1. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying (Vol–1),18th Ed., Laxmi Publications (P) ltd., New Delhi, 2016
2. Chandra A M, Higher Surveying, 3rd Ed., New age International Pvt. Ltd., Publishers, New Delhi, 2015

Reading Materials (s)

1. Survey Lab Manual – Civil Engineering- GMR institute of Technology, Rajam

21ESX01 Employability Skills I

1 0 1 0

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs –POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

How Communication Skills affect Confidence? How to communicate effectively.(with Examples)

Listening: Listening?, Listening Vs Hearing, Possible reasons for why people do not Listen at times, Active Listening Vs Passive Listening, How Listening can affect our relationships? How Listening helps in Campus Placements also? (with Examples)

Goal Setting: Vision Vs Mission Vs Goals, Why Goal Setting? SMART Technique to Goal Setting, Putting First things First, SWOT Analysis and Time Management

Attitude & Gratitude: Attitude Vs Skills Vs Knowledge, Attitude Vs Behaviour, How to develop Positive Attitude? Developing the attitude of Gratitude.

Public Speaking: JAM, J2M, Presentations by Students on General Topics.

16 Hours

2. Quantitative Aptitude

Number system, L.C.M and H.C.F, Problems on Ages, Averages, Time and work, Pipes and cisterns

16 Hours

Unit II

3. Revit Architecture

a. Basic Drawing and editing tools
b. Setting Up Levels And Grids
c. Modeling Walls in 2D and 3D
d. Working With Doors & Windows in 2D and 3D
e. Modeling floors
f. Modeling Ceiling and Roofs
g. Modeling Stairs
h. Modeling Ramp and Railing
i. Modeling Curtain System
j. Adding Components
k. Working with Quantity
l. Working with Schedules

32 Hours
Total: 64 Hours

21HSX11 CC & EC Activities I

0 0 1 0

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs –POs Mapping

COs	PO6	PO7	PO9	PO10
1				3
2	3	2		
3	3			
4			3	
5	3			
6	3			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21CE401 Hydraulics and Hydraulic Machinery

3 0 0 3

Course Outcomes

1. Explain the behavior of flow in open channels under various flow conditions.
2. Develop empirical relationships among the physical variables associated with the flow phenomenon in both model and prototype scenarios
3. Determine the hydrodynamic forces exerted by the fluid jet on flat, inclined, and curved vanes.
4. Develop velocity triangles to enhance the understanding of the operations of various turbines and pumps.
5. Design turbines considering diverse hydraulic conditions.
6. Evaluate the performance characteristics of turbines and pumps operating under various conditions.

COs–POs Mapping

COs	PO1	PO12
1	3	3
2	3	2
3	3	3
4	3	3
5	3	3
6	3	3

3–Strongly linked |2–Moderately linked|1–Weakly linked

Unit I

Open Channel Flow and Critical Flow

Uniform flow: Types of flows-Type of channels– Velocity distribution –Energy and momentum correction factors– Chezy's, Manning's; and Bazin formulae for uniform flow– Most Economical sections. Criticalflow: Specific energy-critical depth–computation of critical depth–critical sub-critical and supercritical flows.

Non-uniform flow: Dynamic equation for G.V.F., Rapidly varied flow, hydraulic jump, energy dissipation. Condition for Max Discharge for a given value of Specific Energy

Minimum Specific Energy in Terms of Critical Depth

12 Hours

Unit II

Hydraulic Similitude and Impact of Jets

Dimensional analysis-Rayleigh's method and Buckingham's pi theorem, study of Hydraulic models – Geometric, kinematic and dynamic similarities-dimensionless numbers – model and prototype relations Impact of jets: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity triangles at inlet and outlet, expressions for work done and efficiency-Angular momentum principle, Applications to radial flow turbines.

Model Testing of Partially Submerged Bodies

12 Hours

Unit III

Hydraulic Turbines

Layout of a typical Hydropower installation – Heads and efficiencies classification of turbines-pelton wheel-Francis turbine-Kaplan turbine-working, working proportions, velocity diagram, work done and efficiency, hydraulic design, draft tube – theory and function efficiency Governing Equations of turbines-surge tanks-unit and specific turbines-unit speed unit quantity-unit power- specific speed performance characteristics-geometric similarity-Cavitation. Outward Radial Flow Reaction Turbines.

The Hydraulic Lift

12 Hours

Unit IV

Centrifugal-Pumps

Pump installation details-classification-work done- Manometric head minimum starting speed-losses and efficiencies-specific speed multistage pumps-pumps in parallel performance of pumps-characteristic curves-NPSH-cavitations., Maximum Suction Lift-Model Testing of Centrifugal Pumps characteristic curves.

The Hydraulic Rams

12 Hours

Total: 48 Hours

Textbook (s)

1. K. Subramanya, Open Channel Flow, 5th Ed., Tata Mc.Grawhill Publishers, New Delhi, 019
2. P.N Modi and S.M Seth, Hydraulics & Fluid Mechanics, 20th Ed., Standard Book House, New Delhi, 2013
3. R.K. Bansal, A Text of Fluid Mechanics and Hydraulic Machines, 9th Ed., Laxmi Publications (P) Ltd., New Delhi, 2015

Reference (s)

1. R.K. Rajput, Fluid Mechanics and Fluid Machines, Revised 9th Ed., S. Chand &Co, 2015
2. V.T. Chow, Open Channel Flow, 7th Ed., McGraw Hill Book Company, 2009
3. S.C Sharma, Fluid Mechanics & Hydraulic Machines, 8th Ed., Khanna Publishers, New Delhi, 2009
4. D.S. Kumar, Fluid Mechanics & Fluid Power Engineering, 8th Ed., Kataria& Sons, 2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	35	15	-
Understand	35	15	-
Apply	30	35	50
Analyze	-	35	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List out all the types of open Channel Flows
2. Define Energy Correction Factor and Momentum Correction Factor for Open Channel flows.
3. List any two types of dimensionless numbers

Understand

1. Explain about Most Economical sections
2. Discuss critical, sub critical and super critical flows in open channels.
3. Explain Chezy's and Manning's Formulae for open channel flows.

Apply

1. Derive equation for Gradually Varied Flow from fundaments. Discuss the applications
2. Explain in detail about the hydraulic jump
3. Discuss different similarities between models and prototypes
4. Explain the working of centrifugal pump with neat sketches
5. Gradually varied flow of water in a wide rectangular channel with a per unit width flow rate of $1m^3/s.m$ and a manning's coefficientof n=0.02 is considered. The slope of the channel is 0.001, and at the location x=0, the flow depth is measured to be 0.8m. (a) Determine the normal and critical depths of the flow and classify the water surface profile, and (b) calculate the flow depth y at x=1000m by integrating the GVF equation numerically over the range 0<=x<=1000m.
6. company. One of your company's best selling product is a water pump, which we shall call pump A. Its impeller diameter is D_A =6.0 cm, and its performance data when operating at n_a =1725 rpm (ω_A =180.6rad/s) are given below table. The marketing research department is recommending that the company design a new product, namely, a larger pump (which we shall call pump B) that will be used to pump liquid refrigerant R-134a at room temperature. The pump is to be designed such that its best efficiency point occurs as close as possible to a volume flow rate of V_B =2400 cm^3 /s and a net head of H_B =450cm(R-134a). The chief engineer (your boss) tells you to perform some preliminary analysis using

pump scaling laws to determine if a geometrically scaled up pump could be designed and built to meet the given requirements. (a) plot the performance curves of pump A in both dimensional and dimensionless form and indentify the best efficiency point. (b) Calculate the required pump diameter $D_{B,}$ rational speed $n_{B,}$ and brake horsepower bh P_B for the new product. Manufacturer's performance data for a water pump operating at 175rpm and room temperature.

V m^3/s	H, cm	$\eta_{pump,}\%$
100	180	32
200	185	54
300	175	70
400	170	79
500	150	81
600	95	66
700	54	38

Analyze

1. Water is to be pumped to a height of 90m. The pumps that run at a speed of 1000 rpm with rated capacity of 200 liters per second are available. How many pumps are required to pump the water if specific speed is 800?
2. A reaction turbine develops 7000kW under a head of 45m with a speed of 150 rpm. What is the specific speed of the turbine? What will be the power and speed when the turbine works under a head of 20m.
3. A cylindrical shaft of 90mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm and 95 mm internal diameter. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity 2.0 pose, determine the power required to overcome viscous resistance when the shaft is rotated at a speed of 240 rpm.

21CE402 Soil Mechanics

3 0 0 3

Course Outcomes

1. Outline the significance of geotechnical engineering
2. Examine and determine physical properties of soil
3. Analyze the hydraulic conductivity in soils due to seepage
4. Apply laboratory compaction tests, Analyze the stress distribution due to different types of loading.
5. Determine one-dimensional consolidation characteristics of fine-grained soils under vertical load
6. Determine the shear strength of soils and describe the differences between drained and undrained shear strength.

COs-POs Mapping

COs	PO1	PO2	PO12	PSO1
1	2	2	2	1
2	2	2	1	3
3	3	3	1	2
4	3	3	1	2
5	3	2	2	2
6	3	3	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Soil Properties: Soil Structure, Basic definitions; Phase relations

Soil Classification: Index properties; Grain size distribution; Soil aggregate properties. Indian standard soil classification system

Clay Mineralogy: Introduction, Classification of Clay Minerals, Clay Mineral Groups, Crystal Structure of Clay Minerals, Clay Mineral Properties, Thermal Methods, Base Exchange Capacity, Industrial Applications, Origin of Clay, Clay Mineral Equilibrium

Soil Formation - Unified Classification

12 Hours

Unit II

Principle of effective stress and related phenomena: Principle of effective stress; Capillarity; Seepage force and quicksand condition; Total, effective and neutral pressures

Permeability and seepage through soils: One-dimensional flow; Darcy's law; Laboratory methods for permeability determination; Field pumping tests for permeability determination; Permeability as a function of soil type, permanent, void ratio, soil fabric, and effective stress; Two-dimensional flow; Flow nets and their characteristics; Uplift pressure, exit gradient, and piping; Criteria for filters

Coefficient of Permeability by Indirect Tests

12 Hours

Unit III

Compaction & Stress Distribution in Soils

Compaction: Laboratory compaction tests; Factors affecting compaction; Structure and engineering behavior of compacted cohesive soils; Field compaction; Compaction specifications and field control.

Stress distribution in Soils: Two to one method, Boussinesq's theory for point, circular loads and Newmark's chart

Stress Distribution for Rectangular Line and Strip Loads

12 Hours

Unit IV

Compressibility, Consolidation Behavior and Shear Strength

Compressibility and consolidation behavior: Components of total settlement; Effects of soil type, stress history, and effective stress on compressibility; Normally consolidated and over-consolidated soils; Terzaghi's

theory of one dimensional consolidation; Time-rate of consolidation; Evaluation of compressibility and consolidation parameters from consolidometer data.

Shear strength: Mohr's stress circle; Mohr Coulomb failure criterion; Laboratory tests for shear strength determination; Effective and total stress shear strength parameters; Shear strength characteristics of clays and sands

3D Consolidation

12 Hours

Total: 48 Hours

Textbooks (s)

1. B.C.Punmia, Soil Mechanics and Foundation Engineering, 17th Ed, Laxmi Publications, 2017.
2. C.V.Ramaiah, A Text Book of Geotechnical Engineering, 3rd Ed, New Age International Publishers, 2006

Reference (s)

1. Gopal Ranjan & ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016.
2. S. K.Gulhati & Manoj Datta, Geotechnical Engineering, 4th Ed, Tata Mc.Graw Hill Publishing Company, New Delhi. 2005.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	25	35	--
Understand	40	35	--
Apply	20	10	50
Analyze	15	20	50
Evaluate			-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define Surface Tension and Capillarity
2. State the meaning of the following symbols used in IS classification of soils
   a. CH
   b. ML
   c. CI
   d. MH-OH
   e. SP
   f. GW
   g. SC
   h. CL
3. Define and mention the formulae for the following terms
   a. Void ratio
   b. Porosity
   c. Degree of saturation
   d. Percentage airvoids
   e. Water content
   f. Density index
   g. Percentage of air voids
4. State all the assumptions of Terezaghi's one dimensional theory of consolidation
5. Write the relationship between principal stresses at failure
6. State the characteristics and application of flow net
7. What are two different methods of compaction adopted in the field?
8. What is liquefaction of sand?

Understand

1. Explain in detail various factors affecting permeability
2. Explain all the factors affecting compaction

3. Explain in detail various factors affecting permeability in detail
4. Explain the affecting shear strength of soil
5. Derive the following relation with neat phase diagrams $es_r = WG$
6. Explain how liquefaction of soil can be prevented?
7. Explain in detail about various soil types
8. Explain in detail important features of Indian soil classification system
9. Explain the different properties of flow net
10. Explain standard compaction test with neat sketch
11. Briefly discuss the Mohr coulomb failure theory
12. Explain how soils formed

Apply

1. An airport runway needs 500,000 m^3 of soil compacted to a void ratio of 0.75. There are two borrow pits A and B from where the required soil can be taken and transported to the site

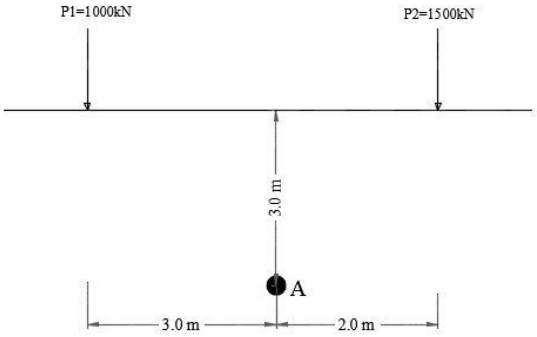
Borrow pit	In-situ void ratio	Transportation cost
A	0.8	Rs. 10/m^3
B	1.7	Rs. 5/m^3

Which of the borrow pits would be more economical?

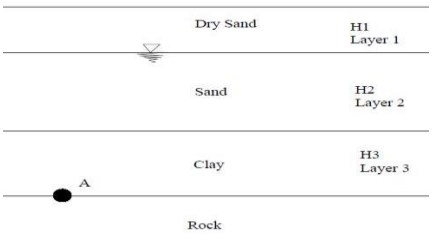
2. A very long embankment is to be built with a width of 10m and side slope of 1 ½. The height of the embankment is 10m. Compute the vertical stress at a depth of 5m from the base at the following points.

   i. Below the toe
   ii. Below the centerline
   iii. Below a point on the slope. Assume, = 21kN/m^3.

3. A structure having rectangular area 3m x 1.5m is uniformly loaded with load intensity of 125 kN/m^2 at the ground surface. Calculate the vertical pressure at a point 4.5m below one of its corners
4. A circular ring foundation for an overhead tank transmits a contact pressure of 300kN/m^2. Its internal diameter is 6m and external diameter 10m. Compute the vertical stress on the center line of the footing due to the imposed load at a depth of 6.5m below the ground level. The footing is founded at a depth of 2.5m.
5. The four legs of a transmission tower form in plan a square of side 4m and together carry a total load of 300kN. Compute the increase in vertical stress data depth of 2m vertically below a leg and also at the center of the plan at 2m depth. Use Bousnesq's theory.
6. Two point loads acts on the same plane as shown in Figure .Determine the increase in vertical stress at point "A.



7. A soil profile consisting of three layers is shown in figure. Layer 1: H1=2.0m. e=0.7, G=2.69, Layer 2: H2=3.5m. e=0.55, G=2.7,Layer 3: H3=1.5m. e=0.1.2, w=38%. How high should the water table rise so that the effective stress at point A is 8.3kg/m^2.



Analyze

1. Compute stresses due to load in soil for the given conditions as given below;
   Below point load of 1000kN at depth of 5m
   Below circular load (diameter: 8m) of intensity 100kPa at depth6m
2. A soil sample has a porosity of 40% .the specific gravity of solids 2.70,Calculate
   a. Void ratio
   b. Dry density
   c. Unit weight if the soil is 50%saturated
   d. Unit weight if the soil is completely saturated
3. The void ratio of clay is 1.56 and its compression index is found to be 0.8 at the pressure 180kN/m^2. What will be the void ratio if the pressure is increased to 240kN/m^2
4. The water table in a certain area is at a depth of 4m below the ground surface. To a depth of 12m, the soil consists of very fine sand having an average void ratio of 0.7. Above the water table the sand has an average degree of saturation of 50%. Calculate the effective pressure on a horizontal plane at a depth 10m below the ground surface. What will be the increase in the effective pressure if the soil gets saturated by capillarity up to a height of 1m above the water table? Assume G =2.65
5. In a falling head permeameter test, the initial head (t = 0) is 40 cm. The head drops by 5 cm in 10 minutes. Calculate the time required to run the test for the final head to be at 20cm. If the sample is 6 cm is height and 50 cm^2 in cross sectional area, calculate the coefficient of permeability, taking area of stand pipe = 0.5cm^2
6. A sand deposit is 10m thick and overlies a bed of soft clay. The ground water table is 3m below the ground surface. If the sand above the ground water table has a degree of saturation of 45%, plot the diagram showing the variation of the total stress, pore water pressure and the effective stress. The void ratio of the sand is 0.70. Take G=2.65
7. Calculate the void ratio, porosity and degree of saturation of a soil sample, if it has the wet density 2.0 g/cc and dry density 1.8 g/cc. Specific gravity of soil is2.7.
8. A sieve analysis of a given sample of sand was carried out by making use of IS standard sieves. The total weight of sand used for the analysis was 522 g. The following data were obtained

Size of the sieve in mm	4.75	2.0	1.0	0.6	0.425	0.3	0.15	0.075	Pan
Weight of soil retained (g)	25.75	61.75	67	126	57.75	78.75	36.75	36.75	31.5

   Plot the grain size distribution curve on semi-log paper and compute the following:
   a. Percent gravel
   b. Percent of coarse, medium and fine sand
   c. Percent of silt and clay
   d. Uniformity coefficient
   e. Coefficient of curvature
9. The following test results are obtained from the direct shear test. Compute the shear strength parameters. Dimensions of the sample are 6cm x 6cm x2cm

Normal stress (kg/cm^2)	0.3	0.4	0.5	0.6	0.7
Shear Load (kg)	6.7	9.0	11.2	13.5	15.7

10. A concentrated load of 2000kN is applied at the ground surface. Determine the vertical stress at a point "A" which is 6m directly below the load. Also calculate the vertical stress at a point "B" which is at a depth of 6m and at a horizontal distance of 5m from the axis of the load

21CE403 Solid Mechanics II

3 0 0 3

Course Outcomes

1. Sketch the shear stress distribution diagram for various beam sections and to determine the diameter of the shaft subjected to the pure torsion
2. Identify the principal planes and principal stresses on an element
3. Determine the safe stresses using failure theories
4. Design the helical spring subjected to loading and to determine the buckling loads of columns
5. Compute the thickness of cylinder subjected to longitudinal, hoop and radial stresses
6. Assess the resultant stresses and stability in the case of chimneys, retaining walls

COs – POs Mapping

Cos	PO1	PO12
1	3	3
2	1	1
3	1	1
4	2	1
5	2	1
6	1	1

3– Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Shear Stresses and Torsion of Circular Shaft

Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.

Torsion of Circular Shaft: Theory of pure torsion – Derivation of Torsion equations – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts

Combined bending and torsion and end thrust

12 Hours

Unit II

Principal Stresses and Strains - Theories of Failures

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for bi-axial stresses -bi-axial stresses accompanied by a state of simple shear (Analytical solutions) – Mohr's circle of stresses (graphical solutions)

Theories of Failures: Introduction –Theories of failures like Maximum Principal Stress theory – Maximum Principal Strain theory – Maximum shear stress theory – Maximum strain energy theory – Maximum shear strain energy theory

Strain Rosette, Failure theories using graphical method

12 Hours

Unit III

Springs - Columns and Struts

Springs: Introduction – Types of springs – deflection of close and open coiled helical springs under axial pull and axial couple – springs in series and parallel – Carriage or leaf springs

Columns and Struts: Introduction – Types of columns – Short, medium and long columns – Axially loaded compression members – Crushing load – Euler's theorem for long columns- assumptions- derivation of Euler's critical load formulae for various end conditions – Equivalent length of a column – slenderness ratio – Euler's critical stress – Limitations of Euler's theory – Rankine – Gordon formula – Long columns subjected to eccentric loading – Secant formula, Empirical formulae

Straight line formula, Prof. Perry's formula

12 Hours

Unit IV

Thin and Thick Cylinders, Direct and Bending Stresses

Thin and Thick Cylinders: Thin seamless cylindrical shells – distribution of longitudinal and circumferential stresses – changes in diameter and volume of thin cylinders - design of thin cylinders–Introduction Lame's theory for thick cylinders – distribution of hoop and radial stresses across thickness – design of thick cylinders

Direct and Bending Stresses: Introduction - Stresses under the combined action of direct loading and B.M, – determination of stresses in the case of chimneys, retaining walls and dams – conditions for stability – stresses due to direct loading and B.M. about both axis

Spherical shells, Compound cylinders, unsymmetrical bending

12 Hours

Total: 48 Hours

Textbook (s)

1. R. Subramanian, Strength of Materials, 3rd Ed., Oxford University Press, NewDelhi,2016
2. Ferdinand P Beer, E. Russell, Johnston, Jr, John T dewolf, Mechanics of Materials, 7th Ed., Tata McGraw-Hill Publications,2014
3. Schaum's Outline Series, Strength of Materials, 6th Ed., McGraw-Hill Professional Publications,2013

Reference (s)

1. R.K.Rajput, Strength of Materials, 4th Ed., S.Chand& Co, New Delhi,2007
2. U.C. Jindal, Introduction to Strength of Materials, 5th Ed., Galgotia Publications,2001

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	-
Understand	20	20	-
Apply	60	60	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

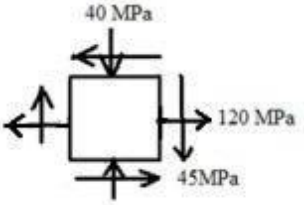
1. Define the term torsional rigidity.
2. What are principal stresses?
3. List out all the theories of failures.
4. Define core of a section.

Understand

1. Derive the shear stress expression in a beam of rectangular cross-section.
2. The internal diameter of a hollow shaft is two-third of its external diameter. Compare its resistance to torsion with that of a solid shaft of the same weight and material Illustrate various steps involved in constructing the Mohr's circle graphically when subjected to a biaxial state of stress.
3. Differentiate between thin and thick cylinders.

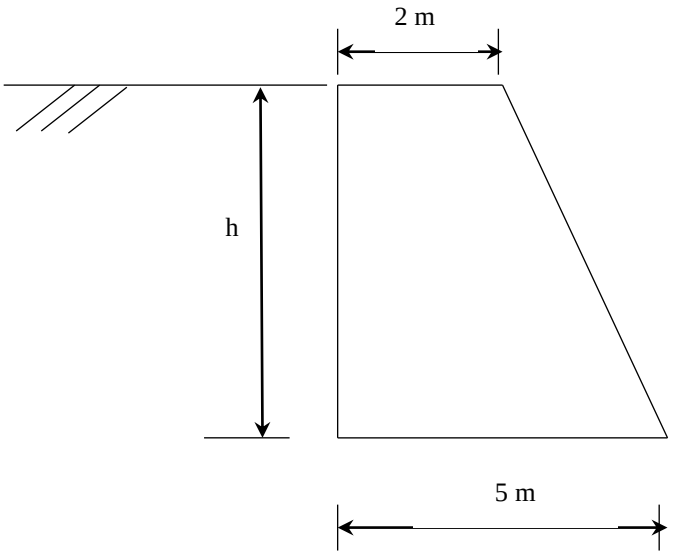
Apply

1. An element in plane stress is subjected to stresses as shown in Fig.
2. Determine (a) The magnitude of principal stresses (b) Find the orientation of principal planes and sketch



the principal stresses on a properly oriented element. (c) Find the maximum shear stresses and sketch the maximum shear stresses on a properly oriented element.

3. A wagon weighing 50 kN is moving at a speed of 8 km/hr. has to be brought to rest. Springs made of 25mm dia rods with a mean diameter of 250 mm and with 24 turns are available. Find the number of springs required in the buffer to stop the wagon at a compression of 180 mm. G = 84 GPa.
4. To what height can the retaining wall shown in below fig. can be constructed without exceeding the maximum compressive stress of 120 MPa and no tension at other end?
   Take Masonry density = 22 kN/m^3.



21CE404 Structural Analysis

3 0 0 3

Course Outcomes

1. Apply strain energy and Castigliano's theorem to determine deflections of statically indeterminate beams and analyse truss using method of joints
2. Analyze propped cantilevers under simple loading conditions, constructing shear force and bending moment diagrams
3. Analyze the fixed beams and continuous beam for various load conditions
4. Analyze three /two hinged arches and obtain internal forces at any cross section
5. Compute the structural response using the Slope Deflection Method
6. Analyse the continuous beams and frames using moment distribution method.

COs–POs Mapping

COs	PO1	PO12
1	3	2
2	2	3
3	2	3
4	3	2
5	3	1
6	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Indeterminate Structural Analysis & Energy theorems

Determination of static indeterminacy, kinematic indeterminacy of beams, frames and trusses. Energy Theorems: Introduction-Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces - Castigliano 's theorem-Deflections of statically indeterminate beams. Analysis of truss using method of joint.

Propped Cantilevers: Analysis of propped cantilevers-simple loading-shear force and bending moment diagrams-Deflection of propped cantilevers.

Static indeterminacy, kinematic indeterminacy of truss

12 Hours

Unit II

Fixed beams and Continuous Beams

Fixed beams: Introduction to statically indeterminate beams with uniformly distributed load, central point load and eccentric point load- shear force and bending moment diagrams - Deflection of fixed beams,

Continuous Beams: Introduction-Clapeyron 's theorem of three moments- Analysis of continuous beams with and without sinking support -shear force and Bending moment diagrams.

Effect of rotation of a support

12 Hours

Unit III

Three Hinged Arches and Two Hinged Arches

Three Hinged Arches: Elastic theory of arches – Determination of horizontal thrust, bending moment, normal thrust and radial shear – effect of temperature.

Two Hinged Arches: Determination of horizontal thrust bending moment, normal thrust and radial shear – Rib shortening.

Eddy's theorem , Temperature Stresses

12 Hours

Unit IV

Slope Deflection Method: Derivation of slope deflection equation of supports application to continuous beams including settlement of supports.

Moment Distribution Method: Stiffness and carry over factors – Distribution factors – Analysis of continuous beams with and without sinking of supports – storey portal frames – including Sway.

Slope Deflection method for frames, Moment Distribution method for frame without sway

12 Hours

Total: 48 Hours

Textbook (s)

1. V.N. Vazirani, M.M Ratwani and S.K. Duggal, ‗Analysis of Structures-Vol I', 17th Ed.,, Khanna Publishers, New Delhi,2015
2. V.N. Vazirani, M.M Ratwani and S.K. Duggal, ‗Analysis of Structures-Vol II', 16th Ed., Khanna Publishers, New Delhi,2015
3. S.S. Bhavikatti, Structural Analysis II, 5th Ed.,Vikas Publishing House Pvt Ltd, 2013

Reference (s)

1. S.B.Junnarkar, Mechanics of Structures Vol.I, 31st Ed., Charotar Publishing House, 2015.
2. S.B.Junnarkar, Mechanics of Structures Vol.II, 24th Ed., Charotar Publishing House, 2015
3. T.S. Thandavamoorthy, Analysis of Structures, 1st Ed., Oxford University Press, New Delhi, 2011.
4. B.C. Punmia, Strength of Materials and Mechanics of Solids,5th Ed., Vol-2Laxmi Publications, New Delhi, 2010
5. C.S. Reddy, Structural Analysis, 11th Ed.,Tata McGhill Publications, New Delhi, 2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	10	10	--
Understand	10	10	--
Apply	30	30	50
Analyze	50	50	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

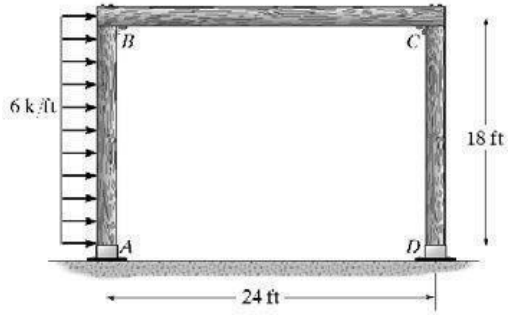
Remember

1. State the Castigliano's theorem-I and mention its application in trusses.
2. Write down the equation for strain energy due to axial force.
3. Give the three moment equation for the analysis of continuous beam with and without settlement.
4. State the limitations of slope deflection method.
5. Why slope-deflection method is called a ‗displacement method'?
6. Define degrees of freedom.
7. In a member AB, if a moment of –10 KNm is applied at A, what is the moment carried over to B?

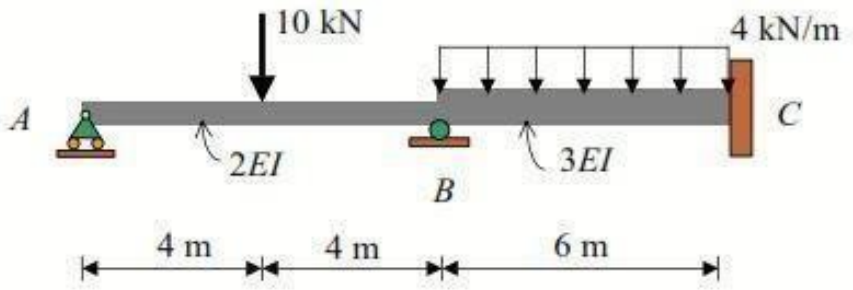
Understand

1. What is the strain energy stored in the simply supported beam ‗L'subjected to a U.D.L of intensity of w' kN/m ?
2. Contrast between Statically determinate structures and indeterminate structures?
3. Show the reactions in a fixed beam of length ‗L'subjected to a rotation at right support in anti- clockwise direction?
4. Determine the moments at each joint and support using Slope Deflection Method. The connections at *B* and

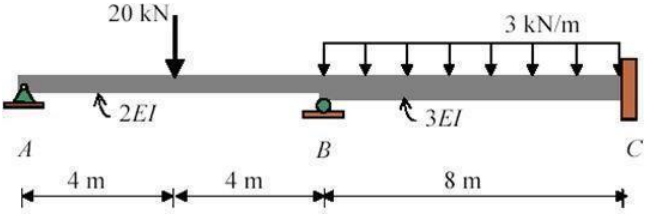
C are rigid fixed. The supports at *A* and *D* are fixed. *EI* is constant.



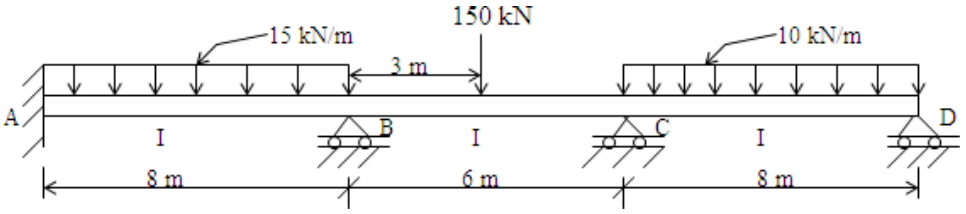
5. Draw the shear force and bending moment diagrams for the beam shown solve using Slope Deflection method. EI is constant.



6. Analyse the Beam shown Below using Moment Distribution Method.

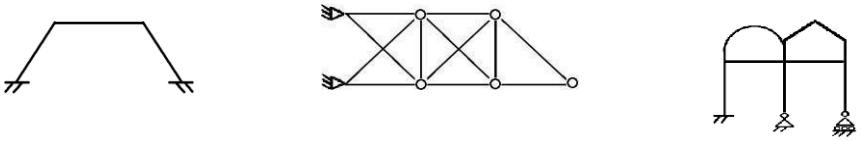


7. Analyse the Beam shown Below using Moment Distribution Method.

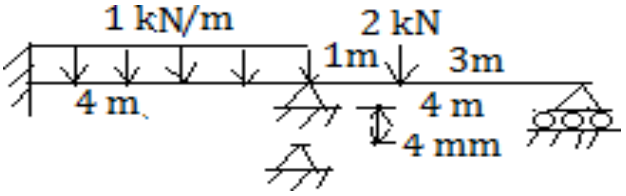


Apply

1. Solve for the static indeterminacy of the frames / trusses shown below?

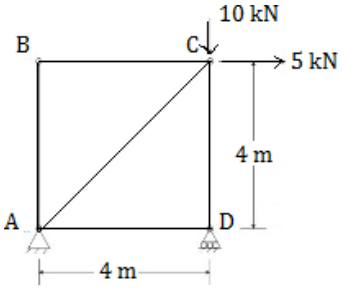


2. A continuous beam loaded as shown in figure determine the support moments. Take EI = Constant. E = 200 GPa, I = 8× 10^6 mm^4. Solve for all the support moments

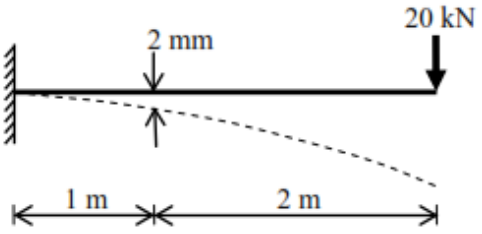


Analyze

1. Examine for the horizontal deflection of joint C of truss ABCD loaded as shown in Fig. Assume that, all members have the same axial rigidity.



2. For the cantilever beam of span 3 m (shown below), a concentrated load of 20 kN applied at the free end causes a vertical displacement of 2 mm at a section located at a distance of 1 m from the fixed end. If a concentrated vertically downward load of 10 kN is applied at the section located at a distance of 1 m from the fixed end (with no other load on the beam), what is the maximum vertical displacement in the same beam (in mm).



21CE405 Transportation Engineering

3 0 2 4

Course Outcomes

1. Develop knowledge of road networks and their classification.
2. Execute various methods involved in planning and highway alignment.
3. Design cross-section elements, ensuring sight distance, and managing horizontal and vertical alignment.
4. Implement traffic studies, traffic regulations, and control measures.
5. Execute various methods involved in accident studies and signal design.
6. Acquire knowledge regarding intersections and rotaries.

COs-POs Mapping

COs	PO3	PO12	PSO2
1	3	3	2
2	3	3	3
3	3	3	3
4	2	3	3
5	3	3	3
6	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Highway Development and Planning

Highway Development in India – Necessity for Highway Planning – Different Road Development Plans; Classification of Roads-Road Network Patterns–Highway Alignment-Factors affecting Alignment-Drawing Reports- Highway Project.

Practical Components:

1. Aggregate Crushing Value,
2. Deval's Attrition,
3. Aggregate Impact Test,
4. Los Angeles Abrasion,
5. Aggregate shape tests,
6. Specific gravity and water absorption test.

12+ 8 Hours

Unit II

Highway Geometric Design

Importance of Geometric Design- Design controls and Criteria- Highway Cross Section Elements- Sight Distance Elements: Stopping sight Distance- Overtaking Sight Distance and Intermediate Sight Distance - Design of Horizontal Alignment: Super Elevation-Extra widening -Design of Transition Curves; Design of Vertical Alignment: Gradients-vertical curves, Curve Resistance.

Practical Components:

1. Gradation of aggregates for bituminous concrete and dense bituminous macadam.
2. Ductility Test
3. Flash and Fire Point
4. Softening Point
5. Penetration Test

12+ 8 Hours

Unit III

Traffic Engineering

Relation between basic traffic characteristics, Traffic Volume and Speed Studies-Data Collection and Presentation, Origin and Destination study, Parking studies - On street& off street, Road Accidents – Causes and Preventive Measures – Accident Data Recording – Condition and Collision Diagram, Traffic Signs – Types and specifications, Road Markings, Design of Traffic Signals-Webster Method.

Practical Components:

1. Parking Studies
2. Spot Speed Studies
3. Traffic Volume Studies.

12 + 8 Hours

Unit IV

Intersection Design

Types of Intersection- At grade and grade separated-Conflicts at Intersection–Requirements of at grade intersections– Channelized and non-Channelized Intersection, Traffic Islands-Need of Roundabout – Design Factors of Rotary.

Practical Components:

1. Merlin Cycle
2. Visual distress survey
3. Pavement condition rating.

12+8 Hours

Total: 48+32 Hours

Textbooks (s)

1. Highway Engineering – S. K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand & Sons, 10th Ed, 2018.
2. Transportation Engineering – L. R. Kadiyali, Khanna Book Publishing Co. (P) LTD, 3rd Ed, 2016.

Reference (s)

1. Principles of Transportation Engineering– Partha Chakraborty, Animesh Das, PHI Learning, 2nd Ed, 2017.
2. Transportation Engineering –C. Jotin Khisty, B. Kent Lall, Pearson Education, 3rd Edition, 2007.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	25	20	50
Understand	35	30	50
Apply	40	50	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List the necessity for Highway Planning.
2. Give 3 examples of different conceptual Rotary designs used in India.
3. List any four the amendments proposed by Jayakar's Committee.
4. List the factors affecting Highway Alignment.
5. Recall the classification of Roads in India.
6. Illustrate the difference between channelized and non-channelized intersection.

Understand

1. If the jam density of a particular roadway is 250 vehicles/mile, what is the density at capacity?
2. A vehicle slows from 60 mph down to 30 mph on a flat grade. Using the standard recommended deceleration rate, what is the braking distance over which this occurs?
3. Outline the Importance of Geometric Design in Highways.
4. Relate the concept of Intermediate sight distance with Sight distance.
5. Outline the requirements of a good Intersection.
6. Recall the importance of weaving length in Rotary Design.

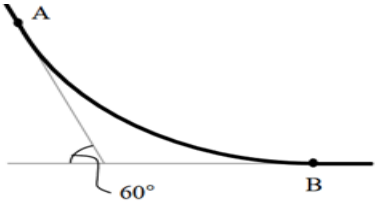
Apply

1. At chainage of613.564 near chilakapalem, the direction of Rajam from NH-16 has the following characteristics:
   - Rural freeway classification
   - PHF = 0.97
   - No HOV lanes
   - 12 ft lane width
   - 10 ft right-side shoulders
   - 4 lanes total (2 in each direction)
   - 0.67 interchanges per mile
   - 2% recreational vehicles
   - 2.11% upgrade for 0.84 miles
   - Driver population adjustment factor = 1.0
   - Volume: use highest volume of 2018 according to the Toll plaza Peak Hour Report

   Find and report the following:
   1. Free flow speed for this section of freeway (to the nearest mile per hour).
   2. The 15-minute passenger-car equivalent flow rate.
2. A 2-lane (12 ft wide lanes) combined horizontal and crest vertical curve is reportedly designed for 35 mph. Both curves begin at point A and end at point B.

   Given the data below, is this section of roadway adequately designed for 35 mph? Show appropriate calculations to support your conclusion.

   Horizontal Curve Data
   - Curve length = 390 ft
   - 60° angle as shown
   - 4% super elevation
   - M_s = 25 ft (perpendicular distance from centreline of inside lane to nearest obstruction)



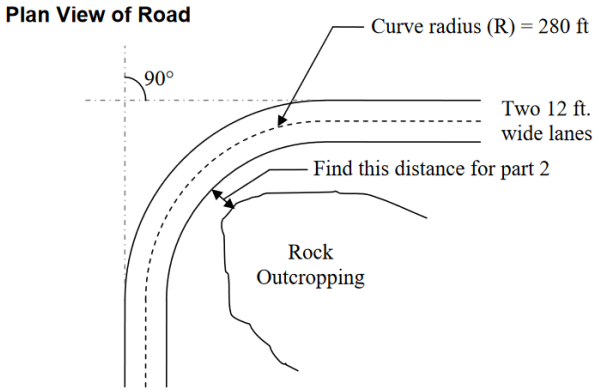
Plan View

Vertical Curve Data
- Curve length = 390 ft
- G1 = 6%
- G2 = -3.5%



Profile View

3. The road up of Araku is being redesigned to accommodate a 35-mph design speed. Part of this road has an existing curve with a 280 ft radius and zero super elevation. Answer the following 2 questions about the redesign of this curve: Demonstrate the various methods of fitting a Flat saddle key in position.
   a. If the existing curve radius is kept unchanged, what super elevation is required for the curve to accommodate a 35-mph design speed (use f_s= 0.23).
   b. How far back from the edge of the road must the rock outcropping be to allow adequate sight distance for a 35-mph design speed.



4. You are designing the vertical alignment of an east-west portion of SH38 through Anadapuram. An equal tangent crest vertical curve must go over an existing north-south oil pipeline. According to IRC regulations, the top of the pipeline must be at least 6 ft below the centerline roadway surface. Known grades, stationing and elevations are given in the drawing below. Design the curve for the highest possible design speed without violating the pipeline's 6 ft cover requirement. Report the curve length, and the associated design speed rounded down to the nearest 5 mph.

21CE406 Fluid Mechanics and Hydraulic Machinery Laboratory

0 0 3 1.5

Course Outcomes

1. Demonstrate the calibration of different flow meters
2. Estimate the coefficient of discharge for different flow conditions
3. Estimate the energy equation to pipe flow problems
4. Apply Bernoulli's equation and Momentum equation for real fluid flow problems
5. Select the required flow rate, pressure rise and the proper pump to optimize pumping efficiency
6. Analyze a variety of practical fluid flow devices and utilize fluid mechanics principles in design

COs–POs Mapping

COs	PO1	PO4
1	3	3
2	3	3
3	3	3
4	3	3
5	3	3
6	3	3

3–Strongly linked |2–Moderately linked|1–Weaklylinked

List of Experiments

1. Calibration of Venturi meter
2. Calibration of Orifice meter
3. Calibration of Rotameter
4. Determination of Coefficient of discharge for a small orifice by a constant head method.
5. Determination of Coefficient of discharge for an external mouth piece by variable head method.
6. Calibration of contracted Rectangular Notch and/or Triangular Notch.
7. Determination of Coefficient of loss of head in a sudden contraction and friction factor.
8. Determination of Coefficient of loss of head in a sudden contraction and friction factor for non-Circular pipe.
9. Verification of Bernoulli's equation.
10. Verification of Reynold's Experiment.
11. Impact of Jet on Vanes
12. Study of Hydraulic jump.
13. Performance test on Pelton wheel turbine
14. Performance test on Francis turbine.
15. Performance test on Kaplan turbine.
16. Efficiency test on Centrifugal Pump.

List of Augmented Experiments[1]

1. Determination of co-efficient of discharge for venture flume
2. Determination of minor losses
3. Determination of Coefficient of discharge for an external mouthpiece by variable head method
4. Determination of hydraulic coefficients of orifice
5. Performance test on Pelton Wheel Turbine
6. Performance test on Single Stage Centrifugal Pump
7. Determination of coefficient of loss of head due to pipe fittings
8. Determination of Coefficient of loss of head in a sudden contraction

Text Book (s)

1. D.S.Kumar, Fluid Mechanics & Fluid Power Engineering ,9th Ed .,Kataria & Sons, Publisher. 2 0 1 8
2. Bangaand Sharma, Hydraulic Machines,8th Ed., Khanna Publishers, NewDelhi,2003

Reading Material(s)

1. Fluid Mechanics & Hydraulic Machinery Lab Manual–Civil Engineering-GMR Institute of Technology Rajam

21CE407 Soil Mechanics Laboratory

0 0 3 1.5

Course Outcomes

1. Determine the basic properties like Moisture content, Specific gravity of the soil.
2. Organize specific field investigations including collection of soil samples for testing and observation of soil properties of the soil.
3. Identify and classify the soil from laboratory tests based on standard geotechnical Engineering practice.
4. Examine the permeability of the soil using constant head and falling head methods.
5. Determine the Compaction properties and CBR of the soil sample
6. Assess the engineering properties of soil samples.

COs – POs Mapping

COs	PO1	PO4
1	2	3
2	2	3
3	3	3
4	3	3
5	3	3
6	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

1. Determination of water content of the soil.
2. Determination of Specific Gravity of the coarse garined soil.
3. Determination of Specific Gravity of the clayey soil.
4. Determination of Field density using Core cutter method.
5. Determination of Field density using Sand replacement method.
6. Determination of Particle Size Distribution through mechanical analysis.
7. Determination of Liquid limit of the soil.
8. Determination of Plastic limit of the soil.
9. Determination of Optimum Moisture Content and Maximum Dry Density for given soil with Proctor Compaction Test.
10. Determination of Coefficient of Permeability of soil using Constant head method.
11. Determination of Coefficient of Permeability of soil using Variable head method.
12. Determination of strength parameters of given soil using Unconfined Compression strength (UCS) test.
13. Determination of strength parameter of given cohesion-less soil by performing Direct Shear Test.
14. Determination of strength parameter of given C-ϕ soil by performing Direct Shear Test.
15. Determination of C.B.R Value of given soil using Laboratory CBR Test.
16. Determination of Free swell index for soil.

List of Augmented Experiments

1. Prepare a remoulded cohesive soil sample with given field conditions (bulk density is 2.0g/cc; water content is 20%) collected at a depth of 10m and determine the strength properties.
2. Determine the OMC and MDD for given soil and draw the Zero air void line and 95% air void line.
3. Prepare a remoulded sample with given field conditions for a cohesionless soils (bulk density is1.95g/cc; water content is 16%) and determine the strength properties.
4. Prepare a remoulded cohesive soil sample with given field conditions (bulk density is 2.0g/cc; water content is 18%) collected at a depth of 1.0m and determine the strength properties.
5. Classify the given fine grained soils by using suitable tests.
6. Find out the field density and dry density of the given soil using suitable test and classify the soil.

Textbook (s)

1. Gopal Ranjan and ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016.
2. C.V.Ramaiah, A Text Book of Geotechnical Engineering, 3rd Ed., New Age International Publishers, 2006
3. B.C.Punmia, Soil Mechanics and Foundation Engineering, 16th Ed., Laxmi Publications, 2005
4. S.K.Gulhati&ManojDatta, Geotechnical Engineering, 4th Ed., Tata McGraw Hill Publishing Company, New Delhi, 2005

Reading Material (s)

1. Soil Mechanics Lab Manual-Civil Engineering- GMR Institute of Technology, Rajam

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[1]Students shall opt any one of the Augmented Experiments in addition to the regular experiments

21ESX01 Employability Skills I

1 0 1 2

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs –POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Building Confidence

Fear? Steps to Overcoming the Fear of Public Speaking?

Self Esteem: Definition? Types of Self Esteem, Causes of Low Self Esteem, Merits of Positive Self Esteem and Steps to build a positive Self Esteem.

Group Discussions (Practice): GD? GD Vs Debate, Overview of a GD , Skills assessed in a GD, Dos & Don'ts, & Conducting practice sessions (Simple Topics).

Motivational Talk: Team Work: Team Vs Group? Stages in Team Building, Mistakes to avoid and Lessons to Learn (Through Stories or Can be a Case Specific)

16 Hours

2. Quantitative Aptitude

Percentages, Profit and loss, Mixtures and Allegations, Simple Interest, Compound Interest

16 Hours

Unit II

1. Total Station

a. Area of an irregular boundary
b. Trilateration and Triangulation
c. Longitudinal and cross sectional levelling
d. Block contouring
e. Radial contouring

32Hours

Total: 64 Hours

21HSX11 CC & EC Activities I

0 0 1 1

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs –POs Mapping

COs	PO6	PO7	PO9	PO10
1				3
2	3	2		
3	3			
4			3	
5	3			
6	3			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21CE501 Design and Detailing of RC Structures

3 0 2 4

Course Outcomes

1. Apply the concepts of limit state design philosophy in designing reinforced concrete structural elements
2. Analyze the reinforced concrete rectangular and flanged beam using limit state design for flexure, shear, torsion, and bond
3. Design the reinforced concrete rectangular and flanged beam using limit state design for flexure, shear, torsion, and bond
4. Design the reinforced concrete columns subjected to axial load, uniaxial and biaxial bending
5. Design the reinforced concrete footings subjected to axial load
6. Design the reinforced concrete slabs and check for serviceability.

COs–POs Mapping

COs	PO3	PO10	PO12	PSO2
1	2	2	2	2
2	3	3	1	2
3	3	3	1	2
4	3	3	1	2
5	3	3	1	2
6	3	3	1	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Reinforced Concrete and Design for Flexure

Introduction to Design Philosophies, Limit State Design: Concepts of limit state design; Characteristic loads; Characteristic strength; Partial load and safety factors; representative stress-strain curves for cold worked deformed bars and mild steel bars; assumptions in limit state design; stress; block parameters; limiting moment of Resistance; analysis and design of singly and doubly reinforced beams.

Practical Components

1. Design and detailing of under reinforced concrete beams (Problem 1).
2. Design and detailing of under-reinforced concrete beams (Problem 2).
3. Design and detailing of doubly reinforced concrete beams (Problem 1).
4. Design and detailing of doubly reinforced concrete beams (Problem 2).

12+8 Hours

Unit II

Flanged Beams and Shear, Torsion & Bond

Flanged Beams: Recommendations of IS 456 – 2000 on flanged sections, limit state analysis and design of singly reinforced flanged (T) beam sections; Shear, Torsion and Bond: Limit state analysis and design of section for shear and torsion; concept of bond

Practical Components

1. Design and detailing of flanged section concrete beams (Problem 1).
2. Design and detailing of flanged section concrete beams (Problem 2).
3. Design and detailing of RC beams for torsional resistance (Problem 1).
4. Design and detailing of RC beams for torsional resistance (Problem 2).

12+8 Hours

Unit III

Columns and Footings

Columns: Short and Long columns – under axial loads, uniaxial bending and biaxial bending – IS Code provisions; Footings: Different types of footings; Design of isolated square and rectangular footing for axial loads

Practical Components

1. Design and detailing of concrete columns for uniaxial bending.
2. Design and detailing of column for biaxial bending.
3. Design and detailing of square footing.
4. Design and detailing of rectangle footing.

12+8 Hours

Unit IV

Slabs and Limit State Design for Serviceability

Slabs: Design of one way slabs, two way slab, and continuous slabs - Limit State Design for Serviceability: Deflection.

Practical Components

1. Design and detailing of one-way concrete slab.
2. Design and detailing of two-way concrete slab.
3. Design and detailing of two-way concrete slab with corners held down
4. Design and detailing of two-way concrete slab with two adjacent edges discontinuous.

12+8 Hours
Total: 48+32 Hours

NOTE

IS 456-2000, Plain and Reinforced Concrete - Code of Practice and SP 16-1982, Design Aids for Reinforced Concrete to IS 456-1978 are permitted to use in classroom and examinations.

Textbook (s)

1. S. Unnikrishna Pillai & Devdas Menon, Reinforced Concrete Design, 3rd Ed., Tata McGraw Hill Publishers, 2010
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design of Reinforced Concrete, 1st Ed., Laxmi Publications Pvt. Ltd., 2015

Reference (s)

1. N. Subramanian, Design of Reinforced Concrete Structures, 1st Ed., Oxford University Press Publishers, 2014
2. N. Krishna Raju and R.N. Pranesh, Reinforced concrete design, 1st Ed., New age International Publishers, 2018

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	10	10	-
Understand	10	10	-
Apply	80	80	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Assessment will be done based on the performance of drawing exercises

Sample Question (S)

Remember

1. What are the permissible effective span to effective depth ratio values in case of cantilever and simply supported beams according to IS:456-1900
2. Define effective length and slenderness ratio of a compression member
3. Write the specifications for the minimum spacing of shear reinforcement in beams as per IS:456-2000
4. What are the main requirements of the footing of a structure?
5. What is the magnitude of crack width allowed in concrete structures?

Understand

1. Why it is essential to provide corner reinforcement in two way rectangular slabs?
2. Why it is necessary to provide transverse steel in one way slab?
3. Distinguish between flexural bond and anchorage bond.
4. Differentiate between the terms Factor of safety and partial safety factors for material strength.
5. Explain the difference in the behavior of one way and two way slabs.

Apply

1. A reinforced concrete beam 230 mm wide and 500 mm overall depth is reinforced with 4 bars of 12 mm diameter at an effective cover of 50 mm. Using M19 concrete and Fe415 steel, estimate the moment of resistance of the section using WSD. If the beam is simply- supported over an effective span of 5 m, find the maximum uniformly distributed load the beam can carry, inclusive of its own weight.
2. A reinforced concrete beam of rectangular section having a width of 350mm and overall depth of 700mm is subjected to an ultimate torsional moment of 100kNm together with an ultimate bending moment of

190kNm. Use M19 grade concrete and Fe 415 HYSD bars. Assuming top and bottom cover of 50mm and side cover of 25mm. Design the suitable longitudinal and transverse reinforcements for the section.

3. Design the reinforcements in a column of size 400mm x 600mm subjected to an axial load of 1900kN. The column has an unsupported length of 3m and is braced against side sway in both directions. Adopt M-19 grade concrete and Fe-415 HYSD bars
4. Examine the limiting moment carrying capacity of a doubly reinforced beam if it is reinforced with 3 no.s of 19mm diameter mild steel bars in compression and 4no.s of 25mm diameter mild steel bars in tension. The size of the beam is 300mm x600mm and the effective covers to compression and tension reinforcement are 30mm and 50mm respectively. Use M-19 grade concrete.
5. A simply supported reinforced concrete beam of size 250mmx400mm effective depth is reinforced with 4 no.s of 19 mm diameter bars in tension zone and 2no.s of 16mm diameter bars in compression zone. The span of the beam is 6.5m. Examine the adequacy of the designed section with respect to limit state of deflection if the concrete used is M19 grade.

21CE502 Environmental Engineering

3 0 0 3

Course Outcomes

1. Understand the objective of water supply and the concept of design period in water supply system planning.
2. Classify the various sources and different characteristics of water.
3. Design various primary units of conventional water treatment plant.
4. Explain the construction, operation, and maintenance of various advanced treatment processes wastewater treatment
5. Design various secondary treatment units in sewage treatment plant
6. Comprehend the regulatory standards for effluent disposal and various sludge disposal methods.

COs-POs Mapping

COs	PO3	PO6	PO7	PO12
1	1	2	3	2
2	2	2	3	2
3	3	2	3	2
4	2	2	3	2
5	3	2	3	2
6	2	2	3	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Water Demand and Quality

Water Demand: Public water supply system, Planning, Objectives, Design period, Population forecasting; Water demand.

Water Quality: Development and selection of source, Sources of water, Characteristics of water, Significance, Drinking Water quality standards; intake structures, Functions.

Laying, jointing and testing of pipes; appurtenances

12 Hours

Unit II

Design of Water Treatment Units

Objectives, Unit operations and processes, Principles, functions, design of water treatment plant units; aerators, flash mixers, Coagulation and flocculation, Clariflocculator, Plate and tube settlers; sand filters; Disinfection; Residue Management; Water softening, Construction, Operation and Maintenance aspects.

Desalination Process; Membrane Filtration

12 Hours

Unit III

Sewage Quality and Design of Sewage Treatment Units

Objectives, Unit Operations and Processes, Selection of treatment processes, Onsite sanitation, - Septic tank, - Grey water harvesting,

Primary treatment: Principles, functions and design of sewage treatment units, Screens, Grit Chamber, Primary Sedimentation tanks, Construction, Operation and Maintenance aspects.

Secondary Treatment: Activated Sludge Process and Extended aeration systems, Trickling filters, Sequencing Batch Reactor (SBR), Membrane Bioreactor, UASB, Waste Stabilization Ponds, Other treatment methods, Reclamation and Reuse of sewage, Recent Advances in Sewage Treatment.

Construction, Operation and Maintenance aspects; Sewer Appurtenances

12 Hours

Unit IV

Design of Ponds and Sludge Disposal

Effluent Disposal: Standards for Disposal, Methods, dilution, Self-purification of river, Oxygen sag curve, deoxygenation and reaeration, Streeter–Phelps model, Land disposal of Sewage.

Sludge Disposal: Sludge characterization, Thickening, Sludge digestion, Standard rate and High rate digester design, Biogas recovery, Sludge Conditioning and Dewatering, Sludge drying beds,

Ultimate residue disposal and recent advances; Soil Dispersion System.

12 Hours

Total: 48 Hours

Text Book (s)

1. B.C. Punmia, Ashok Jain &Arun Jain, Water Supply Engineering, Vol. 1, Wastewater Engineering, Vol. II, 2nd Ed., Laxmi Publications Pvt. Ltd, New Delhi, 2016
2. G.S. Birdi, Water supply and Sanitary Engineering, Revised Ed., Dhanpat Rai & Sons Publishers, 2015
3. 3. K.N. Duggal, Elements of Environmental Engineering, 3rd Ed., S. Chand Publishers,2010

Reference Books (s)

1. Manual on Sewerage and Sewage Treatment Systems Part A, B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim "Wastewater Treatment Plants", CRC Press, Washington D.C., 2010
4. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	30	-
Understand	70	70	-
Apply	-	-	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Enumerate the components of a water supply scheme.
2. Define coagulation.
3. Define design period.
4. Define potable water.
5. What are the factors governing the selection of a water source?

Understand

1. Explain the need for supplying protected water supply.
2. Differentiate between slow and rapid sand filter with respect to (a). Rate of filtration. (b). loss of head.
3. Explain in detail about various factors affecting the water demand.
4. Explain in detail about water requirement for domestic and public uses.
5. Explain in detail about characteristics of water.

Apply

1. Describe the step involved in the design of septic tank. And also explain the working of a trickling filter with neat sketch.
2. Determine the size of a high rate trickling filter for the following data
   Sewage flow= 4.5 million liters per day
   Recirculation ratio = 1.5
   BOD for raw sewage = 230 mg/l BOD removal in PST = 30%
   BOD of treated effluent required = 25 mg/l.
3. The population of 5 decades from 2030 to 2070 is given below in the table. Find out the population of 1, 2, 3 decades beyond the last known decade by using arithmetic increase method.

Year	2030	2040	2050	2060	2070
Population	25000	28000	34000	41900	47000

4. If 2% solution of a sewage sample is incubated for 5 days at 20°C and depletion of oxygen was found to be 5 ppm. Determine the B.O.D. of the sewage.
5. 5. Design a waste treatment plant for a colony having a population of 2 Lakhs and assume the per capita demand of 135 lpcd. Provide additional treatment facility of 30 % for future expansion.

21CE503 Foundation Engineering

3 0 0 3

Course Outcomes

1. Demonstrate the process of exploration for different type of geotechnical engineering projects
2. Analyze forces, activities, and various slope failures to estimate and ensure slope stability in diverse conditions
3. Apply earth pressure theories to determine lateral earth pressures and ensure the stability of various types of retaining walls
4. Determine allowable bearing pressures and load carrying capabilities of shallow foundations
5. Determine allowable bearing pressures and load carrying capabilities of pile foundation
6. Outline the laterally loaded piles and under reamed piles

COs – POs Mappings

COs	PO2	PO3	PO8	PO12	PSO2
1	2	1	1	1	1
2	2	2	1	1	1
3	3	2	1	1	2
4	3	3	1	1	3
5	3	2	2	1	3
6	3	2	2	1	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Soil Exploration

Methods of soil exploration – Boring and Sampling methods – Field tests – Non – invasive tests-planning of Programme - preparation of soil investigation report.

Slope stability: Infinite and finite earth slopes – types of failures – factor of safety of infinite slopes: stability analysis- Swedish Arc Method – Taylor's Stability Number- Stability of slopes of earth dams under different conditions

Geophysical methods, Stability Analysis by Swedish Arc Method

12 Hours

Unit II

Earth Pressure Theories and Retaining Walls

Earth pressure theories: Rankine's theory of earth pressure – earth pressures in layered soils – Coulomb's earth pressure theory – Culmann's graphical method. Retaining walls: Types of retaining walls – stability of retaining walls

Earth Pressure on inclined back of wall, Modes of Failures of Retaining Walls

12 Hours

Unit III

Shallow Foundations and Settlement Analysis

Shallow foundations: Types - choice of foundation – Location of depth – Safe Bearing Capacity –Terzaghi bearing capacity- IS Methods. Safe bearing pressure based on N- value

Settlement analysis: Allowable bearing pressure; safe bearing capacity and settlement from plate load test – allowable settlements of structures

SBC- Meyerhoff and Skempton Methods

12 Hours

Unit IV

Pile Foundation

Pile foundation: Types of piles – Load carrying capacity of piles based on static pile formulae –Pile load tests. Load carrying capacity of pile groups- settlement of pile groups- Laterally loaded piles- Under reamed piles.

Dynamic pile formulae – Engineering News record formula and Danish Formula

12 Hours

Total: 48 Hours

Textbook (s)

1. Gopal Ranjan & ASR Rao, Basic and Applied Soil Mechanics, 3rd Ed., New Age International Pvt. Ltd, 2016

2. K.R.Arora, Soil Mechanics and Foundation Engineering, 7th Ed., Standard Publishers Distributors, Delhi, 2019

Reference (s)

1. Das, B.M., Principles of Foundation Engineering, 9th Ed., Cengege Learning India Pvt. Ltd., 2018
2. Bowles, J.E., Foundation Analysis and Design, 5th Ed., McGraw-Hill Publishing Company, Newyork, 2017
3. S. K.Gulhati & Manoj Datta, Geotechnical Engineering, 16th Ed., Tata Mc.Graw Hill Publishing Company, New Delhi. 2013
4. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Soil Mechanics and Foundations, 17th Ed., Laxmi Publications Pvt. Ltd., New Delhi, 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam (%)
Remember	10	25	-
Understand	40	35	-
Apply	20	10	60
Analyze	30	30	40
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Differentiate Disturbed and Undisturbed soil samples in detail. Explain different procedures for collection of UDS
2. Write a detailed note on “Geophysical Methods” used as part of Geotechnical investigations
3. State and explain the assumptions in Terazaghi’s Bearing Capacity Theory
4. Explain step by step procedure for sinking of a well foundation with a neat sketch
5. What are the functions of well foundations and explain in detail?

Understand

1. Explain how stability of an earthen dam is affected under different seepage conditions, with the help of neatly drawn sketches
2. For adsorption in dilute liquid solutions in stage wise counter current operation, where the Freundlich equation describes the adsorption equilibrium, derive analytical expression in terms of n, m, Y0 and YNp for the minimum adsorbent / solvent ratio when fresh adsorbent is used
3. Differentiate local stability with global stability of the retaining systems
4. What is “Negative skin friction” explain how the same is worked out and taken in to account in the design of piles.
5. Discuss briefly validity of Darcy's law.

Apply

1. Describe how “Culmann’s Graphical method” is used for computation of active earth pressure
2. The following date was obtained from a plate load test carried out on a 60cm square test plate at a depth of 2m below ground surface on a sandy soil which extends up to a large depth. Determine the settlement of a foundation 3.0m X 3.0m carrying a load of 100t and located at a depth of 3.0m below ground surface. Water table is obtained at a large depth from the ground surface.

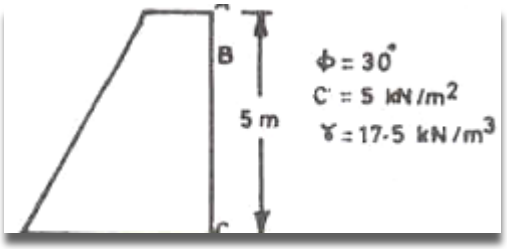
Load intensity, t/m^2	5	10	15	20	25	30	35	40
Settlement, mm	2	4	7.5	11	16.3	23.5	34	45

3. Explain the different types of sampling methods. Mention the types of samples obtained in each and explain the suitability depends on the type of soils.
4. Determine the active pressure by Rankine’s theory per unit run for a retaining wall 4m high, with i=150, Ø1=300 and ɣ=20kN/m3. The back face of wall is smooth and vertical.
5. A 7m high retaining wall is supporting a back fill consisting of two types of soils. The water table is located at a depth of 5m below the top. A capillary raise of 0.90m was found. The properties of soil

from 0 to 3m include c=0 KN/sqm; Φ=18°; γ=16.50KN/cum and those for soil from 3m to 7m include c=0 KN/sqm; Φ=36°; γ=18 KN/cum, γsub=20kN/cum. A surcharge of 200 kPa is applied on the top of backfill. Plot the distribution of active earth pressure and determine the magnitude and point of application of total active earth pressure acting on the retaining wall.

Analyze

1. A gravity retaining wall of height 3m with uniform thickness (ie. rectangular in cross section) of 1.20m is constructed in RRM with a unit weight of 24 KN/cum. The average properties of soil from top to bottom of wall include c=0 KN/sqm; Φ=30°. Subsequently, 1m high fill is placed on top of the existing backfill after constructing a 0.60m thick wall above the existing wall matching with the backfill side face of wall (ie., the offset is provided on the other side of backfill) Analyse the stability of wall against overturning before and after raising the height of backfill.
2. A SPT was conducted at a depth of 3m below the GL. The observations were recorded as 14/18/24. The correction for over burden was read as 1. Apply correction for dilatancy. If a 2m wide square footing is proposed at this level, estimate the allowable bearing pressure for a permissible settlement of 40mm based on the penetration resistance (N" value) as per IS:6403-1981.
3. Propose an inclination for a filling of 12m high is to be constructed with a factor of safety of 1.25. The soil has c = 20kN/m2, ø = 150, Y=17.0kN/m3. The stability number for øm=120 is equal to 0.063 when the slope is 300 and 0.098 when the slope is 45o
4. A 5m height retaining wall shown in figure. Evaluate the Rankine's active earth pressure on wall
    a. Before formation of crack
    b. After formation of crack



5. It is proposed to construct a highway embankment using a c-Φ soil having c=20kPa; Φ=10°, γ=17 KN/cum. Determine the critical height up to which the embankment can be built with an inclination of 29° with a factor of safety of 1.50.

21CE504 Hydrology

3 0 2 4

Course Outcomes

1. Understand the interplay between precipitation, abstractions, and runoff processes, equipping them to analyze and manage water resources effectively.
2. Understand the principles of Unit Hydrograph, including its derivation, limitations, and applications of superposition and S-hydrograph techniques and utilize Unit Hydrograph methods for different durations.
3. Demonstrate proficiency in computing runoff using rational and SCS methods, conducting flood analyses, and employing statistical techniques for flood prediction.
4. Apply flood control measures, conduct flood routing using the Muskingum Method, and perform statistical analyses for accurate flood predictions, contributing to effective water resource management.
5. Understand reservoir management skills, including understanding types, site selection, capacity determination, and applying Mass Curve and Demand Curve concepts for yield analysis.
6. Understand aquifer types, parameters, and flow dynamics, apply steady and unsteady flow concepts, and conduct recuperation tests for sustainable groundwater management.

COs-POs Mappings

COs	PO2	PO3	PO12
1	2	2	3
2	3	3	3
3	2	2	3
4	3	2	3
5	3	3	3
6	3	2	3

3-Strong linked| 2-Moderately linked| 1-Weakly linked

Unit I

Precipitation and Abstractions

Engineering hydrology and its applications, Hydrologic cycle, Types and forms of precipitation, rainfall measurement, types of rain gauges, rain gauge network, average rainfall over a basin, consistency of rainfall data, frequency of rainfall, intensity duration-frequency curves, probable maximum precipitation, evaporation, evapotranspiration, infiltration, infiltration indices.

Practical components

1. Estimation of number rain gauge in a given catchment area.
2. Double Ring Infiltrometer test.
3. Evaporation test using ISI Pan.
4. Lake evaporation using Meyers formula

12+8 Hours

Unit II

Runoff and Hydrograph

Factors affecting runoff, components of runoff, computation of runoff-rational and SCS Methods, separation of base flow, definition of Unit Hydrograph, assumptions, derivation of Unit Hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of UH, Synthetic Unit Hydrograph.

Practical components

1. Design of Unit hydrograph by using Principle of super position
2. Design of Unit hydrograph by using S-hydrograph method
3. Base flow separation.
4. Synthetic unit hydrograph using Snyder's empirical equations

12+ 8 Hours

Unit III

Floods and Reservoir Routing

Flood Control, Flood flows, Statistical analysis for flood prediction, Flood routing, Channel Routing by Muskingum Method, Reservoir planning ,Types of Reservoir, Selection of Site for a Reservoir, Zones of Storage in a Reservoir, Reservoir Regulation, Reservoir Yield, Mass Curve and Demand Curve, Determination of Reservoir Capacity, Yield From a Reservoir of given Capacity.

Practical components

1. Estimation of frequency of flood.
2. Estimation of Reservoir capacity.
3. Seepage from a reservoir using water budget method
4. Flood risk assessment using RS & GIS

12 + 8 Hours

Unit IV

Groundwater Hydrology

Groundwater Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, Permeability, transmissivity and storage coefficients, groundwater Flow lines. Steady flow to a well, steady radial flow to a well in confined aquifer and unconfined aquifer, Unsteady radial flow into a confined aquifer, Non equilibrium Theis equation, Theis method of solution, multiple well system. yield of an open well-recuperation test.

Practical components

1. Estimation of Ground water depth
2. Design of well
3. Ground water potential zones identification using RS & GIS
4. Reservoir site selection using RS & GIS

12 +8 Hours

Total: 48+32 Hours

Textbook (s)

1. K. Subramanya, Engineering Hydrology, 4th Ed., Tata McGraw-Hill Education Private Limited, 2017
2. P.N.Modi, Irrigation Water Resources & Water Power,11th Ed., Standard Book House, 2019.
3. K.R.Arora, Irrigation, Water Power and Water Resources Engineering, 5th Revised Ed., Standard Publishers, New Delhi, 2018

Reference (s)

1. VenTe Chow, Hand Book of Applied Hydrology,4th Ed., Tata-McGraw Hill, 2010 (second reprint)
2. P. Jayarami Reddy, A Text Book of Hydrology, 3rd Ed., Laxmi publications Pvt. Ltd., New Delhi,2016
3. H.M Raghunath, Hydrology: Principles, Analysis & Design,3rd Ed., New Age International Publishers, 2015.
4. David K Todd, Text book on Groundwater hydrology, 3rd edition John Wiley & Sons, Inc.
5. S.K Garg, Irrigation and Hydraulic structures, 36th Ed., Khanna Publishers, 2018
6. B.C. Punmia & Lal, Irrigation and Water Power engineering, Revised 17th Ed., Laxmi publications Pvt. Ltd., New Delhi, 2021.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments (%)
Remember	15	15	-
Understand	25	25	-
Apply	60	60	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define unit hydrograph.
2. What are the different Types and forms of precipitation?
3. Write importance of the synthetic unit hydrograph
4. Define confined and unconfined aquifers.
5. Define evaporation and evapotranspiration.

Understand

1. Briefly explain the significant features of global water balance studies, also discuss the hydrologic cycle with neat sketch.
2. Explain the rational method for determination of peak of a catchment. Write its advantages and disadvantages. Enumerate its limitations.

3. Differentiate between the Unit hydrograph and Synthetic Unit Hydrograph. Give its limitations and applications.
4. Derive the equation for steady state flow of water in a homogeneous and isotropic condition.

Apply

1. A catchment has five rain-gauge stations and the annual precipitations are 900, 1100, 1750, 950, and 1250 mm respectively. Calculate the extra number required or not if error in estimation is limited to 10 percent.
2. The shape of a catchment is in the form of a pentagon ABCDE. There are 4 rain gauge stations P, Q, R & S inside the catchment. The position coordinates in km are (0,0), B(50,75), C(100,70), D(150,0), E(75,-50), P(50,25), Q(100,25), R(100,-25) & S(50,-25). If the rainfalls recorded at P, Q, R & S are 88, 102, 112, 116mm respectively, determine the average depth of rainfall over the catchment using Thiessen polygon method.
3. In a watershed, the expected one-hour rainfall intensity is 6.25 cm, the watershed area is 50 ha, of which 30 ha is pasture on 7% slope and 20 ha is cultivated on 3% slope, and the length of run is 720 m on a 4% slope. Determine the peak runoff rate for a 10-year recurrence interval, when the type of soil for cultivated crops is silt clay and for pasture it is clay and silt loam. Assuming the value of C for respective soils for cultivated crops on 3% slope is 0.5 and for pasture land on 77% slope is 0.36
4. Given below are the observed flows a storm of 6-hour duration on a stream with a catchment of 600 km2. Derive the ordinates of a 6-hour unit hydrograph. Assume the base flow as zero.

Time (min)	0	6	12	18	24	30	36	42	48	54	60
Discharge (m^3/s)	0	100	190	150	90	60	30	15	10	5	0

5. The elevation of water table in an unconfined aquifer at two locations separated by a distance of 100 m is 1026.2 m and 1025.0 m respectively. If the permeability of the aquifer is 12 m/day and porosity is 15 percent, what is the actual velocity in the aquifer

21CE505 Environmental Engineering Laboratory

0 0 3 1.5

Course Outcomes

1. Demonstrate how to perform relevant tests in the laboratory to determine the major characteristics of water and wastewater
2. Understand the importance of determining the concentration of various parameters in waste water.
3. Make use of various equipment/methods available for examining water and wastewater
4. Apply titration methods to accurately determine the concentrations of various parameters.
5. Identify the practical significance of the characteristics, the relevant codes of practice for examination and permissible limits for the characteristics of water and wastewater
6. Assess the appropriate methods for determining the various parameters in water samples.

COs-POs Mappings

COs	PO3	PO6	PO7	PO12
1	3	3	2	3
2	3	3	2	3
3	3	3	2	3
4	3	3	2	3
5	3	3	2	3
6	3	3	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

List of Experiments

1. Determination of pH and Electrical Conductivity
2. Determination and estimation of total Hardness
3. Determination of Calcium and Magnesium hardness
4. Determination of Alkalinity
5. Determination of Acidity
6. Determination of chlorides in water.
7. Determination and estimation of total solids, dissolved solids
8. Determination of Iron
9. Determination of Optimum Coagulant dosage
10. Determination of dissolved oxygen with D.O Meter & Winkler ‘s Method
11. Determination of B.O.D
12. Determination of COD
13. Determination of chlorine demand
14. Determination of Flourides
15. Determination of Sulphate
16. Determination of Phospate

List of Augmented Experiments

1. pH and Electrical Conductivity value of different samples
2. Estimation of total Hardness of bore water
3. Determination of Calcium and Magnesium hardness of bore water
4. Determination of Alkalinity and Acidity of different samples
5. Determination of chlorides in water.
6. Estimation of total solids, dissolved solids in Surface water and sub-surface water sample
7. Determination of dissolved oxygen of pond water with D.O Meter & Winkler ‘s Method
8. Physical parameters-Temperature, Turbidity
9. B.O.D/COD of different samples
10. Determination of chlorine demand for municipal water
11. Determine the Sulphate and Phosphate nature of the water and wastewater samples

Total: 48 Hours

Reading Materials (s)

1. Environmental Engineering Lab Manual-Civil Engineering, GMRIT, Rajam
2. Standard Methods for Examination of Water and Waste Water, 23rd Edition, APHA.
3. KVSG Murali Krishna, Chemical Analyses of Water and Soil,3rd Ed., Reem Publications, New Delhi. 2013

21TPX01 Term Paper

0 0 3 1.5

Course Outcomes

1. Interpret the literature to link the earlier research with the contemporary technologies
2. Communicate effectively as an individual to present ideas clearly and coherently
3. Review the research findings and its correlation to the latest applications
4. Prepare documents and present the concepts clearly and coherently
5. Inculcate the spirit of enquiry for self-learning
6. Identify interdisciplinary oriented topics

COs – POs Mapping

COs	PO1	PO4	PO10	PO12
1	-	2	-	-
2	-	-	3	3
3	3	-	-	-
4	-	-	3	-
5	-	-	-	3
6	1	-	-	-

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21ESX02 Employability Skills II

1 0 1 0

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing

COs – POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

Introduction to Campus Placements: Stages of Campus Placement, Skills assessed in Campus Placements & How to get ready?

Motivational Talk on Positive Thinking: Beliefs, Thoughts, Actions, Habits & Results (Success)

Resume Preparation: Resume? Templates? Mistakes to be avoided in a Resume, Steps to be followed in preparing it.(with examples)

Group Discussions (Recap): GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD? (through Practice Sessions)

Psychometric Tests: Definition, Types of Psychometric Tests: Numerical Computation, Data Interpretation, Verbal Comprehension, Verbal Critical Reasoning and Personality Questionnaires

Exercises related to Communication: Story Writing, TAT etc .

16 Hours

2. Quantitative Aptitude

Square &Cube roots, Partnership, Logarithms, Progressions, Mensuration, Data Sufficiency

16 Hours

Unit II

3. Transport Engineering

Airport Engineering: Airport components, classification, site selection, Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Railway Engineering: Rail components and their Functions - Types of Rails, Joints, Rail Fastenings, Gauges, Coning of Wheels, Creep theory- Sleepers functions, requirements, types – Ballast, depth of ballast, Geometric design of railway Track – Speed and Cant.

Dock and Harbour Engineering: Inland water transportation, Ports and harbour: requirements, classification – Harbour components - breakwaters, jetties, fenders, piers, wharves, dolphins- Navigational aids, types, requirements-Docks– dry docks, wet docks, slipways, lock gates, Dredging – classification, dredgers- Port facilities – general layout, development, planning, facilities, terminals.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes.

32 Hours
Total 64 Hours

Reference (s)

1. Kadiyali, L. R., Traffic Engineering and Transportation Planning, Khanna Publishers, New Delhi, 2016
2. Simon P. Washington, Matthew G. Karlaftis, Fred L. Mannering, Statistical and Econometric Methods for Transportation Data Analysis, CRC Press, Second Edition, 2010
3. Fundamentals of Mathematical Statistics – Gupta, S.C and Kapoor, K. V. Sultanchand.
4. Multivariate Data Analysis –Cootey W.W & Cohens P. R; John Wiley &Sons.
5. Probability Concepts in Engineering, Planning and Design, Vol. I & II by Alfredo H.S. Wilson H. Tang, Wiley International.

21HSX12 CC & EC Activities II

0 0 1 0

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs – POs Mapping

COs	PO6	PO7	PO9	PO10
1	-	-	-	3
2	3	2	-	-
3	3	-	-	-
4	-	-	3	-
5	3	-	-	-
6	3		-	-

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

21SIX01 Summer Internship I

0 0 0 1

Course Outcomes

1. Demonstrate the communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs-POs Mapping

COs	PO1	PO2	PO8	PO10	PO12
1	3				
2	3				
3					3
4				3	
5		2			
6			3		

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CEC11 Principles of Building Architecture

3 0 0 3

Course Outcomes

1. Understand the architectural design, layout regulations and site analysis concepts to apply in the real time projects.
2. Classify the different types of buildings and apply the principles of anthropometry and space standards while designing a building.
3. Integrate building services components, interior design concepts and fire safety standards to create efficient and functional spaces in a building.
4. Apply climate and environmental responsive design strategies to create sustainable buildings that take advantage of natural elements while minimizing negative environmental impacts.
5. Apply the concepts of various passive and active energy control systems for the heating and cooling of buildings, along with green building concepts.
6. Utilize knowledge of energy resources for buildings and energy rating systems to design and develop the energy efficient buildings.

COs–POs Mappings

COs	PO1	PO3	PSO1	PSO2
1	3	1	2	1
2	3	1	2	1
3	3	1	2	1
4	3	1	2	1
5	3	1	2	1
6	3	1	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Architectural Design and Site planning

Architectural Design - Key aspects and concepts – integration of function and aesthetics – Introduction to basic elements and principles of design. Surveys – Site analysis – Development Control – Layout regulations- Layout design concepts.

Evolution of architectural form and space, Gestalt ideas of visual perception.

12 Hours

Unit II

Building Types

Residential, institutional, commercial and Industrial – Application of anthropometry and space standards- Inter relationships of functions – Safety standards – Building rules and regulations – Integration of building services – Interior design

Configuration of architectural spaces, Built form and open space relationships

12 Hours

Unit III

Climate and Environmental Responsive Design

Man and environment interaction- Factors that determine climate – Characteristics of climate types – Design for various climate types – Passive and active energy controls – Green building concept.

Thermal behavior of the building, global climate and greenhouse effect

12 Hours

Unit IV

Energy resources of the buildings

Energy-Forms of energy, sources, Energy Conservation-Renewable energy-Solar, wind, hydrothermal-Energy use in building-Energy rating of the building-Sustainability issues for the buildings.

Non renewable energy sources, embodied energy

12 Hours

Total: 48 Hours

Textbook (s):

1. Muthu Shoba Mohan.G.," Principles of Architecture"., Oxford University Press., New Delhi, 2006
2. Szokolay, Steven V" Introduction to architectural design",Routledge,Taylor and Francis,2014
3. Arvind Krishnan, Nick Baker, Simos Yannas, Szokolay.S.V., "Climate Responsive Architecture"., A

Design Hand Book for Energy Efficient Building, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
4. Pramar. V.S. "Design fundamental in Architecture", Somaiya Publications Pvt. Ltd., New Delhi, 1997.

Reference (s):

1. Rangwala. S.C. "Town Planning" Charotar Publishing House., Anand, 2005.
2. De Chiara.J., Michael. J. Crosbie.,"Time Saver Standards for Building Types", McGraw Hill Publishing Company, New York, 2001.
3. National Building Code of India., SP7 (Group 1) Bureau of Indian Standards, New Delhi, 2015

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam (%)
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define Architecture.
2. Define space.
3. List the various landscape design elements.
4. Define Anthropometrics.
5. Define green building concepts.

Understand

1. Explain in detail how the aesthetics qualities of scale, balance, symmetry, and rhythm influence a building design.
2. Explain the integration of aesthetics and function in architectural design.
3. Explain with suitable drawing how symmetry and rhythm play a role in Hindu and Islamic religious buildings.
4. Explain the basic principles elements of landscape design with neat sketches.
5. How does scale affect the design of buildings? Establish the importance of scale in designing elevations of building facades.

21CEC21 Geometric Design and Highway Materials

3 0 0 3

Course outcomes

1. Summarize various considerations for rural and urban arterials
2. Explain the characteristics and considerations for rotary intersections
3. Describe the optimal characteristics of subgrade soil materials
4. Evaluate the characteristics of bitumen and bituminous mixes
5. Explain durability and quality of flexible pavements
6. Explain the components and the construction of cement concrete pavements

COs – POs Mappings

COs	PO1	PO3	PSO2
1	1	3	1
2	1	3	2
3	1	3	1
4	1	3	1
5	2	3	3
6	1	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Geometric Design Considerations

Geometric design considerations for urban highways, design speeds, volumes, levels of service and other design considerations.

Design of Intersections: Characteristics and design considerations of at-grade intersections; Design of rotary intersection; Interchanges - different types.

Ribbon development, Ramps

12 Hours

Unit II

Properties of Subgrade Soil and Aggregates

Subgrade soil –Soil classification for engineering purposes, Soil stabilization - Classification, requirements, properties, tests, alternative materials for soil stabilization.

Aggregates: blending and gradation, characteristics, properties and alternatives.

Effective CBR, Light weight deflectometer

12 Hours

Unit III

Characteristic of Bitumen and Bituminous Mixes

Origin, preparation, properties and tests, constituents of bituminous road binders, requirements – Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests. Bituminous Mixes: Mechanical properties – Resilient modulus, dynamic modulus, rutting and fatigue characteristics of bituminous mixes.

Tar, Flow number

12 Hours

Unit IV

Design of bituminous and cement concrete mixes

Weathering and Durability of Bituminous Mixes – Performance based Bitumen mix specifications – Marshall and Super pave mix design method. Cement Concrete for Pavement Construction: Requirements, design of mix for CC pavement, joint filler and sealer materials.

Stresses in CC pavement, Bailey gradation

12 Hours
Total: 48 Hours

Textbook (s)

1. Partha Chakraborty and Animesh Das, Principle of Transportation Engineering, PHI Learning Private Limited, New Delhi, 2012.
2. S K Khanna and C E G Justo. Highway Engineering. Nemchand Bros.,, Roorkee, 2017.

Reference (s)

1. Kadiyali, L.R., Principles and practices of Highway Engineering , Khanna Publishers, New Delhi, 2019
2. Alkins and Harold, "Highway Materials Soils and Concretes", Prentice Hall, Pearson, 4th Edition, 2003.
3. Kerbs and Walkes, "Highway Materials", McGraw Hill Book Co. 2007
4. IRC:37-2018 Guidelines for the design of flexible pavements (fourth revision) Indian Roads Congress.
5. IRC:86-2018 Geometric design standards for urban roads and streets, Indian Roads Congress.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	-
Understand	30	30	30
Apply	30	30	40
Analyze	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember
1. Differentiate between horizontal and vertical alignment.
2. What is soil stabilization and its classification?
3. What is mean by Super pave mix design method?

Understand
1. What are the alternative materials available for soil stabilization?
2. What do you understand by level of service?
3. Describe how the type of pavement is selected for heavy rainfall areas.

Apply
1. Discuss the relation between resilient and dynamic modulus.
2. The results of Marshall test for five specimens are given below. Find the optimum bitumen content of the mix.

Bitumen Content %	Stability (kg)	Flow	V_v	VFB %	G_m
3	500	9	12.5	34	2.17
4	717	9.6	7.2	65	2.21
5	912	12	3.9	84	2.26
6	767	14.8	2.4	91	2.23
7	662	19.5	1.9	93	2.18

Analyze
1. Compare and contrast the key elements of Superpave mix design and Marshall method to know the stability of asphalt mixtures.

21CEC31 Prefabricated Structures

3 0 0 3

Course Outcomes

1. Understand the principles, types, materials, and the concept of modular coordination in prefabricated structures.
2. Describe the concept of standardization along with techniques involved in the production, transportation, and erection of prefabricated structures.
3. Choose the appropriate prefabricated components suitable for various building demands.
4. Discuss the different manufacturing methods of precast elements, including their dimensional tolerances and accelerated concrete hardening techniques.
5. Apply techniques for the safe and efficient erection of various precast members, such as beams, columns, slabs, and wall panels
6. Design and implement various types of prefabricated joints for different prefabricated components.

COs–POs Mappings

COs	PO3	PSO2
1	3	2
2	3	2
3	3	2
4	3	2
5	3	2
6	3	2

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction

Need for prefabrication – Principles –Types of prefabrication- site and plant prefabrication - Materials – Economy of prefabrication– Modular coordination – Standardization – Systems – Production – Transportation – Erection.

Light weight prefabricated components, Scope for prefabrication construction

12 Hours

Unit II

Prefabricated Components

Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Prefabricated chaija, Prefabricated beams

12 Hours

Unit III

Production and Hoisting Technology

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening. hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns

Vacuum lifting pads, Errors in construction

12 Hours

Unit IV

Structural Joints and Design Principles

Joints for different structural connections – Dimensions and detailing – Design of expansion joints. Disuniting of structures- Design of cross section based on efficiency of material used – Design Principles - Allowance for joint deformation.

Design of abnormal loads, Equivalent load design

12 Hours

Total: 48 Hours

Textbook (s)

1. Pradeep kumar.M" Prefabricated structures" Shanlax Publications,2016
2. CBRI, Building materials and components, India, 1990
3. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994

Reference (s)

1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam (%)
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List out the limitations of prefabrications.
2. List the advantages and disadvantages of prefabrication system.
3. What is Shear wall?
4. What is the classification of precast concrete walls?
5. List out the different types of construction joints.

Understand

1. Explain the classifications of prefabricated systems?
2. What are the principles of prefabrication techniques and explain in detail and also mention its advantages and disadvantages.
3. Elaborate the process of disunity of prefabricated structures for an earthquake resistant building with their merits and demerits**.**

21CEC41 Data Analysis and Visualization Using Python

3 0 0 3

Course Outcomes

1. Develop a comprehensive understanding of the foundational principles of data science and the role of AI/ML, equipping students to address real-world challenges.
2. Gain proficiency in fundamental statistics, enhancing the ability to analyze data and make predictions within the context of Data Science.
3. Acquire a deep understanding of probability concepts, applying them to hypothesis testing for more informed inferential statistical decisions.
4. Master the fundamentals of Python, enabling the construction and manipulation of Data Frames for various data analysis tasks.
5. Utilize diverse charting methods to visualize data effectively, enhancing comprehension in real-time scenarios.
6. Conduct thorough exploratory data analysis (EDA) to generate high-accuracy, reliable data for both Machine Learning models and real-world applications.

COs-POs Mapping

COs	PO1	PO2	PO5	PO12
1	2	3	2	2
2	2	3	2	2
3	2	3	2	2
4	2	3	2	2
5	2	3	2	2
6	2	3	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Data Science

Data: Types and Categories - Structured and Un-Structured Data – Data Table **-** Data Science**:** Need for Data Science - Advantages and Disadvantages– Components

Data Analysis: Types –Process – Data cleaning, Mining and Wrangling – Tools for Data Analysis - Machine Learning and Artificial Intelligence – ML for Data Science

Categorical data, Ordinal Data

12 Hours

Unit II

Introduction to Statistics

Basis Statistics: Data Objects, Attributes and Attribute types – Histogram – Descriptive Statistics: Central Tendency and 3 Ms - Measures of Dispersion, Range and IQR - Standard Deviation - Coefficient of Variation - Boxplot and Five Number Summary - Correlation Analysis

Probability: Meaning and concepts - Rules for Computing Probability - Marginal Probability – Bayes Theorem. Introduction to Inferential Statistics.

Empirical Rule, Chebyshev Rule

12 Hours

Unit III

Python for Data Science

Python Basics: Variables and its types – Looping and Conditional Statements – Functions

Introduction NUMPYs: List, Tuples and Dictionary's – Arrays and Matrices – Arithmetic Operation in Arrays and Matrices – Accessing and Modifying Arrays, Matrices, List and Dictionary's **Introduction to Pandas:** Series and DataFrames – Accessing – loc and iloc method – Modifying DataFrame – Pandas Functions – Date-Time Module

Info(),Groupby

12 Hours

Unit IV

Data Visualization and Exploratory Data Analysis (EDA)

Data Visualization : Introduction Visualization Libraries - Histogram – Skew – Boxplot – Bar Chart – Line, Scatter Plot and LM plot – Joint and Violin plot – Strip and Swam plot – Cat plot – Heat Map – Pair plot – Plotly – Pie chart - Timeline Charts - Concepts of sub plots

EDA: Sanity Check – Univariate Bivariate and Multivariate analysis – Missing Value Treatment – Outliers detection and Treatment.
Count plot , fillna

12 Hours
Total: 48 Hours

Textbook (s)

1. Daniel J. Denis: Univariate, Bivariate, and Multivariate Statistics Using R: Quantitative Tools for Data Analysis and Data Science, Wiley,2020
2. Mukhiya Suresh Kumar Mukhiya, Ahmed Usman Ahmed: Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data, Packt, 2020
3. Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", 1st edition, O'Reilly Media Inc, 2019.
4. Downey, Allen. Think stats: exploratory data analysis. " O'Reilly Media, Inc.", 2014.
5. Neil H. Spencer: Essentials of Multivariate Data Analysis, CRC Press,2014

Reference (s)

1. Wes McKinney : Python for Data Analysis 2nd Edition,Wiley,2013
2. Glenn J. Myatt, Wayne P. Johnson: Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition,Wiley,2014
3. 1 Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O'Reilly ,2016 2 OssamaEmbarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems,Apress, 2018
4. Wendy L. MartinezAngel R. MartinezJeffrey L. Solka: Exploratory Data Analysis with MATLAB, 2nd Edition,CRC Press,2011
5. Radhika Datar, Harish Garg : Hands-On Exploratory Data Analysis with R , Packt,20206.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Describe the difference between supervised and unsupervised learning in machine learning
2. What are the primary steps involved in the data science workflow?
3. Define probability and provide an example of how it is used to solve a real-world problem.
4. Define "data" in the context of data science and explain its significance.

Understand

1. How can data visualization aid in understanding complex datasets and making data-driven decisions?
2. What is the purpose of statistics, and how does it differ from data science?
3. Describe the concept of sampling and its importance in statistical analysis
4. Explain the difference between descriptive statistics and inferential statistics, providing examples of each.

Apply

1. Using the Plotly library, build an interactive scatter plot to display the relationship between the age and income of customers in a sales dataset, and enable hovering over data points to reveal additional information.
2. Combine Python libraries such as Pandas, Matplotlib, and Seaborn to explore and visualize a dataset containing information about student grades. Create a bar chart to show the average grade per subject and a box plot to compare the distribution of grades across different schools.

21CE004 Construction Techniques

3 0 0 3

Course Outcomes

1. Outline the knowledge of construction of substructures and superstructures
2. Analyze the techniques of Erection of Construction units
3. Demonstrate basic knowledge about Construction equipment and machinery
4. Discuss about hauling and conveying equipment
5. Demonstrate the ability to identify and manage with respect to time and their motion with respect to their movements
6. Understand the importance of mechanization of construction

COs–POs Mapping

COs	PO4	PO5	PO11	PSO2
1	2	1	2	3
2	3	2	2	3
3	2	3	2	3
4	3	2	2	3
5	1	3	2	3
6	3	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Substructure and Superstructure

Digging and excavation of trenches– Grading– Special earth work excavation– Drilling and blasting techniques. Pile driving techniques– sinking wells.

Concrete and reinforced concrete works– form work– reinforcement– concreting– mechanized methods of erection of Buildings and installations. Cast-in-situ and pre-cast concrete, Concreting below G.L. – wall in situ method for cast in situ and precast concrete.

Well Caissons- Pre-Engineered Buildings

12 Hours

Unit II

Erection of Construction Units, Construction Equipment and Machinery

Different types– scaffolding, Erection of steel structures– Tunneling techniques. Precast and prefabricated construction – need and advantages

Earthmoving Equipment Power shovels, Back hoe, Dragline, Clam shell; Tunneling machine – types, hoisting equipment – such as hoist winch, hoisting chains, and hooks and slings, various types of cranes – tower crane, mobile crane and derrick crane. Their characteristics, performance and safety in operation.

Form work- Hauling Equipment

12 Hours

Unit III

Concrete Mixers

Concrete mixers, truck mixers, pneumatic concrete placer, concrete vibrators. Pile Driving Equipment - Tunneling and rock drilling equipment – Pumps and dewatering equipment.

Ready Mix Concrete- Rock Bolting

12 Hours

Unit IV

Time and Motion Studies, Management of Construction Equipment

Process charts – application of queuing or wait line models management of construction equipment

Need for mechanization of construction – planning and financing construction plant and equipment – Owning and operating equipment versus hiring – planning for infrastructure mechanization equipment management – equipment maintenance and repair.

Layouts- Optimization of Machinery Utilization

12 Hours

Total: 48 Hours

Textbook (s)

1. Robert L.P and J.S.Clifford, Construction Planning Equipment Methods. 2nd Ed., Tata Mc Graw Hill, 2003.
2. S.Seetharaman, Construction Engineering and Management, 4th Ed., Umesh publications, New Delhi, 1999.
3. Mahesh varma, Construction Equipment and its Palnning and Applications, 5th Ed., Metroplolitan Book Co. Publishers, 2005.

Reference (s)

1. Sengupta and Guha, Construction Management and Planning, 2nd Ed., Tata Mc Graw Hill, 2002.
2. Rangwala, S.C., Construction of Structures and Management of Works, 5th Ed., (Charotar publishers), 2005.
3. Srivatsava, U.K., Construction Planning and Management, 1st Ed., Galgotia PublicationsPvt. Ltd., 1999.
4. Peurifoy, R.L., Construction Planning, Equipment and Methods, 2nd Ed., Tata McGraw-Hill Education, 1996.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	30	10	-
Understand	50	40	40
Apply	20	50	60
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember
1. What do you mean by grading?
2. What do you mean by design mix?

Understand
1. Explain the pile driving technique.
2. Distinguish between precast and cast in-situ construction

Apply
1. Application of queuing or wait line models.
2. Applications of Time and Motion Study
3. Examine the procedure for concrete mix design.
4. Analyze the time period of dump trucks for soil excavation.

21CE005 Airport, Railways and Harbour Engineering

3 0 0 3

Course Outcomes

1. Proficiency in airport planning and design
2. Discuss the components of permanent way and their functions
3. Understand the principles of geometric design of railway track
4. Develop layout plan of harbor, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same
5. Understand the components and construction materials of shore structures
6. Understand the various features in Harbours and Ports, their construction, coastal protection works, maintenance and coastal regulations to be adopted

COs–POs Mappings

COs	PO1	PO3	PO12
1	2	3	2
2	2	2	3
3	2	3	3
4	3	3	3
5	3	3	2
6	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Airport Planning and Design: Airport site selection, Airport classification-Runway orientation–Wind rose diagram–Runway length – Taxiway design–Terminal area and Airport layout -Visual aids and Air traffic control.

Hanger, Runway marking

12 Hours

Unit II

Introduction to Railway Engineering: Permanent way components -Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast -Rail Fastenings -Creep of Rails- Adzing of Sleepers- Sleeper density.

Geometric Design of Railway Track: Gradients- Grade Compensation- Cant and Cant Deficiency -Degree of Curve - Crossings and Turn outs.

Negative Super elevation, Alternative ballast materials

12 Hours

Unit III

Planning of Shore Structures: Definition of Terms - Harbors, Ports, Docks, Tides and Waves, Littoral Drift, Sounding, Locks and lock gates, Site Selection & Considerations- Proximity to Towns/Cities, Utilities, Construction Materials, Coast Lines, Ports-Requirements and Classification of Harbors.

Light house, Dredging

12 Hours

Unit IV

Construction and Maintenance of Docks & Harbours: Coastal Structures- Piers, Breakwaters, Wharves, Quays, Fenders, Inland Water Transport and Container Transportation. Pipe Ways, Rope Ways, Maintenance of Ports and Harbors – Navigational aids.

Jetties, Dolphins

12 Hours
Total: 48 Hours

Textbook (s)

1. Airport Engineering- Khanna & Arora- Nemchand Bros, New Delhi, 1999
2. Airport engineering Virendra kumar , Dhanpathi Rai Publishers, New Delhi, 1999
3. Docks and Harbour Engineering, Bindra S.P- Dhanpathi Rai & Sons, New Delhi, 2012

Reference (s)

1. Ashford, N. J., Mumayiz, S. A., and Wright, P. H. Airport Engineering: Planning, Design and Development of 21st Century Airports, Fourth Edition, John Wiley & Sons, New Jersey, USA, 2011.

2. Kumar, V., and Chandra, S. Air Transportation Planning and Design, Galgotia Publications Pvt. Ltd., New Delhi, India, 1999.
3. Seetharaman, S. Dock and Harbour Engineering, Umesh Publications, New Delhi, India, 1999.
4. Srinivasan, R., Harbour, Dock and Tunnel Engineering, Charotar Publishing House, Anand, India, 1209.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	-
Understand	50	50	19
Apply	30	30	50
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember
1. Differentiate between basic and design runway length.
2. What are the design factors to be considered for determining the thickness of airport pavements?
3. What is mean by permanent way?

Understand
1. What are the functions of taxiway and hanger in airport layout?
2. What do you understand by littoral drift?
3. Describe how the optimum runway orientation is determined.

Apply
1. On a broad gauge route involving high speed, a 100 m transition curve has been provided and a super elevation of 80mm has been managed. The degree of curve is 10 and the maximum sanctioned speed for the curved section is 170 kmph. Determine maximum permissible speed on the curve.
2. The length of a runway under standard conditions is 2100m. The airport is to be provided at an elevation of 500 m above mean sea level. The airport reference temperature is 19◦C. The construction plan provides gradients of +1.00 %,-0.5%, +0.5%, +0.4 % and -0.1% at chainages 300, 800, 1190, 1600 and 1900 to 2500 m from one end. Determine the actual length of runway to be provided based on ICAO recommendations.
3. Determine the maximum permissible speed on a curve of high speed B. G track having the following particulars: (i) Degree of curve =19 (ii) Amount of Superelevation = 75mm (iii)Length of transition curve = 140meters (iv) Maximum speed of the section likely to be sanctioned = 153 kmph.

Analyze
1. Design a runway pavement section for a wheel load of 27000kg with a tire pressure of 11kg/cm2. For this purpose the plate bearing test with 75cm diameter was carried out on soil subgrade and the plate yielded a pressure of 2kg/cm2 at 0.5cm deflection after ten load repetitions.

21CE006 Construction Economics and Finance

3 0 0 3

Course Outcomes

1. Illustrate the basic principles of engineering economics
2. Describe time value of money and inflation, and its impact on capital budgeting
3. Interpret the cash flow patterns for a construction project
4. Prepare simple financial statements for measuring the financial performance of a firm
5. Evaluate investment proposals through various capital budgeting methods
6. Understand the cost control in construction projects

COs–POs Mapping

COs	PO3	PO10	PO11
1	2	1	3
2	2	1	3
3	2	1	3
4	2	1	3
5	2	1	3
6	2	1	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Economics

Concept of Engineering Economics – Equivalence – Cast flow Diagram – Single Payment present worth factor (SPPWF) – Uniform series compound amount factor – Cash flow involving arithmetic gradient payment of receipts – Arithmetic Gradient – Cash flow involving geometric gradient series – Comparison of alternatives – Present worth method - Future worth method – Annual worth method – Rate of return – Incremental rate of return – Net Present Value – Benefit – Cost analysis – Break-even Analysis

Incremental benefit-cost ratio analysis, and breakeven analysis for two and more alternatives

12 Hours

Unit II

Depreciation and Inflation

Classification of Costs – Time value of money – Depreciation and amortization – Capital Budgeting: Meaning, Need and Techniques of Capital Budgeting – Capital Budgeting Methods – Different Depreciation methods – Inflation

Payback period, profitability index

12 Hours

Unit III

Cost Estimating and Finance

Cost Estimating – Types of Estimates – Approximate Estimates – Parametric Estimates – Cost Planning Techniques – Cost Control during Design and Construction stages – Sources of Finance – Infrastructure Financing – Lifecycle costing

Methods of construction costing, Escalation clause

12 Hours

Unit-IV

Financial Statement Analysis

Financial management – Chart of Accounts - Balance sheet and Profit and Loss accounts – Ratios analysis – Fund Flow Statement – Cash Flow Statement – Financial ratios - Working Capital management – Financial Control

Profit-loss account, credit, and debit statements

12 Hours

Total: 48 Hours

Textbook (s)

1. Pravin Kumar, Fundamentals of Engineering Economics, Wiley India Pvt. Ltd. New Delhi, 2015
2. Rajeev M Gupta, Project Management, 2nd Edition, PHI Learning Pvt. Ltd. New Delhi, 2014

Reference (s)

1. Patil, B. S., Civil Engineering Contracts and Estimates, Universities Press (India) Private limited, 2006.

2. Kwaku, A., Tenah, P. E., Jose M. Guevara, P. E., Fundamentals of Construction Management and Organization, Printice Hall, 1985.
3. Peterson, S. J., Construction Accounting and Financial Management, Pearson Education, Upper Saddle River, New Jersey, 2005
4. Panneer Selvam. R, Engineering economics, 2nd Edition, Prentice Hall of India, New Delhi, 2013
5. Gould, F. E., Managing the Construction Process, 2nd Edition, Prentice Hall, Upper Saddle River, New Jersey, 2002.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	-
Understand	10	20	20
Apply	70	60	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Explain Single payment present worth factor
2. Explain the concept of the time value of money
3. What is the basic classification of costs associated with construction activities
4. What is depreciation and explain with an example
5. List cost planning techniques

Understand

1. Explain the basic difference between net present value, payback period, internal rate of return, and the annual rate of return
2. What is inflation and how does it affect the cash flow patterns
3. Explain the capital budgeting techniques
4. Demonstrate the methods of costing with an example.
5. Summarize the process of preparing a balance sheet for a construction project.

21CE601 Problem Solving Using OOPS

3 0 0 3

Course Outcomes

1. Implement object oriented concepts to the problems
2. Implement applications using different types of inheritances
3. Develop user defined packages
4. Identify and recover runtime exceptions arise in the applications.
5. Demonstrate parallel processing applications using threads
6. Design interactive applications using Hibernate and spring Framework

COs–POs Mappings

COs	PO1	PO5	PO12
1	1	2	3
2	1	2	3
3	1	2	2
4	1	2	2
5	1	2	3
6	1	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Java Fundamentals

Overview of Object Oriented Programming principles, Importance of Java to the Internet, Byte code, Data types, arrays, control statements, Classes and Objects– constructors, methods, call_by_value, call by reference, access control, this keyword, Static keyword, overloading methods and constructors, garbage collection, Strings in java, string tokenizer, string builder.

Features of object oriented programming–Java History–Computer Programming Hierarchy–Role of Java Programmer in Industry

12 Hours

Unit II

Inheritance, Packages & Interface

Inheritance: Hierarchical abstractions, Base class and subclass, Benefits of inheritance, super keyword, final keyword with inheritance, polymorphism, abstract classes Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, Member access rules

Interface: Defining an interface, differences between classes and interfaces, implementing interface, variables in interface and extending interfaces, Nested–Inner Class & Anonymous Classes

Generic Class Types

12 Hours

Unit III

Exception Handling & Multithreading

Exception handling: Concepts and benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built-in and User Defined Exceptions

Multithreading: Definition thread, thread life cycle, creating threads, synchronizing threads, Demon threads.

Inter Communication of Threads– methods used, Deadlock

12 Hours

Unit IV

Event Handling

The AWT class hierarchy, user interface components labels, buttons, text components.

Event Handling: Events, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes, compare basic AWT components with swing components, more user interface components – canvas, scroll bars, check box, choice, lists panels – scroll pane, dialogs, menu bar, layout managers.

Java.util package, Anonymous Inner classes a Short-cut to Event Handling.

12 Hours

Total: 48 Hours

Textbook (s)

1. H. Schildt, Java: The complete reference, 7th Ed., TMH, 2016
2. T. A. Budd, An Introduction to Object–Oriented Programming, 3rd Ed., Addison Wesley Longman, 2012

Reference (s)

1. Dietal & Dietal, Java: How to Program, 8th Ed., PHI, 2010
2. E. Balaguruswamy, Programming with Java A Primer, 4th Ed., Tata McGraw Hill Companies, 2009
3. C. S. Horstmann and G. Cornell, Core Java, Vol 1. Fundamentals, 7th Ed., Pearson Education, 2014
4. C. Horstmann, BIG JAVA Compatible with Java 5 & 6, 3rd Ed., Wiley Publishers, 2008

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	25	35	-
Understand	45	35	-
Apply	30	30	40
Analyze	-	-	20
Evaluate	-	-	40
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember
1. List out 6 different java buzz words
2. List the three OOP principles
3. Define Inheritance
4. List the 5 keywords used in exception handling

Understand
1. Summarize the OOP principles
2. Illustrate the procedure for creating a user defined package
3. Interpret the Thread Life cycle
4. Interpret the Applet Life cycle
5. Define Encapsulation

Apply
1. Implement a java program that read an integer between 0 and 1000 and adds all the digits in the integer
2. Implement an abstract base class shape with two members base and height, a member function for initialization and a function to compute area ( ). Derive two specific classes Triangle and Rectangle which override the function area ( ). Use these classes in a main function and display the area of a triangle and a rectangle.
3. Demonstrate an applet that receives two numerical values as input from the user and then displays the sum of these numbers on the screen.
4. Given are two one dimensional arrays A and B which are sorted in ascending order. Develop a program to merge them into a single sorted array C that contains every item from arrays A and B, in ascending order.
5. Implement a Java program for creating one base class for student personal details and inherit those details into the sub class of student Educational details to display complete student information.

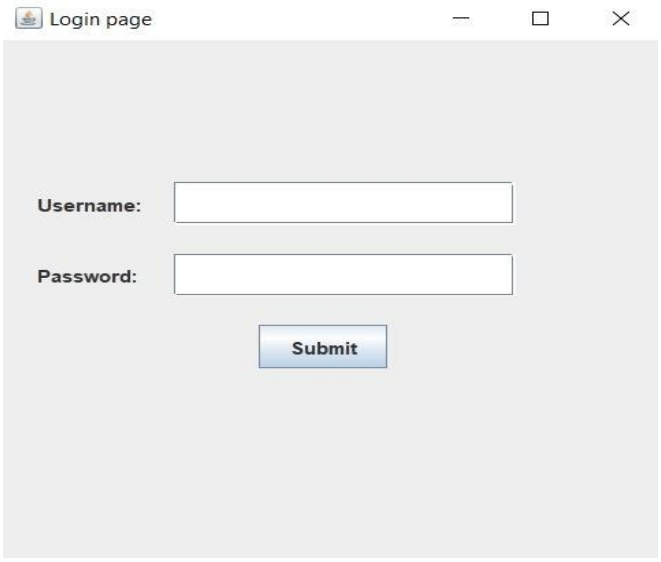
Analyze
1. Compare and Contrast between procedure oriented and object oriented programming.
2. Analyze the concurrent programming using threads.
3. Differentiate method overloading and method overriding.
4. Differentiate sleep and suspend.
5. Analyze platform independency of java with the help of JVM.

Evaluate
1. Judge whether Hybernate and spring frameworks are better for java database connectivity.
2. Asses the performance of threads

3. Determine the importance of run time polymorphism
4. Ramesh's house is located at a junction from which the places of his four friends are located at two coordinate points each. He must be at either one of their houses at the same time. Help him choose which house to go to by finding out the one with the nearest distance from his place. The coordinates of their houses are as follows:

Name	Coordinates
Ramesh	(3,2)
Friend A	(2,3)
Friend B	(0,0)
Friend C	(5,8)
Friend D	(1,4)

6. Write a java to have the solution of above problem. Open Book Exam (For Open Book Examination and not for semester end examination).
7. Rakesh is participating in a Hackathon and it requires him to make a Login page. Help him out by writing a java program to create the page. It should look as follows



21CE602 Design of Steel Structures

3 0 0 3

Course Outcomes

1. Classify the properties of steel sections and design welded and bolted connections according to IS code specifications
2. Design steel members subjected to tension in accordance with IS code specifications
3. Design steel members subjected to compression following IS code specifications
4. Design steel beams subjected to various loads as per IS code specifications
5. Design column bases subjected to various loads in accordance with IS code specifications
6. Design gantry girders and plate girders subjected to various loads as per IS code specifications

COs–POs Mappings

COs	PO3	PO5	PO10	PO12	PSO2
1	3	1	1	2	2
2	2	2	2	2	2
3	2	2	2	2	2
4	3	2	2	1	3
5	2	2	2	2	2
6	2	2	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Design of Welded Connections

Introduction to Structural Steel: Properties of Structural Steel, I. S. Rolled Sections, I. S. Specifications. Welded Connections: Advantages and disadvantages of welding- Strength of welds-Butt and fillet welds: Permissible stresses – IS Code requirements, Lap and Butt Connections, Design of fillet weld subjected to moment acting in the plane and at right angles to the plane of the joints, beam to beam and beam to Column connections only.

Light gauge steel sections, IS code provisions for Bolted connections

12 Hours

Unit II

Design of Tension Members and Compression Members

Tension members: Introduction to different modes of failures – gross section yielding, Net Section rupture and block shear failure, Determines the design strength due to yielding of gross section, rupture of critical section and block shear. Design procedure of tension members.

Compression Members: Effective length of columns, Slenderness ratio, permissible stresses, Design procedure of compression members - Design of built-up sections (Laced and Battened Columns)

Tension Member Splice connection, Tension Member Subjected to UDL along the Longitudinal Axis

12 Hours

Unit III

Beams and Column bases

Beams: Allowable stresses, design requirements as per IS Code-Design of simple and compound beams, check for deflection, shear, buckling, check for bearing, laterally supported beams.

Column bases: Slab base, Gusset base.

Grillage foundation, IS code provisions for laterally unsupported beam,

12 Hours

Unit IV

Plate Girder and Gantry Girder

Introduction: Elements of plate girder, design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices (only introduction), design of plate girder without stiffeners

Gantry Girders: Introduction, various loads, specifications, design of gantry girder without stiffeners

Stiffener design concepts, Temperature Effect on Plate Girder and Gantry Girder

12 Hours

Total: 48 Hours

Note:
IS 800-2007, General Construction in Steel — Code of Practice and Steel tables are permitted to use in classroom and examinations.

All the designs should be taught in the limit state design method as per IS 800-2007. Welding connections to be used and following drawings are to be practiced by the students.

Drawings:
1. Detailing of welded connection In-plane and Perpendicular to plane.
2. Detailing of built-up columns, laced and battened columns.
3. Detailing of Plate girder including curtailment, splicing and stiffeners.
4. Detailing of Gantry girder including curtailment, splicing and stiffeners.
5. Detailing of Slab Base, Gusseted Base.

Textbook (s)
1. N. Subramanian, Steel Structures (Design & Practice), Oxford University Press, 2011
2. S.K. Duggal, Limit State Design of Steel Structures, 3rd Ed., Tata McGraw Hill, New Delhi, 2019
3. S.S. Bhavikatti, Design of Steel Structures by Limit State Method as per IS: 800- 2007, 4th Ed., IK International Publishing House, Bangalore, 2014

Reference Books (s)

1. V.L.Shah and Veena Gore, Limit State Design of steel structures as per IS: 800-2007, Structures Publications, Pune, 2010
2. Sai Ram, Design of steel Structures, 2nd Ed., Pearson Publications, 2013
3. M.R Shiyekar, Limit State Design in Structural Steel,3rd Ed., PHI learning private limited, New Delhi, 2011

Internal Assessment Pattern

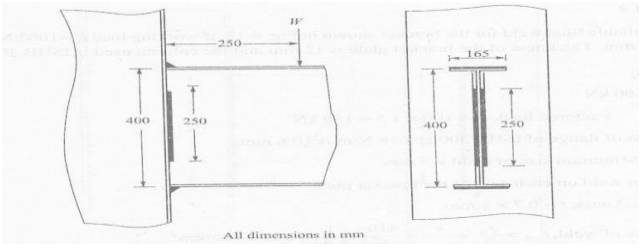
Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	5	5	-
Understand	10	10	-
Apply	85	85	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember
1. What are the partial safety factors of materials?
2. What are the various types of tension members?
3. What is meant shear lag?
4. State the possible failure modes of axially loaded column.
5. What are the types of stiffeners used for welded girders?

Understand
1. Enumerate the differences between structural steel and reinforcement steel.
2. What is the use of providing column bases?
3. Why do compression flanges require lateral support?
4. Why are rolled I-sections widely used as beam members?
5. What are the various parameters influencing the compressive strength of a member?

Apply
1. An I section bracket is connected to a column by welds as shown in figure. Determine the load which can be safely carried. The size of the web weld is 5 mm while the size of the flange weld is 10 mm. Assume field welds.



2. Design a suitable angle section to carry a tensile force of 250 KN. The angle is to be connected to a gusset plate through one of its leg by fillet welding. fy=250 N/mm2, fu=410 N/mm2. Also design the Welded Connection.
3. Design a simply supported beam of 6m span carrying a reinforced concrete floor capable of providing lateral restraint to the top compression flange. The total UDL is made up of 80kN load plus 120 KN imposed load (assuming a stiff bearing length of 65-100 mm). (Hint: ISMB or ISMC). (For Open Book Examination and not for semester end examination)
4. Design a suitable tension member to carry a tensile force of 250 KN. The member is to be connected to a gusset plate through one of its leg by welding. fy=250 N/mm2, fu=410 N/mm2. Also design the Welded Connection. (Hint: Assume type of section, type of welding).
5. Design a suitable column base for the column 2 ISMB300 placed at 300 mm c/c carrying a factored load of 3400 KN. The column is to be supported on concrete pedestal built with M20 concrete. (Hint: Slab base or Gusset base, type of welding connecting base with column).

21CE603 Estimation and Costing

3 0 0 3

Course Outcomes

1. Determine the cost of different item of work with including both materials and labours based on the qualities, quantities and methods of execution of works
2. Estimate the quantity of steel reinforcement required for various types of structural element
3. Estimate the current worth of an asset
4. Understand the legal recording of transaction between individual and business entities
5. Identifying clear procurement, market analysis, market sounding and engagement strategies
6. Estimate the quantity of various item of work for the existing infrastructure

COs–POs Mappings

COs	PO1	PO12
1	1	1
2	3	2
3	3	2
4	2	3
5	3	3
6	3	2

3–Strongly linked | 2–Moderately linked 1–Weakly linked

Unit I

Specification and Analysis of Rates

Estimates, types of estimates – approximate and detailed estimate. Specifications – general and detailed specifications. Analysis of rates for various items of works.

Prime cost, Schedule of rates

12 Hours

Unit II

Reinforcement bar Bending Schedules and Valuation of Buildings

Reinforcement bar bending and bar requirement schedules. Valuation of various components of buildings

Scrap value of buildings for different materials, Depreciation

12 Hours

Unit III

Detailed Estimates of Buildings

Estimation of Buildings by using Separate or individual wall method and center line method.

Standard measurement forms, Revised Estimate

12 Hours

Unit IV

Contracts and Tenders

Different types of contacts, their relative advantages and disadvantages, Elements of tender operation, Evaluation of tenders and Award of work. Disputes and arbitration. Legal aspects related to land acquisition,

Tender notice, Responsibility of Engineer

12 Hours
Total: 48 Hours

Textbook (s)

1. B.N. Dutta, Estimating and Costing, 28th Revised Edition, UBS Publishers, 2020.
2. M Chakraborti, Estimating, Costing, Specification & Valuation, Chakraborti Publishers,2006

Reference (s)

1. Standard Schedule of Rates and Standard data Book, Public Works Department.
2. IS 1200 (Parts I to XXV - 1992/ method of measurement of building and Civil Engineering works - B.I.S.)
3. National Building Code.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam (%)
Remember	20	20	--
Understand	20	20	--
Apply	60	60	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Write down the unit of 12mm thick plastering work and reinforcement.
2. Enumerates the list of labor required for reinforcement concrete work.
3. Write down the expression related to expected time duration calculation in PERT.
4. Write down the basic essential to draw a network diagram.
5. What do you mean by latest event time?

Understand

1. Analyze the rate for 2.5 cm thick cement concrete flooring with (1:4:8). unit 1 sq.m, take 100 sq.m.
2. Explain general item of work in building and write down its unit.
3. What is the main objective of construction costing and management?
4. What do you mean by analysis of rate? Write down its objectives?
5. 5. With the use of longwall and short wall method find out the quantity of earthwork in excavation in foundation, cement concrete foundation, brickwork in foundation and plinth,2.5cm thick DPC, brickwork in super structure of a single room building. For calculate the quantity draw the plan and elevation with suitable assumptions?

Apply

1. What is an estimate? Draw the standard measurement form for detail and abstract estimate & also write down the requirements for estimation.
2. Explain general item of work in building and write down its unit.
3. Analyze the rate for 12mm thick cement plastering with (1:6) . unit 1sq.m, take 100 sq.m. With the use of center line method find out the quantity of earthwork in excavation in foundation, cement concrete foundation, brickwork in foundation and plinth,2.5cm thick DPC, brickwork in super structure of a 2BHK room building. For calculation of quantity, sketch the plan and elevation with suitable assumptions (OBE Test should contain only questions related to Higher Order Thinking (HOT) Skills).
4. A room 300cmx400cm has a flat. There is one T beam in the center(c/s below the slab20cmx40cm) and the slab is 12cm thick. Estimate the quantity required for reinforcement from the data given below: Main bars (8-19mmØ in 2 rows of 4 each (all 4 in bottom being straight and other bent)), stirrups (8mmØ and 18cm c/c throughout), Anchor bars (2-12mmØ bar).
5. A RCC rectangular beam 25cm widex40cm deepx4.5m overall length is reinforced with 3-20mmØ two outer bar straight and L hooked at ends and inner bar bent up at 45 degree at appropriate places with L hooked ends. At top two outer hanger bars are 16mmØ straight and L hooked at ends. Stirrups are 8mm in Ø and spaced at 180mm c/c.

21CE604 Programming Language Laboratory

0 0 3 1.5

Course Outcomes

1. Make use of JAVA SDK environment to create debug and run java programs
2. Create applications based on code reusability
3. Develop programs using threads
4. Develop and debug real time problems using exception handling
5. Using IDE, create interactive application as using event handling mechanisms
6. Design Graphical User Interface using AWT components and Swing

CO–PO Mapping

COs	PO1	PO2	PO3	PO5
1	1	2	2	2
2	1	3	3	2
3	1	2	2	2
4	1	2	2	2
5	1	2	3	2
6	1	3	2	2

3–Strongly linked | 2–Moderately linked 1–Weakly linked

List of Experiments Write Java programs to:

1. Demonstrate the basics of Java using various data types, classes, methods and objects.
2. Demonstrate Call_by_value, Call_by_reference (object reference) methods.
3. Demonstrate overloading methods and constructors methods.
4. Demonstrate Sting handling function in java.
5. Demonstrate the different types of inheritance concept,
6. Demonstrate inheritance concept using method overriding, super & final keywords and runtime polymorphism.
7. Demonstrate the concept of multiple inheritance through interfaces.
8. Implement matrix operations One dimensional, multidimensional arrays.
9. Create a User define package which has classes and methods nad acess the package in another package.
10. Extracting tokens using String Tokenizer, String Bulider.
11. Handle checked and unchecked exceptions using try-catch, finally, throw and throws keywords
12. Handle user-defined Exceptions.
13. Demonstrate the concept of multithreading
14. Design a Job Application/ Student Admission Form using awt and applet.
15. Handle simple event to display cut/copy/paste events using Swings.
16. Evaluate the swing components by creating a registration form.

List of Augmented Experiments

1. New Patient Registry Management System
2. Restaurant Billing Management System
3. Library Management System
4. ATM Management System
5. S. Bus Ticket Booking Management System
6. Movie Ticket Booking Management System
7. Queuing Management System
8. Attendance Management System
9. Medical Store Billing Management System
10. Text Editor Projects in java
11. Google e Search Engine Filter
12. Electronic voting System
13. Day Planner
14. Library management System
15. Personal Finance Management System

Total: 48 Hours

21MPX01 Mini Project

0 0 3 1.5

Course Outcomes

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation
6. Execute the project in a collaborative environment

COs – POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO_1	PSO_2
1	3	2	-	-	-	3	2	-	-	-	-	-	3	3
2	3	3	-	-	3	-	-	-	-	-	-	-	3	3
3	3	3	3	2		-	-	-	-	-	2		3	3
4	-	-	-	-	-	-	-	-	-	3	-	2	3	3
5	-	-	-	-	-	-	-	3	-	-	-	-	3	3
6	-	-	-	-	-	-	-	-	3	-	-	-	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21ESX02 Employability Skills II

1 0 1 2

Course Outcomes

1. Demonstrate oral communication and writing skills as an individual to present ideas coherently
2. Develop life skills with behavioral etiquettes and personal grooming
3. Assess analytical and aptitude skills
4. Develop algorithms for engineering applications.
5. Solve engineering problems using software
6. Utilize simulation tools for testing.

COs POs Mapping

COs	PO1	PO2	PO5	PO8	PO10	PO12
1					3	2
2				1	2	2
3	2	1		2		
4	2		2			
5	2		2			
6	2		2			

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

1. Communication Skills, Confidence and Quantitative Aptitude

Resume (Recap): Resume? Templates? Mistakes to be avoided in a Resume and Steps to be followed in preparing it.

Group Discussions (Recap) & Practice: GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD?

Practice sessions and sharing Feedback. (Screening sample Videos)

Interview Skills: Interview? Types of Interview, Dos & Don'ts, Skills assessed in an Interview, Mistakes to be avoided, How to equip oneself to excel? How to handle the Typical Interview Questions? (with Examples)

Mock Interviews: Practice sessions with Feedback.

Exercises related to Communication: Email Writing, Voice Versant., etc.

16 Hours

2. Quantitative Aptitude

Time and Distance, Problems on Trains, Blood relations, Ratio and Proportions, Calendars, Clocks.

16 Hours

Unit II

3. Structural Modeling and Design Lab

a. Analysis and Design of Simply Supported Beam
b. Analysis and Design of Cantilever Beam
c. Analysis and Design of Continuous beam
d. Analysis and Design of fixed beam
e. Analysis and Design of 2D RCC and Steel Portal Frame

32 Hours

Total 64 Hours

Reference (s)

1. Shellito, Bradley A., Discovering GIS and ArcGIS, New York, NY : W. H. Freeman : Macmillan Learning, 2017.
2. Mesev, Victor, Integration of GIS and remote sensing, Chichester, England; Hoboken, NJ : Wiley, 2007.

21HSX12 CC & EC Activities II

0 0 1 1

Course Outcomes

1. Interpret and present the abstractive technical information through an activity
2. Think critically in providing solutions to the generic and common problems
3. Demonstrate the creative thinking in dealing with liberal arts
4. Instill team sprit through active engagement with the peer
5. Develop programs of common interest having social impact
6. Empower the under privileged through motivational activities

COs – POs Mapping

COs	PO6	PO7	PO9	PO10
1	-	-	-	3
2	3	2	-	-
3	3	-	-	-
4	-	-	3	-
5	3	-	-	-
6	3	-	-	-

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Audit Course

0 0 0 0

Course Outcomes

1. Interpret the meaning of values and select their goals by self- Investigation based on personal values activity
2. Interpret the major events and issues related to a period in Indian history
3. Assess the benefits and limitations of science and its application in technological developments towards human welfare
4. Check the awareness regarding basic human rights and to uphold the dignity of every individual
5. Assess the individual and group behaviour, and understand the implications of organizational behaviour on the process of management
6. Determine the appropriateness of various leadership styles and conflict management strategies used in organizations

COs – POs Mapping

COs	PO12
1	3
2	3
3	3
4	2
5	3
6	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CEC12 Building Services

3 0 2 4

Course Outcomes

1. Explain the principles of lighting and design guidelines of natural ventilation.
2. Illustrate the fundamentals of electrical and allied installations.
3. Discuss the HVAC systems and the concepts of sound insulation and noise control.
4. Outline the various plumbing services.
5. Infer the fire safety measures and firefighting systems.
6. Demonstrate the basics of lift, escalators, landscape development and signage structures.

COs–POs Mappings

COs	PO3	PO7	PO12	PSO2
1	3	2	1	1
2	3	2	1	1
3	3	2	1	1
4	3	2	1	1
5	3	2	1	1
6	3	2	1	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Lighting, and Natural Ventilation and Electrical Installations

Lighting and Natural ventilation: Principles of lighting - Measurement of light – Daylighting – Types of Lighting - Design considerations for natural ventilation. Electrical Allied Installations: Basic terminologies - Electrical sources - General Requirements - Planning- Single and Three-phase power supply - Distribution of Supply - Cabling - Wiring - Earthing.

Practical Components:

1. Creating structural model including foundation, column, beam and floor
2. Adding rebar to the foundation and column
3. Adding rebar to the beam and slab
4. Material takeoff and Rebar schedule

12+8 Hours

Unit II

HVAC systems, Acoustics, Sound Insulation and Noise Control

HVAC Systems: Heating – Heat transfer mechanism - Types of heating. Mechanical Ventilation – Objectives – Types of mechanical ventilation. Air Conditioning: basic refrigeration cycle and its components –Design considerations - Types of air conditioning systems. Acoustics, Sound Insulation and Noise Control: Definition and terminologies – Planning against outdoor and indoor noise – Sound absorbing materials.

Practical Components:

1. Applying diffuser and VAV system
2. Creating duct work for supply system
3. Applying return diffuser with duct work
4. Applying exhaust and AHU with chiller

12+8 Hours

Unit III

Plumbing Services

Water supply systems: Basic principles – water supply requirements of buildings – water sources and quality - water treatment layout – Water distribution system – Pipe materials. Drainage and Sanitation systems: Different drainage pipe systems – Types of sanitary appliances – Bio-toilet. Solid Waste management: Types of solid waste – SW management systems – Assessment –Treatments. Gas Supply systems, and its regulations.

Practical Components:

1. Applying plumbing fixture
2. Creating water supply systems
3. Creating waste water system
4. Plumbing Schedule

12+8 Hours

Unit IV

Fire safety and miscellaneous services

Fire Safety: Fire Prevention - Grouping of building – Fire Zones – Type of Construction – General requirements. Life Safety: Egress Components. Fire Fighting systems - Installations of Lifts, Escalators and Moving Walks - Information and communication-enabled installations – Landscape planning, Design and development – Signs and outdoor display structures.

Practical Components:

1. Calculating lux value and schedule
2. Applying lighting fixture and switches
3. Creating power system
4. Conduit routing and cable tray designing.

12+ 8 Hours
Total: 48+ 32 Hours

Textbook (s)

1. National Building Code of India 2016-Volume-2, Bureau of Indian Standards.
2. National Building Code of India 2016-Volume-1, Bureau of Indian Standards

Reference (s)

1. Susan Dawson, Architect's Working Details (Volume 1-10), E- Map Construct; 2004.
2. Landscape Construction, Delmar publisher, 2000.
3. Richardson Dietruck, Big Idea and Small Building, Thames and Hudson, 2002.
4. Nelson L Burbank, House Carpentry Simplified, Simmons-Board- McGraw Hill Publishing Corporation, New York, 1986.
5. Francis. D. K. Ching, Building Construction Illustrated, John Wiley & Sons, 2011.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Recall the principles of good lighting.
2. Relate the concepts of Natural ventilation and sustainability.
3. Define MEP.
4. List the selection criteria of lifts.
5. What is hybrid ventilation?

Understand

1. Demonstrate the various types of escalators.
2. Illustrate heating, ventilation and air conditioning systems.
3. Explain the different water supply and drainage systems.
4. Illustrate the different safety standards against fire prevention.
5. Elaborate different AC Systems.

Apply

1. Build a relation between orientation of building and daylighting.
2. Discuss the requirements of electrical and allied installations of a building.
3. Organize heating systems requirements of a building.
4. Plan AC system requirements of a building.
5. Experiment with water supply and drainage system requirements of a building.

21CEC22 Highway Design and Simulation

3 0 2 4

Course Outcomes

1. Build knowledge on design aspects related to expressways.
2. Understand the parameters involved in the pavements design.
3. Illustrate the design procedure of high low volume flexible pavement as per IRC, and low-volume rigid pavements as per IRC.
4. Design rigid pavement for high volume roads and white topping overlays according to latest codes.
5. Explain different types of special pavements and their applications
6. Design drainage facilities for pavements.

COs – POs Mappings

COs	PO1	PO3	PSO2
1	3	1	1
2	3	1	2
3	3	3	3
4	2	3	3
5	3	2	1
6	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Geometric Design of Expressways: IRC Specification for geometric design of expressways, types and specifications for interchanges , IRC standards and guidelines for design of hill roads.

Practical components

1. Calculation of geometric features of Expressway for 120 kmph design speed.
2. Plotting Marshall curves to find out optimum bitumen content.
3. Calculation of Vehicle Damage Factor for a particular based on traffic load data given.

12+8 Hours

Unit II

Black top pavement design: Road pavements and pavement layers - types, functions, choice, factors affecting design, loads – axle load distribution, ESWL, EWL, VDF due to varying loads. Design of flexible pavements by IRC & AASHTO. Design of flexible pavements for low volume roads.

Practical components

1. To plot the Hand-held GPS coordinates in the Google earth software
2. Plotting gradation curves for single size aggregate gradation for cement concrete pavement according to MoRTH.
3. Plotting gradation curves for single size aggregate gradation for bituminous concrete pavement according to MoRTH.

12+8 Hours

Unit III

White top pavement analysis and design

Types of stresses and causes; Introduction to Westergaard's equation for calculation of stresses in rigid pavements due to wheel loads and temperature; Considerations in rigid pavement analysis, wheel load stresses, warping stresses, frictional stresses, combined stresses. Design of rigid pavements by IRC procedure. Design of rigid pavements for low volume roads

Practical components

1. Design of flexible pavement according to IRC-37-2001.

IRC-58-2015 Design of flexible pavement

2. To estimate the effective subgrade modulus for flexible pavement design.
3. Design Example to check the Adequacy of Granular Sub-base thickness
4. Design of Bituminous concrete Pavement with Granular Base and Sub-base
5. Computation of Cumulative Fatigue Damage in Cement Treated Base(CTB) Layer
6. Design of Bituminous Pavement with Reclaimed Asphalt Pavement (RAP) material treated with Foamed Bitumen/Bitumen Emulsion and Cemented Sub-base
7. Design of Bituminous concrete Long-life Pavement

12+8 Hours

Unit IV

Special Pavements and drainage

Introduction to Concrete block pavements and design, Semi rigid pavements, perpetual pavements, porous pavements. Significant failures in pavements. Design of Pavement Drainage: Detrimental effects of water, methods for controlling water in pavements. Drainage materials: aggregates, geo-textiles, pipes. Estimation of inflow, determination of drainage capacity.

Practical components

1. Back calculation of Resilient modulus of the pavement layers from the FWD deflection data using IITKGPBACK-IRC-115-2014.
2. Design of Rigid pavement according to the code IRC-58-2002.
3. Design of Rigid Pavement according to the code IRC-58-2015.

12+8 Hours
Total: 48+32 Hours

Textbook (s)

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019
3. IRC: SP: 99 (2013), Manual of specifications and standards for expressways.

Reference (s)

1. E. J. Yoder, M. W. Witczak, Principles of Pavement Design, 2nd Edition, Wiley, 2015
2. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018
3. IRC: 58 (2015), Guidelines for the design of plain jointed rigid pavements
4. IRC: 37 (2018), Guidelines for the design of flexible pavements
5. IRC: SP 62 (2014), Guidelines for the design and construction of cement concrete pavement for rural roads
6. IRC: SP 72 (2015), Guidelines for the design of flexible pavements for low volume roads

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	20	20	-
Understand	30	30	-
Apply	30	30	100
Analyze	20	20	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List the special considerations for hill roads.
2. What are the effects of temperature on CC pavements?
3. What are methods of flexile pavements design?
4. What are perpetual pavements?

Understand

1. Outline the geometric considerations for urban arterials.
2. Explain VDF and the concept in the determination of the equivalent wheel load.
3. Explain the factors governing the design of flexible pavements for low volume roads.
4. Classify various types of special pavements with their applications.

Apply

1. Determine the EWLF or VDF value of the following two axle loads in terms of the standard axle load of 8.16 t (a) LCV with rear axle load of 1.8t (b) HCV with rear axle load of 16.0 t
2. Design a Bituminous pavement with
3. Granular base and sub-base

4. Cemented base and sub-base with SAMI layer over CT-Base course
   Data:
   a. 4-lane divided carriageway
   b. Initial traffic in each direction in the year completion of construction = 5500 CV/day
   c. Design life = 15 years
   d. Design CBR of subgrade soil = 5%
   e. Traffic growth rate = 5%
   f. Vehicle damage factor = 4.5

Analyze

1. Determine the warping stresses at interior, edge and corner of a 26 cm thick cement concrete pavement with transverse joints at 4.50 m interval and longitudinal joints at 3.50 m interval. The modulus of subgrade reaction, K is 20 kg/cm^3 and radius of loaded area is 14 cm. Assume maximum temperature differential during day to be 0.60^0C per cm slab thickness (for warping stresses interior and edge) and maximum temperature differential of 0.40^0C per cm slab thickness during the night (for warping stress at the corner). Additional data are: $e = 1 \times 10^{-5}/^0C, E = 3 \times 10^5$ kg/cm^2 and $\mu = 0.13$.
2. The traffic studies and axle load distribution studies carried out during project preparation indicated that there are (i) 9500 vehicles per day with rear axle loads in the range of 2500 to 3500 kg and growth rate of 6.50% per annum and (ii) 1900 heavy vehicles with rear axle loads in the range 11000 to 13000 kg and growth rate of 4.00% per annum. The road pavement is expected to be constructed in a period of 2.50 years after this study and the flexible pavement structure is to be designed for a life of 12 years. Determine value of cumulative standard axles (CSA) used for design.

21CEC32 Pre Engineered Buildings

3 0 2 4

Course Outcomes

1. Choose the materials used for Pre Engineered Building
2. Outline the difference between Conventional steel and Pre Engineered building
3. Discuss the primary and secondary main frame system of building components
4. Explain the design of Pre Engineered frame
5. Discuss the influence of various loads on the Pre-Engineered buildings
6. Explain the PEB components and design methodology

COs – POs Mappings

COs	PO3	PO11
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to Pre-Engineered Buildings

Introduction – History - Advantages of PEB - Applications of PEB – Materials used for manufacturing of PEB. Difference between Conventional Steel Buildings and Pre-Engineered buildings.

Practical Components:

1. Modeling steel columns
2. Parametric changes in steel columns
3. Column connections
4. Columns schedules

12+8 Hours

Unit II

Pre-Engineered Building Components

Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts – Bracing System: Rod, angle, Portal.

Practical Components:

1. Modeling steel beams
2. Parametric changes on steel beams
3. Beam connections
4. Beam schedules

12+8 Hours

Design Loads on Pre-Engineered Buildings

Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code.

Practical Components:

1. Modeling PEB building
2. Applying Loads
3. Analysis of PEB buildings
4. Analysis report generation

12+8 Hours

Unit IV

Additional PEB Components and Design Methodology

Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases.

Guidelines for PEB design, Design codes, Structural design Process loop, optimal structural design

Practical Components:

1. Modeling bracings in PEB buildings
2. Modeling sheeting and cladding
3. Modeling Ventilators
4. Modeling staircases

12+8 Hours
Total: 48 + 32 Hours

Textbook (s)

1. L. Mokk, "Prefabricated Concrete for Industrial and Public Structures," Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. T. Koncz, "Manual of Precast Concrete Construction", Vol. I, II, III & IV, Berlin, 1971.

Reference (s)

1. B. Lewicki, "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam, London, New York, 1998.
2. Structural Design Manual, Precast Concrete Connection Details, Society for the
3. Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.
4. Hass, A.M. Precast concrete design and Applications, Applied Science Publishers,1983

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	40	40	50
Understand	60	60	50
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember
1. What is the meaning of Pre Engineering buildings?
2. What are disadvantages of Pre Engineering buildings?
3. List out the technical parameters of PEB?
4. List out the application of PEB.

Understand
1. Explain the different components of Pre Engineering buildings.
2. Explain the different process flow of Pre Engineering buildings.
3. Distinguish the pre-engineered buildings and conventional steel buildings.
4. Explain the various design steps of PEB.

21CEC42 ML for Civil Engineering

3 0 2 4

Course Outcomes

1. Gain an appreciation for popular ML algorithms and their mathematical foundations, providing a solid understanding of the underlying principles.
2. Develop proficiency in implementing supervised learning algorithms in Python using fundamental machine learning modules.
3. Recognize the significance of ensemble strategies in resolving real-world problems with machine learning algorithms.
4. Appreciate the mathematical basis of unsupervised algorithms, enhancing understanding and application.
5. Acquire practical experience in solving interdisciplinary problems using hands-on applications of unsupervised algorithms.
6. Master the skill of tuning ML model parameters and selecting the most suitable models for challenges across diverse domains.

COs-POs Mapping

COs	PO1	PO2	PO4	PO5	PO12
1	2	3	2	2	2
2	2	3	2	2	2
3	2	3	2	2	2
4	2	3	2	2	2
5	2	3	2	2	2
6	2	3	2	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

ML Introduction and Supervised Learning

Introduction to Machine Learning - Supervised and unsupervised learning - Regression and Classification problems - Introduction to Machine Learning - Linear Regression - Multiple Variable Linear Regression - Logistic Regression - Naive Bayes Classifiers - Solving civil Engineering case-studies/problems using Supervised Learning.

Practical Components

1. Take a dataset with missing values or inconsistencies and demonstrate the steps involved in cleaning and integrating the data. Apply techniques such as data imputation, outlier detection, and data standardization to preprocess the dataset
2. Select a dataset with numerical quantities and perform linear regression to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, MSE or RMSE.
3. Select a dataset and perform Logistic Regression to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
4. Select a dataset and perform Naive Bayes Classifiers to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.

12+8 Hours

Unit II

Ensemble Techniques

k-NN Classification – Normalization and Standardization - Support Vector Machines - Decision Trees - Bagging - Random Forests - Boosting - Solving civil Engineering case-studies/problems using Ensemble Techniques.

Practical Components

1. Select a dataset and perform k-NN Classification to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
2. Select a dataset and perform Support Vector Machines Classification to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
3. Select a dataset and perform Decision Trees to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.
4. Select a dataset and perform Bagging and Boosting to forecast a specific target variable. Evaluate the performance of the model using evaluation metrics such as Score, Recall, Precision and F1.

12+8 Hours

Unit III

Unsupervised Learning

K-means Clustering - Hierarchical Clustering - Dimension Reduction - PCA - Solving civil Engineering case-studies/problems using Unsupervised Learning

Practical Components

1. Select a dataset and apply the k-means clustering algorithm to perform clustering for classification purposes. Use evaluation metrics such as silhouette coefficient, cohesion, and separation to assess the quality of the clustering results.
2. Select a dataset and apply the Hierarchical Clustering (Agglomerative) algorithm to perform clustering for classification purposes.
3. Select a dataset and apply the Hierarchical Clustering (Divisive) algorithm to perform clustering for classification purposes.
4. Select a dataset and apply the Principal Component Analysis (PCA) is to reduce the dimensionality of a dataset.

12+8 Hours

Unit IV

Featurisation, Model Selection & Tuning

Feature Engineering - Model Selection and Tuning - Model Performance Measures - Regularising Linear Models - Ml Pipeline - Bootstrap Sampling - Grid Search CV - Randomized Search CV - K Fold Cross-validation - Solving civil Engineering case-studies/problems using above method.

Practical Components

1. Select a dataset and perform parameter tuning using Grid Search CV for various ML algorithms.
2. Select a dataset and perform parameter tuning using Randomized Search CV for various ML algorithms.
3. Select a dataset and perform parameter tuning using K Fold Cross-validation for various ML algorithms.
4. Select a data related to Civil Engineering and perform parameter tuning using Grid Search CV and K Fold CV algorithms.

12+8 Hours

Total: 48 + 32 Hours

Textbook (s)

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020)
2. Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition
3. Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition

Reference Book (s):

1. Ian Goodfellow, Yoshoua Bengio, and Aaron Courville Deep Learning MIT Press Ltd, Illustrated edition.
2. Christopher M. Bishop Pattern Recognition and Machine Learning - Springer, 2nd edition
3. Trevor Hastie, Robert Tibshirani, and Jerome Friedman - The Elements of Statistical Learning: Data Mining, Inference, and Prediction - Springer, 2nd edition.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessments
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is Machine Learning, and how does it differ from traditional programming?
2. Explain the main types of machine learning paradigms, with a focus on supervised learning.
3. Describe bagging and boosting techniques, and provide an example of when each might be beneficial.
4. Describe the purpose of cross-validation and how it helps in model evaluation.
5. What is feature engineering, and why is it important in machine learning?

Understand

1. How does Random Forest differ from a single Decision Tree, and what are the advantages of using Random Forest?
2. How does clustering work, and what are some common clustering evaluation metrics?
3. Describe three techniques for handling categorical variables during featurization.
4. How do hyperparameters affect a machine learning model's performance, and what are some techniques to tune them effectively?

Apply

1. Use the Random Forest algorithm to classify handwritten digits in the MNIST dataset. Perform model selection by tuning hyperparameters such as the number of trees in the forest and the maximum depth of each tree. Compare the performance of different models using cross-validation and select the best one.
2. Apply K-means clustering to group customers based on their purchasing behavior using an e-commerce dataset. Visualize the clusters and interpret the results to identify distinct customer segments for targeted marketing.

21CE007 Engineering Geology

3 0 2 4

Course Outcomes

1. Acquire knowledge of the topographical formation, interior earth, earth process, and weathering.
2. Interpret the various types of minerals and assess their physical, mechanical, and engineering properties.
3. Interpret the various types of rocks and assess their physical, mechanical, and engineering properties.
4. Determine geological structures and their relevance to civil engineering projects.
5. Analyze subsurface geological features using geophysical investigation and applications pertinent to civil engineering projects.
6. Application of remote sensing to examine the geological characteristics of a site's viability for civil engineering structures.

CO-PO Mapping:

COs	PO1	PO2	PO4	PSO1
1	2	2	2	1
2	3	2	3	1
3	3	3	3	2
4	1	3	3	1
5	3	2	3	3
6	3	2	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Physical Geology

Geology in civil engineering – branches of geology – structure of earth and its composition - weathering of rocks – scale of weathering – Earth processes – Work of wind, rivers and sea and their engineering importance. Plate tectonics – Earthquakes – Seismic zones in India.

Practical components

1. **Physical Properties of Minerals:** Rock Forming Minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
2. **Physical Properties of Minerals:** Ore Forming Minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc…
3. **Megascopic Identification:** Rock Forming Minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc, Chlorite, Olivine, Kyanite, Asbestos, Tourmelene, Calcite, Gypsum, etc…
4. **Megascopic Identification:** Ore Forming Minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc.

12+8 Hours

Unit II

Mineralogy and Petrology

Mineralogy: Definition of mineral, Importance of study of minerals, Physical properties of minerals - Role of study of physical properties in their identification, Study of physical properties of different rock forming mineral groups.

Petrology: Geological classification of rocks - igneous, sedimentary and metamorphic rocks, Different methods of formation of igneous, sedimentary and metamorphic rocks. Description, occurrence, engineering properties, distribution and use of following rocks Granite, Syenite, Diorite, Basalt, Sandstone, Limestone, Conglomerate, shale, Quartizite, Marble, Slate, Gniess.

Practical components

1. **Megascopic Description and Identification of Rocks:** Igneous Rocks: Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Poryphery, Basalt, etc…
2. **Megascopic Description and Identification of Rocks:** Sedimentary Rocks: Sandstone, Ferrugineous Sandstone, Limestone, Shale, Laterite, Conglomerate, etc…
3. **Megascopic Description and Identification of Rocks:** Metamorphic Rocks: Biotite, Granite Gneiss, Slate, Muscovite &Biotite Schist, Marble, Khondalite etc…
4. Identification of economic minerals.

12+8 Hours

Unit III

Structural Geology and Geophysical Methods

Attitude of beds – out crop - geological maps – study of structures – folds, faults and joints their bearing on engineering construction. Geophysical methods – Seismic and electrical methods for subsurface investigations

Practical components

1. Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities etc.
2. Geological cross sections and study of geological maps.
3. Simple strike and dip problems.
4. Simple Structural Geology problems.

12+8 Hours

Unit IV

Application of Geological Investigations

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings – Hydrogeological investigations and mining – Coastal protection structures. Investigation of Landslides, causes and mitigation.

Practical components

1. Simple Problems on Electrical Resistivity.
2. Simple Problems on Seismic Refraction Prospecting.
3. Study of models of geological structures.
4. Study of models of out crops patterns of different types of rocks and land forms.

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. Subinoy Gangopadhyay, Engineering Geology, 1st Edition, Oxford University Press, New Delhi, 2013
2. A.Parthasaradhy, V.Panchapakesan, R.Nagarajan, Engineering Geology, 1st Edition, Wiley Private India Limited, New Delhi, 2013

Reference (s)

1. N Chenna Kesavalu, Text Book of Engineering Geology, 2nd Edition, Trinity Press, Hyderabad, 2014.
2. HalukSucuoglu, SinanAkkar, Basic Earthquake Engineering, 1st Edition, Springer International Publishing, 2014.
3. David George Price, Engineering Geology: Principles and Practice, 2nd Edition, Springer International Publishing, 2009
4. Engineering Geology Lab Manual-Civil Engineering- GMRIT, Rajam

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	20	20	-
Understand	40	40	50
Apply	40	40	50
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is earth structure and its composition.
2. Explain geological classification on earth.
3. Illustrate folds.

Understand

1. Describe remote sensing applications in civil engineering.
2. Illustrate the hydrological investigations on mining.
3. Demonstrate the seismic zones in India.

21CE008 Irrigation and Water Resources Engineering

3 0 2 4

Course Outcomes

1. Interpret the various types of irrigational necessities and outline its water quality standards.
2. Acquire knowledge on soil-water-plant relationships and choose the design of lined & unlined Canals
3. Understand the components of diversion head work & its design and describe the types, selections, designs, and failures of earth dams
4. Recognize the various types and design principles of gravity dams and spillways.
5. Understand the different types of canal falls, canal regulators, cross drainage works, and their uses.
6. Develop the design principles of canal regulators and cross-drainage works

COs-POs Mappings

COs	PO3	PO5	PO10	PO12
1	2	3	3	3
2	2	3	3	3
3	2	3	3	3
4	3	3	3	3
5	3	2	3	3
6	3	3	2	3

3-Strong linked| 2-Moderately linked| 1-Weakly linked

Unit I

Soil-Water-Plant Relationship and Design of Canals:

Irrigation: Necessity and Importance of Irrigation, advantages and ill effects of Irrigation, types of Irrigation, methods of application of Irrigation water, water logging and drainage, standards of quality for Irrigation water, principal crops and crop seasons, crop rotation. Vertical distribution of soil moisture, soil moisture tension, Consumptive use, estimation of consumptive use, factors affecting duty, depth and frequency of Irrigation, irrigation efficiencies. Classification of canals, design of canals by Kennedy's and Lacey's theories, canal lining.

Practical Components

1. Design of canal using Kennedy theory.
2. Design of canal using Lacey's theory.
3. Design of lined canal.
4. Design of canal drop.

12+8 Hours

Unit II

Diversion Head Works and Earth Dams.

Types of Diversion head works-diversion and storage head works, weirs and barrages, layout of diversion head works. Types of dams, merits and demerits, factors affecting selection of type of dam, factors governing selecting site for dam. Types of Earth dams, causes of failure of earth dam, criteria for safe design of earth dam, seepage through earth dam-graphical method, measures for control of seepage.

Practical Components

1. Draw the diversion head works with components parts
2. Design and draw the earth dam with main features.
3. Design of tank surplus weir.
4. Design of Tank sluice with tower head.

12+8 Hours

Unit III

Gravity Dams and Spillways

Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a low gravity dam, stability analysis, drainage galleries. Types of spillways, design principles of Ogee spillways, types of spillway gates.

Practical Components

1. Design and draw the gravity dam with all important features
2. Draw the longitude section and cross section of spillway.
3. Draw the ogee spillways
4. Design of canal regulator and river regulator

12+8 Hours

Unit IV

Canal Falls & Regulation Works and Cross-Drainage Works

Types of falls and their location, design principles of Sarda type fall, trapezoidal notch fall and straight glacis fall. Head regulator and cross regulator, design principles of Cross regulator and head regulators, canal outlets, types of canal modules, proportionality, sensitivity and flexibility. Types, selection of site, design principles of aqueduct, siphon aqueduct and super passage.

Practical Components

1. Draw the layout of cross regulator and head regulator with parent channel
2. Design and draw the cross section and longitudinal section of Aqueduct.
3. Draw the cross section and longitudinal section of super passage.
4. Draw the layout of siphon aqueduct.

12+8 Hours

Total: 48+32 Hours

Textbook (s)

1. S.K Garg, Irrigation Engineering and Hydraulic Structures, 36th Ed., Khanna publishers 2018.
2. K.R.Arora, Irrigation,Water Power and Water Resources Engineering, 5th Revised Ed.2018 , Standard Publications, New Delhi
3. R.K. Sharma and T.K. Sharma, Irrigation Engineering, 1st Ed., S. Chand Publishers, 2017.

Reference (s)

1. G.L. Asawa, Irrigation and Water Resources Engineering, 1st Revised Ed., New Age International Publishers, 2017
2. Varshney, Gupta & Gupta, Theory and Design of Hydraulic Structures, 4th Ed., Nem Chand & Bros, 2007.
3. Satyanarayana Murthy. Challa, Water Resources Engineering, 2nd Ed., New Age International Publishers, 2019

Internal Assessment Pattern

Cognitive Level	Int.Test1 (%)	Int. Test 2 (%)	Lab Assessment
Remember	15	15	-
Understand	20	30	-
Apply	40	30	50
Analyze	25	25	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is the importance of the irrigation?
2. Name the components parts of diversion head works.
3. Label the functions of diversion headworks.
4. Select suitable site for diversion head work.
5. Define piping.

Understand

1. Explain Typical Cross-section of gravity dam.
2. Explain Forces Acting on Gravity Dam.
3. Indicate Classification based on purpose.
4. Indicate Classification based on control.
5. Indicate Classification based on prominent feature.

Apply

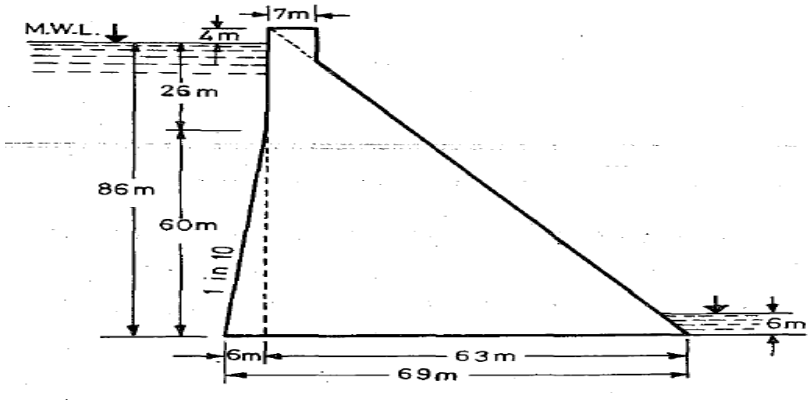
1. Relate Construction of Galleries in Gravity Dams.
2. Examine Gravity Method or Two Dimensional Stability Analysis
3. Relate Functions and Types of Galleries in Dams.
4. An impervious floor of a weir on permeable soil is 16 m long and has sheet piles at both the ends. The upstream pile is 4 m deep and the downstream pile is 5 m deep. The weir creates a net head of 2.5 m. Neglecting the thickness of the weir floor, calculate the uplift pressures at the junction of the inner

faces of the pile with the weir floor, by using Khosla's theory.

5. A concrete gravity dam having the data, maximum allowable compressive stress in concrete is 3000 KN/m2, maximum reservoir level 190m, R.L. of bottom of dam 100m, specific gravity of concrete 2.4 and unit weight of water 9.8 KN/m3. Determine whether the gravity dam is low or high.

Analyze

1. Analyze overturning (or rotation) about the toe.
2. Analyze crushing and development of tension in gravity dams.
3. Analyze shear failure called sliding in gravity dam.
4. Examine the stability of the dam section given in below. Also state that the magnitude of maximum compressive stress and maximum shear stress that may develop under any conditions of loading in the dam and also state whether tension is developed anywhere or not.



5. Compute the suitable cross drainage work for the given data.
   Canal: Full supply level=R.L.213.5, canal bed level=R.L.212.0m, canal water depth=1.5m. Drainage: High flood level 210.0m, high flood depth=2.5m, general ground level=212.5 m.

21PWX01 Project Work

0 0 16 8

Course Outcomes

1. Identify a contemporary engineering application to serve the society at large
2. Use engineering concepts and computational tools to get the desired solution
3. Justify the assembled/fabricated/developed products intended.
4. Organize documents and present the project report articulating the applications of the concepts and ideas coherently
5. Demonstrate ethical and professional attributes during the project implementation.
6. Execute the project in a collaborative environment.

COs –POs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2				3	2						3	3
2	3	3			3								3	3
3	3	3	3	2							2		3	3
4										3		2	3	3
5								3					3	3
6									3				3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21SIX02 Summer Internship II

0 0 0 1

Course Outcomes

1. Demonstrate communication skills to meet the requirement of industry
2. Develop logical thinking and analytical skills to thrive in competitive examinations
3. Use mathematical concepts to solve technical quizzes
4. Develop technical skills to work out real time problems
5. Develop algorithms for different applications
6. Solve industry defined problems using appropriate programming skills

COs –POs Mapping

COs	PO1	PO2	PO5	PO6	PO10	PO12
1					3	
2	3	1				
3	3					
4	3	1	3			2
5	3	1	3	3		1
6	3	1	3			1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CEC13 Building Information Modeling

3 0 0 3

Course Outcomes

1. Illustrate the AEC business model and the processes of BIM
2. Explain the different dimensions of BIM with various software associated with it
3. Discuss the facility management system for the stakeholders
4. Summarize the applications of BIM in construction management perspective
5. Describe the concept and importance of life cycle assessment
6. Outline the process on the integration of life cycle assessment with BIM

COs–POs Mapping

COs	PO3	PO5	PO10	PSO2
1	2	3	1	3
2	2	3	1	3
3	2	3	1	3
4	2	3	1	3
5	2	3	1	2
6	2	3	1	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I
Introduction to BIM
The Current AEC Business Model - New Tools and New Processes in BIM - BIM as a Lifecycle Platform - Benefits of BIM - Challenges in BIM – The concept of different dimensions - Core Technologies and Software- Collaboration and Interoperability.
Benefits of BIM; Impacts of BIM in design; Hardware system requirements.

12 Hours

Unit II
Facility Management System
BIM for owners: owner's role in BIM project – Cost and Time management – BIM implementation on project – Barriers and issues in implementation BIM on projects. BIM for Architects and Engineers: BIM use in design process – Building models and libraries. BIM for contractor, sub-contractors and fabricators.
Facility and Information Asset Management; Visualization and Coordination.

12 Hours

Unit III
BIM for Construction Management
Value – Role – Scheduling and controlling schedules– Logistics – Estimating cost and controlling cost – Constructability – Analyzing data in BIM – Material management- Tracking equipment – Managing facilities – Level of development - Model-based coordination.
BIM 360 document management; Common data environment.

12 Hours

Unit IV
Life Cycle Assessment and BIM
Introduction of LCA – History of LCA – Methodology – life cycle impact assessment – Life cycle interpretation analysis - LCA on construction and demolition waste management – Integrating LCA and BIM – SWOT analysis on integration – The relation between LCA and BIM for sustainable construction.
Embodied energy; the relation between CO_2 emission and LCA

12 Hours
Total: 48 Hours

Textbook (s)

1. Rafael Sacks, Charles Eastman, Ghang Lee, Paul Teicholz (2011). BIM handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers. Third Edison, John Wiley & Sons.
2. Brad Hardin, Dave McCool (2015). BIM and construction management: proven tools, methods, and workflows. Second Edition, John Wiley & Sons.

Reference (s)

1. Paul Teicholz, BIM for Facility Managers, John Wiley & Sons (2013).
2. Raja. R.A. Issa, Svetlana Olbina, Building Information Modeling: Application and Practices, ASCE publications (2015).
3. Laura Alvarez Antón, Joaquín Diaz, Integration of LCA and BIM for Sustainable Construction, World Academy of Science, Engineering and Technology, International Journal of Civil and Environmental Engineering Vol:8, No:5, 2014.
4. Mark Kyeredey Ansah, Xi Chen, Hongxing Yang, Lin Lu a, Patrick T. I. Lam, Developing an automated BIM-based life cycle assessment approach for modularly designed high-rise buildings, Environmental Impact Assessment Review 90 (2021) 106618.
5. Ruben Santos, Antonio Aguiar Costa, Jose D. Silvestre, Thomas Vandenbergh, Lincy Pyl, BIM-based life cycle assessment and life cycle costing of an office building in Western Europe, Building and Environment 169 (2020) 106568.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	40	40	-
Understand	60	60	100
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Explain the AEC model.
2. What is a facility management system?
3. Give your opinion on controlling schedules.
4. Illustrate the concept of life cycle assessment.
5. Infer the concept of interoperability.

Understand

1. Demonstrate the different dimensions of BIM.
2. Describe the different libraries in BIM.
3. Illustrate the concept of level of development.
4. Summarize the integration process of LCA and BIM for G+5 story residential building.
5. Examine the facility management system for an assumptive commercial building.

21CEC23 Highway Project Formulation and Economics

3 0 0 3

Course Outcomes

1. Discuss the concepts of economic evaluation and preparation of a detailed project report.
2. Analyze the computation of road user cost for evaluation of highway projects.
3. Analyze the basic methods of economic analysis carried out for transportation engineering projects
4. Discuss transportation project feasibility using economic, Toll, and financial methods.
5. Describe the importance of EIA for transportation engineering projects.
6. Outline the environmental impact assessment factors for highway projects

COs–POs Mapping

COs	PO2	PO5	PO10	PSO2
1	2	2	2	2
2	3	3	1	2
3	3	3	1	2
4	3	3	1	2
5	3	3	1	2
6	3	3	1	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Project Formulation and Preparation of DPR

Requirements in project formulation; Criteria fixation; Components of project; Non-monetary and monetary Criteria in formulation of project; Decision making Criteria input in Project formulation. DPR – Guidelines; Transport Projects and development of cash flow diagrams; Cost and benefit components; Discounting criteria; Preparation of Project; Highway Planning; Traffic infrastructure; Project formulation; Road Network project development; Need for Economic Evaluation; Principles of economic evaluation; Welfare economics; Social costs, Vest change, Rate of return.

Road network in India. EMI, Compound Interest

12 Hours

Unit II

Road user costs

Value of Travel time Savings; Economic concept of evaluation of travel time savings; Issues connected with evaluation of travel time savings. Vehicle operating costs; Components of VOC, Road User Cost study in India; Accident costs; Methodologies for economic evaluation of an accident; Factors involved, Basic methods of economic analysis.

EEE measures to reduce accidents, Travel time reliability.

12 Hours

Unit III

Basic methods of economic and financial analysis

Equivalent Uniform Annual Cost Method; Present worth of cost method; Equivalent uniform annual net return method; Net present value method; Benefit cost ratio method; Rate of Return Method; Applications of these methods to highway projects; Project appraisal by shadow pricing with case studies. Toll system analysis, Financial analysis; Budgeting.

Rate of Interest, Inflation, Salvage value, Monopoly

12 Hours

Unit IV

Environmental impact assessment

Basic Concepts, Objectives, Transportation Related Environmental Impacts; Vehicular Impacts; Safety and Capacity Impacts; Roadway Impacts; Construction Impacts; Environmental Impact Assessment; Environmental Impact Statement, Environment Audit, Typical case studies.

Distinguish EIA and SEA (Strategic Environmental Assessment)

12 Hours

Total: 48 Hours

Textbook (s)

1. Transportation Engineering Economics by Heggie. I. G.; Mc Graw Hill Publishers, 1972.
2. Economic Analysis for Highways by Winfrey. R; International Textbook; 1st edition, 1969

Reference (s)

1. Traffic Engineering and Transport Planning by L.R Kadiyali, Khanna Publishers, 2000
2. Road User Cost Study, CRRI
3. IRC: SP: 30-1993, Manual on Economic Evaluation of Highway Projects in India, IRC Publications, New Delhi.
4. IRC: SP: 19; 2001, Manual for Survey, Investigation & Preparation of Road Projects, IRC Publications, New Delhi.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	10	10	-
Understand	60	60	20
Apply	30	30	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is project formulation?
2. Define DPR.
3. List out any four DPR requirements.
4. What is cashflow diagram?
5. What is EIA?

Understand

1. Distinguish between monetary and non-monetary benefits.
2. Differentiate between Economical and financial analysis.
3. Explain the difference in the Shadow pricing and salvage value.
4. Explain the concept of budgeting.
5. Discuss shadow pricing with suitable case studies.

Apply

1. What is the amount of Rs.1000, compounded at (a) 6% per annum (b) 6% per every quarter, for 10 years?
2. What is the effective interest rate, when a sum of money is invested at a nominal interest rate of 10% per annum, compounded annually, semi-annually, quarterly, monthly and daily?
3. If the interest is 5% per annum , what sum would accumulate after 6 years, if Rs.1000 were invested at the end of each year for 6 years?
4. A parent wishes to establish college amount for a new born child. The parent estimates the education will cost Rs. 4,00,000, 18 years from now. If the interest on the account is guaranteed at 8% indefinitely, how much money must be invested today to have 4lakhs rupees on the child 18^{th} birthday.
5. A realtor buys a house for Rs. 2,00,000 and spends Rs.1000per year on maintenance for the next 8 years. For how much should he sell the property to make a profit Rs.40,000. Assume i=12% per annum.

21CEC33 BIM for Pre-Engineered Building

3 0 0 3

Course Outcomes

1. Explain the concepts of BIM and PEB
2. Illustrate the most practiced PEB workflow
3. Explain the BIM framework development and evaluation for PEB
4. Discuss BIM design workflows and material quantification
5. Outline the reverse modeling approach, customization and generalization
6. Summarize the 5'D BIM concept for PEB automation.

COs–POs Mapping

COs	PO3	PO5	PO10	PSO2
1	2	3	1	3
2	2	3	1	3
3	2	3	1	3
4	2	3	1	2
5	2	3	1	3
6	2	3	1	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

BIM and PEB Introduction

BIM-Introduction- Need –benefits- BIM tools and parametric modeling- Interoperability- BIM for in design and development phase-BIM in Construction Phase- BIM for Operation phase, Level of Development. PEB-Introduction- Advantages- Applications- Difference between Conventional Steel Buildings and Pre-Engineered buildings.

Model-based scheduling, Estimating, and analysis; Importance of BIM for PEB.

12 Hours

Unit II

BIM framework for PEB construction Project

Introduction- PEB industry's most practiced process and workflow-Importance and applications of BIM for PEB industry- Challenges and Obstacles of BIM implementation on PEB- Development of a BIM framework for PEB- Evaluation of the framework for PEB industry.

Risk associated with BIM implementation PEB; PEB industry Vs. Pre-fabrication industry.

12 Hours

Unit III

Automation in BIM process with PEB

Introduction- 3D model creation- 3D Coordination- Design workflows- Material quantification- Project management and reverse modeling- Customization and Generalization-Application based classification – flaw analysis- Evaluation.

LOD Classifications; Optimization in Level of Development.

12 Hours

Unit IV

5'D BIM concept for PEB automation

Introduction- Material quantification (take-off) MTO – 5D BIM vs 5D contribution for MTO and procurement system- Challenges and barriers to BIM-assisted MTO and procurement system- Resolving the 5D BIM challenges- Evaluation process 5'D BIM concepts in PEB projects.

Automation in BIM Process; BIM workflows.

12 Hours

Total: 48 Hours

Textbook (s)

1. Andre Borrmann, Markus Konig, Christian Koch, Jacob Beetz, "Building Information Modeling Technology Foundations and Industry Practice", Springer Publications.
2. Mohammad Delavar, "BIM Assisted Design Process Automation for Pre-Engineered Buildings (PEB)", Electronic Thesis and Dissertation Repository, Western Graduate & Postdoctoral Studies, The University of Western Ontario.

Reference (s)

1. Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, "BIM Handbook, A guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors", Second Edition, John Wiley & Sons, Inc. Publications.
2. Alexander Newman, "Metal Building Systems Design and Specifications", Second Edition, McGraw-Hill Publications.
3. Fabio Roberti, Decio Ferreira, "Increasing Autodesk Revit Productivity for BIM Projects, A Practical guide to using Revit workflows to improve productivity and efficiency in BIM Projects", Packt publishing Ltd.
4. Vivek K S, "Pre-Engineered Steel Building, Limit state Design of Structural Members", Atlantic Publishers

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	40	40	-
Understand	60	60	100
Apply	-	-	-
Analyze		-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Illustrate the concept of interoperability.
2. Recall the advantages and applications of PEB
3. Give your opinion on BIM framework on PEB.
4. Summarize the 5'D BIM concept for PEB automation.
5. Infer 3D coordination in PEB.

Understand

1. Demonstrate the various BIM tools and parametric modeling.
2. Explain the challenges and obstacles of BIM implementation on PEB.
3. Relate the concepts of project management and reverse modeling.
4. Illustrate the BIM's 5'D contribution on material quantification.
5. Describe BIM automation in a assumptive PEB building.

21CEC43 AI for Civil Engineering

3 0 0 3

Course Outcomes

1. Proficient in designing, implementing, and optimizing neural networks using Tensor Flow and Keras for various real time applications.
2. Proficient in fundamentals of Convolutional Neural Networks, implementing key mechanisms like convolution, pooling, and padding for image recognition.
3. Adopt at analyzing and applying major transfer learning architectures, enabling them to make informed decisions for diverse computer vision tasks.
4. Apply cutting-edge computer vision techniques, mastering object detection, instance and semantic segmentation and face recognition for solving diverse and challenging visual perception tasks
5. Proficient in NLP fundamentals, including stop words removal, tokenization, stemming, lemmatization, and the application of Bag of Words model and Word Vectorization for text data.
6. Efficiently navigate sequential data and RNNs, addressing challenges like vanishing and exploding gradients, and applying advanced models like LSTMs for effective processing of sequential data in NLP applications.

COs-POs Mapping

COs	PO1	PO2	PO4	PO5	P012
1	3	3	3	2	1
2	3	3	3	2	1
3	3	3	3	2	1
4	3	3	3	2	1
5	3	3	3	2	1
6	3	3	3	2	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Neural Networks and Deep Learning

Introduction to Perceptron & Neural Networks - Activation and Loss functions - Gradient Descent - Batch Normalization - TensorFlow & Keras for Neural Networks - Hyper Parameter Tuning.

Loss Function, Normalization

12 Hours

Unit II

Computer Vision I

Introduction to Convolutional Neural Networks - Introduction to Images - Convolution, Pooling, Padding & its Mechanisms - Forward Propagation & Backpropagation for CNNs - CNN architectures like AlexNet, VGGNet, - InceptionNet & ResNet.

Generative Adversarial Networks (GANs) for Image Generation, Transfer Learning and Fine-tuning Pretrained Models

12 Hours

Unit III

Computer Vision II

Transfer Learning - Object Detection - YOLO, R-CNN, SSD - Semantic Segmentation - U-Net - Face Recognition using Siamese Networks - Instance Segmentation.

One-Shot Learning, , Inception.

12 Hours

Unit IV

NLP (Natural Language Processing)

Introduction to NLP - Stop Words - Tokenization - Stemming and Lemmatization - Bag of Words Model - Word Vectorizer - Introduction to Sequential data – RNNs and its Mechanisms - Vanishing & Exploding gradients in RNNs - LSTMs - Long short-term memory

GRUs - Gated Recurrent Unit , LSTMs Applications

12 Hours

Total: 48 Hours

Textbook (s)

1. Nikhil Buduma, “Fundamentals of Deep Learning”, ORELLIY, 1st Edition, 2017.
2. Laurene Fausett, "Fundamentals of Neural Networks" , Pearson Education, 2004.
3. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep Learning." An MIT Press book in preparation,2015

Reference (s)

1. Satish Kumar,”Neural Networks: A Classroom Approach” Tata McGraw Hill Education, 2004.
2. Simon Haykin, " Neural networks and Learning Machines", Prentice Hall, 2008
3. Josh Patterson and Adam Gibson ”Deep Learning A Practitioner’s Approach” O’Reilly Media, Inc. 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	40	20	50
Understand	60	60	50
Apply	--	20	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. List out the various applications of AI?
2. What are the stages of learning AI?
3. What is the difference between Strong AI and Weak AI?
4. What is A* Search Algorithms in AI?
5. Explain Markov’s Decision Processes in Artificial Intelligence?

Understand

1. Explain in detail how the object detection done using AI?
2. Explain the methods used to avoid overfitting in neural networks?
3. Enumerate the real-world examples of K-means?
4. Explain in details the advantages and components of an expert system?
5. Enumerate the significance of NLP?

Apply

1. Discuss how AI can be used to analyze soil and geotechnical data to assess the stability of foundation structures and predict potential risks, aiding in better foundation design.
2. How can AI-driven systems be employed to optimize energy consumption in large buildings, utilizing smart sensors and predictive analytics to regulate heating, cooling, and lighting?
3. How can AI algorithms be applied to optimize traffic signal timings at busy intersections to reduce congestion and improve traffic flow, taking into account real-time traffic data?

21CE010 Ground Improvement Techniques

3 0 0 3

Course Outcomes

1. Understand the Principles and suitable techniques of dewatering
2. Understand the Principles and methods of grouting techniques
3. Understand diverse in situ densification methods, encompassing surface and subsurface techniques for ground improvement
4. Understand the principles and suitability of various stabilization techniques
5. Identify and improve the expansive soils
6. Classify different geosynthetics and understand their field applications

COs – POs Mappings

COs	PO2	PO12	PSO1	PSO2
1	2	1	1	3
2	2	2	2	1
3	2	2	3	2
4	3	2	3	2
5	3	3	1	2
6	2	2	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Dewatering and Grouting

Methods of de-watering - sumps and interceptor ditches- single, multi stage well points - vacuum well points- Horizontal wells-foundation drains-blanket drains- criteria for selection of fill material around drains - Electro- osmosis.

Grouting: Objectives of grouting- grouts and their properties- grouting methods - ascending, descending and stage grouting- hydraulic fracturing in soils and rocks- post grout test.

Design Steps for Dewatering Systems, Applications of Grouting

12 Hours

Unit II

In Situ Densification Methods in Cohesion less and Cohesive Soils

Vibration at the ground surface, Impact at the Ground Surface, Vibration at depth, Impact at depth. Preloading or dewatering, Vertical drains - Sand Drains, Sand wick geodrains - Stone and lime columns - thermal methods

Compaction Quality Control, Selection of Field Compaction Procedure

12 Hours

Unit III

Stabilization and Expansive Soils

Methods of stabilization mechanical cement lime bituminous - chemical stabilization with calcium chloride sodium silicate and gypsum

Expansive Soils: Problems of expansive soils - tests for identification - methods of determination of swell pressure - Improvement of expansive soils. Foundation techniques in expansive soils - under reamed piles.

Chemical Stabilization Using Natural and Synthetic Polymers

12 Hours

Unit IV

Geosynthetics and Reinforced Earth

Geotextiles- Types, Functions and applications - geogrids and geomembranes - functions and applications.

Reinforced Earth: Principles - Components of reinforced earth - factors governing design of reinforced earth walls - design principles of reinforced earth walls.

Properties of Geosynthetics, purpose of different components of reinforced earth

12 Hours

Total: 48 Hours

Textbook (s)

1. Purushotham Raj, Ground Improvement Techniques, 2st Ed., Laxmi Publications, New Delhi, 2016
2. Hausmann M.R., Engineering Principles of Ground Modification, McGraw-Hill International Edition, 2015

Reference (s)

1. Moseley M.P, Ground Improvement, 2nd Ed., Blackie Academic and Professional, Boca Taton, Florida, USA,2004
2. Xanthakos P.P, Abramson, L.W and Brucwe, D.A , Ground Control and Improvement, John Wiley and Sons, New York, USA, 1994

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	50	50	-
Apply	20	20	50
Analyze	-	-	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What do you mean by grouting?
2. List out the methods of ground improvement.
3. What is an expansive soil? Give one example.
4. What are the requirements of soil stabilization?
5. Define swell pressure.

Understand

1. Write the sequence to be followed in jet grouting with neat sketch.
2. Explain briefly the role of geosynthetics as a separator with the help of neat sketches.
3. Explain how the stone columns are installed using vibro-flotation technique with the help of neat sketch and also write the uses of stone columns.
4. Discuss the components of the reinforced earth wall with the help of a neat sketch.

Apply

1. Illustrate any two methods of in-situ densification for cohesion less soils.
2. List out the various dewatering methods. What are the dewatering methods available for fine grained soils and explain any one of the method with a neat sketch.

Analyze

1. A soil profile has an active zone of expansive soil of 3 m. The liquid limit and average natural moisture content during the construction are 54% and 19% respectively. What measures you will take before you start constructions in an expansive soil? Explain in brief**.**

21CE011 Advanced Reinforced Concrete Design

3 0 0 3

Course Outcomes

1. Design and Detail the components of a retaining wall as per the recommendations of IS Code.
2. Design & Detail the staircase as per the recommendations of IS Code.
3. Design & Detail the flat slab as per the recommendations of IS Code.
4. Design & Detail the combined footing as per the recommendations of IS Code.
5. Design & Detail the pile Foundation as per the recommendations of IS Code.
6. Design & Detail the Rectangular and circular overhead tank as per the recommendations of IS Code.

COs–Pos Mapping

COs	PO2	PO3	PO10	PO12	PSO2
1	2	3	3	3	3
2	2	3	3	3	3
3	2	3	3	3	3
4	2	3	3	3	3
5	2	3	3	2	3
6	1	3	1	2	3

3–Stronglylinked|2–Moderatelylinked|1–Weakly linked

Unit I

Retaining Walls

Introduction – Types of retaining walls –Active and passive earth pressure-Design principles of cantilever retaining walls with horizontal back fill- Design principles of Counter fort retaining walls with horizontal backfill-Reinforcement detailing and bar bending schedule.

The design of the counter-fort retaining walls, detailing of counter-fort retaining walls

12 Hours

Unit II

Staircases and Flat Slabs

Introduction- types- dog-legged staircases – Design of flat slabs – Types – Design methods, IS code recommendations–Reinforcement details.

Exterior panel design, detailing of dog-legged staircases

12 Hours

Unit III

Combined Footings and Pile Foundations

Design of combined footing - rectangular and trapezoidal footing. Types of piles–Load carrying capacity of piles – Group action in piles – Structural design of RC piles – Design of pile cap for 2 or 3 piles – Reinforcement detailing and bar bending schedule.

Trapezoidal footing, detailing of trapezoidal footing

12 Hours

Unit IV

Liquid Retaining Structures

Design of rectangular and circular water tanks- both below and above ground level- Design of overhead water tank (AsperIS3370(Part I-III))

Design of underground rectangular tank, Design of over head rectangular tank

12 Hours

Total: 48 Hours

Text Book(s)

1. N. Krishna Raju, Structural Design and Drawing (Concrete and Steel) 3rd edition, University press publications, 2005.
2. N. Krishna Raju and R.N. Pranesh, Reinforced concrete design, 1stedition, New age International Publishers, 2009.

Reference(s)

1. S.N Sinha, Reinforced concrete Design 2nd edition, Tata Mc.Hill publications, 2002.
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Limit State Design of Reinforced concrete design '1stedition, Laxmi publications, 2016.
3. Punmia B.C., Ashok Kumar Jain & Aurn Kumar Jain, Reinforced concrete structures, volume I,

5thEdition, Laxmi publications Pvt. Ltd., 2008.
4. Varghese P.C., Limit State Design of Reinforced Concrete Structures, 3rd Edition, Prentice Hall of India, 2005.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	-
Understand	20	20	-
Apply	60	60	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember
1. What is a retaining wall?
2. What is a flat slab?
3. What is a combined footing?
4. What is pile foundation and discuss its types?
5. Name three liquid retaining structures?

Understand
1. Explain about types of retaining walls and on what basis that type is selected by the designer?
2. Discuss the types of stair cases & in what situation we adopt that stair case?
3. What is the need to use combined footing?
4. In what situation, the designer will adopt Pile foundation?
5. For what stresses we design liquid retaining structures?

Apply
1. A combined rectangular footing is to be designed for two columns spaced at 6m c/c. Face of one of the columns of section 400 mm x 400 mm coincides with the property line and subjected to a load of1500KN at service state and other column section 500 mm x 500 mm and subjected to load of 2500 KN at service state. Use concrete of grade M-20 and steel Fe-415. Design the combined footing, having a central beam joining the columns. Draw the reinforcement details of transverse and longitudinal sections?
2. Design a rectangular RC water tank (resting on the ground) with an open top for a capacity of 80,000litres. The inside dimension of the tank may be taken as 6 m x 4 m. Design the side walls of the tank using M-20 and Fe- 250 grade-1 steel. Permissible stresses should comply with IS: 456:2000, and IS:3370(Part-II)-1965. Sketch cross section of the elevation and plan of the tank showing reinforcement details in the tank.
3. Design a cantilever retaining wall to retain an earth embankment with a horizontal top of 4 m above the ground level. Density of earth = 18 kN/m^3. Angle of internal friction = 30^0. SBC of soil= $200kN/m^2$. Coefficient of friction between soil and concrete =0.5. Use M-20 and Fe-415. Sketch the C/S of retaining wall showing the reinforcement details and also sketch the longitudinal section curtailment.
4. A R.C.C. retaining wall with counter forts is required to support earth to a height of 7 m above the ground level. The top surface of the backfill is horizontal. The trial pit taken at the site indicates that soil of bearing capacity 220 kN/m^2 is available at a depth of 1.25 m below the ground level. The weight of earth is $18kN/m^3$andangleofreposeis 30°. The coefficient of friction between concrete and soil is 0.58. Use concrete M20 and steel grade Fe415.Design the retaining wall**.**
5. Design a pile cap for a group of two files spaced 1.5 m apart. The piles are 400 mm diameter and the column transmits a factored load of 1000 kN and is of size 500 mm × 500 mm. Adopt M-20 grade concrete and Fe-415grade HYSD bars. Sketch the details of reinforcement.

21CE012 Construction Methods and Equipment

3 0 0 3

Course Outcomes

1. Evaluate equipment ownership and operating costs
2. Estimate the earthwork quantity and estimate the equipment requirements
3. Assess the soil stabilization techniques and equipment requirements
4. Select construction equipment appropriate to various construction-related activities
5. Assess the equipment productivity and costs
6. Estimate and schedule activities using equipment productivity and costs

COs–POs Mapping

COs	PO2	PO7	PO12
1	3	3	2
2	3	3	2
3	2	2	2
4	3	3	2
5	3	2	2
6	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Equipment Economics and Planning for Earthwork Construction

Equipment records, Cost of Capital, Elements of ownership cost, Operating cost, Replacement Decisions, Rent and Lease Considerations

Earthwork planning, Graphical Presentation of Earthwork, Earthwork Quantity, Mass Diagram

Pricing Earthwork Operations, Reduced levels for earthwork estimation

12 Hours

Unit II

Compaction and Stabilization Equipment

Compaction of Soil and Rock, Types of Compacting Equipment, Dynamic Compaction, Stabilizing Soils with Lime, Cement Soil Stabilization, Mobile Equipment Power Requirements, Required Power, Available Power, Usable Power, Performance Charts

Geotextiles and geogrids for soil stabilization, lime for soil stabilitation

12 Hours

Unit III

Excavating, Hauling, and Finishing Equipment

Introduction, Performance Characteristics of Dozers, Pushing Material, Land Clearing, Scraper types, Operation, Performance Charts, Production Cycle, Hydraulic Excavators, Shovels, Hoes; Trucks, Productivity, Performance Calculations, Graders, Trimmers

Types of cranes and uses, Gradal uses

12 Hours

Unit IV

Asphalt and Concrete Mix Production and Placement

Asphalt Mixing Plant, Hauling, Paving Equipment, Concrete mixers, Types, Agitators, Transit mixers, Placement, Finishing

Placement of dowel bars in concrete pavement construction, Finishing and tining in rigid pavement construction.

12 Hours

Total: 48 Hours

Textbook(s)

1. Peurifoy, R. L., Schexnayder, C. J., Schmitt, R. L., and Shapira, A. Construction Planning, Equipment, and Methods, 9th Edition, McGraw Hill LLC, 2018.
2. Gransberg, D. D., and Rueda-Benavides, J. A., Construction Equipment Management for Engineers, Estimators, and Owners, 2nd Edition, CRC Press, 2020.

Reference (S)

1. Sharma, S. C., Construction Equipment and Management, 1st Edition, Khanna Publishers, New Delhi, India, 2019.
2. Schaufelberger, J. E., and Migliaccio, G. C., Construction Equipment Management, 2nd Edition, Routledge, London, 2019.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	15	15	20
Understand	85	85	80
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

SAMPLE QUESTION(S)

Remember

1. What are the elements of ownership and operating costs?
2. What are the various types of equipment used for earthwork-related activities?
3. List the types of scrapers and their use
4. What are the steps followed in the asphalt mix production process?
5. What are the types of hauling and trucking equipment used in construction?

Understand

1. What is the difference between dozers, scrapers, and trucks?
2. Why soil stabilization is performed?
3. Discuss the production cycle of a crane.
4. What are the types of excavators and explain their cycle time and production with an example
5. Discuss the productivity of Side Drum Truck of 5T capacity.

21CE013 Basics of Dynamics and Earthquake Engineering

3 0 0 3

Course outcomes

1. Compute the response for single degree of freedom (SDOF) systems and for multi-degree of freedom systems (MDOF) subjected to free vibration for damped and undamped system
2. Evaluate the response of SDOF and MDOF systems subjected to forced vibrations for damped and undamped system
3. Comprehend seismic phenomena, including earthquake causes, plate tectonics, elastic rebound theory, earthquake characteristics, measurement techniques in engineering seismology
4. Identify the possible causes of failure in poorly designed structures subjected to earthquake loading.
5. Evaluate the Earthquake forces as per IS:1893 – 2002
6. Discuss the design methodology for Earthquake resistant structures as per IS codal provisions.

COs–POs Mapping

COs	PO1	PO2	PO3	PO12	PSO2
1	3	3	3	3	3
2	2	3	3	3	3
3	2	3	3	1	3
4	3	3	3	2	3
5	2	3	3	3	3
6	2	3	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Theory of vibrations and multiple degree of freedom system

Static loading and dynamic loading – Degree of freedom – idealisation of structure as single degree of freedom system – Formulation of Equations of motion of SDOF system - D'Alemberts principles – effect of damping – free and forced vibration of damped and undamped structures – Two degree of freedom system – formulation of equations of motion of multi degree of freedom (MDOF) system - Eigen values and Eigen vectors – Response to free and forced vibrations - damped and undamped MDOF system – Modal superposition methods.

Consequences of vibration, Vibration control in the design of structures

12 Hours

Unit II

Elements of seismology

Elements of Engineering Seismology - Causes of Earthquake – Plate Tectonic theory – Elastic rebound Theory – Characteristics of Earthquake-Measurement of Earthquake– Estimation of earthquake parameters - Magnitude and intensity of earthquakes – Spectral Acceleration.

Types of Earthquake, Tsunami.

12 Hours

Unit III

Response of structures to earthquake

Effect of earthquake on different type of structures – Behaviour of Reinforced Cement Concrete, Steel and Prestressed Concrete Structure under earthquake loading – Pinching effect – Bouchinger Effects – Evaluation of earthquake forces as per IS:1893 – 2002 - Response Spectra – Lessons learnt from past earthquakes.

Effect of Earthquake on Steel concrete composite structures and Water retaining structures

12 Hours

Unit IV

Design Methodology

Causes of damage – Planning considerations / Architectural concepts as per IS:4326 – 1993 – Guidelines for Earthquake resistant design – Earthquake resistant design for masonry and Reinforced Cement Concrete buildings – Later load analysis – Design and detailing as per IS:13920 – 1993.

Special Construction features of Earthquake resistant structures, Seismic strengthening of RC structures

12 Hours

Total: 48 Hours

Textbook(s)

1. Chopra, A.K., "Dynamics of Structures – Theory and Applications to Earthquake Engineering", 5th Edition, Pearson Education, 2020.
2. Damodarasamy S R, Kavitha S.," Basics of structural Dynamics and Aseismic Design", PHI Learning Private Limited, 2013.

Reference(s)

1. Agarwal. P and Shrikhande. M., "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd. 2017.
2. Biggs, J.M., "Introduction to Structural Dynamics", McGraw Hill Book Co., New York, 1964.
3. Dowrick, D.J., "Earthquake Resistant Design", John Wiley & Sons, London, 2019.
4. Paz, M. and Leigh.W. "Structural Dynamics – Theory & Computation", 4th Edition, CBS Publishers & Distributors, Shahdara, Delhi, 2016.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	30	30	40
Apply	40	40	60
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. What is underdamped system and overdamped system?
2. What are the consequences of vibration?
3. Write orthogonal principles in two degrees of freedom.
4. List out any four recent Indian earthquakes with year and magnitude of occurrence
5. What is meant by frequency ratio?

Understand

1. State and prove orthogonality property of mode shapes.
2. Explain briefly plate tectonic theory.
3. Describe faults and types of earthquake.
4. Explain briefly about elastic rebound theory.
5. Write the characteristics of strong ground motion**.**

Apply

1. A vibratory system consist of 1000kN and a spring of 80kN/m. The damped ratio of two successive amplitude is 1,0.85.Determine the a) Logarthmic decrement b) Damped frequency c) Damping ratio d) Ratio of two successive amplitudes.
2. Determine the natural frequencies and mode shapes of the system shown in Figure

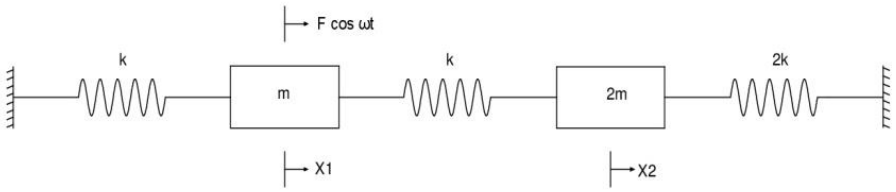


Figure .1

3. Determine the natural frequencies shown in Figure .2.

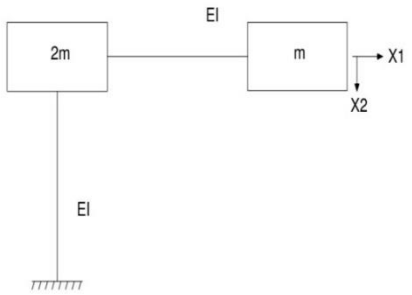


Figure.2

4. A three storeyed symmetrical RC school building situated at Bhuj with following data:
   Plan dimension: 7 m
   Storey height: 3.5 m
   Total weight of beams in a storey: 130 kN
   Total weight of slab in a storey: 250 kN
   Total weight of columns in a storey: 50 kN
   Total weight of walls in a storey: 530 kN
   Live load : 130 kN Weight of terrace floor : 655 kN
   The structure is resting on hand rock. Determine the total base shear and lateral loads at each floor level for 5% of damping using seismic coefficient method

5. A four-storey reinforced concrete frame building as shown in Figure.3 is situated at Roorkee. The height between the floors is 3 m and total height of building is 12 m. The dead load and live load is lumped at respective floor. The soil below the foundation is assumed to be hard rock. Assume building is intended to be used as a hospital. Determine the total base shear as per IS1893 (PART1): 2002. Distribute the base shear along the height of the building.

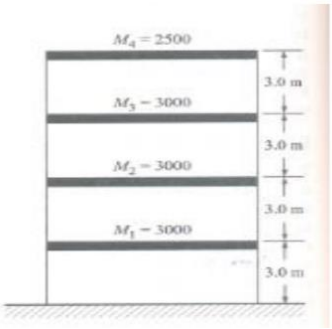


Figure.3

21CE014 Pavement Analysis and Design

3 0 0 3

Course outcomes

1. Foundational understanding of pavement engineering
2. Proficiency in pavement material characterization
3. Evaluate structural and functional stresses in flexible and rigid pavement
4. Synthesize components of flexible pavement design
5. Synthesize components of rigid pavement design
6. Evaluate the distress states of pavement and recommend maintenance measures

COs–POs Mapping

COs	PO3	PO12	PSO2
1	3	2	3
2	3	3	3
3	3	3	3
4	2	2	3
5	2	2	3
6	2	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Pavement Engineering

Functions of Pavements; Types of Pavements: Flexible, Rigid, Composite Pavements; Variables Considered in Pavement Design: Material Characteristics, Traffic Volume, Factors related to Axle and Wheel Loads, Concept of Equivalent Single Wheel Load (ESWL), Factors related to Climatic and Surrounding Environment; Drainage Considerations.

IRC Traffic Loading Classifications, axle configurations

12 Hours

Unit II

Pavement Materials: Stresses and Strains

Necessity of Pavement Materials Characterization, Soil: Resilient Modulus, Permeability, Shear Test, CBR Test, Plate Load Test; Stone Aggregate: Crushing Test, Impact Test, Abrasion Test, Shape Test, Water Absorption and Specific Gravity; Bituminous Materials: Viscosity, Ductility, Specific Gravity; Bituminous Mixes: Marshall Test; Stresses and Strains in Flexible Pavement using: Single layer and Double layer theory; Stresses and Strains in Rigid Pavement for: Wheel Load, Temperature and Friction.

Marginal Pavement Materials, elastic recovery of bituminous materials

12 Hours

Unit III

Design of Components in Flexible and Rigid Pavement

Overview of IRC design method for Flexible Pavement and Rigid Pavement; Design of Flexible Pavement: Salient features of IRC: 37 (2018), Design of Flexible Pavement using IRC: 37 (2018) guidelines, Design of Rigid Pavement using IRC: 58 (2015) guidelines; Design of Joints in Rigid Pavements: Tie Bars, Dowel Bars, Tie Bars.

Semi-rigid Pavements, IIT Pave

12 Hours

Unit IV

Introduction to Highway Maintenance and Management

Importance of Highway Maintenance Works; Deterioration and Damages in Road Infrastructure; Maintenance requirement for different Road Components; Distresses in Flexible Pavement and Maintenance Measures; Distresses in Rigid Pavement and Maintenance Measures; Structural Evaluation of Flexible Pavement by using Benkelman Beam Deflection Approach.

Pavement Overlay, Falling Weight Deflectometer

12 Hours

Total: 48 Hours

Textbook(s)

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019

Reference(s)

1. Yang H. Huang, Pavement Analysis and Design, 2nd Edition, Pearson, 2004
2. E. J. Yoder, M. W. Witczak, Principles of Pavement Design, 2nd Edition, Wiley, 2015
3. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018
4. IRC: 58 Guidelines for the design of rigid pavements (2015)
5. IRC: 37 Guidelines for the design of flexible pavements (2018)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	10
Understand	30	30	30
Apply	30	30	40
Analyze	20	20	20
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. List the variables considered in flexible pavement design.
2. What is the effect of temperature differential in the design of slab thickness?
3. What are the methods of flexile pavements construction?
4. List the various maintenance works of bituminous surfaces.
5. List the various layers of flexible pavements.

Understand

1. Outline the importance of rigid pavements over Flexible pavements.
2. Explain ESWL and the concept in the determination of the equivalent wheel load.
3. Explain the factors governing the design of concrete pavements for low volume roads.
4. Classify different types of joints in cc Pavements of a rigid pavement and mention the objects of each.
5. Explain the functions of various component layers of pavements.

Apply

1. A circular load of radius 16cm with uniform contact pressure of 7.5 kg/cm2 is applied on the surface of homogeneous elastics mass. Determine the vertical stress under the center of the load at a depth of 48cm from the surface using stress distribution chart for single layer.
2. Determine the EWLF or VDF value of the following two axle loads in terms of the standard axle load of 8.16 t (a) LCV with rear axle load of 1.8t (b) HCV with rear axle load of 16.0t
3. Determine the total thickness of flexible pavement assuming single layer elastic theory and using the following data: Design wheel load = 5100kg, p=7 kg/cm2, E=180 kg/cm2, permissible deflection =0.25 cm.
4. Determine the spacing between contraction joints for 3.5 meters slab width having thickness=22cm and f=1.5, for the following two cases
   For plain cement concrete, allowable S_c = 0.8 kg/cm^2. For reinforced cement concrete, 2.0 cm dia. Bars at 0.4m spacing.
5. Design a Bituminous pavement with
   (a) Granular base and sub-base
   (b) Cemented base and sub-base with SAMI layer over CT-Base course

   Data:
   1. 4-lane divided carriageway
   2. Initial traffic in each direction in the year completion of construction = 5500 CV/day
   3. Design life = 15 years
   4. Design CBR of subgrade soil = 5%
   5. Traffic growth rate = 5%
   6. Vehicle damage factor = 4.5

Analyze

1. Discuss the Westergaard's concept and assumptions for wheel load and temperature stresses.
2. Plate bearing test conducted with 30 cm diameter plate on a subgrade sustained a load of 1500 kg at 0.25cm deflection. The test when carried out on a base course of thickness 18 cm sustained a load of

5500 kg at 0.25 cm deflection. Determine the thickness of pavement section for a wheel load of 5500 kg with tyre pressure of 7.5 kg/cm^2 using Burmister's approach.

3. Calculate the spacing of expansion joint from the following data Maximum joint width = 2cmTemperature of laying concrete= 20^{o}C Maximum slab temperature expected = 55^{o}C Coefficient of thermal expansion=10 x 10^{-6} per ^{o}C
4. Determine the CC pavement thickness which is to be constructed in Nellore district of Andhra Pradesh for a national highway , spacing of expansion and contraction joints, dowel bars and tie bars for a wheel load of 5100 kg. Assume all suitable data
5. The CBR value of subgrade soil is 8 percent. Determine the most economical flexible pavement design thickness by comparing the design using
    - Design curve developed by California State Highway Department
    - Design chart recommended by IRC
    - Design formula developed by the U.S. Corps of Engineers

    Assume light traffic or 3175 kg wheel load and tyre pressure of 5 kg/cm^2

21CE015 Prestressed Concrete Structures

3 0 0 3

Course Outcomes

1. Explain the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing
2. Evaluate the short-term and long-term losses in prestressing and design prestressed structures considering these losses
3. Analyse the stresses in a prestressed concrete member
4. Analyse the flexural behaviour and effect of shear in a prestressed concrete member
5. Design the prestressed concrete members for flexure and shear
6. Calculate the short term and long-term deflection in prestressed members

COs–POs Mapping

COs	PO3	PO10	PO12	PSO2
1	3	3	2	2
2	3	3	1	2
3	3	2	1	2
4	3	2	1	2
5	3	2	1	2
6	2	3	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Prestressed Concrete

Historic development – General principles of prestressing, pretensioning and post tensioning – Advantages and limitations of prestressed concrete – Materials – High strength concrete and high tensile steel their characteristics. I.S. Code provisions, Methods and Systems of Prestressing; Pre-tensioning and post tensioning methods – Analysis of post tensioning - Different systems of prestressing like Hoyer System, Magnel System Freyssinet system and Gifford – Udall System.

Properties of Strands, Properties of Tendon

12 Hours

Unit II

Losses and Analysis of Prestress

Loss of prestress in pre-tensioned and post-tensioned members due to various causes like elastic shortage of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel and frictional losses. Load Balancing Concept. Elastic analysis of concrete beams prestressed with straight, concentric, eccentric, and parabolic tendons.

Cracking moment, Anchorage Slip

12 Hours

Unit III

Design of Sections for Flexure and Shear

Allowable stress, Design criteria as per IS Code – Elastic design of simple rectangular and I-section for flexure, shear, and principal stresses – design for shear in beams – cable profile, Detailing requirements for shear and flexure. Transmission of Prestress – Transmission length – End zone reinforcement.

Kern Lines, Flexural strength for T-section

12 Hours

Unit IV

Deflections of Prestressed Concrete Beams

Importance of control of deflections – factors influencing deflections – short term deflections of uncracked members, stage wise prestressing. Limits of span-to-effective depth ratio Calculation of Crack Width – Method of calculation – Limits of crack width

Prediction of long-term deflection, short term deflection of cracked members

12 Hours

Total: 48 Hours

Textbook (s)

1. N. Krishna Raju, Prestressed Concrete, 4th Ed., Tata Mc. Graw Hill Publications,2006
2. N. Rajasekharan, Prestressed Concrete, 2nd Ed., Narosa Publications, 2014

Reference (s)

1. S. Ramamrutham, Prestressed Concrete,5th Ed., Dhanpatrai Publications, 2013
2. T.Y. Lin & Ned H. Burns, Design of Prestressed concrete structures, 3rd Ed., John Wiley & Sons,1981
3. BIS code on prestressed concrete, IS 1343.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	30	20	-
Understand	20	20	-
Apply	25	30	70
Analyze	25	30	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is known as kern zone and pressure line?
2. Define cracking moment.
3. What is the necessity of shear reinforcement?
4. List out short-term and long-term deflection.
5. What are the remedies for flexure and shear failure?

Understand

1. Write the advantages and limitations for prestressed concrete.
2. Differentiate between Pre tensioning and Post tensioning
3. Write the various types of prestressing systems in pre tensioned and post tensioned.
4. Discuss the importance of control of deflections and factors influencing deflections.
5. How the cable profile will affect the deflection of PSC member? Explain with neat sketch.

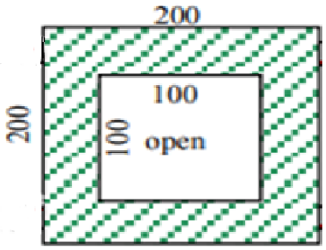
Apply

1. A prestressed concrete beam, 200 mm wide and 300 mm deep, is prestressed with wires area of 320 mm^2 located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/ mm^2. The span of the beam is 10 m. Calculate the percentage of loss of stress in wires if (a) the beam is pretensioned and (b) the beam is post tensioned, using the following data: Modulus of elasticity of steel = 210 kN / mm^2; Modulus of elasticity of concrete = 35 kN / mm^2 ; Shortening due to creep = 30 x 10^{-6} mm /mm per N / mm2 of stress; Shrinkage of concrete for pretensioning = 300 x 10^{-6} mm per unit length; and posttensioning 200 x 10-6 mm per unit length; Relaxation of steel stress = 5 % of initial stress; Creep coefficient = 1.6; Slip at anchorage = 1 mm; Frictional coefficient for wave effect = 0.0015 per m.
2. A post-tensioned bridge girder with unbonded tendons is of box section of overall dimensions 1200 mm wide by 1800 mm deep, with wall thickness of 150 mm. The high-tensile steel has an area of 4000 mm^2 and is located at an effective depth of 1600 mm. The effective prestress in steel after all losses is 1000 N/mm2 and the effective span of the girder is 24 m. If fck = 40 N/mm^2 and fp = 1600 N/mm2, estimate the ultimate flexural strength of the section using IS code provisions.
3. A concrete beam is prestressed by a cable carrying an initial prestressing force of 300kN. The cross-sectional area of the wires in the cable is 300 mm^2. Calculate the percentage of loss of stress in the cable only due to shrinkage of concrete using IS: 1343 recommendations assuming the beam to be, (a) pre-tensioned and (b) post-tensioned. Assume Es = 210 kN/mm^2 and age of concrete at transfer = 8 days.
4. An unsymmetrical I – section is used for a 30 m span prestressed concrete bridge girder having the top flange width and thickness of 1200 and 250 mm. The web is 1500 mm deep and 200 mm thick. The bottom flange is 500 mm wide and 400 mm deep. The girder is prestressed by cables having an initial tensile force of 6053 kN at an eccentricity of 850 mm at centre of span and 180 mm at the supports. The girder has to support an ultimate shear force of 1909 kN at the supports. The loss ratio is 0.85. Cube strength of concrete as 50 N/mm^2 and Fe 415 HYSD bars of 8 mm diameter, design suitable spacing for the stirrups conforming to the IS: 1343 – 2012 recommendations.

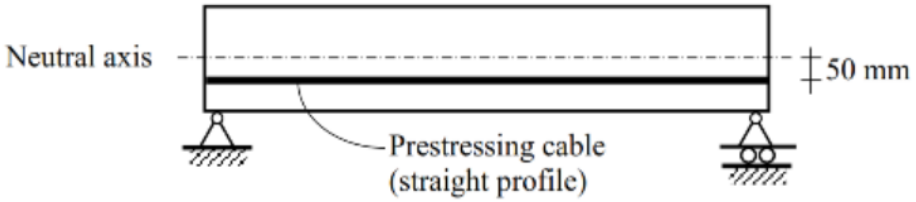
5. A pretensioned T section has a flange width of 1200mm and 150mm thick. The width and depth of the rib are 300mm and 1500mm respectively. The high-tension steel has an area of 4700mm^2 and is located at an effective depth of 1600mm. If the characteristic cube strength of the concrete and the tensile strength of steel are 40Mpa and 1600Mpa respectively; calculate the flexural strength of the section.

Analyze

1. A concrete beam with a symmetrical I section has flange width and depth of 200 mm and 60 mm, respectively. The thickness of the web is 80 mm and over all depth is 400 mm. The beam is prestressed by a cable carrying a force of 1000kN. The span of the beam is 8 m. The centre line of the cable is 150 mm from the soffit of the beam at the centre of span, linearly varying to 250 mm at the supports. Compute the initial deflection at mid span due to prestress and the self-weight of the beam, assuming Ec = 38kN/mm^2. Compare the deflection with the limiting deflection permitted in IS 1343 (Dc = 24kN/m^3).
2. A simply supported beam with a uniform section spanning over 6m is post tensioned by two cables both of which have an eccentricity of 100mm below the centroid of the section at mid span. The first cable is parabolic and is anchored at an eccentricity of 100mm above the centroid at each end, the second cable is straight and parallel to the line joining the supports. The C/S area of each cable is 100mm2 and they carry an initial stress of 1200 MPa. The concrete has a c/s of 20000 mm2 and a radius of gyration of 120 mm. The beam supports two concentrated loads of 20kN each at the third points of the span. Ec = 38kN/mm^2. Calculate
    a) The instantaneous deflection at the centre of span
    b) The deflection at the centre of span after 2 years, assuming 20% loss in prestress and the effective modulus of elasticity to be one-third of the short-term modulus of elasticity
3. A concrete beam having a rectangular section 100mm wide and 300mm deep is prestressed by a parabolic cable carrying an initial force of 240kN. The cable has an eccentricity of 50mm at the centre of span and is concentric at the supports. If the span of the beam is 10m and the live load is 2kN/m, estimate the short-term deflection at the centre of the span.
   Assuming Ec = 38kN/mm^2 and creep coefficient is 2, loss of prestress is 20% of the initial stress after 6 months. Estimate the long-term deflection at the centre of the span at this stage assume the dead load and live load are simultaneously applied after the release of prestress.
4. A hollow member is reinforced with 4 wires of 62.5 mm^2 each pretensioned f_{si} = 1030MPa. If fc = f_{ci} = 34.4 MPa, n = 7, determine the stresses when the wires are cut between members. Determine the moment that can be carried at a maximum tension of 0.5√(fc) and a maximum of fc= 0.45fc. If 240 MPa of the prestress is lost (in addition to the elastic deformation) determine this limiting moment.



5. A 6 m long simply supported beam is prestressed as shown in the figure.



The beam carries a uniformly distributed load of 6 kN/m over its entire span. If the effective flexural rigidity EI = 2×10^4 kNm^2 and the effective prestressing force is 200 kN, Find the net increase in length of the prestressing cable.

21FIX01 Full Semester Internship (FSI)

0 0 0 8

Course Outcomes

1. Use the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. Select appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
4. Use ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
5. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
6. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Cos – POs Mapping

COs	PO1	PO2	PO5	PO8	PO9	PO10	PSO1	PSO2
1	3							3
2		3						3
3			3					
4				3				
5					3		1	1
6						3	3	

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

21CE016 Repair and Rehabilitation of Structures

0 0 0 3

Course Outcomes

1. Understand structural distress and deterioration in various types of structures, including the causes, mechanisms, and preventative measures to mitigate deterioration
2. Understand structural deterioration due to corrosion of steel reinforcement, exploring its causes, effects, mechanisms, and prevention strategies.
3. Acquire knowledge on damage assessment methodologies, including non-destructive testing (NDT), semi-destructive tests to assess structural integrity
4. Identify the appropriate method for strengthening of existing members
5. Understand levels and components of structural health monitoring system, recognizing its necessity for continuous monitoring of structures
6. Gain knowledge of smart materials and their applications in SHM, understanding their role and significance in enhancing structural monitoring and ensuring structural health.

Cos – POs Mapping

COs	PO2	PO7	PO12	PSO2
1	3	3	2	3
2	3	3	2	3
3	2	2	2	3
4	3	3	2	3
5	3	2	2	3
6	2	2	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Structural Distress and Structural Damage

Introduction to Structural Distress – Deterioration of Structures – Causes and prevention of Deterioration. Introduction to Structural Damage– Types of causes of Damage-Mechanism of Damage.
Importance of Maintenance – Facets of Maintenance – Need for Rehabilitation

12 Hours

Unit II

Corrosion and Damage Assessment

Introduction to Corrosion of Steel Reinforcement – Causes and Effects – Mechanism and Prevention of Corrosion. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation Introduction to Damage assessment, Inspection and Testing – Symptoms and Diagnosis of Distress – Damage assessment – NDT – Mechanical and Chemical Properties – Semi destructive Tests
Ground Penetrating Radar (GPR) – NDT Methods for Corrosion Monitoring

12 Hours

Unit III

Damage Repairs and Retrofitting

Introduction to Repair of Structure – Common Types of Repairs – Material selection for Repair – Repair in Concrete Structures – Repairs in Under Water Structures – Repair Techniques – Guniting – Shotcrete – Underpinning. Introduction to Retrofitting – Strengthening of Structures – Strengthening Methods – Retrofitting techniques – Jacketing
Rust Eliminators – Seismic Retrofitting of Beams and Columns

12 Hours

Unit IV

Structural Health Monitoring

Introduction – Need for continuous monitoring – Levels of system Identification – Components of SHM system –Techniques of SHM – Sensors, actuators and its role in SHM – Principle and organization of a SHM system – Smart materials in SHM
Non-Invasive techniques for SHM – Case study using SHM and Building Instrumentation in SHM

12 Hours
Total:48 Hours

Text Book(s)

1. Poonam I. Modi, Chirag N. Patel, Repair and Rehabilitation of Concrete Structures, PHI Learning Pvt. Ltd.,
2. E F & N Spon, Defects and Deterioration in Buildings, 2nd Ed., Spon press London

Reference(s)

1. W. H. Ranso, Concrete Repair and Maintenance Illustrated, RS Means Company Inc, 1993
2. B. A. Richardson, Building Failures: Diagnosis and Avoidance, EF & N Spon, London, 1991
3. Bungey, Non-Destructive Evaluation of Concrete Structures, Surrey University Press, 1982
4. B.L. Gupta and Amit Gupta, Maintenance and Repair of Civil Structures, 1st Ed., Standard Publications, 2009

Internal Assessment Pattern

Cognitive Level	Int. Test 1(%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	15	15	-
Understand	85	85	100
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What are the main distress symptoms in a structure?
2. What are the causes for deterioration and distress in structures?
3. What are the various crack repair techniques?
4. Define the terms Repair, Rehabilitation and Retrofitting of structures with examples.

Understand

1. How can the defects and cracks be prevented to appear in concrete? How can these be repaired?
2. Enunciate different causes of cracks in concrete elements.
3. How is corrosion caused in reinforcing steel in R.C. work? Explain some, of the corrosion control methods commonly adopted.
4. List the various non-destructive testing methods for determining physical conditions of concrete and monitoring of defects. Give short details of the tests.
5. Discuss the evaluation procedure for repair and strengthening of concrete structures deteriorated due to corrosion.

21CE017 Spatial Analysis Techniques in Remote Sensing and GIS

0 0 0 3

Course Outcomes

1. Understand the basic concepts, platforms, and sensors involved in remote sensing.
2. Understand GIS, its fundamental operations, and its applications in different fields
3. Explain the geographic information system and its related concepts like database management and metadata.
4. Illustrate foundational understanding of spatial data models.
5. Understand the fundamentals of geospatial data analysis.
6. Apply GIS and remote sensing techniques in engineering geology, water resources engineering, and transportation engineering.

COs–POs Mapping

COs	PO1	PO2	PO5
1	3	1	2
2	3	2	2
3	3	1	3
4	3	2	3
5	3	3	3
6	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Basic Concepts, Platforms and Sensors

Remote Sensing Concepts: Basic Concepts and Foundation of remote sensing, Elements involved in Remote Sensing, Electromagnetic Spectrum, Remote Sensing Terminology and Units, Energy Resources, Energy Interactions with Earth Surface features and Atmosphere, Spectral properties of Vegetation, Soil and Water bodies. Remote Sensing Platforms & Sensors: Introduction, Characteristics of Imaging Remote Sensing Instruments, Satellite Remote Sensing System - A Brief Overview, other Remote Sensing Satellites, Concept of Resolution in Remote Sensing.

Indian Remote Sensing Satellites and their features-Indian Space Program

12 Hours

Unit II

Geographic Information System

Geographic Information System: Introduction, GIS definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, A theoretical framework for GIS, Applications and Advantages of GIS, Layer based GIS, Feature based GIS mapping, Functions of GIS, Process of GIS. Data Management and Metadata Concept: Introduction, Concept of Database and DBMS, Advantages of DBMS, Functions of DBMS, File and Data Access, Data Models, Database Models, Data Models in GIS.

Concept of Meta Data

12 Hours

Unit III

Spatial Data Model and Geospatial Analysis

Spatial Data Model: Introduction, Different dimensions of Geographic Data, Spatial Entity and Object, Spatial Data Model, Raster Data Model, Vector Data Model, Raster versus Vector, Object Oriented Data Model, File Formats of Spatial Data.

Geospatial Analysis: Introduction, Geospatial Data Analysis, Integration and Modelling of Spatial Data, Geospatial Data Analysis Methods, Database Query, Geospatial Measurements, Overlay Operations, Network Analysis, Surface Analysis.

Raster Data Spatial Analysis-Introduction to Web GIS

12 Hours

Unit IV

Applications of GIS and Remote sensing

Applications in Engineering Geology and Water Resources Engineering: LULC, Agriculture, Forestry, Geology, Geomorphology, Urban Development, Flood Zone Delineation and Mapping, Ground Water Prospects and Recharge. Applications in Transportation Engineering: GIS database design for Physical Facility Planning, Decision Support Systems for Land Use Planning. GIS based Highway Alignment, GIS based Road Network Planning and GIS based Traffic Congestion Analysis, Accident investigation.
Irrigation Management-Rainfall-Runoff Modelling

12 Hours
Total: 48 Hours

Textbook (s)

1. Thomas M Lillesand, Ralfh W Kiefer, Jonathan.W. Chipman, Remote Sensing and Image Interpretation, 5th Ed., Wiley India Pvt. Ltd, 2014.
2. Basudeb Batta, Remote Sensing and GIS, 2nd Ed., Oxford University Press, New Delhi, 2011.

Reference (s)

1. Floyd F. Sabins, Remote Sensing: Principles and Interpretation, 3rd Ed., W.H.Freeman and Company, New York, 1997.
2. James B. Cambell, Rondolph H. Wynne, Introduction to Remote Sensing, 5th Ed., Guilford Press, London and Newyork, 2011.
3. A.M.Chandra and S.K.Ghosh, Remote Sensing and Geographical Information System, 1st Ed., Narosa Publishing House, New Delhi, 2007.
4. M.Anji Reddy, Text Book of Remote Sensing and Geographical Infromation Systems, 4th Ed., BS Publications, 2012.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	10	10	-
Understand	40	40	50
Apply	50	50	50
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. List ten remote sensing satellites launched by India.
2. What are the requirements of ground data in remote sensing data analysis?
3. Define interpretation key.
4. Define GIS.
5. Define Spatial data and attribute data.

Understand

1. Illustrate the importance of GIS in the context of infrastructure.
2. Explain the process to integrate the spatial and non spatial data to make a GIS project
3. Describe vector overlay with suitable examples.
4. Illustrate the use of multi seasonal remote sensing data in wasteland classification.
5. Summarise the scientific approach of remote sensing data analysis

Apply

1. Utilize RS and GIS techniques for the preparation of LULC.
2. Construct the flow chart for highway alignment using RS and GIS techniques.
3. Apply the RS and GIS techniques to solve traffic congestion problems in any urban area.
4. Apply RS and GIS techniques to evaluate the potential sites for artificial recharge of ground water.

21CE018 Pavement Management System

0 0 0 3

Course Outcomes

1. Expand knowledge on fundamental aspects of Pavement Management System (PMS).
2. Demonstrate structural and functional evaluation techniques for pavements.
3. Differentiate distress and surveys conducted on pavements.
4. Analyze design strategies and conduct economic evaluations.
5. Apply expert systems in pavement management systems.
6. Develop knowledge on project appraisal and its components.

Cos – POs Mapping

COs	PO5	PO12
1	1	1
2	2	1
3	3	2
4	2	1
5	1	3
6	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Pavement Management Components Levels and functions

Definition - Components of pavement management systems, essential features. ideal PMS - network and project levels of PMS - influence levels - PMS functions – function of pavement evaluation

Major Phases and Components of the Pavement System Methods - Various Tools and Usage in Pavement Management Systems

12 Hours

Unit II

Pavement Performance and Evaluation of Pavement Structural capacity

Serviceability concepts – roughness - roughness components – equipment – IRI - modelling techniques, structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models, basics - Non-Distractive Testing (NDT) and Analysis — Condition Surveys – Distress - Destructive Structural Analysis - Application in Network and Project Levels

User Related Evaluation Vs. Engineering Evaluation of Pavements - Pavement Evaluation with respect to User Cost and Benefits

12 Hours

Unit III

Pavement Design Selection and Alternatives

Design objectives and constraints, basic structural response models, physical design inputs, Alternate pavement design strategies and economic evaluation, life cycle costing, analysis of alternate pavement strategies based on distress and performance, case studies. Equipment.

General Response of Pavement Subjected to Traffic Loads and Temperature Induced Stresses

12 Hours

Unit IV

Expert Systems and Pavement Management, Project Appraisal decision support system

Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge - based expert systems, case studies. Project appraisal: private sector participation - Environmental impact assessment – Total Quality Management (TQM) in highway projects

Rehabilitation and Maintenance Policies - Methods for Economic Evaluation of Pavement

12 Hours

Total: 48 Hours

Textbook(s)

1. Ralph Haas, W. Ronald Hudson, Pavement Management Systems, McGraw Publishers, 2015
2. S. K. Khanna & C. E. G Justo, Highway Engineering, 10th Ed., Nem Chand & Bros., Publisher, 2018

Reference(s)

1. AASHTO Guidelines on Pavement Management, American Association of State Highway and Transportation Officials, Washington D.C., 9p. 1985.
2. National Cooperative Highway Research Program Synthesis of Highway Practice 135: Pavement Management Practices. NCHRP, TRB, National Research Council. Washington, D.C. 1987
3. National Cooperative Highway Research Program Synthesis 222: Pavement Management Methodologies to Select Projects and Recommend Preservation Treatments. Transportation Research Board, National Research Council. Washington, D.C. 1995.
4. International Roughness Index. Web page from the Road Roughness Home Page: http://www.umtri.umich.edu/erd/roughness/iri.html).
5. Pavement Performance, Lijun Sun, in Structural Behaviour of Asphalt Pavements, ScienceDirect, 2016.
6. IRC 115. (2014). Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique. New Delhi.

Internal Assessment Pattern

Cognitive Level	In Test 1(%)	In Test 2(%)	Open Book/Assignment Exam(%)
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	**100**	**100**	**100**

Sample Question(s)

Remember

1. Illustrate the components of PMS
2. List out the equipment involved in non-distractive testing of highway performance.
3. Explain the concept of life cycle cost with respect to a highway.
4. List out the model available to assess the present condition of highway and explain the significance of each model in PMS.
5. Explain the concept of project appraisal in context of highway project and illustrate major involved in it.

Understand

1. Explain the difference between the PMS at network level and project level.
2. Explain the concept of pavement serviceability and methods to evaluate it.
3. Relate the concepts of PMS to new highway project and illustrate the data required in various steps of PMS.
4. Explain the role of alternative design strategies for highway project implementation and clearly discuss various steps involved in pavement rehabilitation.
5. Explain the relevance of environment impact assessment with respect to highway projects.

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Open Electives - AR21 Regulations

No.	Course Code	Course	POs	L	T	P	Credits
1	21CE001	Disaster Management	2,7	3	-	-	3
2	21EE001	Electrical Installation, Safety and Auditing	2,3,6,8	3	-	-	3
3	21ME001	Fundamentals of Optimization Techniques	1,2,3,5	3	-	-	3
4	21EC001	Sensors for Engineering Applications	1	3	-	-	3
5	21CS001	Fundamentals of Artificial Intelligence	1,2,3	3	-	-	3
6	21CH001	Energy Conversion and Storage Devices	1,3,6,7	3	-	-	3
7	21IT001	Fundamentals of Multimedia	3,5,7	3	-	-	3
8	21BS001	Nano Materials and Technology	1,12	3	-	-	3
9	21DS001	Fundamentals of Data Science	1,2	3	-	-	3
10	21CE002	Air Pollution and Environmental Impact Assessment	6,7,12	3	-	-	3
11	21EE002	Renewable Energy Sources	2,7	3	-	-	3
12	21ME002	Principles of Entrepreneurship	1,5,8,11	3	-	-	3
13	21EC002	Electronics for Agriculture	1,2	3	-	-	3
14	21CS002	Fundamentals of Machine Learning	2,5	3	-	-	3
15	21CH002	Industrial Safety and Hazard Management	1,2,3,6,8	3	-	-	3
16	21IT002	Fundamentals of Cloud Computing	2,6,7,8,12	3	-	-	3
17	21BS002	Advanced Numerical Techniques	1,2	3	-	-	3
18	21BS003	Functional Materials and Applications	1,7	3	-	-	3
19	21CE003	Solid Waste Management	3,7,12	3	-	-	3
20	21EE003	Fundamentals of Electrical Vehicle Technology	2,3,12	3	-	-	3
21	21ME003	Industrial Engineering and Management	1,11	3	-	-	3
22	21EC003	Interfacing and Programming with Arduino	1,2	3	-	-	3
21	21CS003	Data Science for Engineering Applications	2,3,4	3	-	-	3
24	21CH003	Industrial Ecology for Sustainable Development	2,6,7	3	-	-	3
25	21IT003	Fundamentals of Mobile Computing	1,7	3	-	-	3
26	21BS004	Advanced Materials of Renewable Energy	1,7	3	-	-	3
27	21BS005	Applied Linear Algebra for Engineers	1,12	3	-	-	3
28	21CE019	Green Buildings	1,7,12	3	-	-	3
29	21EE017	Sustainable Energy	2,3,12	3	-	-	3
30	21ME019	Total Quality Management	1,11	3	-	-	3
31	21EC011	Communication Technologies	1,2	3	-	-	3
32	21CS020	Applications of Artificial Intelligence	2,3,6,7	3	-	-	3
33	21CH016	Green Technologies	2,6,7	3	-	-	3
34	21IT015	Human Computer Interaction	1,7	3	-	-	3
35	21BS006	Handling of Industrial waste and waste water	1,7	3	-	-	3
36	21OE001	Robotics and Automation	5,6,7	3	-	-	3
37	21OE002	Introduction to IoT	1,2	3	-	-	3
38	21OE003	Fundamentals of Image processing	1,2	3	-	-	3
39	21OE004	Fundamentals of Data Acquisition systems	1,2	3	-	-	3
40	21OE005	Airport Operations Management	2,4,11,12	3	-	-	3
41	21OE006	Fundamentals of Embedded Systems	1,2	3	-	-	3
42	21OE007	Remote Sensing and GIS	1,2,5,7,10	3	-	-	3
43	21OE008	Big Data Analytics	1,7	3	-	-	3
44	21OE009	Fundamentals of Cyber Security	3,6,8	3	-	-	3
45	21OE010	Smart Cities	7,12	3	-	-	3
46	21OE011	Nano Materials and Thin Film Technology	1,12				
47	21CSMC1	Cloud computing	2,3	3	-	-	3
48	21CSMC2	Ethical Hacking	1,2,3	3	-	-	3
49	21CSMC3	Fundamentals of Web Development	2,3,5	4	-	-	4
50	21OE012	Business Intelligence & Analytics	2,3,5	3	-	-	3
51	21OE013	Introduction To Industry 4.0 And Industrial IoT	2,3	3	-	-	3
52	21OE014	Natural Language Processing	2,3	3	-	-	3

21CE001 Disaster Management

3 0 0 3

Course outcomes

1. Build knowledge about need and importance of hazard management in the concern field
2. Understand the causes of Natural and Manmade disasters
3. Discuss the mitigation measures for Natural and Manmade disasters
4. Understand the importance of science and technology in disaster risk management
5. Build knowledge on importance of authorities and their risk management
6. Understand the scenarios of various disasters and mitigation

COs–POs Mapping

COs	PO2	PO7
1	2	2
2	3	3
3	3	2
4	3	3
5	1	2
6	1	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Disaster Management

Components of disaster management-Organizational structure for disaster management–Disaster management schemes- Disaster Risk Reduction–Global Policies and Practices - Basic Strategies and Practices of Disaster Reduction- Disaster Risk Reduction with Global Framework.

Role of Government and NGO Bodies, Role of Engineers on Disaster Management.

12+3 Hours

Unit II

Natural and Manmade Disasters

Management of Natural Disasters: Floods, Droughts, Earthquakes, Global Warming, Cyclones, Landslides, Tsunamis Causes, effects, mitigation. Effects on poverty, Climate Change and Human Health.

Management of Manmade Disasters: Solid waste, Fire, Bio-terrorism, Emerges infectious diseases, Transportation Accidents, Structural failures Causes, effects, mitigation.

Volcanic eruptions, mining.

11+4 Hours

Unit III

Science and Technology in Disaster Management

Implementation of Technology for Infrastructure, Disaster Management for Infrastructure, Geospatial Information in Agriculture Drought Assessment and Monitoring. Multimedia Technology in Disaster Risk Management Training, Disaster Communication System (Early Warning and its Dissemination) - Essentials of School Disaster Education, Community based Disaster Management.

Role of IT in Disaster Preparedness, Role of Educational Institute

11+4Hours

Unit IV

Disaster Risk Management in India and Case Studies

Disaster Management Indian scenario - India's vulnerability profile – Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders, Policies and legislation for disaster risk reduction, DRR programs in India and the activities of National Disaster Management Authority.

Cases Studies: Natural Disaster -Floods, Earthquakes, Cyclones, Tsunamis. Manmade Disaster: Industrial Accidents, Transportation Accidents and Terrorism & Bio-terrorism.

Droughts, *Nuclear Disaster.*

11+4Hours

Total: 45+15Hours

Text Book(s):

1. Disaster management - Global Challenges and local solution, Edited by Rajibshash and R.R.Krishnamurthy (2009) published by universities press
2. Disaster management - future challenges and opportunities (2007) editor by Jagbirsingh. Published by I K international Publishing house pvt.Ltd.
3. Disaster management, (2021), editor by R. Subramanian, Vikas Publishing, Noida.

Reference Book(s):

1. Disaster management edited by H K Gupta (2013) published by universities press.

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	40
Understand	60	60	60
Apply	--	--	
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. What are the different phases of disaster management cycle?
2. "Prevention is better than cure is opted proverb in the context of disaster management" Explain.
3. How do you frame a system to overcome the risk occurred by a new hazard. **(For Open Book Examination and not for semester end examination)**

Understand

1. Explain the causes of global warming.
2. Explain the difference between environmental and social vulnerabilities.
3. How do you give frame a system for a three kinds of natural disasters? **(For Open Book Examination and not for semester end examination)**

21EE001 Electrical Installation, Safety and Auditing

3 0 0 3

Course Outcomes

1. Summarize the concepts of estimation and costing
2. Select a suitable wiring system for domestic and industrial applications
3. Identify the safety standards in residential, commercial and agricultural applications
4. Explain the energy demand and supply, energy crisis and future energy scenario
5. Illustrate Energy management techniques and perform energy audit
6. Explain various energy management measuring devices and tools

COs – POs Mapping

COs	PO_2	PO_3	PO_6	PO_8
1	2	2	2	2
2	3	3	3	3
3	3	3	3	3
4	2	2	2	2
5	2	2	2	2
6	2	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Principles of estimation and design of domestic & industrial wiring

Purpose of estimating and costing, Elements of estimating & costing, Tender Document, Purchase systems, Overhead charges, Labour charges, contingencies. Types of wires, types of wiring systems, selection of wire, wiring accessories and protective devices

IE rules for Domestic & Industrial wiring, estimate for single store yard, Estimate for a small workshop

Estimation of power wiring systems **(11+4Hours)**

UNIT-II

Safety in residential, commercial, agricultural, installation of plant & Protective tools equipment

Electricity, its Usefulness and Hazards, statutory Provisions, Indian Standards, Effects of Electrical parameters on human body, Safety measures for electric shock, overhead and other protections, portable electrical apparatus, Electric work in hazardous atmosphere, Energy conservation and safety

Precautions and safety measures in substation **(11+4 Hours)**

UNIT-III

Characteristics of Energy audit & Management

Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results, case study, Electrical system optimization

Demand side management (DSM)-techniques of DSM, peak clipping, peak shifting, valley filling, types of tariffs.

Energy efficient equipment **(12+3 Hours)**

Unit IV

Introduction to Energy Audit

Introduction Energy situation – world and India, energy consumption, conservation-need in thermal utility, Codes, standards and Legislation, Energy economic analysis-the time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit.

Energy Policy based on management **(11+4 Hours)**

(Total: 45+15=60 Hours)

Textbook (s)

1. J .B Gupta, *"A Course in Electrical Installation, Estimating and Costing"*, S.K Kataria & Sons, 2nd Edition, 2013.
2. Albert Thumann, "*Fundamentals of Energy Engineering*", Prentice Hall Inc, Englewood Cliffs, New Jersey, 3rd Edition, 2013.
3. Dr. K U Mistry, "*Fundamentals of Industrial Safety and Health*" ,Siddharth Prakashan, 1st Edition, 2008

Reference (s)

1. Surjeet Singh, *"Estimating and Costing",* Dhanpat Rai & Co., 2nd Edition, 2003.
2. D.P.Sen, K.R.Padiyar, Indrane Sen and M.A.Pai, "*Recent Advances in Control and Management of Energy Systems*", Interline Publisher, 1st Edition, 2013
3. Rao, S. and Saluja, H.L., "*Electrical Safety, Fire Safety Engineering and Safety Management*, Khanna Publishers, 1988.
4. Albert Thumann and Willium. J. Younger, "*Handbook of Energy Audits*, River Publishers, 9th Edition, 2012.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	25	---
Understand	25	75	---
Apply	50	---	50
Analyze	---	---	50
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Remember

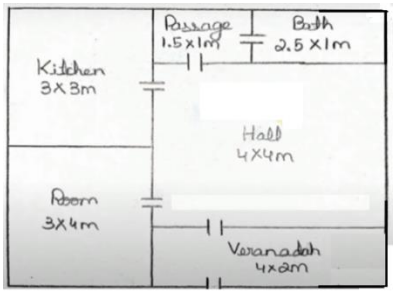
1. Define estimation and state its purpose.
2. Define power wiring.
3. Define principle of energy audit
4. Define energy management and auditing
5. Name the factors on which the fusing current depends.

Understand

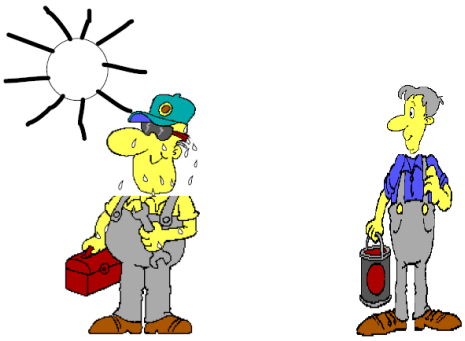
1. Interpret the size of conduit for different ratings of motors
2. Classify various types of domestic wiring and suggest their suitability for respective installation.
3. Explain the types of energy audit
4. Explain about depreciation with all methods
5. Summarize the duties of energy auditor and manager
6. Illustrate Load management
7. Formulate energy auditing report in tabular form

Apply

1. Draw the electrical circuit and develop the quantity of materials required for conduit wiring used in a house, the plan of which is shown in Figure 1. Assume the height of the ceiling is 3.6m and one plug point is to be provided in each room.



2. Develop a neat diagram showing the position of switch boards, distribution boards and accessories for a hall 0f 15m*5m*4.5m height. The hall is to be fitted with fand and light points. Make your own assumptions for the number of light and fan points and other missing data.
3. (i)Why might Worker A be injured more than Worker B if they were both shocked by the same amount of electrical current?



A B

(ii)How do electrical fires start and how can they be prevented?
(iii)How does electrical shock occur and how can it be prevented?
(iv) What are electrical safety risks in a lab?
(For Open Book Examination and not for semester end examination)

Analyze

1. Analyze how the ratings of cables and fuse wires for wiring a motor installation are determined.
2. Survey different types of domestic wiring systems.
3. Classify different types of industrial wiring systems.
4. Discover the significance of earthing systems in distribution systems.
5. Design the main control panel for a small workshop for control of three phase motors. The main distribution panel should be provided with TP MCB of 63 ampere rating, TP, MCB's for control of three phase motors, three bus bars and one ELCB. The supply to the power system should commence through 3-phase energy meter and an alternate source of supply from diesel generator set. Both supplies should be controlled through their respective main switches (filled with built in HRC fuses. The triple pole change over switch should be installed to ensure continues power supply to the motors. Show power connections to at least one motor starter TP. MCB and ELCB to be installed close to the motor. The equipment should be installed on the motor control panel close to the motor.
   (For Open Book Examination and not for semester end examination)

21ME001 Fundamentals of Optimization Techniques

3 0 0 3

Course Outcome(s)

1. Explain the need of optimization of engineering systems.
2. Apply classical optimization techniques, linear programming, transportation problem.
3. Explain the fundamental knowledge of dynamic programming problems.
4. Use classical optimization techniques and numerical methods of optimization.
5. Solve the problems of project management using CPM and PERT.
6. Solve Non-linear programming problems of some kinds.

CO-PO Mapping

COs	PO_1	PO_2	PO_3	PO_5
1	3	2	2	1
2	3	2	2	2
3	2	2	2	1
4	2	2	2	2
5	2	2	3	1
6	2	2	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit- I

Introduction and Classical optimization Techniques:

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

11+4 hours

Unit- II

Linear Programming Problem: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

11+4 hours

Unit- III

Dynamic Programming (D.P): Multistage decision processes. Concepts of sub optimization, Recursive Relation-calculus method, tabular method, LP as a case of D.P.

Classical Optimization Techniques: Single variable optimization without constraints, Multi variable optimization without constraints, multivariable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical Methods For Optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method.

11+4 hours

Unit- IV

CPM and PERT: Drawing of networks, Removal of redundancy, Network computations, Free slack, Total slack, Crashing, Resource allocation.

Non-Linear Programming: Characteristics, Concepts of convexity, maxima and minima of functions of n-variables using Lagrange multipliers and Kuhn-Tuker conditions, One dimensional search methods, Fibonacci, golden section method and gradient methods for unconstrained problems.

12+3 hours

Total: 45+15 hours

Textbook(s)

1. Operations Research: An Introduction, Prentice Hall of India (2007) 8th ed.
2. Kasana, H.S., Introductory Operation Research: Theory and Applications, Springer Verlag (2005).
3. Rardin, Ronald L., Optimization in Operations research, Pearson Education (2005). Ravindran A, Phllips D.T. and Solberg J.J.
4. Operation Research: Principles and Practice, John Wiley (2007).
5. Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd, Publishers
6. Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms John Wiley Publications
7. Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication
8. Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers
9. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
10. Operations Research by Hillar and Liberman, TMH Publishers

Sample Question(s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination
Remember	10	10	-
Understand	10	10	-
Apply	80	80	50
Analyze	-	-	40
Evaluate	**-**	**-**	10
Create	**-**	**-**	**-**
Total (%)	**100**	**100**	**100**

Remember

1. What are the types of classical optimization techniques?
2. What are the draw backs of classical optimization techniques?
3. State the assumptions of cpm and pert.
4. Discuss simplex algoritham of LPP.

Understand

1. What are the limitations of PERT and CPM?
2. How non-linear programming problems are different from linear programming problems ?
3. What kind of problems can be solved through dynamic programming technique?

Apply

1. By using simplex method, inimize $Z = 2X_1+9X_2+ X_3$ Subjected to the constraints: $X_1+4X_2 +2X_3 \geq 5$, $3X_1+X_2 +2X_3 \geq 48$, $X_1 \geq 0$, $X_2 \geq 0$, $X_3 \geq 0$.
2. Find the optimal solution to the following transportation problem for which the cost, origin-availabilities and destination-requirements are as given below

	A	**B**	**C**	**D**	
I	1	2	-2	3	**70**
II	2	4	0	1	**38**
III	1	2	-2	5	**32**
	40	**28**	**30**	**32**	

3. A college student has 7 days remaining before final examinations begin in her four courses, and she wants to allocate this study time as effectively as possible. She needs at least 1 day on each course, and she likes to concentrate on just one course each day, so she wants to allocate 1, 2, 3, or 4 days to each course. Having recently taken an OR course, she decides to use dynamic programming to make these allocations to maximize the total grade points to be obtained from the four courses. She estimates that the alternative allocations for each course would yield the number of grade points shown in the following table:

	Estimated Grade Points			
	Course			
Study Days	1	2	3	4
1	3	5	2	6
2	5	5	4	7
3	6	6	7	9
4	7	9	8	9

Solve this problem by dynamic programming.

21EC001 Sensors for Engineering Applications

3 0 0 3

Course Outcomes

1. Summarize sensor characteristics and applications
2. Demonstrate acceleration, shock and vibration sensors
3. Demonstrate position and weight sensors
4. Demonstrate sound, ultrasound and infrared sensors
5. Outline the working principle of bio sensors
6. Exemplify the applications of chemical sensors

COs–POs Mapping

COs	PO_1
1	2
2	3
3	3
4	3
5	3
6	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Sensor Fundamentals and applications

Sensor Characteristics, System Characteristics, Instrument Selection, Data Acquisition and Readout, Installation, Acceleration, Shock and Vibration Sensors: Technology Fundamentals, Selecting and Specifying Accelerometers, Applicable Standards, Interfacing and Designs

Sensor limitations, measurement issues and criteria

16 Hours

Unit II

Position and weight sensors

Position, direction, distance measurement-large scale, distance travelled, and rotation. Force, Load and Weight Sensors : Quartz Sensors-Charge Mode High-Impedance Piezoelectric Force Sensor, Voltage Mode Low-Impedance Piezoelectric Force Sensor, Piezoelectric Force Sensor Construction, types of Strain Gage Sensors

Special applications of strain gage sensors, gravitational sensing

16 Hours

Unit III

Sound, Ultrasound and Infrasound sensors

Principles, Audio to electrical sensors and transducers: moving iron microphone, moving coil microphone, capacitor microphones. Microphone problems, frequency and wavelengths. Electrical to audio transducers: moving iron transducer, moving coil transducer, Capacitor transducers. Ultrasonic transducers, Infrasound sensors.

Building acoustics, Microphone Standards

15Hours

Unit IV

Biosensors and Chemical Sensors

Introduction to Biosensors, Applications of Biosensors, Origin of Biosensors, Bioreceptor Molecules, Transduction Mechanisms in Biosensors, Application Range of Biosensors, Technology Fundamentals of chemical sensors, chemical sensing techniques and applications.

Evolution of Biosensors, smoke sensors

13 Hours

Total: 60 Hours

Textbook (s)

1. Jon Wilson ,Sensor Technology Hand Book, Newnes 2004.
2. Ian.R.Sinclair,Sensors and Transducers, third edition, Newnes publications
3. Patranabis D. ,Principles of Industrial Instrumentation,TMH. 2nd edition

Reference (s)

1. Patranabis D, Sensors and Transducers, 2nd Edition, PHI, New Delhi, 2010
2. E. O. Doeblin ,Measurement system: Applications and Design, fourth edition,McGraw Hill Publications.

SAMPLE QUESTION (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	50	40	--
Apply	30	40	60
Analyze	-		40
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Define sensors
2. List types of microphones
3. Define bioreceptor molecules.
4. List types of strain gages

Understand

1. Represent acceleration sensors
2. Illustrate Charge Mode High-Impedance Piezoelectric Force Sensor.
3. Identify Transduction Mechanisms in Biosensors.

Apply

1. Demonstrate electrical to audio transducers.
2. Demonstrate Transduction Mechanisms in Biosensors.
3. Demonstrate gas chromatograph.
4. Find a suitable sensor for the treatment of insulin-dependent diabetes with open loop approach that is portable and requires minimal operational skill. **(For Open Book Examination and not for semester end examination)**.
5. Water's conductivity varies by several orders of magnitude as it varies from ultrapure to ordinary tap water. Carry-out the use of a simple inexpensive sensor to measure water impurities. **(For Open Book Examination and not for semester end examination)**

Analyse

1. Compare capacitor microphones and capacitor transducers. **(For Open Book Examination and not for semester end examination)**
2. Outline the process of using stars for finding the position. **(For Open Book Examination and not for semester end examination)**

21CS001 Fundamentals of Artificial Intelligence

3 0 0 3

Course Outcomes

1. Summarize the fundamental concepts of Artificial Intelligence.
2. Illustrate the Concepts of Heuristic Search Techniques.
3. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information
4. Make use of concept of Game Playing Algorithms.
5. Outline the concept of Planning System
6. Explain the Natural language processing system

CO–PO Mapping

CO	PO_1	PO_2	PO_3
1	2	1	2
2	2	2	3
3	3	1	1
4	1	2	2
5	1	3	2
6	1	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction

Definition, AI problems, AI techniques, Defining problem as a state space search, Production Systems-Control Strategies, Problem characteristics, Production system characteristics. Problems – tic-tac-toe, 8-puzzle problem, Chess problem, Water Jug Problem, Missionaries and cannibals' problem, Monkey and banana problem.

Application of AI-Tower of Hanoi problem- *Travelling Salesman Problem*

12+3 Hours

Unit II

Heuristic Search Techniques

Generate-and-test, Hill climbing, Best-first-search – OR Graphs – A* Algorithm, Problem reduction – AND-OR Graphs – AO* Algorithm, constraint satisfaction - cryptarithmetic problem.

Depth-first search – Breadth-first search- Data abstraction

11+4 Hours

Unit III

Knowledge representation

Knowledge Representation Issues, Representation and mapping, Approaches to Knowledge Representation, Frame Problem, Propositional logic, Predicate logic, Resolution, weak slot and filler structure-semantic nets.

Filler structures-conceptual dependency-scripts

11+4 Hours

Unit IV

Game Playing and Planning

Mini-max search, Alpha-beta cutoffs, planning system, Block world problem, goal stack planning, hierarchical planning, Natural language processing, syntactic processing. Decision trees, Perception, Vision, Speech recognition.

Learning - Navigation – Manipulation - Robot Architecture

11+4 Hours

Total: 45+15 Hours

Textbook (s)

1. E. Rich K .Knight, and B. Nair, Artificial Intelligence, 3rdEdition, TMH, 1 July 2017
2. Russel Norvig, Artificial Intelligence A modern Approach, 3rd Edition, Pearson Education, 2010.

Reference (s)

1. Patrick henry Winston, Artificial Intelligence, third edition, Pearson Education Asia, 2005
2. Dan W. Patterson, Introduction to Artificial intelligence and Expert Systems, 2nd Edition, PHI, 2009

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	--
Understand	30	40	--
Apply	30	20	70
Analyze	--	--	30
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

SAMPLE QUESTION (S)

Remember

1. State the tasks, which are associated with A.I.
2. Give an example of crypt-arithmetic problem.
3. Define Speech Recognition.
4. Recall Intelligence

Understand

1. Explain Turing Test.
2. Explain the characteristics of production system.
3. Write A* algorithm in detail and explain its functionality to solve 8-puzzle problem.
4. Explain the semantic analysis phase done through case grammars in Natural Language understanding

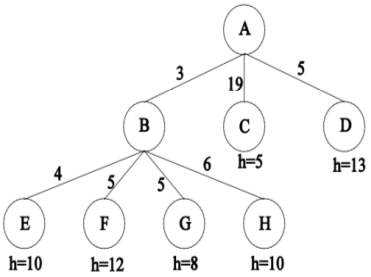
Apply

1. Distinguish between weak and strong slot filler structures
2. Discuss the tic-tac-toe problem in detail and explain how it can be solved using AI technique
3. Construct semantic net representation for the following:
   (i) Pompeian (Marcus), Blacksmith (Marcus)
   (ii) Mary gave the green flowered vase to her favorite cousin.

Analyze

1. Show that the tower of Hanoi problem can be classified under the area of AI. Give a state space representation of the problem.
2. Give an example of a problem for which breadth-first search would work better than depth-first search. Justify your answer.
3. Consider the following sentences:
   John likes all kinds of food.
   Apples are food.
   Chicken is food
   Anything anyone eats and isn't killed by food.
   Bill eats peanuts and is still alive.
   Sue eats everything Bill eats.
   (a) Translate these sentences into formula in predicate logic.
   (b) Convert the formulas of part a into clause form.

   Prove that John likes peanuts using resolution.
4. Consider the following search tree produced after expanding node A, where each arc is labeled and the leaves are labeled with the value of a heuristic function, h. **(For Open Book Examination and not for semester end examination).**



(i) Identify the node, which is expanded next by each of the following search methods?
   (a) Breadth First Search
   (b) Depth-First Search
   (c) Best-First Search
   (d) A* Search
   (e) AO* Search

(ii) Construct the Min Max Tree for the above figure (ignoring the cost values)

(iii) Identify whether the tree is eligible for pruning or not, if it is yes trace the alpha beta prunes.

21CH001 Energy Conversion and Storage Devices

3 0 0 3

Course Outcomes

1. Outline the need of energy storage systems
2. Identify new technologies for energy storage and conversion systems
3. Select and defend appropriate fuel cell technology for a given application
4. Summarize the different types of fuel cells and batteries
5. Analyse the performance of specific battery and fuel cell systems
6. Design and develop suitable hydrogen storage system to be used along with fuel cell system

COs – POs Mapping

COs	PO_1	PO_3	PO_6	PO_7
1	3	--	2	3
2	3	3	2	3
3	2	1	2	3
4	2	3	2	3
5	3	1	2	3
6	3	1	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Energy Conversion and Storage Systems

Classification of Energy Sources, Principle fuels for energy conversion, Necessity of energy storage, different types of energy storage, mechanical, chemical, electrical, electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies

Fuel cells- Batteries- Super capacitors

12+3 Hours

Unit II

Energy Conversion Systems

Fuel cells: Introduction and overview, operating principle, polarization curves, components, types of fuel cell, low and high temperature fuel cells, fuel cell stacks. Fuel cell characterization and analysis of polarization curve and calculate kinetic, ohmic, and transport losses; estimate internal resistance and hydrogen cross-over of the fuel cell

Faraday's law, Open circuit voltage, ohomic resistance, limiting current

11+4 Hours

Unit III

Energy Storage Devices

Fundamentals and technologies, characteristics and performance comparison: Lead-acid, Nickel-Metal hydride, Lithium Ion; Battery system model, emerging trends in batteries.

Hybrid systems for energy storage

12+4 Hours

Unit IV

Design and Applications of Energy Storage

Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application-Portable storage systems and medical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage

Nernst equation- Butler–Volmer theory- Gibbs free energy

11+3 Hours

Total: 45+15 Hours

Textbook(s)

1. O' Hayre R. P., Cha S. W., Colella W., and Prinz F. B., Fuel cell fundamentals, John Wiley, 2008
2. Larminie J., Dicks A. and McDonald M. S., Fuel cell systems explained. Vol. 2, Wiley, 2003
3. Bailie, Richard C, Energy conversion engineering, Wesley, 1978

Reference (s)

1. Vielstich W., Lamm A., and Gasteiger H. A, Handbook of Fuel Cells: Fundamentals, Technology, Applications, Vol (1-4), Wiley, 2003
2. Gupta R. B, Hydrogen Fuel: Production, Transport and Storage, CRC Press, 2008

3. Bard A. J., Faulkner L. R., Leddy J., and Zoski, C. G, Electrochemical methods: fundamentals and applications (Vol. 2), Wiley, 1980

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	--
Understand	30	30	40
Apply	50	50	60
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any two types of fuel cells and their uses.
2. What is open circuit voltage?
3. Define limiting current.
4. Define glass transition temperature.

Understand

1. Distinguish high temperature fuel cells and low temperature fuel cells.
2. Explain in detail the principle and mechanism of lithium ion battery.
3. Explain about fuel cell characterization.
4. Discuss about portable energy storage systems.

Apply

1. A company is developing a new car powered by a fuel cell system that runs on H2. You have been asked to consider generating the H2 by electrolysis with a fuel cell. The H2 tank to be used is 10 liters in volume and a fill-up requires a pressure of 34 atm.
2. Consider the following specifications of the system. 60% conversion of H2O Eo = 1.172 V The cathode pressure is maintained at 1 atm. The anode pressure is maintained at 1 atm Membrane thickness = 100 μm Membrane conductivity (σ) = 0.1 S/cm (S = 1/Ω) Electrolysis T = 373 K (assume water is in the gas phase) H2 storage tank T = 298 K
   a) Calculate the current required to operate at a voltage of 1.8V.
   b) Calculate the rate of hydrogen production per membrane area and the total membrane area required to fill the tank in 2 minutes.
   c) How the fuel cell car is more viable than a diesel or petrol car. Justify?
3. The polarization curve for the fuel cell consists of 3 different losses such as ohmic, activation and mass transport in these 3 losses what is predominant loss. explain various precautions/ designs can overcome these losses. **(For Open Book Examination and not for semester end examination).**
4. Describe the selection criterion for choosing the specific fuel cell among the alternatives present in the market, for household application what fuel cell you suggest? Justify your answer. **(For Open Book Examination and not for semester end examination).**

21IT001 Fundamentals of Multimedia

3 0 0 3

Course Outcomes

At the end of the course, students will be able to

1. Understand key concepts in multimedia technology.
2. Identify basic multimedia types and data representations.
3. Describe transmission of audio and video.
4. Explain multimedia data compression techniques.
5. Identify various video and audio compression techniques.
6. Demonstrate technical knowledge and limited proficiency in designing production elements.

CO – PO Mapping

COs	PO_3	PO_5	PO_7
1	3	3	2
2	3	3	1
3	3	3	2
4	2	3	2
5	3	3	1
6	2	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I

Introduction to multimedia

What is multimedia?, Multimedia and Hypermedia, World Wide Web, Overview of Multimedia Software Tools, Graphics and Image Data Representations: Graphics/Image Data Types, Color in Image and Video: Color Science, Color Models in Images, Color Models in Video.

Popular file formats.

13+3 Hours

Unit II

Fundamental Concepts in Video and Digital Audio

Types of Video Signals, Analog Video, Digital Video, Digitization of Sound, MIDI, Quantization and Transmission of Audio.

DPCM, DM, ADPCM

10+5 Hours

Unit III

Multimedia Data Compression

Lossless compression algorithms: Run-Length Coding, Variable Length Coding, and Dictionary Based Coding. Lossy compression algorithms: Quantization, Transform Coding, Wavelet-Based Coding

Arithmetic Coding, Lossless Image Compression

12+4 Hours

Unit IV

Basics of Video and Audio Compression

Introduction to Video Compression, Video Compression based on MotionCompensation, Search for Motion Vectors, Video Coding Overview of MPEG-1, MPEG-2, MPEG-4

ADPCM in Speech Coding, MPEG Audio Compression.

MPEG-7, Basics of Computer and Multimedia networks

10+3 Hours

Total: 60 Hours

Textbook (s)

1. Ze-Nian Li and Mark S.Drew, "Fundamentals of Multimedia", 1st Edition, PHI/Pearson Education, 2009.
2. Weixel, "Multimedia Basics", 2nd Edition, Thomson Press, 2006.

Reference (s)

1. Nigel Chapman and Jenny Chapman, "Digital Multimedia", 3rd Edition, Wiley Dreamtech, 2009.
2. Steve Heath, "Multimedia and Communications Technology", 2nd Edition, Elsevier (Focal Press), 1999.
3. Steinmetz, Ralf, Nahrstedt, "Multimedia Applications", 1st Edition, Springer, 2004.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	10	--
Understand	30	30	--
Apply	40	50	40
Analyze	10	10	30
Evaluate	--	--	30
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define multimedia
2. List some multimedia software.
3. List some multimedia hardware

Understand

1. Explain the application of multimedia in education and e-commerce
2. Explain analog and digital video in details
3. Explain the need of multimedia and write down is applications
4. Illustrate the scope of multimedia in e-governance

Apply

1. Identify the applications of multimedia in entertainment industry
2. Identify three novel applications of the Internet or multimedia applications. Discuss why you think these are novel

Analyze

1. Compare plain text and formatted text.
2. Analyze various video compression techniques
3. Analyze various audio compression techniques

Evaluate

1. If a set of ear protectors reduces he noise level by 30dB, how much do they reduce the intensity (the power)?
2. My old SoundBlaster card is an 8-bit card.
    a. What is it 8 bits of?
    b. What is the best SQNR it can achieve?
5. Implement Huffman coding, adaptive Huffman coding, arithmetic coding and LZW coding algorithms using your favorite programming language. Generate at least three types of statistically different artificial data sources to test your implementation of these algorithms. Compare and comment on each algorithm's performance in terms of compression ratio for each type of data source. **(For Open Book Examination and not for semester end examination).**
6. Assume we have an unbounded source we wish to quantize using an M-bit mid tread uniform quantizer. Derive an expression for the total distortion if the step size. **(For Open Book Examination and not for semester end examination).**

21BS001 Nano Materials and Technology

3 0 0 3

Course Outcomes

1. Explain the properties of nano-materials and their applications in relation to bulk materials
2. Describe the nano size effect on optical, electrical, magnetic and thermal properties
3. Apply various chemical and physical methods for the synthesis of nanomaterials
4. Characterize nano materials by powder XRD and microscopy techniques.
5. Illustrate the structure, properties and applications of Fullerenes and Carbon nanotubes.
6. Review the applications of nanomaterials, specially semiconducting metal oxides for sensing and catalysis

COs – POs Mapping

COs	PO_1	PO_{12}
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Nanomaterials

Introduction to nanomaterials and nanotechnology, Nano-sizes and their unique properties: comparison with the bulk materials, Different shapes sizes and morphology of nanomaterial; Defects in Nano crystalline materials, Effect of grain size on physical properties – magnetic, electrical, optical, thermal and mechanical properties.

Graphite to graphene – effect on properties

11+3 Hours

Unit II

Synthesis Techniques of Nanomaterials

Top Down Approaches: Grinding, Planetory milling and comparison of particles; Bottom Up Approach: Wet Chemical Synthesis - Microemulsion Approach, Colloidal Nanoparticles Production, Co-precipitation, Sol Gel Method, Hydrothermal method, Sonochemical Approach,; Gas phase Production Methods - Chemical Vapour Deposition; Carbon Nano structures: carbon clusters, carbon nano tubes, graphene- synthesis, formation.

Microwave synthesis and Atomization

12+4 Hours

Unit III

Characterization of Nanomaterials

Fractionation principles of particle size measurements, Particle size and its distribution, distinguishing the nano size from bulk by powder X-ray Diffraction patterns; Optical transitions in solids, photonic crystals, Microscopy techniques: Scanning Electron Microscopy, EDAX, Atomic Forced Microscopy, Scanning Tunneling Microscopy, and Transmission Electron Microscopy

Zeta potential, density of states

11+4 Hours

Unit IV

Applications of Nanomaterials

Self-assembly and molecular manufacturing; Surfactant based system & Colloidal system – Applications; Functional materials - Nano coatings, GaN wires, quantum dots, Nano crystalline TiO_2 and ZnO; Applications of single & multi walled CNTs

Nano sensors - based on optical properties

11+4 Hours

Total: 45+15 Hours

Textbook (s)

1. B. S. Murthy, P. Shankar, Baldev Raj, B.B. Rath, Ames Murday, Text book of Nanoscience and Nanotechnology, Springer & Universities Press (India) Pvt. Ltd., 2013.
2. S. K. Kulkarni, Nanotechnology: Principles & Practices, 3rd Ed., Springer, 2015

Reference (s)

1. S. M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009
2. R. Kelsall, I. Hamley, M. Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005
3. G. L. Hornyak, H.F. Tibbals, J. Dutta , J. J. Moore, Introduction to Nanoscience and Nanotechnology CRC Press, 2008

4. J. H. Davies, The Physics of Low Dimensional Semiconductors: An Introduction, Cambridge University Press, 1998

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	60
Analyze	-	-	40
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. Define Nano structured material.
2. List any four applications of nanotechnology.
3. State Moore's first law and second law.

Understand

1. What is the difference between Nano science and nanotechnology?
2. Describe elastic scattering and inelastic scattering of electrons
3. Explain the sol-gel method of synthesis of Nano powders

Apply

1. Explain the principle behind protection of skin from UV radiation by sun screen lotion
2. Show that the surface area to volume ratio increases drastically as particle size comes down from micro to Nano size.
3. Assess the variation of thermal and optical properties of nanomaterial with that of the bulk
4. Show how the shape and size can be controlled in the formation of nanostructures using surfactants
5. Nano materials are increasingly being used in various applications. Answer the following questions regarding Nano materials and technologies:
   (i) Classify the Nano materials based on the dimensionality and represent with examples.
   (ii) Construct the block diagram of chemical vapour deposition (CVD) method and explain the process of synthesis of nanomaterials using CVD.
   (iii) Model the Electronic band structure and explain photonic crystals.
   (iv) Select any four applications of GaN nanowires and assess their impact on daily life.
   (**For Open Book Examination and not for semester end examination**)

Analyze

1. Compare the bottom up & top down approaches in nanotechnology
2. Outline how powder XRD technique can be used for characterization of a nano material
3. Electrical and magnetic properties vary for nano material compared to bulk material. Justify
4. Distinguish between single walled carbon nano tubes and multi walled carbon nano tubes.
5. Nano materials are increasingly being used in various applications. Answer the following questions regarding Nano materials and technologies:
   (i) Show the various types of defects in nanocrystalline materials and attribute their effect on properties.
   (ii) Schematically illustrate the sol-gel method of preparation of nanomaterials and assess its advantages/disadvantages with other methods.
   (iii) Propose various characterization methods of nanomaterials and explain the merits/demerits of using powder X-ray diffraction method.
   (iv) Assess any four applications of nanocrystalline TiO_2 in detail.
   (For Open Book Examination and not for semester end examination)

21DS001 Fundamentals of Data Science 3 0 0 3

Course Outcomes

1. Understand the key steps and pipeline of Data Science and its application in solving real-world problems.
2. Understand the importance of measuring similarity and dissimilarity between features in data for variousanalysis tasks.
3. Explain the significance of pre-processing techniques in preparing data for analysis in real-time scenarios.
4. Identify the characteristics and practical applications of different regression models used in real-worldscenarios.
5. Apply classification models using appropriate metrics, including the confusion matrix, to assess model performance and make informed decisions.
6. Understand the principles of ensemble modeling and clustering and apply appropriate ensemble techniques to improve the accuracy and reliability of machine learning models.

COs–POs Mapping

COs	PO1	PO2
1	3	3
2	3	3
3	3	3
4	3	2
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

UNIT-I **12 hours**

Introduction: Relation among AI, ML, and Data Science, Importance of Data Science; Data Science Process.

Data Exploration: Objectives of Data Exploration, Forms of Data -Structured, Semi Structured, Unstructured, Datasets-data objects and types of attributes/fields, Characteristics of Datasets and corresponding Statistical Measures.

Data Visualization: Univariate Visualization, Multivariate Visualization.

Categorization of Data Science Algorithms,

UNIT-II **12 hours**

Data Similarity/Dissimilarity: Data Matrix, Dissimilarity Matrix, Proximity/Similarity Measures for various types of data- nominal data, ordinal data, binary data and numerical data, Cosine Similarity.

Data Preprocessing: Data Preprocessing Pipeline, Preprocessing techniques for Cleaning Data, Data Integration, Data Reduction, Data Transformation and Discretization.

Distance-based similarity-Euclidean distance, Jaccard Similarity.

UNIT-III **12 hours**

Regression: Linear Regression, Logistic Regression, and Regularization techniques for improving model performance.

Classification: Classification Principles, Classification Model Evaluation Metrics-Confusion Matrix, Classification using Decision Trees, Distance based Classifier- KNN, Bayesian classifier.

Regression vs classification.

UNIT-IV **12 hours**

Ensemble Learning: Conditions for Ensemble Modeling, Overview of ensemble techniques-Voting, Bagging, Boosting and Random Forest.

Clustering: Clustering Principles, Applications and Purpose of Clustering, Types of Clustering, Clustering Algorithms K-Means clustering, Agglomerative clustering, Divisive clustering.

Applications of clustering, Purpose of Ensemble Learning.

Total: 48 Hours

Textbooks:

1. Vijay Kotu&Bala Deshpande, "Data Science: Concepts and Practice", 2nd Edition, Morgan KaufmannPublication, 2017.
2. JlaweiHan&MichelineKamber,"DataMining:ConceptsandTechniques",3rdEdition,MorganKaufmannPublishers,2012.
3. Pang-NingTanetal.,"IntroductiontoDataMining",2nd Edition,PearsonPublications,2019.

References:

1. Vijay Kotu & Bala Deshpande, "Data Science: Concepts and Practice", 2nd Edition, Morgan Kaufmann Publication, 2017.
2. TomM.Mitchell,"MachineLearning",TataMcGrawHill,1997.
3. SunilaGollapudi,"PracticalMachineLearning"FirstEdition2016,PacktPublishingLtd.

Internal Assessment Pattern

CognitiveLevel	Int.Test1(%)	Int.Test2(%)	OpenbookTest1(%)
Remember	20	20	--
Understand	50	30	--
Apply	30	30	80
Analyze	--	20	20
Evaluate	--	--	--
Create	--	--	--
Total(%)	**100**	**100**	**100**

SAMPLEQUESTION(S)

Remember

1. What are the different forms of data in data science? Provide examples for each form.
2. Name the statistical measures used to analyze datasets in data science.

Understand

1. Why is pre-processing important in machine learning? Explain with relevant examples
2. What is the difference between supervised and unsupervised algorithms? Provide an example for each type.

Apply.

1. Imagine you have a dataset containing information about houses. How would you handle the following scenarios using pre-processing techniques:
    a. Data Cleaning: How would you deal with missing values in the dataset? What approach would you take to handle outliers or inconsistent data?
    b. Data Integration: Suppose you have additional datasets with relevant information about houses, such as neighborhood demographics or school ratings. How would you combine this information with the existing dataset?
    c. Data Reduction: The dataset contains numerous features. How would you simplify the dataset by reducing the number of features without losing important information?
    d. Data Transformation and Discretization: How would you standardize numerical features in the dataset? Additionally, how would you convert continuous variables, such as house prices, into categorical variables for analysis purposes?

Open Book Question(s)

1. Discuss the importance of data visualization in data science. Provide examples of univariate and multivariate visualizations, and explain how they can be used to gain insights from complex datasets. Support your answer with relevant illustrations or diagrams.
2. Compare and contrast supervised and unsupervised learning algorithms. Provide a detailed explanation of each type, including their characteristics, applications, and differences in the training process. Give an example scenario where you would use each type of algorithm.
3. Assume you have been given a dataset with various features related to customer demographics and their purchasing behavior. Design a data science pipeline to address the following tasks:
    a. Data exploration and statistical analysis of the dataset.
    b. Preprocessing steps, including handling missing values, data cleaning, and feature transformation.
    c. Applying a suitable regression model to predict customer spending based on the available features.
    d. Evaluating the performance of the regression model using appropriate evaluation metrics.

21CE002 Air Pollution and Environmental Impact Assessment

3 0 0 3

Course Outcome

1. Understand basic aspects on air pollution and the quality of atmospheric environment
2. Evaluate different types of air pollution and the means of abatement control
3. Identify the sources for noise pollution and control methods
4. Understand the different steps within environmental impact assessment
5. Compare both orally and in written form the key aspects of environmental impact assessment
6. Analyze different case studies/examples of EIA in practice

COs–POs Mapping

COs	PO6	PO7	PO12
1	1	2	1
2	1	2	1
3	1	2	1
4	2	1	1
5	2	1	1
6	2	1	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Sources and Effects of Air Pollution

Classification of Air pollutants, Particulates and gaseous pollutants, effects of air pollution on human being, materials, animals and vegetation; global warming- ozone layer depletion, sampling and analysis, basic principle of sampling, source of ambient sampling, analysis of pollutants, principles

Sampling of air Pollutants; Ambient air quality standards.

12 Hours

Unit II

Air Pollution Control and Noise Pollution

Air Pollution Control: Particulate control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation- selection criteria for equipment- gaseous pollutant control by adsorption, absorption, condensation, combustion.

Noise Pollution**:** Sources, Effects, Assessments, Standards and Control Methods, Prevention Methods.

Plume rise behavior ;Measurement of Noise level.

12 Hours

Unit III

Environmental Impact Assessment

Impacts of Development on Environment, Environmental Impact Assessment (EIA): Objectives, Historical development, EIA Types, EIA Notification and Legal Framework, Stakeholders and their Role in EIA.

Screening and Scoping in EIA: Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna EIA Methods- Matrices – Networks – Checklist Methods.

Rio Principles of Sustainable Development; Mathematical models for Impact prediction.

12 Hours

Unit IV

Environmental Management Plan

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna, Environmental Monitoring Plan, EIA Report Preparation, Review of EIA Reports, and Environmental Clearance.

Case Studies**:** EIA case studies pertaining to Infrastructure Projects, Roads and Bridges, Ports and Harbor, Airports, Dams and Irrigation projects, Power plants, CETPs.

Public Hearing; Post Project Monitoring.

12 Hours

Total Hours: 48 Hours

Text book (s)

1. M. N. Rao and H. V. N. Rao, Air pollution, Tata McGraw-Hill, New Delhi, 1993 2. N
2. D. Nevers, Air Pollution Control Engineering, McGraw-Hill International Ed., 1993
3. Canter, R.L, "Environmental impact Assessment ", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
4. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental

Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank,1997.
5. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers,2009

Reference (s)

1. K. Wark, C. F. Warner, Air Pollution, Its Origin and Control, Harper and Row, New York, 1981
2. C. S. Rao, Environmental Pollution Control Engineering, New Age International, 2005
3. Becker H. A., Frank Vanclay, "The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
4. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
5. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
6. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

Sample Question(s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	--
Understand	70	70	--
Apply	--	--	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Classify Air Pollutants
2. Define Wind Rose
3. give the plume rise behavior formula
4. Define EIA
5. What are the objectives of Environmental Impact Assessment (EIA)?

Understand

1. Briefly discuss about the various types of gases in air pollution
2. Discuss in detail about effects of air pollution on environment
3. What are the basic concepts of EIA?
4. Explain the various steps in preparing of E1A report.
5. Explain in detail about different methods used in EIA

Apply

1. A plate type ESP use in a cement plant for removing dust particles consist of 10 equal channels. The spacing between plates is 15 cm and the plates are 3 m high and 3 m long. Unit handles 20,000 m^3 /h of gas. a) What is the efficiency of collection plates? b) What is the collection rate of particles having density 9.2 gm/m3? c) What should be the length of the plate for achieving efficiency of 99% keeping another parameter same? (**For Open Book Examination and not for semester end examination**)
2. A highway project is proposed between Visakhapatnam to Bhubaneswar. It is recommended to prepare an environmental impact assessment report for the proposed project by considering all parameters. **(For Open Book Examination and not for semester end examination)**

21EE002 Renewable Energy Sources

3 0 0 3

Course Outcomes

1. Outline the operation of solar energy system
2. Summarize the operation of wind and biomass energy systems
3. Develop solar/wind energy systems for a given application
4. Interpret working principles of geothermal energy system
5. Summarize the operation of ocean, tidal, fuel cells, small hydro and magneto hydro energy system
6. Extend renewable energy sources to direct energy conversions & micro grids

COs – POs Mapping

COs	PO_2	PO_7
1	2	3
2	2	3
3	3	3
4	2	3
5	2	3
6	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction & Solar Energy

Introduction to renewable energy, advantages of generating power through renewable energy sources – technical & economical, Solar Energy: Physics of sun, the solar constant, extra-terrestrial and terrestrial solar radiation, instruments for measuring solar radiation and sun shine. Flat Plate and Concentrating Collectors, classification of concentrating collectors, thermal analysis of flat plate collectors, Photo voltaic energy conversion, PV cell model and characteristics, Maximum power point tracking for photovoltaic power systems. Types of Maximum power point tracking methods Perturb and Observe.

Solar applications-solar heating /cooling technique

(12 Hours)

Unit II

Wind & Bio-Mass Energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria, Maximum power generation. Principles of Bio-Conversion, Anaerobic/aerobic digestion, Types of Bio-Gas Digesters, gas yield, Combustion characteristics of bio-gas.

Utilization for cooking, IC Engine operation

(12 Hours)

Unit III

Geothermal & Ocean Energy

Types of Resources (hydrothermal, geo-pressured, hot dry rock), types of wells, and methods of harnessing the energy (Vapour dominated, liquid dominated), Ocean thermal energy conversion, principles, Open loop & closed loop OTEC Cycles. Tidal energy- potential, conversion techniques-single basin, two basin system. Wave energy: conversion techniques.

Captive power plant

(12 Hours)

Unit IV

Direct energy conversion & introduction to Micro-grid

Fuel cells-Principle of working of various types of fuel cells and their working, Hydrogen generation, battery energy storage system. Magneto-hydrodynamics (MHD)

Define grid, microgrid, importance of DG & microgrid, typical structure and configuration of a microgrid, AC and DC microgrids, modes of operations (grid connected & islanded).

Distributed generation (DG)

(12 Hours)
(Total: 48 Hours)

Textbook (s)

1. G.D. Rai, "*Non-Conventional Energy Sources"*, Khanna Publishers, 2nd Edition, 2017.

2. B H Khan, "*Non-conventional energy resources"*, Tata McGraw Hill Education Private Limited, 3rd Edition, 2015.
3. Alexis Kwasinski , Wayne Weaver, Robert S. Balog, "*Micro grids and other local area power and energy systems"*, Cambridge University Press, 1st Edition, 2016

Reference (s)

1. Tiwari and Ghosal, "*Renewable energy resources*", Narosa Publishing house, 2ndEdition, 2001
2. Ranjan Rakesh, Kothari D. P. & Singal K. C., "*Renewable Energy Sources and Emerging Technologies*", PHI, 2nd Edition, 2013.
3. Nikos Hatziargyriou, *"Micro grids: Architectures and Control*", Wiley, 1st Edition.
4. Electricity Act 2003, Renewable Energy Act 2015.
5. Indian Constitution-Articles 51A, 47, 48A.

Sample Question (s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	40	40	---
Understand	60	60	50
Apply	---	---	50
Analyze	---	---	---
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Remember

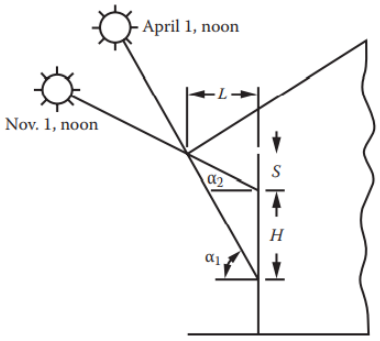
1. Define renewable energy
2. List out the advantages HAWT
3. List out the disadvantages non concentration collector
4. Define solar radiation
5. Define micro-grid

Understand

1. Explain need of micro-grid
2. Interpret faraday's laws
3. Explain closed loop OTEC Cycles system
4. Explain Principle of working of MHD Power plant
5. Compare HAWT and VAWT

Apply

1. Compute the power coefficient of wind turbine
2. Demonstrate storage of energy from battery
3. Assess magnetic flux density due to circular ring
4. Compute solar cell working
5. Assess the nature of micro-grid
6. a) Find the roof overhang L of a south-facing window of height H = 1 m, such that the window is completely shaded at solar noon on April 1 and not shaded at all at noon on November 1. Assume that the roof extends far beyond the window on either side. Location: Gainesville, Florida. Also, find the overhang if S = 1.3 m from the below figure.



b) Repeat the above example for Canberra, Australia, for a north-facing window, such that the window is completely shaded at noon on November 1 and completely lit at noon on April 1.**(For Open Book Examination and not for semester end examination)**

7. Find the solar altitude and azimuth angles at solar noon in i) Gainesville, Florida, on February 1 ii) Canberra, Australia on February 1. Also find the sunrise and sunset times in Gainesville on that day. Since the sunrise and sunset times are calculated when the center of the sun is at the horizon, they differ from the apparent times. If we use $\alpha = -50'$, the apparent sunrise and sunset times would be 7:20 a.m. EST and 6:06 p.m. EST, respectively. **(For Open Book Examination and not for semester end examination)**

8. As a technical engineer you are appointed in a planning and commission team of govt of India. The duty has been assigned that the Leh and Ladakh people are suffering electricity problem from decade. The NDA government has declared that the power generation plant has to be operated there within a year with 10 MW generation in only renewable energy aspect.
   (i) Propose the type of plant which is more suitable to that area and having uninterrupted power supply with grid connection mode
   (ii) Describe the advantages of that plant compared to conventional energy sources
   (iii) What's are the measure precautions to be taken for that plant operation and maintenance purpose.
   (iv) Give the details constructional block diagram of the power plant.
   (For Open Book Examination and not for semester end examination)

21ME002 Principles of Entrepreneurship

3 0 0 3

Course Outcomes

1. Explain the role of entrepreneur in economic development
2. Demonstrate methods of generating ideas
3. Develop the business plan to start enterprises
4. Analyze various production aspects such as manufacturing costs control, marketing management and waste reduction strategies
5. Assess financial and marketing plans and control for enterprises
6. Find the institutional support for entrepreneurship

COs POs Mapping

COs	PO_1	PO_5	PO_8	PO_{11}
1	3	-	3	2
2	3	-	1	-
3	3	-	1	3
4	3	3	2	2
5	3	3	3	3
6	3	-	1	3

3-Strongly linked, 2-Moderately linked, 1-Weakly linked

Unit I

Introduction to Entrepreneurship Definition of Entrepreneur, Entrepreneurial Traits, Entrepreneur Vs. Manager, Entrepreneur Vs Entrepreneur. The Entrepreneurial decision process- Role of Entrepreneurship in Economic Developments, Ethics and Social responsibility of entrepreneurs, Woman as entrepreneur. *Opportunities for entrepreneurs in India and abroad*

12 Hours

Unit II

Creating and starting the venture Sources of new Ideas, Methods of generating ideas, creating problems solving- Product planning and development process The business plans Writing Business plan, Evaluating Business plans, Using and implementing business plans, marketing plan, financial plan and the organizational plan launching formalities.
Nature and scope of business plan

12 Hours

Unit III

Financing and managing the new venture Source of Capital, record keeping, recruitment, motivating and leading teams, financial controls, Marketing and sales controls. E Commerce and Entrepreneurship New venture expansion strategies and issues Features evaluation of joint ventures, acquisitions, merges, franchising, Public issues, rights issues, bonus issues
Internet advertising

12 Hours

Unit IV

Institutional support Entrepreneurship Role of Dire crate of Industries, District Industries, Centers (DICS), Industrial development Corporation (IDC), state Financial corporation (SFCs), Small Scale Industries Development Corporations (SSIDCs), Khadi and village Industries Commission (KVIC), Technical Consultancy Organization (TCO), small Industries Service Institute (SISI), National Small Industries Corporation (NSIC), Small Industries Development Bank of India (SIDBI), salient provision under Indian Factories Act, Employees State Insurance Act, Workmen‟s Compensation Act and payment of Bonus Act.
Labor legislation

12 Hours
Total: 48 Hours

Textbook (s)

1. Robert Hisrich & Michael Peters, Entrepreneurship, TMH, 5th Edition, 2009.
2. Dollinger, Entrepreneurship, Pearson Education, 4th Edition, 2004.

3. Robert J. Calvin, Entrepreneurial Management, Tata McGraw-Hill Education, 2004.
4. Vasant Desal, The Dynamics of Entrepreneurial Development and Management Himalaya publishing House, 5th Edition, 2017.
5. Kaplan, Patterns of Entrepreneurship, Willey, 4th Edition, 2005

Reference (s)

1. William A. Sahlman, James Stancill, Arthur Rock, Harvard Business Review on Entrepreneurship, Harvard Business School Press, Revised Edition, 2019.
2. Gurmeet Naroola, The Entrepreneurial Connection: East Meets West in the Silicon Valley, Special edition, TiE, 2001.
3. Bill Bolton & John Thompson, Entrepreneurs Talent, Temperament, Technique, Routledge, 7th Edition, 2016.
4. Agrawal, A.N. & Agarwal, M.K., Indian Economy: Problems of Development and Planning, New Age International, 42nd Edition, 2017.
5. Gaurav Datt & Ashwani Mahajan, Dutt & Sundaram‟s Indian Economy, S. Chand, 72nd Edition, 2016.
6. Srivastava, Industrial Relations Labour Laws, Vikas Publishing House, 6th Edition, 2005.
7. Aruna Kaulgud, Entrepreneurship Management by Vikas publishing house, 2003.
8. Thomas W. Zimmerer & Norman M. Scalbrorough, Essential of Entrepreneurship and small business management, PHI, 4th Edition, 2005.
9. Mary Coulter, Entrepreneurship in Action, PHI 2nd Edition, 2005.
10. ND Kapoor, Industrial Law, Sultan Chand & Sons, 14th Revised Edition, 2013.

Sample Question (s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book examination (%)
Remember	30	40	-
Understand	70	60	-
Apply	-	-	35
Analyze	-	-	45
Evaluate	-	-	20
Create	-	-	-
Total (%)	100	100	100

Remember

1. List the different methods of generating ideas and explain any four methods.
2. List the difference between entrepreneur vs manager.
3. What are the objectives of market research?
4. What are the market research activities? List them.
5. List the important functions of IDBI.

Understand

1. Compare between entrepreneur vs manager.
2. Illustrate the characteristics or traits of an entrepreneur.
3. Outline the sources of new ideas for entrepreneur.
4. Explain the various steps involved in writing a business plan.
5. Summarize the various sources of capital required for business venture.
6. Demonstrate the role of E-commerce in entrepreneurship with its applications.
7. Illustrate marketing plan and financial plans required for an entrepreneur.
8. Show the factories act 1948.
9. Rephrase the reasons for the need of labor legislation becomes important.

Apply

1. Develop the business plan to establish a startup by taking an industrial case.
2. Identify the various sources of capital required to meet the new ideas of an entrepreneur for the economic development of a business venture.
3. Organize the role of entrepreneur in choosing the institutional supports to entrepreneurship.
4. In recent years, the entrepreneurial educator and author Steve Blank began applying lean startup principles to various US governmental agencies. Through a Hacking for Diplomacy course,

students at Stanford University began tackling problems for the Department of State. A former US ambassador to the United Nations, a State Department representative to Silicon Valley and senior advisor for technology and innovation, a retired US Army colonel, and other entrepreneurial educators joined Blank in applying lean startup methods to State Department issues. Then Secretary of State John Kerry even visited the Stanford students and said he was looking forward to the solutions students develop during the ten weeks. One project that emerged was from a group calling themselves Team Space Evaders. The team was tasked with working on the problem of satellite collision. Members charted satellite positioning data and explored how information about potential collision was shared by commercial operators and governmental entities ranging from the Federal Aviation Administration to the Department of Defense.

a. Apply the lean startup methodology to identify potential customer segments and problems and solutions that students such as yourself could identify for the State Department on the issue of satellite collision.
b. Choose a unique value proposition for a State Department solution to this issue. Identify a high-level concept pitch work when selling the concept within the State Department?

Analyze

1. Analyze the role of E commerce in the business plan of all production aspects and its applications to an entrepreneur.
2. Discover the opportunities for Woman as entrepreneur to start their own enterprise with production aspects in India.
3. Discover the role of National Small Industries Corporation (NSIC) in all the production aspects of entrepreneurs in establishing the new ventures.

Evaluate

1. Assess the role of Entrepreneurs and entrepreneurship institutions in the economic development of any country.
2. Estimate marketing plan and financial plans required for an entrepreneur along with the support from entrepreneurship institutions in these aspects.
3. Compare acquisitions, mergers and franchising in the evaluation process of joint ventures.

21EC002 Electronics for Agriculture

3 0 0 3

Course Outcomes

1. Illustrate various sensors and electrical motors for agricultural sector.
2. Asses the modern remote sensing technology for the agricultural development.
3. Predict the diversity of precision farming
4. Demonstrate the importance of electrical and instrument technology for the benefits of agricultural development.
5. Interpret environmental parameters with Electronics systems
6. Outline advanced agricultural technologies.

COs – POs Mapping

COs	PO_1	PO_2
1	2	1
2	3	2
3	3	2
4	3	2
5	3	2
6	3	3

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Instrument technology for agriculture

Instrument for measurement: pH, Electrical conductivity, gas analysis, humidity, leaf area, chlorophyll content and soil moisture & temperature. Use of electrical energy in agriculture, electromechanical energy conversion, Electrical motors, Selection of motors for different farming applications, renewable energy sources.

Importance of pH value, Environmental issues

12 Hours

Unit II

Precision Farming

An introduction to precision farming. GIS/GPS positioning system for precision farming, Yield monitoring and mapping, soil sampling and analysis, Computers and Geographic information systems, Precision farming-Issues and conditions, Role of electronics in farm machinery for precision farming.

Agriculture and Forestry investigations, Atmospheric investigation,

12 Hours

Unit III

Electronics in Agriculture Instrument for crop monitoring – moisture measurement – capacitive, infrared reflectance and resistance. Monitoring soil and weather – measurement of soil properties and meteorological parameters – irrigation control systems. Instruments for crop establishment monitoring. Crop spraying – selective crop spraying – flow control. Yield monitoring. Technology for precision farming. Instruments for protected cultivation – green house environment control – transducers and control system. Instruments and systems for crop handling processing and storage.

Role of engineering in agricultural sector, Electronic control system for grape drying process

12 Hours

Unit IV

Advanced Agricultural Technologies: Difference between traditional and modern agricultural practices; Internet of Things (IoT), Online Marketing of agro based products, Information and Communication Technology (ICT), Mobile Technology, Agricultural Drones & Robotics, Artificial Intelligence (AI) based farming.

Governance services in agriculture sector, Role of Electronics Governance in Agricultural sector.

12 Hours

Total: 48 Hours

Text Books

1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education
2. Kuhar, John. E. 1977. The precision farming guide for agriculturalist. Lori J. Dhabalt, USA

Reference Books

1. De Mess M. N. Fundamental of Geographic Information System. John Willy & sons, New York, Datta S.K.1987.

2. K. Krishna Swamy, "Process Control"; New Age International Publishers
3. Manual of Soil & Water conservation Engineering. Oxford & IBH Co. Sigma & Jagmohan, 1976.

SAMPLE QUESTION (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book Examination (%)
Remember	25		--
Understand	35	25	--
Apply	20	45	60
Analyse	20	30	40
Evaluate	--		--
Create	--		--
Total (%)	100	100	100

Remember

1. List the use of electrical energy in agriculture.
2. List the sensors used to access various parameters in agriculture.

Understand

1. Illustrate the use of ICT in Online marketing of agro based products.
2. Illustrate the use of Agricultural Drones & Robotics in agriculture.

Apply

1. Demonstrate the role of GPS positioning system for precision farming.
2. Demonstrate the process involved in modern agricultural practice.

[Open Book Examination Questions]

Analyse

1. Justify the statement "electronics has a positive influence on improving agriculture".
2. Outline the role of electronics in agriculture.

[Open Book Examination Questions]

21CS002 Fundamentals of Machine Learning

3 0 0 3

Course Outcomes:

1. Classify the variety of learning algorithms.
2. Choose a learning algorithm to data using various tools of Machine Learning.
3. Identify the strengths and weaknesses of many popular machine learning approaches.
4. Examine the performance of learning algorithms and model selection.
5. Identify mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
6. Model Artificial Neural Networks and Deep Neural Networks in solving complex real world problems.

COs–POs Mapping

CO	PO_2	PO_5
1	1	2
2	3	2
3	3	1
4	3	2
5	3	2
6	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

UNIT I

Overview of Machine Learning, **Learning**: Types of Machine Learning, Hypothesis Formulation and Model Selection, **Phases of ML**: Training, Testing and Validation-Splitting, Cross Validation; **Evaluation of Machine Learning Models:** Error Analysis, Performance Indices, Confusion Matrices, The Bias-Variance Trade-off, Feature Selection; **Regression**: Linear Regression, Linear Regression with Multiple Variables, Logistic Regression.
Basic Statistics: Variance and Covariance, Correlation Vs Regression, Feature Scaling and Standardisation, Machine Learning Tools: Weka, R, Python, MATLAB.

12 Hours

UNIT II

Learning with Trees: Constructing Decision Trees, ID3 Classifier, Constructing Rules from a Decision Trees Classification; **Graphical Models**: Bayes' Theorem, Bayesian Learning, Bayesian Networks, Naïve-Bayes Classifier, **Instance based Learning**: Nearest Neighbor Classifiers.
Modeling a Supervised Learning System, Conditional Probability

12 Hours

UNIT III

Clustering: Similarity and Distance Measures, **Clustering Techniques**: K-Means Algorithm, Hierarchical Clustering, Clustering of Categorical Attributes; **Dimensionality Reduction**: Linear Discriminant Analysis, Principal Component Analysis; **Ensemble Learning**: Boosting, Bagging, Stacking.
Comparison of Clustering Techniques, Curse of Dimensionality.

12 Hours

UNIT IV

Artificial Neural Networks: Model, Activation functions, Perceptron, The Multilayer Perceptron (MLP), Error Propagation, Delta Rule, Back Propagation Algorithm, **Deep Learning**: Convolutional Neural Networks (CNN), Applications, A case study on Object Recognition using CNN.
Linear Separability, Gradient Descent, XOR Gate.

12 Hours
Total: 48 Hours

Textbook (s)

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", (Chapman & Hall/CRC Machine Learning & Pattern Recognition), Second Edition, 2014.

2. Sunila Gollapudi and Rodolfo Bonnin, “Practical Machine Learning: Experimental algorithms and techniques for machine learning and artificial intelligence”, Packt Publishing Ltd., Mumbai, Second Edition, 2018.

Reference (s)

1. Tom M. Mitchell, "Machine Learning ", Tata McGraw Hill, New Delhi, 2017.
2. Raschka Sebastian and Mirjalili Vahid, “Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2”, Packt Publishing Ltd., Mumbai, 3rd Edition, 2019.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, The MIT Press, 2016

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	40	30	--
Understand	40	20	--
Apply	20	30	80
Analyze	--	20	20
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

SAMPLE QUESTION (S)

Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process in detail.
4. Demonstrate Genetic Operations in detail.

Apply

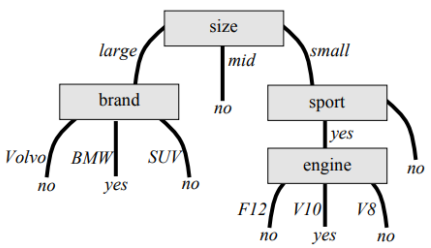
1. Apply the concept of Regularization to solve overfitting problem.
2. Build a Linear Regression for a given dataset.
3. Apply k-Means algorithm on a given dataset to identify clusters.
4. Apply Back Propagation Algorithm to the the given dataset.

Analyze

1. Distinguish between Logistic Regression and SVM.
2. Analyze Dimensionality Reduction using PCA
3. Analyze various Neural Network Architectures in Machine Learning.

Open Book Examination

1. Suppose that we want to solve the problem of finding out “*what a good car is*” by using Decision Tree algorithm.



a) Generate rules from the constructed decision tree?
b) Which parameters required for generating the tree?
c) What would be the suitable values of those parameters for the given problem? Provide a short explanation for each.
d) Explain your answer in a clear and compact manner by providing the pseudo code of the algorithm

2. About 2/3 of your email is spam so you downloaded an open source spam filter based on word occurrences that uses the Naive Bayes classifier. Assume you collected the following regular and spam mails to train the classifier, and only three words are informative for this classification, i.e., each email is represented as a 3-dimensional binary vector whose components indicate whether the respective word is contained in the email.

'study'	**'free'**	**'money'**	**Category**
1	0	0	Regular
0	0	1	Regular
1	0	0	Regular
1	1	0	Regular
0	1	0	Spam
0	1	0	Spam
0	1	0	Spam
0	1	0	Spam
0	1	1	Spam
0	1	1	Spam
0	1	1	Spam
0	1	1	Spam

a) You find that the spam filter uses a prior p(spam) = 0.1. Explain why this might be sensible.
b) Give the following model parameters when estimated as maximum-likelihood with add-one smoothing (i.e., using pseudocounts of one).
P(study|spam), P(study|regular), P(free|spam), P(free|regular), P(money|spam), P(money|regular)
c) Based on the prior and conditional probabilities above, give the model probability P(spam|s) that the sentence s="money for psychology study" is spam.
d) What should be the value of the prior p(spam) if we would like the above sentence to have the same probability as being spam as not spam, i.e., it would be classified as spam with probability 0.5?

21CH002 Industrial Safety and Hazard Management

3 0 0 3

Course Outcomes

1. Demonstrate the safety and ethical issues that may arise from industrial processes
2. Explain industrial hygiene practices and its procedures
3. Illustrate the toxic pathways and elimination of toxicity on bio organisms
4. Understand hazards arising from runaway reactions, explosions and fires, and how to deal with them.
5. Choose a suitable method for prevention of fires and explosions
6. Evaluate the process and able to do Hazards Identification and risks Risk Assessment

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_6	PO_8
1	2	2	1	3	3
2	1	2	1	3	3
3	3	2	3	1	1
4	3	1			
5	3	3	3		2
6	3	3	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Safety & Industrial Hygiene

Safety programs, Engineering ethics, Accident and Loss Statistics, Acceptable Risk, Public Perceptions, The nature of the Accident Process, Inherent Safety, Government of India and OSHA regulations, Industrial Hygiene, Identification, Evaluation & Control

Lethal dosage–Material Safety Data Sheets

12 Hours

Unit II

Toxicology, Fires and Explosions

how toxicants enter biological organisms, how toxicants are eliminated from biological organisms, effects of toxicants on biological organisms The fire triangle, Distinction between fire and explosions, Definitions, Flammability characteristics of liquids and vapors, MOC and inerting, ignition energy, Auto ignition, Auto oxidation, Adiabatic compression, Explosions

Firefighting equipment–Personal protecting equipment–Building fire safety codes

12 Hours

Unit III

Designs to Prevent Fires and Explosions

Inerting, static electricity, controlling static electricity, explosion proof equipment and instruments, ventilation, sprinkler systems, miscellaneous designs for preventing fires and explosions

Work permit–Earthling–Color codes for identification of process

12 Hours

Unit IV

Hazards Identification and Risk Assessment

Process hazards checklists, hazards surveys, hazards and operability studies, safety reviews, other methods. Review of probability theory, event trees, fault trees, QRA and LOPA

Health and safety foundation–5S Practice–Emergency procedures

12 Hours

Total: 48 Hours

Text book (s)

1. D. A. Crowl, J. F. Louvar, Chemical Process Safety: Fundamentals with Applications, 3rd Ed., Prentice Hall, 2011
2. Reese, Charles D. Industrial Safety and Health for People-oriented Services. CRC Press, 2008

Reference (s)

1. H.H.Fawcett and W.S.Wood, Safety and Accident Prevention in Chemical Operations, John Wiley and sons, 2nd Ed., New York, 1982
2. Hammer, Willie, and Dennis Price. Occupational safety management and engineering. Pearson College Division, 2001

3. R. K. Sinnot, Coulson and Richardson's Chemical Eengineeringseries Vol.6, Butterworth–Heinmann Ltd. 1996

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book Examination (%)
Remember	20	20	--
Understand	30	20	--
Apply	30	20	35
Open book Questions	20	30	35
Evaluate	--	20	30
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)
Remember

1. Define terms hazard and accidents
2. List three-step of accidents process?
3. Define terms LD and ED
4. Define any two methods of representation of toxicants dose concentration
5. List any four reversible effects that caused by toxic exposure
6. Describe four phases in any industrial hygiene
7. Define terms risk, loss prevention

Understand

1. Identify the initiation, propagation, and termination steps for motor accident
2. Would you say chemicals do more good than harm, more harm than good, or about the same amount of each?
3. Explain about how toxicants enter biological organisms
4. Explain the key responsibilities' of professional engineers
5. Explain the inherent safety techniques that are used in the chemical industry
6. Explain how toxicants are eliminated from biological organisms
7. List the ingredients of safety program for outstanding safety program

Apply

1. An employee works in a plant with a FAR of 4. If this employee works a 4-hr shift, 200 days per year, what are the expected deaths per person per year?
2. Air contains 5 ppm of diethylamide (TLV-TWA of 5 ppm), 20 ppm of cyclohexanol (TLV-TWA of 50 ppm), and 10 ppm of propylene oxide (TLV-TWA of 2 ppm). What is the mixture TLV-TWA and has this level been exceeded?
3. The following accident report has been filed. Failure of a threaded 1½″ drain connection on a rich oil line at the base of an absorber tower in a large (1.35 MCF/D) gas producing plant allowed the release of rich oil and gas at 850 psi and –40°F. The resulting vapor cloud probably ignited from the ignition system of engine driven re compressors. The 75′ high × 10′ diameter absorber tower eventually collapsed across the pipe rack and on two exchanger trains. Breaking pipelines added more fuel to the fire. Severe flame impingement on an 11,000-horsepower gas turbine–driven compressor, waste heat recovery, and super-heater train resulted in its near total destruction. Identify the initiation, propagation, and termination steps for this accident
4. A process has a reported FAR of 2. If an employee works a standard 8-hr shift 300 days per year, compute the deaths per person per year

Open book Questions

1. Can gate valves be placed between a vessel relief and its vessel
2. Liquid levels in storage tanks are frequently determined by measuring the pressure at the bottom of the tank. In one such tank the material stored in the tank was changed and an overflow resulted. Why?
3. How to convert your kitchen in to XP area
4. Does LOPA really replace 90% of the QRA?

21IT002 Fundamentals of Cloud Computing

3 0 0 3

Course Outcomes

1. Interpret the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
2. Illustrate various problems and evaluate related cloud computing solutions.
3. Apply the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud and hybrid cloud to different problems.
4. Analyze cloud provider for a defined environment and to a specific platform in a cost effective way.
5. Analyze case studies to derive the best practice model to apply when developing and deploying cloud based applications
6. Build a virtual machine with a machine image

COs – POs Mapping

COs	PO_2	PO_6	PO_7	PO_8	PO_{12}
1	3	2	1	2	1
2	3	2	1	3	2
3	3	2	1	1	3
4	2	2	2	2	2
5	3	2	1	3	1
6	2	2	3	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I

Understanding Cloud Computing

Cloud computing: Introduction, Cloud application architectures, Value of cloud computing, Cloud Infrastructure models, Cloud Services, History of Cloud Computing, Advantages of Cloud Computing, Disadvantages of Cloud Computing, Companies in the Cloud Today, Amazon Web Services, Windows Azure, Google services, IBM Cloud Before the move into the cloud- Know Your Software Licenses, The Shift to a Cloud Cost Model, Service Levels for Cloud Applications Ready for the cloud: Web Application Design, Machine Image Design, Privacy Design, Design, Database Management.

Tata Cloud- Salesforce.com

12 Hours

Unit II

Virtual Machines and Virtualization of Clusters and Data Centers

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation Case Studies: Cloud centers in detail, Comparing approaches, Xen, Eucalyptus, Cloud Stack, and Open Stack

VMware- KVM.

12 Hours

Unit III

Cloud Computing Software Security Fundamentals

Cloud information Security Objectives, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Approaches to Cloud Software Requirements Engineering, Cloud Security Policy Implementation. Cloud Computing Risk Issues: The CIA Triad, Privacy and Compliance Risks, Threats to Infrastructure Data and Access Control, Cloud Access Control Issues, Cloud Service Provider Risks.

Security concepts-Confidentiality-privacy-integrity-authentication-non-repudiation-availabilit- access control- defense in depth- least privilege

12 Hours

Unit IV

Cloud Programming and Software Environments

Features of Cloud and Grid Platforms, Parallel and Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

Ubiquitous Cloud: Cloud Trends in supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud.

12 Hours
Total: 48 Hours

Textbook (s)

1. George Reese, Cloud Application Architectures, 1st Edition O'Reilly Media, 2009
2. Ronald L.Krutz and Russell Dean Vines, Cloud Security, 1st Edition, Wiley Publishing, 2010

Reference (s)

1. Michael Miller, Cloud Computing-Web Based Applications that change the way you work and collaborate online, 1st Edition, Pearson Education, Publishing, 2011
2. Kai Hwang, Geoffrey C Fox and .Jack J.Dongarra, Distributed & Cloud Computing from Parallel Processing to the Internet of Things , 1st Edition, MK Publishing, 2010
3. David S Linthicum, Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide, 1st Edition, Addison-Wesley, 2009

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	45	--
Understand	40	45	--
Apply	20	10	80
Analyze	--	--	20
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)
Remember

1. Define Cloud Computing
2. List types of virtualization
3. Define proactive scaling
4. What is CIA Triad?

Understand

1. Explain different cloud Infrastructure models
2. Explain different levels of virtualization
3. Explain about cloud Network security in detail?
4. Explain about Recovery Point Objective.

Apply

1. Explain any IaaS service provided by Amazon
2. What is cloud Stack?
3. How disaster recovery planning can be done
4. How Web Application Design is used in designing cloud applications

Analyze

1. Compare cloud center and service infrastructure.
2. Analyze different cloud services provided by Amazon
3. With neat diagram explain the functioning of Xen Architecture.
4. List and explain various cloud service providers risks.

21BS002 Advanced Numerical Techniques

3 0 0 3

Course Outcomes

1. Apply the knowledge of finding roots of nonlinear equations and different errors in series approximations
2. Understand the consistency and inconsistency of linear system of equations
3. Evaluate the solution of Initial and Boundary value problems
4. Perform numerical differentiation and integration.
5. Analyze the solution of PDEs under given conditions
6. Apply Knowledge of numerical techniques to Engineering problems

COs–POs Mapping

COs	PO_1	PO_2
1	3	2
2	3	2
3	3	3
4	3	2
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Errors in numerical calculations and Solutions of algebraic and transcendental equations

Absolute, relative and percentage errors, a general error formula, errors in a series approximation Locating Roots of Equations with one variable: Secant method, Muller's method

Solution of nonlinear equations - Introduction, Iteration method, Newton-Raphson method

Bisection method, Regula Falsi method, Order of convergence.

12 Hours

Unit II

Solution of Linear Systems and Interpolation

Direct methods -LU Decomposition, Iterative methods –Jacobi method, Gauss-Seidel method, Interpolating polynomials using finite differences- Bessel interpolation, Piecewise and spline interpolation -Piecewise Linear interpolation, Quadratic spline interpolation

Matrix inversion method, Lagrange and Newton's divided difference interpolation formula.

12 Hours

Unit III

Numerical Integration and BVP (ODE)

Newton-Cotes methods (Weddle's rule)

Solution of BVP - Finite difference method, shooting method, the cubic spline method

Trapezoidal Rule, Simpson's 1/3 Rule and Simpson's 3/8 Rule.

12 Hours

Unit IV

Numerical solutions of PDEs

Introduction, Finite difference approximations to derivatives, Solutions of Laplace & Poisson equations using Jacobi's, Gauss-Seidel & SOR methods. Solution of parabolic equation using -Bender-Schmidt & Crank-Nicolson methods. Solution of hyperbolic equation

Classification of second order partial differential equations, Canonical forms.

12 Hours

Textbook(s)

1. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical methods for Scientific and Engineering Computation, 4th Edition, New Age International publishers, New Delhi.
2. S.S.Sastry, Introductory methods of numerical analysis, 4th Edition, PHI.
3. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna publishers, New Delhi.

Reference(s)

1. S. C. Chapra& R. P. Canale, Numerical Methods for Engineers, 6th Edition, McGraw Hill(2012).

2. Cleve Moler, Numerical Computing with MATLAB, SIAM.

Sample Question(s)

Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	-
Understand	40	40	-
Apply	30	30	60
Analyze	--	--	30
Evaluate	--	--	10
Create	--	--	--
Total (%)	100	100	100

Remember

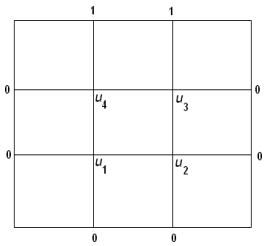
1. List out different Errors in Numerical calculations.
2. List the three numerical methods to solve Algebraic and Transcendental equations.
3. Define initial and boundary value problem for Ordinary differential equations.
4. List the numerical methods in solving Laplace's, partial differential equations i.e. Parabolic and hyperbolic.

Understand

1. Summarize the Absolute, relative and percentage Errors.
2. Illustrate the procedure for Newton-Raphson method for finding root of an algebraic equation.
3. Explain the mechanism involved in LU decomposition method in solving linear system.
4. Explain spline interpolation formula.

Apply

1. Given $f(x) = \sin x$, construct the Taylor series approximations of orders 0 to 7 at $x = \pi/3$.
2. Apply Newton-Raphson method to find a root of the equation $x^3 - 2x - 5 = 0$.
3. Given the set of data points (1,-8), (2,-1) and (3, 18) satisfying the function $y = f(x)$, find the linear splines.satisfying the given data. Determine the approximate values of y(2.5) and $\dot{y}(2)$.
4. Apply Gauss-Seidel's method to solve Laplace equation for the region given in the figure.



Analyze

1. Compare the roots obtained from Secant method, Muller's methods and explain which method is preferable.
2. Analyze the physical significance of spline's interpolation formula.
3. Differentiate shooting and cubic splines methods for numerical integration.
4. Analyze the platform for the application of Laplace Equation.

21BS003 Functional Materials and Applications

3 0 0 3

Course Outcomes

1. Understand crystal structures of various solids.
2. Explain the X-ray diffraction and it's use in the study of solids.
3. Acquire knowledge of Dielectric materials and their applications.
4. Discuss magnetism, different magnetic materials and their properties.
5. Demonstrate the applications of magnetic materials.
6. Summarize core knowledge and applications of various new materials.

COs–POs Mapping

COs	PO1	PO7
CO_1	3	2
CO_2	3	2
CO_3	3	2
CO_4	3	2
CO_5	3	2
CO_6	3	2

3 – Strongly Correlating; 2 – Moderately Correlating & 1 – Weakly Correlating

Unit I

Crystal structures

Classification of Solids – Amorphous and Crystalline, Lattice Points and Space Lattice - Basis and Crystal Structure, Unit cell, Premitive cell, Crystal Systems and Bravais Lattices, Common Crystal Structures: Diamond, Zinc Blende, NaCl and CsCl Structure - Directions, Planes and Miller Indices, Separation Between Lattice Planes in a Cubic Crystal, X-Ray Diffraction – Brag's Law, Reciprocal Lattice, Concept of Brillion Zone, Laue's Equation. Inter Planar Distance - The Laue Method of XRD - The Powder Method - Analysis of Polycrystalline Pattern (Debye-Scherer Method).

Packing fraction and coordination number of SC, BCC and FCC.

11+3 Hours

Unit II

Dielectric Materials

Introduction, Dielectric Materials, Dielectric Constant, Polarization, D, E and P relation, Types of Polarizations, Electronic Polarization, Ionic Polarization, Orientation Polarization, Interfacial or Space Charge Polarization, Local Field or Internal Field, Clausius-Mossotti Equation, Frequency Dependence of Polarization, Piezoelctricity and piezoelectric materials, Types of Dielectric Materials, Dielectric Loss, Dielectric Break Down. Ferroelectric Materials, Applications of Dielectric Materials.

Pyroelectrics, Electrets.

11+4 Hours

Unit III

Magnetic materials

Introduction, Magnetic Permeability, Susceptibility, Magnetization, B, H and M relation, Origin of Magnetism in Materials, Bohr Magneton, Classification of Magnetic Materials (Dia, Para and Ferro magnetics), Weiss theory of Ferromagnetism, Hysteresis of Ferromagnetic Material, Soft and Hard Magnetic Materials, Ferrimagnetic (Ferrites) Materials, Anti-ferromagnetic Materials, Applications of Magnetic Materials - Microwave Applications, Storage and Memory Elements Applications - Magnetoresistance Materials.

Nuclear Magnetic Resonance (NMR) Electron Paramagnetic Resonance (EPR).

11+4 Hours

Unit IV

New Materials

Metallic glasses, Shape Memory Alloys: Copper, Nickel and Titanium based Alloys, Graphene and its Properties - Ceramics: Types and Applications - Composites: Classification, role of Matrix and Reinforcement, Processing of Fibre Reinforced Plastics and Fibre Reinforced Metals - Biomaterials:

hydroxyapatite, PMMA, Silicone, Nanomaterials: ZnO, TiO_2 Properties and Applications - Sensors: Chemical Sensors, Bio-Sensors, Conducting, Semiconducting and Photoresponsive Polymers.
Nanosensors, Application of Nanosensors.

12+4 Hours
Total: 45+15 Hours

Textbook (s)

1. Charles Kittel Introduction to solid state Physics, John Wiley & Sons, In, 8th edition, 2012.
2. Wahab, M.A. Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.
3. Raghavan, V. Materials Science and Engineering: A First course,PHI Learning, 2015.
4. Balasubramaniam, R., Callister's Materials Science and Engineering, Wiley India Pvt. Ltd. 2014.

Reference (s)

1. Smith, W.F., Hashemi, J. & Prakash. R. Materials Science and Engineering, Tata Mcgraw Hill Education Pvt. Ltd., 2014.
2. Askeland, D. Materials Science and Engineering, Brooks/Cole Publishing Company 2010.
3. G. L. Hornyak, H.F. Tibbals, J. Dutta , J. J. Moore, Introduction to Nanoscience and Nanotechnology CRC Press, 2008

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	25	25	20
Understand	35	35	20
Apply	30	30	30
Analyze	10	10	30
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample question (s)
Remember
1. Define Bravais Lattices.
2. List any four applications of dielectric materials.
3. State Bohr Magneton.

Understand
1. Explain the concept of Brillion zone.
2. Differentiate Soft and Hard ferromagnetic materials
3. Describe the processing of fibre reinforced plastics and fibre reinforced metals.

Apply
1. Identify the principle behind the working of X-ray diffraction.
2. Develop the relation between D, E and P in dielectrics.
3. Choose the energies involved in origin of domains in ferromagnetic material.

Analyze
1. Examine the properties of metallic glasses and shape memory alloys.
2. Analyze why ferrites are advantageous for use as transformer cores.
3. Distinguish between conducting and semiconducting polymers.

Open Book Exam Question
1. Discuss uses of Shape memory alloys in health sector.

21CE003 Solid Waste Management

3 0 0 3

Course Outcomes

1. Classify the sources and types of municipal solid wastes
2. Understand the on-site storage methods and source reduction technique
3. Explain the different collection methods and need for transfer station
4. Demonstrate the off-site processing techniques for resources recovery from solid waste
5. Summarize the various disposal methods of solid wastes
6. Understand different types, handling of hazardous waste

COs–POs Mapping

COs	PO3	PO7	PO12
1	2	3	3
2	2	3	3
3	2	3	3
4	3	3	3
5	3	3	3
6	3	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Basics of Solid Waste

Sources and types of municipal solid waste – Waste generation rates – Factors affecting generation, composition, characteristics – Methods of sampling – Effects of improper disposal of solid wastes – Public health and environmental effects – Elements of solid waste management – Municipal solid waste rules – Role of NGO's, EPA

11+4 Hours

Unit II

Source Reduction, Storage, Collection and Transfer

Source Reduction and Storage: Source reduction of waste – Reduction, Reuse, Recycling and Recover – Segregation of wastes at source – Onsite storage methods – Materials used for containers.

Collection and Transfer: Methods of Collection – types of vehicles – Vehicle time management - Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions

11+4 Hours

Unit III

Processing and Waste Disposal

Processing: Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation; Thermal processing options.

Disposal: Land disposal of solid waste- Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas – Landfill bioreactor – Dumpsite Rehabilitation.

12+3 Hours

Unit IV

Hazardous Waste Management

Basics of Hazardous Waste: Need for hazardous waste management – Sources of hazardous wastes- Characteristics of Hazardous Waste- Effects on community – Basic Terminology and classification – Storage and collection of hazardous wastes.

Types of Hazardous Waste: Types, Classification, Handling, Storage and Disposal of Nuclear Waste, e-Waste, Biomedical waste and Chemical Waste.

11+4 Hours

Total: 45+15 Hours

Textbook (s)

1. George Tchobanoglous and Frank Kreith., "Handbook of Solid waste management", McGraw Hill, New York, 2002
2. John Pitchel., "Waste Management Practices-Municipal, Hazardous and industrial", CRC Press, Taylor and Francis, New York, 2014

Reference (s)

1. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation", Government of India, New Delhi, 2014
2. William, A. Worrell., P. Aarne Vesilind., "Solid Waste Engineering", Cengage Learning, 2012
3. Ramachandra, T. V., "Management of Municipal Solid Waste", TERI Press, New Delhi, 2009
4. Marc J. Rogoff and Francois Screve., "Waste to Energy Technologies and Project Implementation", Second Edition, Noyes Publication, USA, 2011

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	25	25	-
Understand	75	75	100
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define Solid Waste
2. List the need of transfer station
3. List any two onsite processing technique
4. What are the important factors governing the selection of solid waste?
5. List the characteristics of solid waste

Understand

1. Explain in detail about functional elements of solid waste
2. Explain in detail about different components of landfill
3. Explain in detail about source, types, handling and disposal methods of biomedical waste.
4. A city is having a population of 10 lakhs. Suggest a suitable storage system by dividing into different zone, develop a collection routes with all its components (collection time, frequency, manpower and type of vehicle). It is also required to adopt a suitable onsite processing technique and best disposal methods for the solid waste. **(For open Book Examination, not for Semester Examination)**
5. Explain in detail about India's Underground Radioactive Waste Disposal site at Gogi in Karnataka? **(For open Book Examination, not for Semester Examination)**

21EE003 Fundamentals of Electrical Vehicle Technology

3 0 0 3

Course Outcomes

1. Outline the dynamics of electric vehicles
2. Illustrate the layout of electric and hybrid electric vehicles
3. Identify suitable vehicle for the given application
4. Outline the speed torque characteristics of various drives
5. Summarize the various factors affecting the capacity of battery
6. Identify suitable drive and battery for the given application

COs – POs Mapping

COs	PO_2	PO_3	PO_{12}
1	2	2	3
2	2	2	3
3	3	3	3
4	2	2	3
5	2	2	3
6	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Fundamentals of Vehicle

Vehicle Resistance, Types: Rolling Resistance, Grading resistance, Aerodynamic drag, Calculation of total force, Total Tractive Force, Wheel torque, Wheel Speed, Motor Torque, Motor Speed, Motor Power, Battery Power, Transmission: Differential, Clutch, gear box.

Battery design for two-wheeler

12 Hours

Unit II

Electric & Hybrid Electric Vehicles

Components, General Layout and Configurations of EV, EV Classification, Components of hybrid EV, General layout of HEV, Types of Hybrid EV.

Comparison with Internal combustion Engine: Benefits and Challenges

12 Hours

Unit III

Electric Vehicle Motors & Drives

DC Motor Drive-Construction, Principle, Closed loop control of dc drive, Induction Motor Drive-Construction, Principle, V/f control of Induction motor drive, BLDC motor drive- Construction, Principle, Speed & Torque Control of bldc drive.

PMSM drive

12 Hours

Unit IV

Cells and Batteries

Conversion of chemical energy to electrical energy, Classification of cells, factors affecting the capacity of the battery, Ampere-Hour & Watt- Hour efficiency, trickle charging, indications of full charged battery, Battery design Performance criteria for EV batteries, Vehicle propulsion factors, Power and energy requirements.

battery power calculation for an EV

12 Hours

Total: 48 Hours

Text Book(s):

1. *Tom Denton , "Electric and Hybrid Vehicles", CRC Press publications, second edition, 2020.*
2. *Chris Mi, Abul Masrur and David Wenzhong Gao, "Hybrid Electric Vehicles-Principles and Applications with Practical Perspectives", A John Wiley & Sons, Ltd., Publication, 2nd Edition, 2017.*
3. *Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press; 3rd edition, 2021.*

4. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles', CRC Press, 2018.

Reference Book(s):

1. *Amgad Elgowainy, "Electric, Hybrid, and Fuel Cell Vehicles", Springer publisher, New York, NY, 2021.*
2. *Amir Khajepour, Saber Fallah, Avesta Goodarzi, "Electric and hybrid vehicles technologies, modelling and control a mechatronic approach" Wiley Publications, first edition, 2014.*
3. *Per Enge, Nick Enge, Stephen Zoepf , "Electric Vehicle Engineering", McGraw-Hill Education, first edition, 2021.*
4. *Joeri Van Mierlo, "Plug in hybrid Electric vehicle(PHEV)", MDPI journal, special edition, 2019.*

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	50	50	---
Understand	50	50	---
Apply			100
Analyze	---	---	---
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample question (s)

Remember

1. List the challenges faced by hybrid electric vehicle.
2. List any five differences between electric vehicle and hybrid electric vehicle.
3. List the components of a hybrid electric vehicle.
4. List the advantages and disadvantages of hybrid cars.
5. State and explain the dynamic equation of vehicle motion.

Understand

1. Explain the term rolling resistance and aerodynamic drag in vehicles and derive the expression for vehicle translational speed from fundamentals.
2. Obtain the mathematical modeling of electric vehicle to describe its performance.
3. Explain various electric drive train topologies.
4. Explain the design of a Hybrid Electric Vehicle (HEV) as a case study.
5. Explain the two-quadrant operation of chopper DC motor drive with suitable waveforms for electric Vehicle

Apply

1. Rolling resistance 0.015
   Vehicle Mass 111 Kg
   Driver Mass 80 Kg
   Acceleration due to gravity 9.81 m/s^2
   Grade 0^o
   Area 0.875 m^2
   Air Desnsity 1.225 Kg/m^3
   Drag Coefficient 0.22
   Radius of Wheel 0.1524 m
   Gear ratio 7.4
   Transmission efficiency 0.85
   Motor efficiency 0.9
   GVM 191 Kg
   GVW 1873.1 Kg
   Motor controller efficiency 0.85
   Design the motor requirement for the above system.

(For Open Book Examination and not for semester end examination)

2. Determine the torque vs speed and torque vs current characteristics for a separately excited dc motor with the following paprameters: 2.3hp, 220V, 600 rpm, Ra=1.39 ohms, La=0.00182 H, Kb=0.331 volt/rad/sec.The machine has rated field excitation and its armature is fed a constant voltage of 220 V dc.

(For Open Book Examination and not for semester end examination)

21ME003 Industrial Engineering & Management

3 0 0 3

Course Outcome(s)

1. Design organization structure and implement management principles in real time business environment
2. Establish layouts for different types of industries, manufacturing, process and service sectors
3. Elaborate productivity and profitability by implementing work study and SQC
4. Select and maintain skilled and sufficient manpower for various business proposals
5. Find total production time and cost by using networking techniques
6. Enunciate a best method of making a product in the production process

COs- POs Mapping

COs	PO_1	PO_{11}
1	3	2
2	3	2
3	3	1
4	3	2
5	2	1
6	3	1

3 Strongly linked | 2 Moderately linked | 1 Weakly linked

Unit I

Evolution of Management Thought-Organizational Structures - Douglas McGregor‟s Theory X and Theory Y, Maslow‟s Hierarchy of Human Needs, Systems Approach to Management. Designing. Basic concepts related to Organization, Depart mentation and Decentralization, Types of mechanistic and organic structures of organization (Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization) and their merits, demerits and suitability. Cellular Organization and team structure

12 Hours

Unit II

Facilities location- Work study - Plant location, definition, factors affecting the plant location, comparison of rural and urban sites methods for selection of plant, Matrix approach, Plant Layout; definition, objectives, types of production, types of plant layout, various data analyzing forms, travel chart. Definition, objectives, method study; definition, objectives, steps involved, various types of associated charts. Work measurement- definition, time study, steps involved, equipment, different methods of performance rating, allowances, standard time calculation. Work Sampling, definition, steps involved. Standard time calculations and differences with time study

12 Hours

Unit III

Materials Management-Quality Control- Objectives, Inventory, functions, types, associated costs, inventory classification techniques, EOQ, ABC and VED analysis. Inspection and quality control, types of inspections, Statistical Quality Control; techniques, variables and attributes, assignable and non assignable causes, variable control charts, and R charts, attributes control charts, p charts and c charts. sampling plans. Introduction to TQM, Quality Circles, ISO 9000 series procedures

12 Hours

Unit IV

Introduction to PERT / CPM-Introduction to Human Resource Management - Project management, network modelling: PERT/CPM Time and cost estimations. Functions of HRM, Job Evaluation, different types of evaluation methods, Job description, Merit Rating, difference with job evaluation. Different methods of merit ratings, wage incentives.

12 Hours
Total: 48 Hours

Textbook(s)

1. O.P. Khanna, Industrial Engineering and Management, S Chand & Co Publications, 3rd Edition, 2013
2. Teslang Martand, Industrial Engineering and Production Management, S Chand & Co Publications, 1st Edition, 2002
3. Phillip E Hicks, Industrial Engineering and Management; a new perspective, TMH publications, 2nd Edition, 1994
4. H.T. Amrine, J. A. Ritchey and O.S. Hulley, Manufacturing Organization and Management, Prentice-Hall, 2nd Edition, 1966
5. P.C. Tripathi and P.N. Reddy, Principles of Management, TMH Publications, 4th Edition, 2012

Reference(s)

1. H. Koontz & H. Weihrich, Essentials of Management, Tata McGraw Hill, 8th Edition, 2010
2. Paneer Selvam, Production and Operations Management, PHI, 3rd Edition, 2012

Sample Question (s)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	35	35	-
Understand	45	35	20
Apply	20	30	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Remember

1. List the five objectives of work study
2. List any four merits and demerits of committee organization
3. Define Mc-Gregor‟s theory X and theory Y
4. List the three types of plant layout
5. List any four functions of HRM
6. List the three functions of material management?

Understand

1. Explain the factors effecting plant locations
2. Explain about purchase management
3. Write about Statistical Quality Control-techniques
4. Compare the Mc-Gregor‟s Theory X and Theory Y

Apply

1. Explain the attribute charts
2. Compare the PERT and CPM
3. Explain about stores management and stores records
4. What are the different types of evaluation methods and explain them?
5. Identify duties of purchase manager

21EC003 Interfacing and Programming with Arduino

3 0 0 3

Course Outcomes

1. Summarize the hardware and software of Arduino development board
2. Explain the working of I/O devices
3. Demonstrate the interfacing and programming of I/O devices with Arduino
4. Explain the working of different sensors
5. Demonstrate the interfacing and programming of sensors with Arduino
6. Organize different applications of Arduino

COs – POs Mapping

COs	PO1	PO2
1	2	
2	2	
3	3	2
4	2	
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Arduino – Hardware and Software

Features of Arduino UNO Board, Arduino IDE Software, Serial Peripheral Interface (SPI) Communication Protocol, Inter-Integrated Circuit (I2C) Communication Protocol, Structure of Arduino Programming, Function,

Features of ATmega328, map function

12 Hours

Unit II

Interfacing and programming of IO Devices with Arduino

Interfacing and programming of Arduino with LED, Seven-segment display, LCD, push button, keypad, relay for high voltage devices, interfacing and programming of Arduino using PWM technique.

DC motor and Motor Driver IC L293D

12 Hours

Unit III

Interfacing and programming of Sensors with Arduino

Interfacing and programming of Arduino with temperature sensor, humidity and temperature sensor, light dependent register, touch sensor, smoke detector, ultrasonic sensor, soil moisture sensor.

Rain sensor and Bluetooth

12 Hours

Unit IV

Arduino based simple projects

Obstacle Detection and Warning System, Gas Leakage Detection, Burglar Detection, Weather Monitoring System, Plant Watering System

Mobile Phone Controlled Light

12 Hours
Total: 48 Hours

Textbook (s)

1. Yogesh Misra, Programming and Interfacing with Arduino, CRC Press, 1st Edition, 2021
2. James A. Langbridge, Arduino Sketches: Tools and Techniques for Programming Wizardry, Wiley, January 2015,

Reference (s)

1. Michael Margolis, “Arduino Cookbook”, First Edition, March 2011, O'Reilly Media, Inc

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember			--
Understand	70	40	--
Apply	30	50	50
Analyze	--	**10**	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Recall the microcontroller used in Arduino UNO board.
2. List the pin numbers having PWM capabilities in Arduino UNO board.

Understand

1. Exemplify the SPI protocol for on board communication interface.
2. Exemplify the I2C protocol for on board communication interface.
3. Demonstrate the purpose of compiler and linker in firmware design.
4. Illustrate the different components of Arduino UNO board.
5. Illustrate the working of capacitive touch sensor.

Apply

1. Construct an interfacing diagram of LCD with Arduino board and develop the software to display a message from the 5^{th} row and 2^{nd} column of LCD.
2. Construct an interfacing circuit of 220 V ac operated bulb with Arduino board and develop the software to turn it on and off after a delay of 10 seconds.
3. Implement the hardware and software for automatic street light logic.

21CS003 Data Science for Engineering Applications

3 0 0 3

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the fundamentals of data science.
2. Explain how data is collected, managed, and stored for data science.
3. Analyze the data by applying various techniques.
4. Explore data visualization techniques.
5. Explore the technologies for data visualization
6. Investigate several applications in data science.

COs–POs Mapping

CO	PO2	PO3	PO4
1	1	2	2
2	3	2	2
3	3	1	2
4	3	2	2
5	3	2	2
6	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit-I: Fundamentals of Data science **12 Hours**

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Unit-II: Data analysis **12 Hours**

Basics of Data Analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT.

Algorithms: Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit-III: Data visualization **12 Hours**

Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Unit-IV: Data Science-Applications **12 Hours**

Applications of Data Science, Technologies for visualisation, Bokeh (Python), Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Total: 48 Hours

Textbook:

1. Jeffrey S. Saltz,Jeffrey M. Stanton,"An Introduction to Data Science", SAGE Publications, 2018.
2. Anil K. Maheshwari, "Data Analytics Made Accessible", 2015 (Online)
3. Laura Igual ,SantiSeguí, "Introduction to Data Science A Python Approach to Concepts, Techniques and Applications", Springer Publications,2014

Reference(s)

1. Glenn J. Myatt, Wayne P. Johnson: Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition,Wiley,2014
2. Joseph F Hair, Barry J. Babin, Rolph E. Anderson, William C. Black: Multivariate Data Analysis Cengage, 2018

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination[1] (%)
Remember	40	30	--
Understand	40	20	--
Apply	20	30	80
Analyze	--	20	20
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

SAMPLE QUESTION (S)

Remember

1. What is data science.
2. Define purpose of different data visualtion aids
3. List any two steps involved in EDA.

Understand

1. Explain different data represenation
2. Explain the role of various data grouping methods
3. Explain purpose of hypothesis testing in detail

Apply

1. Apply various visual aids to identify behavior of data
2. Make use of Multivariate Analysis methods for data nanlysis
3. Examine data with various distribution function

Analyze

1. Comapre and contrast varius data grouping methods.
2. Distinguish various methods to address problems with dummy variables
3. Examine various string handling methods

Evaluate

1. Evaluate the statistics of a given dataset
2. Justify the importance of data skewness
3. Measure data dispersion methods on a dataset

Open Book Exam Questions

Question 1:

Perform below analysis on a house price prediction dataset.

a) Univariate Analysis
    i. Analysis of a numerical feature
    ii. Analysis of a categorical feature
b) Bivariate Analysis
    i. Relationship of a numerical feature with another numerical feature
    ii. Relationship of a numerical feature with a categorical feature

Question 2:

Perform below analysis on weather prediction dataset.

a. Correlation Analysis
    a. Correlation Heat Map
    b. Zoomed Heat Map
b. Investgation of missing values
    a. What's missing? to what extent?

Visualizing missing values in a dataframe

21CH003 Industrial Ecology for Sustainable Development

3 0 0 3

Course Outcomes

1. Explain the basic concepts of industrial ecology and sustainability
2. Compare between biological and industrial organisms
3. Analyze energy and material flows in natural and technical systems at different scales
4. Utilize the concept of life cycle assessment before designing a product or process
5. Utilize the concept of industrial symbiosis to develop sustainable technical collaboration
6. Evaluate the availability of renewable and fossil resources for industrial processes

CO-PO Mapping

CO	PO_2	PO_6	PO_7
1	3	3	3
2	3	3	3
3	3	3	3
4	3	3	3
5	3	3	3
6	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Sustainability as Applied to Industrial Ecology

The tragedy of the commons–Technological evolution and the master (IPAT) equation–Industrial ecology activities and sustainability–Linking industrial ecology activities to sustainability–Greening of engineering Biological and industrial organisms and ecosystems–Engineering by biological and industrial organisms–Metabolisms of biological and industrial organisms–Risk assessment and management–Social dimensions of industrial ecology

Limits to Growth

11+4 Hours

Unit II

Sustainable Engineering & Life Cycle Assessment

Green chemistry and engineering–Process design and life cycle–Green technology and sustainability–Design for Environment and Sustainability

Concept of life cycle assessment–The LCA framework–Goal setting and scope determination–Life cycle of industrial products–Impact and interpretation–Limitations of LCA

Life cycle assessment of processes

11+4 Hours

Unit III

Industrial Ecosystems

Ecosystems and food chains–Food web–Industrial symbiosis–Designing and developing symbiotic industrial ecosystem–Eco-industrial Park - Material flow analysis, utility of material flow analysis

Eco-industrial Park initiatives around the world

11+4 Hours

Unit IV

Energy and Industrial Ecology

Energy and organisms–Energy and the product life cycle–Energy and mineral resources–Energy and industrial ecology

Industrial ecology and sustainable engineering in developing economies–Industrial ecology and sustainability in the corporation

Energy efficiency through industrial ecology

12+3 Hours

Total: 45+15 Hours

Text Book (s)

1. T. E. Graedel, B. R. Allenby, Industrial Ecology and Sustainable Engineering, 1st Ed., Pearson, USA. 2010

Reference Book (s)

1. R. U. Ayres, L. W. Ayres, A Handbook of Industrial Ecology, Edward Elgar Publishing, 2002

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment test (%)
Remember	20	20	10
Understand	40	40	40
Apply	40	40	50
Analyze	--	--	
Evaluate	--	--	-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. State any two drivers for and barriers to industrial ecosystems.
2. State the order of precedence for approaches to packing in decreasing order of preference.

Understand

1. What do you mean by 3-2 heuristic in industrial symbiosis?
2. What do you mean by material flow analysis?
3. Present any two thoughts/desirables on development in lesser developed countries.

Apply

1. What are the three types of consumption pattern? What is sustainable consumption and how does IPAT equation help in achieving sustainable consumption
2. Discuss about rapidly developing country and slowly developing country dynamics and perspectives?
3. Discuss about the alternative corporate approaches including defensive, cost-oriented and proactive approaches to environment and sustainability?
4. For a metal processing system using only virgin raw material with $E_p = 31$ GJ/t, $E_f = 5$GJ/t, $E_m = 5$GJ/t and $\beta = 0.1$, compute the energy consumed per kg of output material (φ). E_p, E_f, and E_m are the energy consumed during production, fabrication, and manufacture and, β is the fraction of throughput that is reused as prompt scrap.
5. Discuss the concept of circular economy. How was it applied to the entire economy in China?

13+4 Hours

21IT003 Fundamentals of Mobile Computing

3 0 0 3

Course Outcomes

At the end of the course, students will be able to

1. Interpret the GSM architecture and its services.
2. Understand the various wireless applications and study technical feasibility of various mobile applications.
3. Utilize the mobile network layer protocols and its functionalities.
4. Explain any existing or new models of mobile environments for 4G networks
5. Understand platform, protocols and related concepts of Ad hoc and Enterprise wireless networks
6. Understand IP and TCP layers of Mobile Communications

CO – PO Mapping

COs	PO_1	PO_7
1	3	2
2	3	2
3	3	2
4	3	2
5	3	1
6	3	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I **12 Hours**

Introduction: Mobile Communications and Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices. Global System for Mobile Communication (GSM): Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, New Data Services, GPRS Architecture, GPRS Network Nodes.

Evolution of Mobile computing

Unit II **12 Hours**

Medium Access Control (MAC) : Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), Wireless LAN/(IEEE 802.11) architecture, key IEEE802.11 a/b/c/d/e/g/i/n/T/ac/ standards. Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless markup Languages (WML). Wireless Local Loop (WLL): Introduction to WLL Architecture.

wireless Local Loop Technologies

Unit III **12 Hours**

Mobile Network Layer : IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation,

Mobile Transport Layer : Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP. Third Generation (4G) Mobile Services: Comparison of different generations, Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision.

Wideband Code Division Multiple Access, Time out freezing

Unit IV **12 Hours**

Mobile Ad hoc Networks (MANETs) : Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc. , Mobile Agents, Service

Discovery ,case study using NS2 –traffic analysis using CBR and VBR Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology.

Blue tooth Protocols.

Total: 48 Hours

Textbook (s)

1. Jochen Schiller, "Mobile Communications", Addison-Wesley, Second Edition, 2009.
2. Raj Kamal, "Mobile Computing", Oxford University Press, 2007, ISBN: 0195686772

Reference (s)

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing, Technology Applications and Service Creation" Second Edition, 2010 McGraw Hill.
2. Martin Sauter, "From GSM to LTE-Advanced: An Introduction to Mobile Networks and Mobile Broadband," Second Edition, 2014 Wiley.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	-
Understand	70	70	40
Apply	-	-	60
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. List any four Application of Mobile Computing
2. Define Mobile Computing

Understand

1. Explain Mobile Ad hoc Networks
2. Explain the role Blue tooth technology in Mobile Computing
3. Illustrate Classification of Routing Algorithms

Apply

1. Discuss about Mobile transport Layer
2. Illustrate Blue tooth technology
3. Describe classification of Routing algorithms
4. Illustrate challenges of MANET

Open Book Exam Questions

1. Why "MAC protocol designed for infrastructure based wireless network may not work satisfactory in infrastructure less environment " – justify?
2. why the traditional IP cannot be used in a mobile network. What are the main differences between the traditional IP and the mobile IP? How does mobile IP support mobile hubs?

21BS004 Advanced Materials for Renewable Energy

3 0 0 3

Course Outcomes

1. Understand the conventional and renewable energy sources.
2. Explain hydrogen production, storage and use as fuel.
3. Illustrate the concept and types of fuel cells.
4. Understand the various solar cells and their applications
5. Demonstrate energy storage through batteries and their technologies.
6. Understand the concept of supercapacitor and their characteristics.

COs–POs Mapping

COs	PO1	PO7
1	2	3
2	2	3
3	2	3
4	2	3
5	2	3
6	1	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Renewable and Nonrenewable Energy sources

Introduction - Conventional fossil fuels- Coal and natural gas- Renewable energy sources-Photovoltaics- Hydrogen production from biomass, geothermal, solar and wind energy - Fuel cells-principle and working.
Advantages of renewable energy technologies.

10+3 Hours

Unit II

Fuel Cells & Hydrogen Production and Storage

Materials for hydrogen production - storage, utilization & dispensing - Electrochemical: Electrolysis, Photo electro chemical. Biological: Photo Biological, Anaerobic Digestion Fermentative Micro- organisms. Physical and chemical properties - Principles of fuel cells, types of fuel cells, fuels for fuel cells, low, medium and high temperature fuel cells, power generation by fuel cells.
Applications of fuel cells.

13+4 Hours

Unit III

Photovoltaics

Solar Spectrum, Solar constant–Materials for Renewable energy conversion- Photovoltaics - Silicon (Si) solar cells, Crystalline/ Semi crystalline/ Amorphous Si solar cells- Thin film solar cells. Photochemical cells, photocatalytic, Mechanism of photovoltaics- Factors affecting electron transfer. Organic solar cells-polymer solar cells- perovskite solar cells.
Hybrid solar cells

11+4 Hours

Unit-IV

Energy Storage- Batteries and super capacitors

Batteries -Primary and Secondary cells-Conventional battery technologies- merits and demerits- Recent battery technologies- Lithium-ion- Sodium ion- Metal-air batteries - Design, Fabrication, operation and evaluation-Super capacitors- Fundamentals of Electrochemical Super capacitors, Electrode and electrolyte interfaces and their capacitances, Charge-Discharge characteristics, Energy/power density.
Applications of batteries and super capacitors

11+4 Hours

Total: 45+15 Hours

Text Book (S)

1. B.K. Hodge, "Alternate Energy Systems and Applications", John Wiley & sons, Inc., 2010.
2. C. Brabec, "Organic Photovoltaics", Wiley-VCH, 2008.
3. Norman S. Allen (Ed.), "Photochemistry and Photophysics of Polymeric Materials", 2010.
4. V. Hacker, S. Mitsushima(Eds.), "Fuel Cells and Hydrogen: From Fundamentals toApplied Research", Elsevier, 2018.
5. C. Daniel and Jurgen O. Besenhard, "Handbook of Battery Materials", Wiley-VCH Verlag,2011.
6. A. Yu, V. Chabot, and J. Zhang, "Electrochemical Super capacitors for Energy Storage and delivery" 1st Ed., CRC Press, Taylor & Francis group, 2012.
7. L. Liu and S.Bashir, "Advanced Nanomaterials and their Applications in RenewableEnergy", Elsevier Science, 2015.

Reference (S)

1. X. Moya David and Muñoz-Rojas (Ed.), "Materials for Sustainable Energy Applications Conversion, Storage, Transmission, and Consumption",Pan Stanford Publishing Pvt. Ltd. 2016.
2. Alan J. Heeger, Niyazi Serdar Sariciftci and Ebinazar B. Namdas, "Semiconducting and Metallic Polymers", Oxford Univ Press 2010.
3. W. Streicher and M. Kaltschmitt (Ed.) "Renewable energy. Technology, economics and environment", Springer, 2007.
4. N. Armaroli, V. Balzani and N. Serpone, "Powering Planet Earth – Energy Solutions for the Future", WILEY- VCH, 2012.
5. A.J. Bard, L.R. Faulkner, "Electrochemical Methods, Fundamentals and Application". Wiley, 2001.
6. K.E. Aifantis, S.A. Hackney, and R. V. Kumar (Ed.) "High Energy Density Lithium Batteries Materials, Engineering, Applications", WILEY-VCH Verlag GmbH & Co. KGaA, 2010.
7. Delivery Fundamentals and Applications, Taylor & Francis Group, 2013.
8. F. Beguin and E. Frackowiak, "Super capacitors- Materials, Systems, and Applications", Wiley- VCH Verlag GmbH & Co. 2013.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	25	25	10
Understand	45	45	10
Apply	30	30	80
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. What is renewable energy?
2. List any two Conventional fossil fuels.
3. State primary and secondary batteries.

Understand

1. Explain the concept of fuel cell.
2. Differentiate organic and polymer solar cells.
3. Describe the processing of power generation by fuel cells.

Apply

1. Identify the principle behind wind energy.
2. Select various factors affecting electrontransfer in solar cells.
3. Choose materials for Photovoltaics.

Open Book Exam

1. You are given the job of fabricating a super capacitor.
   (a) Which process/ process parameter you choose for material synthesis? What factors do you consider while choosing the process?
   (b) Among the cost, raw material availability, morphology, material category (crystalline/ glass/ composite), which factor do you think should be given priority? Justify your answer.
   (c) *Change in material morphology leads to change in the super capacitance behaviour*. State True or False and Justify your answer.

21BS005 Applied Linear Algebra for Engineers

3 0 0 3

Course Outcomes

1. Understand about Eigen values and Eigen vectors of Complex matrices
2. Compute solution of system of non-homogenous equations
3. Learn the basic notion of Vector Spaces and understand related properties
4. Study about Basis and Dimensions of vector spaces
5. Understand the properties of Linear Transformations
6. Apply the concept of Vector Spaces using Linear Transformations

COs – POs Mapping

COs	PO_1	PO_{12}
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Complex Matrices & System of Non-Homogenous Equations

Complex Matrices - Introduction, Hermitian, Skew-Hermitian and Unitary Matrices, Properties of Hermitian, Skew-Hermitian and Unitary Matrices, Eigen values and Eigen Vectors of Complex Matrices, Power method.
System of non-homogenous equations - Cholesky's Method, Crout's Method
Invertible Matrices and their some applications in Cryptography

12+3 Hours

Unit II

Vector Spaces

Vector Spaces - Introduction, Properties of Vector Spaces, Subspaces, Algebra of Subspaces, Linear combination of vectors, Linear Span, Linear Independence and Dependence of vectors (All theorems without Proof)
Study of Linear Independence and Dependence using Wronskian

11+4 Hours

Unit III

Finite dimensional Vector Spaces

Finite Dimensional Vector Spaces - Basis of Vector Space, Basis Extension Theorem, Dimension of a Vector Space, Dimension of a Subspace, Quotient Spaces and Dimension of Quotient space (All theorems without Proof)
Study about Row and column spaces

11+4 Hours

Unit IV

Linear transformations and Applications

Linear transformations - Linear Operators, Properties of Linear Transformations, Algebra of Linear Operators, Range Space of Linear Transformation, Null space of Linear Transformation, Rank and Nullity of Linear Transformations, Rank-Nullity Theorem (All theorems without Proof)
Application of Linear Transformation to Animation on a Computer screen

11+4 Hours
Total:45+15 Hours

Textbook (s)

1. J.N Sharma and A. R Vasista, "Linear Algebra", Krishna's Educational Publishers, Meerut, 2021.
2. B. S. Grewal, "Higher Engineering Mathematics", 42nd Ed., Khanna Publishers, New Delhi, 2014.
3. A Ramkrishna Prasad, "Kreyszig's,Mathematical Methods",Wiley India,2009

Reference (s)

1. Shanti Narayana ,A Text Book of Matrices, , S. Chand Publishing,2020.

2. Jin Ho Kwak and Sungpyo Hong,"Linear Algebra", 2nd Ed., Springer, 2004.
3. T K V Iyengar, B Krishna Gandhi, S Ranganatham and M.V.S.S.N Prasad, "Mathematical Methods", S. Chand,2016.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	-
Understand	50	50	30
Apply	30	30	70
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. Define Skew Hermitian matrix.
2. Define Vector Space.

Understand

1. Show that the set S={(-1,0,1,0),(1,-3,2,-4),(1,3,-4,-2),(2,2,-4,0)} in R^4 is linearly dependent.
2. Show that $T: R^3 \to R^3$ is defined by $T(x, y, z) = (x - y, 0, y + z)$ is a linear transformation.

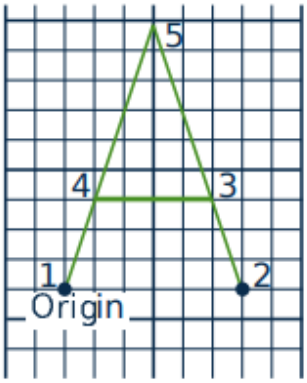
Apply

1. Using Power Method, determine the largest Eigen value and the corresponding Eigen vector for the matrix $A = \begin{pmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{pmatrix}$.

2. Find rank of the transformation $T: R^2 \to R^3$ defined by $T(x, y) = (x + y, x - y, y)$ using Rank-Nullity Theorem.

Open book Examination question(s)

1. Model the matrix for the figure given below.
   i. Draw the image corresponding to the matrix obtained by multiplying $\begin{bmatrix} 1 & 0.2 \\ 0 & 1 \end{bmatrix}$ with obtained matrix in (i)
   ii. Sketch the image and write the corresponding matrix by rotating the following figure through the angle $\frac{\pi}{6}$ about the point $\begin{bmatrix} 4 \\ 5 \end{bmatrix}$.



2. Consider the letter L as shown in the figure below. L can be represented by a matrix with coordinates of the vertices as

$$\begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 \end{matrix}$$

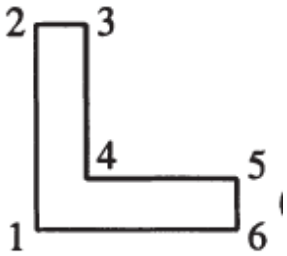
$$\begin{bmatrix} 0.0 & 0.0 & 0.5 & 0.5 & 2.0 & 2.0 \\ 0.0 & 2.0 & 2.0 & 0.5 & 0.5 & 0.0 \end{bmatrix} = A$$

Where first row values represents X-coordinates and second row values represents Y-coordinates.

i. Model the matrix obtained by multiplying $B = \begin{bmatrix} 1 & 0.25 \\ 0 & 1 \end{bmatrix}$ with A.

ii. Sketch the image of (i).

iii. What kind of figure can you have, if $B^T A$ replaced with BA.



21CE019 Green Buildings

3 0 0 3

Course Outcomes

1. Apply the knowledge in development of green field infrastructure in relation to sustainable environment.
2. Explain Green Building specifications and various eco-friendly materials
3. Choose and size building components, as well as energy and environmental systems suitable for different categories of buildings to achieve the smallest feasible life-time environmental impact.
4. Utilize a variety of tools and methodologies suitable for evaluating the resource consumption and overall environmental performance of buildings in different stages of their life cycles
5. Summarize importance of solar energy in green buildings.
6. Demonstrate the passive energy system and components of building fabrics and materials

COs–POs Mapping 33

COs	PO1	PO7	PO12
1	3	3	2
2	2	3	1
3	3	3	1
4	3	3	1
5	3	3	2
6	3	3	2

3–Strongly linked | 2–Moderately linked | 1– Weakly linked

Unit I

Green Buildings

Definition of Green Buildings, typical features of green buildings, benefits of Green Buildings, Green building Principles, Sustainable site selection and planning of buildings to maximize comfort, day lighting, ventilation, planning for storm water drainage

Smart Buildings, technologies

11+4 Hours

Unit II

Environmentally Friendly Building Materials and Technologies

Natural Materials like bamboo, timber, rammed earth, stabilized mud blocks, hollow blocks, lime & lime pozzolana cements, materials from agro and industrial waste, ferro-cement, alternative roofing systems, various paints reducing the heat gain of the building, etc.

Ferro Concrete, bamboo as a construction material

11+4 Hours

Unit III

Energy and Resource Conservation and Use of Renewable Energy Resources

Need for energy conservation, various forms of energy used in buildings, embodied energy of materials, energy used in transportation and construction processes- water conservation systems in buildings- water harvesting in buildings – waste to energy management in residential complexes or gated communities. Wind and Solar Energy Harvesting.

Case studies of fully solar energy-based buildings in India

12+3 Hours

Unit IV

Building Resources and Green Building Rating Systems

Passive energy system design, Building envelope, orientation and components of building fabric and shading, Construction of curtain walls, Sourcing and recycling of building materials. Introduction to Leadership in Energy and Environment Design (LEED), Green Rating systems for Integrated Habitat Assessment – Modular wastewater treatment systems for built environment.

Building management systems, LEED certification

11+4 Hours

Total: 45+15 Hours

Textbook (s)

1. K.S.Jagadish, B. U. Venkataramareddy, K. S. Nanjundarao, Alternative Building Materials and Technologies, 2nd Ed., New Age International, 2007
2. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010

Reference (s)

1. Kibert, C. J, Sustainable Construction:Green Building Design and Delivery, 3 rd Ed., John Wiley & Sons, Inc., 2012
2. G. D. Rai, Non-Conventional Energy Resources,6th Ed., Khanna Publishers.1988
3. Greening Building – Green Congress, US. (Web).
4. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	-
Understand	50	50	100
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the aims and objectives of green building development?
2. What is a LEED Building?
3. What are the principles of green buildings?
4. Discuss the various forms of energy and energy scenario in India **(For Open Book Examination, not for Semester Examination)**

Understand

1. Explain various rating systems for the assessment of sustainability.
2. Explain the necessity of understanding basic concepts of green buildings and intelligent buildings.
3. Explain about the various rating systems for the assessment of sustainability **(For Open Book Examination, not for Semester Examination).**

21EE017 Sustainable Energy

3 0 0 3

Course Outcomes

1. Understand various terms related to sustainability
2. Understand the estimation and valuation of different energy sources
3. Identify the key issues and lessons learned for sustainable development
4. Outline the technical performance of sustainability
5. Summarize the interaction of energy systems with the environment
6. Identify the environmental benefits and implications of sustainable energy

COs – POs Mapping

COs	PO_2	PO_3	$P0_{12}$
1	2	1	1
2	3	2	2
3	2	1	2
4	2	1	1
5	3	2	2
6	1	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit-I

Fundamentals of Sustainable Energy

Sustainable Energy Systems: Issues for the 21st century, Critical challenges for a sustainable energy future, definitions, indicators, Key energy stakeholders, Energy: conservation, efficiency.
investments and divestments.

12 Hours

Unit-II

Estimations and Evaluation of Energy resources

Units of measurement: Energy and Power, comparison of different forms of energy, the energy life cycle, estimation and valuation of fossil mineral fuels, estimation and valuation of Nuclear Fuel Resources, Estimation and Valuation of Renewable Energy Resources.
Lessons for Sustainable Development

12 Hours

Unit III

Technical Performance: Efficiency and Production Rates

The Relation of Technical Performance to Sustainability, An Introduction to Methods of Thermodynamic Analysis, The Importance of Rate Processes in Energy Conversion, Chemical Rate Processes, The Physical Transport of Heat, Energy Requirements for Gas Separation Processes, Use and Abuse of Time Scales,
Energy Resources and Energy Conversion: Fertile Common Ground.

12 Hours

Unit IV

Local, Regional, and Global Environmental Effects of Energy

How Energy Systems Interact with the Environment, Adverse Environmental Effects over Local and Regional Length Scales, Global Climate Change: Environmental Consequences over Planetary Length Scales, Attribution of Environmental Damage to Energy Utilization, Methods of Environmental Protection, Environmental Benefits of Energy,
Implications for Sustainable Energy.

12 Hours
Total: 48 Hours

Text Book(s):

1. Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, and William A. Peters "Sustainable Energy: Choosing among options" Second edition, The MIT Press Cambridge, Massachusetts London, England, 2012.62
2. Frank kreith, Susan krumdieck, "Principles of sustainable energy systems", second edition, CRC Press, Taylor and Francis group, 2008.

Reference Book(s):

1. Ibrahim Dincer and Marc A. Rosen (Eds.), "Exergy. Energy, Environment and Sustainable Development"second edition, Elsevier sciences, 2013
2. Course readings and other reference are available on Canvas: https://umich.instructure.com/
3. US Department of Energy, Energy Information Administration: http://www.eia.doe.gov/
4. International Energy Agency: http://iea.org/
5. US DOE Office of Energy Efficiency and Renewable Energy (EERE) http://energy.gov/eere/office-energyefficiency-renewable-energy
6. Renewable Energy World News and Network: http://www.renewableenergyworld.com
7. OpenEnergyInfo Gateway to world energy information/ data http://en.openei.org/wiki/Main_Page

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	15	---
Understand	50	35	---
Apply	25	50	100
Analyze	---	---	---
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the critical challenges of future sustainable energy?
2. What is energy conservation?

Understand

1. Explain how estimation is done for nuclear fuel resources?
2. Demonstrate the rate process in energy conservation?

Apply

1. Taking the recent World Energy Council and United Nations resource-base figures for the total amount of fossil energy in the ground worldwide as 356,000 quads, how long will it take to exhaust our fossil resources, assuming that we can recover one-half of the resource base and that usage grows at 3% per year? The world currently consumes about 400 quads of primary energy per year, of which 85% is from fossil sources. (Hint: you will need to account for the compounding, exponential growth effect of the 3% per year increase in consumption.)Identify the key factors from the case study of the city Paris- a city of modernity?
2. How much power in MW are you delivering to your car when you fill it up at a self-service gas station?
3. A novel heat engine is being considered for producing work from the thermal energy contained in the wastewater discharge from a large food-processing plant. On an average day, 35 ° C wastewater leaves the plant and is discharged into the ocean at 1,000 gallons per minute. If the average annual ocean temperature is 10 ° C at that location, what is the maximum power that could be produced by this heat engine? What would be the thermal cycle efficiency of your maximum power engine? You can assume that the heat capacity of water at constant pressure is constant at 4,200 J/kg K.
   (For Open Book Examination and not for semester end examination)
4. Estimate the rate of heat loss due to radiation from a covered pot of water at 95 ° C. How does this compare with the 60 W that is lost due only to convection and conduction losses? What amount of energy input would be needed to maintain the water at its boiling point for 30 minutes? The polished stainless steel pot is cylindrical, 20 cm in diameter and 14 cm high, with a tight-fitting flat cover. The air temperature in the kitchen is about 25 ° C. State any assumptions you make in deriving your estimates.
   (For Open Book Examination and not for semester end examination)

21ME019 Total Quality Management

3 0 0 3

Course Outcome(s)

1. Demonstrate the demining philosophy as a frame work for TQM
2. Identify customer needs to enhance the quality management
3. Appraise the employee's involvement critically for effective team work requirements
4. Describe several techniques of quality management tools
5. Apply benchmarking and FMEA processes for effective quality management.
6. Apply ISO standards for design and development of products and services.

COs-POs Mapping

COs	PO_1	PO_{11}
1	2	3
2	1	3
3	2	1
4	3	2
5	2	1
6	3	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction- Definition and principles of quality Evolution of Quality Quality Planning Quality policies and objectives. Dimensions of product and service quality. Contributions of Demeing, Juran and Crosby Customer focus. Customer stratification, Customers complaints and Customer retention.

Basic concepts of TQM, Barriers to TQM, customer feedback.

Unit II

TQM Principles-Employee's- Motivation, Empowerment, Team & Team work, Recognition and Reward, Performance appraisal Benefitsof employee's involvement, performance measure, balance score card, Continuous Process Improvement, PDCA cycle, Kaizen 5s, Reengineering Supplier relationship Partnering, Supplier selection, Supplier rating.

Unit III

TQM Techniques- New management tools, New and old 7 QC tools, an affinity diagram, tree diagram, matrix diagram, Six sigma methodology, infrastructure, implementation, Bench marking, process, Taguchi philosophy of quality control.

TPM concepts, improvement needs

Unit IV

Quality System- Need for ISO 9000 system, Advantages, Clauses of ISO 9000, Implementation of ISO 9000, Quality costs, Quality auditing, Case studies of TQM implementation in manufacturing and service sectors including IT industry.

Need for quality system, Principles, Revision standards.

Total: 48 Hours

Textbook(s)

1. Dale H. Besterfiled, Total Quality Management, Pearson, 3rd Revised Edition, 2011
2. Subbaraj Ramasamy, Total Quality Management, Tata McGraw Hills, New Delhi, 4th Edition, 2012

Reference(s)

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, 8th Edition, Fist Indian Edition, Cengage Learning, 2012
2. K. C. Jain and A. K. Chitale, Quality Assurance and Total Quality Management, Khanna Publication, 3rd Edition, 2003
3. Suganthi, L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd., 3rd Edition, 2006
4. Douglas C. Montgomery, Design and Analysis of Experiments Minitab manual, JWS, 7th Edition, 2010

Web Reference(s)

1. https://archive.nptel.ac.in/courses/110/101/110101010/
2. https://archive.nptel.ac.in/courses/112/107/112107259/

Video Reference(s)

1. https://archive.nptel.ac.in/courses/112/106/112106249/
2. https://archive.nptel.ac.in/courses/112/106/112106253/

Sample Question(s)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	35	-
Understand	35	25	20
Apply	40	40	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Remember

1. Examine the definitions of quality by the quality gurus
2. List out the basic concepts of TQM
3. Define quality policies and its objectives
4. Explain the five distinct dimensions of quality
5. Explain the purpose of different quality statements

Understand

1. Explain concepts of continuous improvement
2. Briefly explain the eight pillars of TPM
3. Contrast and compare Six Sigma with total quality management
4. Explain mutually beneficial supplier relationships

Apply

1. Discuss in detail about the various tasks of employee involvement.
2. Enumerate the seven magnificent quality tools which form a significant part of the six-sigma tool kit.
3. Discuss the eight quality principles of management on which ISO9000 is based.

21EC011- Communication Technologies

3 0 0 3

Course Outcomes

1. Illustrate the importance of analog and digital communication.
2. Interpret the concept of satellite communication.
3. Asses the operation of RADAR
4. Explain various Fibre Optic phenomena
5. Demonstrate the characteristics of fibre optic elements.
6. Outline the operation of cellular system.

COs – POs Mapping

COs	PO1	PO2
1	2	
2	2	
3	3	2
4	2	
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Principles Of Communication

Structure of Communication, Transmission modes (Simplex, half duplex, Full duplex), Synchronous and Asynchronous transmission, Serial and Parallel communication, Need of Modulation, Amplitude modulation (Definition and block diagram of AM wave generation), Frequency modulation (Definition and block diagram of FM wave generation), Pulse code modulation block diagram, Digital modulation techniques(Definitions and block diagram), Multiplexing (Definition and need), Time division multiplexing, Frequency division multiplexing.

Frequency spectrum, Phase modulation **12 Hours**

Unit II

Satellite Communication & Radar

Microwave link, advantages of satellite communication system, classification of satellites, Geo-stationary Satellites, azimuth, elevation, apogee, perigee, transponder, up-link and down-link frequencies, active and passive satellites, applications of satellites, Introduction to Radar system – Radar range equation.

DTH, CW radar – MTI radar **12 Hours**

Unit III

Fibre Optic Communication

Optical fibre – Total Internal Reflection (TIR), Numerical Aperture(NA), Modes and dispersion, losses in fibres, fibre optic cables – Splices, connectors, optical couplers , switches & relays – optical emitters (LED & LASER diode) – optical detectors (PIN diode & APD)

Dense wavelength division multiplexing (DWDM), Submarine cables..

12 Hours

Unit IV

Mobile Communication

Evolution of mobile radio communication, Cellular concept and frequency reuse, Radio wave propagation issues in personal wireless systems, Multipath fading, Multiple Access Techniques-FDMA, TDMA and CDMA systems.

Parameters of mobile multipath channels, Antenna systems in mobile radio. **12 Hours**

Total: 48 Hours

Text Book(s):

1. B. P. Lathi, " Modern Digital And Analog Communication Systems: ", Oxford University Press, 2017.
2. Frenzel, " Communication Electronics", TMH, 2017.
3. Trimothy Pratt, Charles W. Bostian, Jeremy E. Allnutt,"Satellite Communications", John Wiley and Sons, 2002.

Reference Book(s)

1. Gottapu Sasibhushana Rao, " Mobile and Cellular Communications". Pearson Education, 2013
2. Gerd Keiser "Optical Fiber Communication", TMH, 2017.
3. Andreas F.Molisch "Wireless Communications", Wiley, Second Edition, 2014.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	15	--
Understand	75	50	--
Apply	--	35	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

REMEMBER

1. Define Nyquist rate
2. Define numerical aperture
3. List the two technologies of 4G communication

UNDERSTAND

1. Explain the basic elements of digital communication system
2. Illustrate the characteristics of geo stationary satellites
3. Explain the evolution of mobile communication system

APPLY

1. Find the Nyquist rate of the following.
   (i)$x(t)=5\cos(1000\pi t)\cos(4000\pi t)$ (ii) $y(t)=\text{Sinc}(200t)$
2. Find the maximum range of Radar for the following specifications –
   Peak power transmitted by the Radar, Pt=250KW
   Gain of transmitting Antenna, G=4000
   Effective aperture of the receiving Antenna, Ae=4m2
   Radar cross section of the target, σ=25m2
   Power of minimum detectable signal, Smin=10−12W

3. A step-index fiber has a core index of refraction of n1 = 1.425. The cut-off angle for light entering the fiber from air is found to be 8.50o. Find the following (a) numerical aperture of the fiber? (b) index of refraction of the cladding of this fiber?

21CS020 Applications of Artificial Intelligence

3 0 0 3

Course Outcomes

1. Illustrate the scope of Artificial Intelligence (AI) in gaming and expert systems.
2. Demonstrate various applications of AI related to perception and biometrics.
3. Summarize and learn different case studies in classification and recognition systems.
4. Describe and apply natural language processing techniques for designing AI Bots,
5. Illustrate the role of AI in robotics.
6. Demonstrate the state of AI in solving human labor problems for social equity.

CO-PO Mapping:

COs	PO2	PO3	PO6	PO7
1	3	3	3	1
2	3	3	3	1
3	3	3	2	1
4	2	2	2	2
5	2	1	1	2
6	1	1	1	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit -I **11 Hours**

AI for Everyone, Gaming and Expert Systems

AI for Everyone- What is AI?AI Explosion, AI at work, AI at Society, Applications of AI**. Gaming –** Games as search problems**-** Mini Max Search, Alpha Beta Cutt-Offs, State of the Art Games- Chess & Checkers Problem. **Expert Systems-** Representing and using domain knowledge, Expert System Shells, Explanation and Knowledge Acquisition. **Case Study:** MYCIN expert system using AI to identify bacteria causing Infections.

AI in fashion, Ethics and Laws for Holding AI,

Unit -II **13 Hours**

Perceptions and Biometrics

Perceptions-Image formation, Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D world, Object recognition from structural information. Using Vision for manipulation and navigation.**Biometrics-** Understanding the Biometric fingerprints, facials, voice, iris, palm, and finger vein patterns Identifies Challenges in Biometric Systems. **Case Study I**: Text Classification System **Case Study II:** Face Recognition System.

AI in Health Care, Medical Imaging, Role, Benefits and Tools of AI

Unit -III **12 Hours**

Natural Language Processing and Natural Language Communication

Natural Language Processing- Language Models, Text Classification, Information Retrieval and Information Extraction. **Natural Language Communication-** Phrase Structure Grammars, Syntactic Analysis, Augmented Grammars and Semantic Analysis, Machine Translation and Speech Recognition. Case Study: Automatic Speech Recognition System. **Case Study I**: Understand the development and deployment of AI Chat Bots.

Question and Answer Problem, Information extraction and Translation, Corpus,

Unit -IV **12 Hours**

Robotics and Impact of AI on Human Labor and Social Equity

Robotics- Robot Hardware- Robot Perception- Planning to Move- Planning Uncertain Movements- Planning Moves- Robotic Software Architectures and Domains. **Impact of AI on Human Labor and**

Social Equity -Benefits on this Technological Revolution- Need and Necessity of Labor based Economy and Society- Distribute future assets more equitably-Support for Unemployed.
Future Impacts of AI, Fault Detection, Diagnosis and Optimization.

Total: 48 Hours

Text Book (s)

1. Russel and Norvig, Artificial Intelligence A Modern Approach, 4th Edition, Pearson Education 2021.
2. StevanFinaly, Artificial Intelligence for Everyone, Relativistic Publications, Great Britan,2020.
3. E. Rich K. Knight and B.Nair – Artificial Intelligence– Third Edition – Tata McGraw Hill, 2017.
4. Jerry Kaplan, Artificial Intelligence- What everyone needs to know, Oxford University Press,2016.

Reference (s)

1. Artificial intelligence: a very short introduction; Margaret A. Boden; Oxford University Press; 2018.
2. Artificial Intelligence and Social Work; MilindTambe, Eric Rice; Cambridge University Press; 2018.
3. Artificial Unintelligence; Meredith Broussard; The MIT Press; 2018.
4. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam [5] (%)
Remember	25	20	-
Understand	35	40	30
Apply	40	40	40
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample question (s)

Remember

1. Define AI.
2. List any five AI applications.
3. Define a curve matrix.

Understand

1. What is an Expert System??
2. How perception and biometrics differw.r.tAI?
3. Explain confusion matrix with an example

Apply

1. Write a program to convert text to speech.
2. Develop a robot using an AI simulating software.
3. Write a program to demonstrate the working of the expert system to trace its decision.

Analyze

1. Implement a fake product monitoring system using biometrics.
2. Develop and Automatic Attendance Monitoring System.
3. Design and AI BOT to pay Snake game between two players.

Open Book Question(s)

1. MrNeerukonda is a famous real estate agent and always busy with uplift of houses in the nearby villages and small cities. He one day popped with his busy schedule, came into a decision to build a model to predict House prices by taking a coder help called MrTrevedhi, who was a gem in Artificial Intelligence. MrNeerukonda, started off by collecting data on the houses in the areas which he is most interested and nearby too. Assuming that thousands of sample houses data is collected, where each sample contained information on a given house's properties and handed

over the details to MrTrivedhi. Among these properties include the number of bedrooms, number of bathrooms and square footage. Common sense would lead anyone to believe that there is relationship between the number of bedrooms, the number of bathrooms and the square footage of the house. In other words, anyone can easily suspect that the higher the square footage of a house, the more bedrooms, and bathrooms it contains. If the properties are highly correlated, is it necessary that should we have three individuals for the same underlying property in size, do explain and help MrTrivedhi to resolve this and provide a solution to MrNeerukondasQuery. Apply relevant common-sense reasoning and help MrTrivedhi to determine which of the variables accounts for the most variance in house price, suggesting him an algorithm for solving the same representing with both procedure and pictorial model.

2. Vamsi and Tirumalesh are two best friends, who does all the activities in parallel either in college or in their room. It might depend on various factors like whether or not these two get free from the college on time and able to leave on time, whether they can reach room before 7 pm in the evening depending upon traffic or whether their roommates have some other activity already scheduled that day; in all the cases, their decision to go out to play a game, tennis with their roommates depends mainly upon the particular day and its endure.If everything is fine, and if they are free from college and reach the room in time and if their roommates doesn't have any other class, may want to go out to the tennis court with them. If they reach on time but already has some other activity scheduled that day, they might want to just relax at room, writing the record. Determine and suggest the best algorithm for solving the same.

21CH016 Green Technologies

3 0 0 3

Course Objectives:

1. Understand the principles of green chemistry and engineering.
2. Familiarize with Environmental green standards
3. Design processes those are benign and environmentally viable.
4. Utilize Nano technological principles for better environment
5. Design processes and products those are safe and hazard free.
6. Modify chemical processes making hazardous products and make them green safe and economically acceptable by using biotechnology.

CO-PO Mapping

CO	PO_2	PO_6	PO_7
1	3	3	3
2	3	3	3
3	3	3	3
4	3	3	3
5	3	3	3
6	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

UNIT- I

Fundamentals of Green Chemistry and Technology- The twelve Principles of Green Chemistry and green engineering with examples Principles of Green Chemistry and technology, green chemistry metrics, atom economy, atom efficiency, E-factor, and other green chemistry metrics.

UNIT- II

Industrial Safety and Hazard analysis- Introduction to ISO standards, hazard identification, life cycle analysis, and safety aspects related to transport, handling and storage of hazardous chemicals. green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity- WEHAB -eco-restoration- phyto-remediation, ecological sanitation, renewable energy technologies, industrial ecology, agro ecology and other appropriate green technologies , global warming; greenhouse gas emissions, impacts, mitigation and adaptation.

UNIT- III

Green processes- Microwave assisted reactions, ultra-sonication assisted reactions, ionic liquids as solvent, water as a reaction medium, solvent free reactions, supercritical solvents, safe product and process design, case studies Green Nanotechnology – Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste Management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

UNIT- IV

Concept of Cleaner Production, Definition of Cleaner Production, Cleaner Production and End of Pipe Solution, Good House Keeping checklist, tools to be discuss in details with example, Material and Energy Balance of Process, CP Methodology, Barriers and Drivers in cleaner production, Case studies Green Productivity concepts, methodology & techniques, Guidelines of APO on Green Productivity, CEPI Index Emerging technologies and their techno economic evaluation

Text Book (s)

1. Clark, James H., and Duncan J. Macquarrie, eds. Handbook of green chemistry and technology. John Wiley & Sons, 2008.

Reference Book (s)

1. Lancaster, Mike. Green chemistry: an introductory text. Royal society of chemistry, 2020.
2. Lapkin, Alexei, and David Constable. Green chemistry metrics. Wiley, 2008.
3. Manahan, Stanley. Environmental chemistry. CRC press, 2017.
4. Matlack, Albert. Introduction to green chemistry. CRC press, 2010.
5. Anastas, Paul T., and John C. Warner. "Green chemistry." Frontiers 640 (1998): 1998.
6. Dr Bharat Jain, Cleaner Production and its implementation in Industries, GCPC, 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment test (%)
Remember	20	20	10
Understand	40	40	40
Apply	40	40	50
Analyze	--	--	--
Evaluate	--	--	-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. List various benefits of cleaner production.
2. Write the differences between cleaner production and end-of-pipe approach.
3. List the major non-conventional energy resources in India?

Understand

1. Discuss how you identify the opportunities to better assess cleaner production.
2. Write about environmental management hierarchy.
3. Discuss the future need of conventional energy resources.
4. Write the sustainability of geothermal energy in Indian practice.
5. Discuss the strategies in detail how to achieve sustainable development in a country through green technologies.

Apply

1. Explain in detail the factors affecting green technologies.
2. Discuss various barriers of cleaner production process. Also write the processes which do not come under cleaner production.
3. Write the problems, causes and possible solutions for cleaner production Financing.
4. Discuss in details methods for analyzing data and effectiveness in prevention of pollution and achieving cleaner production.
5. Discuss how important to utilize wind based and solar based energy with the associated principles.

21IT015 Human Computer Interaction

3 0 0 3

Course Outcomes

At the end of the course students will be able to

1. Demonstrate the capabilities of both humans and computers from the viewpoint of human information processing.
2. Understand typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms.
3. Understand interactive design process and universal design principles to designing HCI systems
4. Apply HCI design principles, standards and guidelines.
5. Understand user models, user support, socio-organizational issues, and stakeholder requirementsof HCI systems
6. Understand HCI issues in groupware, ubiquitous computing, virtual reality, multimedia, and WordWide Web-related environments.

COs – POs Mapping

COs	PO_1	PO_7
1	1	3
2	1	3
3	3	1
4	1	2
5	2	3
6	1	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I **12 Hours**

Introduction

Importance of user Interface-definition, importance of good design, Benefits of good design, A brief history of Screen design, The graphical user interface-popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user-Interface popularity, characteristics-Principles of user interface.

Design methodologies-participatory design-Usability and tests-Acceptability tests

Unit II **12 Hours**

Design process

Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions, Screen Designing:-Design goals-Screen planning and purpose, organizing screen elements, ordering of screen data and content-screen navigation and flow- Visually pleasing composition- amount of information-focus and emphasis-presentation information simply and meaningfully-information retrieval on web-statistical graphics-Technological consideration in interface design.

Design Visual thinking-virtual-environments-item presentation sequence-layout-form fill-in dialog boxes

Unit III **12 Hours**

Windows

New and Navigation schemes selection of window, selection of devices based and screen based controls, Components-text and messages, Icons and increases-Multimedia, uses problems, choosing colors.

Goals of Co-operation-asynchronous interactions-synchronous distributed-application to education-social uses

Unit IV **12 Hours**

Software Tools and Interaction Devices

Specification methods, interface-Building Tools, Keyboard and function keys, pointing devices-speech recognitiondigitization and generation-image and video displays-drivers.

Database query and phase search in documents, *multimedia document searches*, *information visualization*

Total: 48 Hours

Textbook (s)

1. Wilbert O Galitz, Wiley Dream Tech, The essential guide to user interface design, 3rdEdition, Wiley Computer Publishing, 2007.
2. Ben Shneidermann, Designing the user interface, 3rd Edition, Pearson Education Asia, 2008.

Reference (s)

1. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, Human Computer Interaction., 3rd EditionPearson Education, 2004.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	--
Understand	60	40	80
Apply	--	20	20
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define Human Computer Interaction.
2. What is the basic goal of Human Computer Interaction?
3. State the long term goal of HCI
4. List the factors HCI designers must consider for User Interface Design

Understand

1. Demonstrate the HCI importance.
2. Extend the Trouble faced by human with Computers.
3. Illustrate Psychological Responses to Poor Design
4. Interpret Human-factor variables used in Comparison of pointing devices

Apply

1. Identify the amount of Information need to present in a page.
2. Organize the different Software tool specification methods.
3. Model out the six types interaction tasks properties of Pointing devices (For Open Book Examination and not for semester end examination)

21BS006 Handling of Industrial waste and waste water

3 0 0 3

Course Outcomes

1. Understand the procedures for assessment of quality of Industrial water and processes of handling of waste water.
2. Demonstrate the utilization of waste water in industry by adopting different processes.
3. Explain the sampling, preservation and characterization of waste water and its treatment.
4. Understand the discharge of industrial waste water into water bodies and its management.
5. Illustrate the functioning of effluent treatment plants and effluent disposal.
6. Identify the nature of liquid waste coming from different industries and propose the suitable treatment techniques.

COs–POs Mapping

COs	PO1	PO7
1	2	3
2	2	3
3	2	3
4	2	3
5	2	3
6	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Requirement of Quality and Quantity of water to Industry

Process water for industries like Textiles, Food processing, power plants, fertilizers, pharma, Selection of water source based on quality and quantity. Utilization of Municipal wastewater in Industries, waste water treatment-Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Elutriation, Removal of Colour, Odour and Taste.

Waste Water composition in steel industry

11+3 Hours

Unit II

Industrial Wastewater Management

Survey on Industrial waste –evaluation of industrial waste water Flow-generation rates – Sampling of Industrial wastewater and preservation of samples for analysis - characterization of waste water-Toxicity of industrial effluents-Treatment of wastewater, recycling, reuse and recovery of resources.

Proper handling of waste water

12+4 Hours

Unit III

Discharging of Industrial wastewater

Discharges into Streams, Lakes and oceans and associated problems, Land treatment - Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method *Discharge levels of toxic contaminants in industrial effluent*

11+4 Hours

Unit IV

Processing and treatment of waste water

Water utilization in manufacturing Process, origin, characteristics, effects and treatment methods of liquid waste from industries like (i) Steel plants (ii) Fertilizers (iii)Textiles (iv) Paper and Pulp industries (v) Pharmaceutical Plants.

Removal of dyes from the industrial waste water

11+4 Hours

Total: 45+15 Hours

Text Book(s)

1. M. N. Rao and A. K. Dutta, "Wastewater Treatment", 3rd Ed., Oxford & IBH Publishing, 2020.
2. K.V. S. G. Murali Krishna, "Rural, Municipal and Industrial Water management", Reem Publications, 2008.
3. Metcalf & Eddy Inc., "Wastewater Engineering: Treatment and reuse", 4th Ed., McGraw Hill Education (India), 2017.

Reference(s)

1. A. D. Patwardhan, "Industrial Wastewater treatment", 2nd Ed., PHI Learning, 2017.
2. G. L. Karia and R.A.Christian, "Wastewater Treatment: Concepts and Design Approach", 2nd Ed., Pentice Hall India Learning Private limited, 2013.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	--
Understand	50	50	50
Apply	20	20	50
Analyse	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample questions(s)

Remember

1. What is meant by industrial waste water?
2. What is the composition of steel industry waste water?

Understand

1. Explain the treatment methods for generation of liquid waste from textile industry
2. Explain the process of separation of particles from industrial waste by Elutriation method
3. Illustrate the industrial waste discharges into oceans

Apply

1. How the industrial wastes are purified by using effluent plants?
2. Illustrate what measurements are taken in the handling of preservation of different industrial waste samples.
3. Compare the handling of different industrial waste waters

Open Book Exam question

1. In industrial area, one of the industry discharges waste waters, how to identify toxicity of industrial effluents in that water. Suggest and explain the process for that industrial waste water to purification, recycling and reuse

21OE001 Robotics and Automation

3 0 0 3

Course Outcomes

1. Identify different types of robots and their parts using basic robotics and automation concepts
2. Asses the simple robot motion control strategies using kinematics and dynamics principles.
3. Assess the scope of automation in various applications
4. Set up basic feedback control systems in robots
5. Demonstrate different types of sensors and actuators to robotic systems
6. Explore future trends and case studies of robotics and automation in industrial and service sector

COs	PO5	PO6	PO7
1	3	3	2
2	3	3	3
3	3	3	3
4	3	3	3
5	2	3	2
6	3	3	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit 1: Introduction to Robotics and Automation

Basics of Robotics Definition and scope of robotics, History and evolution of robotics, Types of robots - industrial, service, mobile robots- Basic components of a robot, Overview of robotic joints and links

Introduction to Automation Definition and scope of automation, Differences between automation and mechanization, Applications of automation in various industries, Advantages of using robots and automation, Current trends and future of robotics and automation **10 Hours**

Unit 2: Robot Kinematics and Trajectory Planning

Robot Kinematics Degrees of freedom (DOF), Forward and inverse kinematics, Introduction to Denavit-Hartenberg (DH) parameters, Basic concepts of dynamics in robotics

Trajectory Planning Path and trajectory planning basics, Joint space vs. Cartesian space trajectories, Introduction to motion control, Basics of control systems - open loop and closed loop, Introduction to advanced control strategies -adaptive and intelligent control **13 Hours**

Unit 3: Sensors and Actuators

Introduction Types of sensors used in robotics -proximity, vision, tactile - Sensor specifications and selection criteria, Basics of sensor integration and signal processing, Types of actuators, Characteristics and applications of different actuators, Basics of actuator control

Sensor and Actuator Interfacing Interfacing techniques for sensors and actuators, Introduction to communication protocols, Basics of microcontrollers and microprocessors in robotics

Feedback Systems- Importance of feedback in robotics, Types of feedback systems, Basics of feedback loop implementation **13 Hours**

Unit 4: Robot Programming and Industrial Applications

Robot Programming: Methods of programming, features of programming, simple programs, Emerging technologies, AI in robotics, collaborative robots, IoT integration

Industrial Applications Overview of industrial robots and automation systems, Case studies of robotic applications in manufacturing- welding, assembly, painting- Introduction to service robots, Basics of mobile robotics **12 Hours**

Text books:

1. John J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th edition Published by Pearson (March 4, 2022) © 2018
2. Kevin M. Lynch and Frank C. Park, *Modern Robotics: Mechanics, Planning, and Control*, Cambridge University Press, 1st Edition, 2017.
3. Tadej Bajd, Miomir Vukobratović, "Introduction to Robotics," Springer, 3rd Edition, 2019.

Reference Books

1. K.S. Fu, R.C. Gonzalez, and C.S.G. Lee, *Robotics: Control, Sensing, Vision, and Intelligence*, McGraw-Hill, 1st Edition, 1987.
2. Mukherjee, S., "Service Robotics," Nova Science Publishers, 1st Edition, 2023.
3. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modeling and Control," Wiley, 2nd Edition, 2020.
4. Bruno Siciliano and Oussama Khatib (Editors), *Handbook of Robotics*, Springer, 2nd Edition, 2016.
5. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, and Nicholas G. Odrey, *Industrial Robotics: Technology, Programming, and Applications*, McGraw-Hill, 1st Edition, 1986.

Sample questions

Remember

1. What are industrial robots typically used for in manufacturing?
2. List two examples of service robots.
3. Identify three emerging technologies in robotics.

Understand

1. Explain the selection criteria for choosing a sensor in a robotic system.
2. Describe the characteristics and applications of electric actuators.
3. Summarize the importance of feedback in robotic systems.
4. Explain the difference between forward and inverse kinematics.
5. Summarize the basics of PID control in motion control systems.

Apply

1. Integrate a proximity sensor with a microcontroller for a robotic application.
2. Design a basic control system for a pneumatic actuator.
3. Implement a feedback loop for a robotic arm using a tactile sensor.

21OE002 Introduction to IoT

3 0 0 3

Course Outcomes

1. Abstract the basic concepts of IoT
2. Summarize the structural knowledge of IoT
3. Exemplify M2M in the context of Internet of Things.
4. Infer the IoT Reference Architecture
5. Interpret the Internet of things systems for the given problem
6. Find IoT for various engineering applications

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	2	2
3	2	2
4	2	-
5	2	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Introduction and Fundamental IoT Mechanisms

What is the Internet of Things? History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks, IoT Definitions, IoT Architecture, Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy..

IOT paradigm-smart objects, Bits an atoms-goal orientation, RTLS+ GPS-agents, Multi agent system

12 Hours

Unit II

M2M to IoT

A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Introduction to Atmega 8 /16 microcontroller, Architecture of the AVR Microcontroller, Pin description of the Microcontroller.

12 Hours

Unit III

IoT Reference Architecture

Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Interaction and remote control. Industrial realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation- Introduction, Case study: phase one commercial building automation today, Case study.

Specification-Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View.

12 Hours

Unit IV

IoT for Business Applications

Internet of Things Application: IoT for Smart Grid ,City Automation, Automotive Applications, Home Automation, Smart Cards , Process Monitoring / Automation, Sensor Technology, Raspberry- pi Interface, Smart Healthcare, Smart Transportation, M2M Communication, Smart Metering, Systems and Services Integration, Hands-on training, Smart Waste Management System.

Sharing Sensor Data on Social Networks-Twitter-Facebook Connection App, Updation of Sensor Data on Website /Blog.

12 Hours

Total: 48 Hours

Textbook (s)

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
2. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, ISBN: 978-1-118-47347-4, Willy Publications, 2014.
3. Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things, ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.

Reference (s)

1. Parikshit N. Mahalle & Poonam N. Railkar, Identity Management for Internet of Things, River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook), 2015.

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	25	25	--
Understand	75	50	--
Apply	--	25	100
Analyse	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Write the major significance of Internet of Things.
2. State the crucial requirement f IoT in terms of application and its supporting natures.
3. List the dominant technologies behind IoT development.
4. Identify two major differences between Internet of Everything and Industrial IoT.
5. Write about the data-center based cloud tools that use to run the machine learning algorithm internally.
6. Recognizes an alternative approach that results in better adaptivity in case of network fluctuations and increased latency.

Understand

1. Identify the evolutionary terms of Internet of Things (IoT) that use to interact and live with the physical objects.
2. Illustrate the reference architecture of IoT that unifies the smart objects and human beings to provide the ubiquitous communication
3. Illustrate the service-oriented architecture of IoT that ensures the interoperability among the heterogeneous devices
4. Illustrate the API-Oriented Architecture of IoT that use SOAP and Remote Method Invocation (RMI) as a means for describing, discovering, and calling services
5. Discuss the resource capacity, selecting and provisioning the resources that greatly impact Quality of Service (QoS) of the IoT applications
6. Classify the taxonomy of resource management activities of IoT.

Apply

1. Interpret a study analysis on open-source prototyping platform for the industrial IoT.
2. Implement a suitable OPENIoT Architecture for IoT/Cloud Convergence that provides an abstract presentation of the functional elements of architecture.
3. Sketch W3C SSN-XG ontology and how to semantically enable real time sensor feeds.
4. Execute the two-tier data dissemination model for large-scale wireless sensor network.
5. Demonstrate SPARQL query caching in order to improve the performance of semantic web applications.
6. Illustrations a technique to cluster semantically similar QA pairs for retrieving an answer for a newly given query without asking the QA engine on the cloud side.
7. Design a 4bit binary adder using Finate state machine.

8. Discuss various business applications of IoT such as Smart Grid, City Automation, Automotive Applications, Home Automation, and Smart Healthcare. Explain the role of sensor technology, Raspberry Pi interface, M2M communication, and smart metering in these applications.
   [Open Book Examination Question]
9. Describe the transition from Machine-to-Machine (M2M) communication to IoT. Outline the architectural changes, main design principles, and capabilities required for IoT. Compare M2M value chains with IoT value chains and discuss the emerging industrial structure for IoT.

21OE003 Fundamentals of Image processing

3 0 0 3

Course Outcomes

1. Interpret the fundamental concepts of gray and color image processing
2. Infer image transforms
3. Exemplify image enhancement techniques in spatial and frequency domains
4. Illustrate image restoration techniques
5. Summarize line, point, threshold and region based segmentation for digital images
6. Assess various compression models and compression techniques for digital images

COs – POs Mapping

COs	PO1	PO2
1	2	-
2	2	-
3	2	-
4	2	2
5	2	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Digital Image Fundamentals

Fundamental steps in digital image processing, Components of an Image processing system, Elements of visual perception, Image sampling and quantization, basic relationships between pixels.

Color fundamentals, Color models, Pseudo color Image Processing, Full Color Image Processing, color transformations.

Color Image Enhancement in spatial and frequency domain

12 Hours

Unit II

Introduction to Image transforms: Two Dimensional Discrete Fourier Transform(2D-DFT) and its properties, Discrete cosine transform(2D-DCT), Discrete Wavelet Transform(2d-DWT).

Image Enhancement

Enhancement in spatial domain: Intensity transformations, Histogram Processing, smoothing and sharpening, ImageEnhancement in Frequency Domain: Smoothing and Sharpening Filters

Walsh Transform, Hadamard Transform

12 Hours

Unit III

Image Restoration

Image Degradation/Restoration model, Noise models, Restoration using spatial filtering, Periodic noise reduction by frequency domain filtering, Linear Position-Invariant Degradations, Inverse filtering, Minimum Mean Square Error Filtering, Constrained Least squares filtering.

Estimating the degradation function, Geometric Mean filter

12 Hours

Unit IV

Image Segmentation and Compression

Image segmentation: Fundamentals, point, Line and Edge detection, Thresholding, Region based Segmentation, Image Compression: Fundamentals, Image Compression Models, Lossless Compression, Lossy Compression,Transform coding.

Watershed algorithm, JPEG compression standard **12 Hours**

Total: 48 Hours

Textbook (s)

1. Rafel C.Gonzalez and Richard E.Woods, Digital Image Processing, Pearson Education, 3rdEdition 2011
2. S.Sridhar, Digital Image Processing, Oxford publishers, 2nd Edition, 2016

Reference (s)

1. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson Education, 1st Edition, 2015
2. S.Jayaraman, S.Esakirajan, T.Veerakaumar, Digital Image Processing, McGraw Hill publishers, 2011
4. M.Sonka,V. Hlavac, R. Boyle, Image Processing, Analysis and Machine Vision, Vikas Publishing House,2001

SAMPLE QUESTION (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Assignment Test (%)
Remember	25	25	--
Understand	75	50	--
Apply	--	25	100
Analyse	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

REMEMBER

1. List the 6 components of digital image processing system
2. Define image enhancement
3. Define image segmentation
4. State the lossy compression
5. List out the 3 color models

UNDERSTAND

1. Interpret the process of image sampling and quantization
2. Summarize the fundamental steps in digital image processing
3. Represent RGB color model
4. Explain the properties of 2D Discrete Fourier Transform
5. Illustrate contrast stretching transformation function to increase the dynamic range of the gray levels in theimage

APPLY

1. Consider the image segment shown below. Compute N4, N8 distances

   3 1 2 1 (q)
   2 2 0 2
   1 2 1 1
   (p) 1 0 1 2
2. Compute histogram equalization for a given 8x8 image
3. Compute the efficiency of Huffman Coding for the given symbols

Symbol	a1	a2	a3	a4	a5	a6
Probability	0.1	0.4	0.06	0.1	0.04	0.3

4. Implement segmentation on given image using bimodal thresholding

5. Show that a linear, spatially –invariant degradation system with additive noise can be modeled in the spatial domain as the convolution of the degradation function with an image followed by addition of noise

21OE004 Fundamentals of Data Acquisition systems

3 0 0 3

Course Outcomes

1. Illustrate various digital data acquisition systems
2. Summarize various data transfer techniques
3. Interpret the working principle of serial interface
4. Summarize the working principle of various digital instruments
5. Interpret various signal condition techniques
6. Assess various Remote data Acquisition techniques

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	2	2
3	2	2
4	2	2
5	2	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Introduction to Data Acquisition systems

Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition, Instrumentation systems: Types of Instrumentation systems, Components of an analog Instrumentation Data – Acquisition system. Multiplexing systems, difference between TDM and FDM systems, Uses of Data Acquisition Systems, Use of Recorders in Digital systems, Digital Recording systems, Modern Digital Data acquisition system, operation of sample Hold circuits.

sample & hold circuits- specifications and design considerations.

12 Hours

Unit II

Data Transfer Techniques:

Interfacing To PC: Expansion Buses- ISA Bus, EISA Bus, PCI Bus. Plug in data Acquisition and Control Boards: Functions of Plug in DAQ boards, Design of General purpose DAQ boards, Data Acquisition using Serial Interface: Serial Interface Standards Rs 232, USB-Features of USB, USB Transfer, GPIB/IEEE-488, LAN, Universal serial bus, HART protocol, Zigbee, Bluetooth.

Foundation Field bus, ModBus.

12 Hours

Unit III

Digital Instruments

Digital voltmeters (DVMs): working principle, construction, operation, salient features, range selection– Ramp type, dual slope integrating type, successive approximation type, Digital Frequency Meter: working principle and its construction using block diagram, frequency ratio meter, Recorders: The working principle, construction, operation and salient features of X-t strip chart recorder, Block diagram of PLC, difference between PLC and PC.

X-Y strip chart recorder and Magnetic type recorder. **12 Hours**

Unit IV

Signal Conditioning and DAQ Systems

Single channel and multichannel, Graphical Interface (GUI) Software for DAS, RTUs, PC-Based data acquisition system, Data logging - applications - Automobile, Aerospace Manufacturing, Environmental monitoring. Temperature Measurement using Thermistor, Thermocouple, Strain Measurement System, Interfacing Light Emitting Diode and Photo sensor, Acceleration Measurement, Function Generator, operation of DC servo meter and its characteristics, Remote data Acquisition using Internet

Machine vision-based inspection system, IC engine data

12 Hours

Total: 48 Hours

Text Books

1. Di Paolo Emilio, Maurizio , "Data Acquisition Systems from Fundamentals to Applied Design", Springer; 2013.
2. S. Gupta, J.P. Gupta, PC Interfacing for Data Acquisition and Process Control, ISA, 1994, 2nd Edition
3. Bell David A, "Electronic Instrumentation and Measurement", PHI, Inc, New Delhi (1994).
4. Tocci Ronald J, "Digital Systems Principles and Applications", PHI, New Delhi (2002)

Reference Books

1. A. D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1st Edition, 2015.
2. R. K. Jain, "Mechanical & Industrial Measurements", Khanna pub.
3. Chennakesava R Alavala, "Principles of Industrial Instrumentation and control systems", Cengage publ.

SAMPLE QUESTION (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book Examination (%)
Remember	25	25	--
Understand	75	50	--
Apply	--	25	100
Analyse	--	--	--
Evaluate	--		--
Create	--		--
Total (%)	100	100	100

Remember

1. List the Converter Characteristics and explain them
2. Discuss the objectives of DAS.

Understand

1. Draw the circuit diagram of Polynomial converter and explain its operation in detail
2. Explain the concept of Digital signal processing system in Digital Acquisition System along with circuit diagram
3. Define Error? Explain the different Error sources present in ADC and DAC systems in detail

Apply

1. Design a digital Voltmeter of range 0 to 20 v
2. Determine the working principal of HART protocol
3. Construct a digital frequency meter
4. Analyze various data loggers
5. Justify the working principal of Machine vision-based inspection system. IC engine data
6. Compare Various Remote data Acquisition using Internet

[Open Book Examination Question]

21OE005 Airport Operations Management

3 0 0 3

Course Outcome

1. Demonstrate the overview of aviation industry.
2. Describe the passenger and cargo traffic forecasting principles.
3. Explain the passenger and cargo operations in airports.
4. Describe airside infrastructrure operations and maintenances.
5. Outline the operations and maintenance of airfield lighting and safety systems.
6. Optimize airport operations and service quality.

COs–POs Mapping

COs	PO2	PO4	PO11	PO12
1	1	2	3	2
2	1	2	3	2
3	1	2	3	2
4	1	2	3	2
5	1	2	3	2
6	1	2	3	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Overview of Aviation Industry

Stakeholders of aviation industry - International organizations - ICAO, IATA, ACI, Regulatory regime- CAA, DGCA,FAA. Airport Master Plans. India's airports operations and management - ICAO SARPs - Airport capacity and determinants. Passenger traffic and cargo traffic forecasting principles. Definition meaning of terms- Airport classifications.

12 Hours

Unit II

Passenger operations and Cargo Operations

Passenger process flow- Baggage process flow. Planning requirements and spatial requirements. Service level requirements and design inputs. PTB design concepts- Systems description. Cargo – process flow, infra and facilities required, planning parameters

12 Hours

Unit III

Airside Operation

Airfield pavements, types- Runway, Taxiway, Apron. Aircraft movement flow in the airfield - Obstacle Limitation Surfaces (OLS) - Airfield terms and importance- Strip, RESA, TORA,TODA,ASDA, LDA - Visual Aids- Pavement marking, Airfield Ground Lighting systems- System description - Rescue and Fire Fighting - Air Navigation Services Principles- Air Traffic Management, Communication, Navigation and Surveillance (CNS) system, Meteorological services - Safety and security management - Apron services. Apron control.

12 Hours

Unit IV

Operation and Maintenance Management

Typical Organization chart. Regulatory Requirements- Objective and subjective service quality parameters and measurement. Service quality delivery assessment by third parties. Passenger experience - Operational efficiency - Maintenance- maintenance schedules and implementation - Control centres. Emergency planning. Standard Operating Procedures. Contingencies. Incident reports - On Time Performance (OTP) of flights. Operations manual - Certifications, accreditations. Bird, wildlife and hazard management.

12 Hours

Total: 48 Hours

Textbook (s)

1. Airport Planning & Management, Seventh Edition (AVIATION) by Seth Young, Alexander T. Wells, McGraw-Hill Education Publicaitons, 2019.
2. Introduction to Aviation Management by Andreas Wald, Christoph Fay, and Ronald Gleich, Lit Publications, 2012.
3. Airport Systems: Planning, Design, and Management by Richard de Neufville and Amedeo R. Odoni, McGraw-Hill Education Publicaitons, 2013.

Reference (s)

1. Aviation Safety Programs: A Management Handbook by Richard H. Wood and Robert W. Sweginnis, Jeppesen Sanderson publisher,2003.
2. Global Airport and Aviation Management: Cases in Airport, Airline, and Aerospace Management by C. Daniel Prather
3. Airport Operations by Norman J. Ashford, H.P. Martin Stanton, and Clifton A. Moore, McGraw-Hill Education publications, 2012.
4. Air Transport Management: An International Perspective by Lucy Budd and Stephen Ison, Routledge Publications, 2020.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	40	40	40
Understand	60	60	60
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is an Airport Master Plan?
2. What factors determine airport capacity?
3. What are the key stages in the passenger process flow within an airport terminal?
4. Define airside operations.
5. How organizational chart is useful to operation and maintenance.

Understand

1. Explain the importance to have an efficient baggage process flow in an airport terminal.
2. Illustrate service level requirements influence the design of a passenger terminal building (PTB).
3. Explain in details about Obstacle Limitation Surfaces.
4. Describe the concept of on time performance.
5. Infer the importance of safety in aviation.

21OE006 Fundamentals of Embedded Systems

3 0 0 3

Course Outcomes

1. Interpret embedded system architecture.
2. Illustrate the Quality Attributes to be optimised during embedded system design.
3. Classify the communication interface of embedded system.
4. Explain the hardware and firmware development.
5. Summarize the embedded target boards.
6. Demonstrate interfacing of sensors, actuators and IO peripherals with embedded boards.

COs – POs Mapping

COs	PO_1	PO_2
1	2	2
2	2	2
3	2	2
4	2	2
5	2	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Introduction to Embedded Systems

Embedded Systems - Definition, Structure, Characteristics and Examples. Quality Attributes (Non-operational & Operational), Core of Embedded System, Memory: Masked ROM, Programmable ROM, EPROM, EEPROM, Flash, RAM) Microprocessor vs Microcontroller, Harvard and Von-Neumann Architecture, RICS vs CICS Architecture, Little-Endian vs Big-Endian Processor, Classification of Embedded System Based on Generation, Complexity and Performance, Embedded System vs. General Computing System.

Reset Circuit, Watchdog Timer

14 Hours

Unit II

Communication Interfaces

On board communication interfaces: Inter Integrated Circuit (I2C), Serial Peripheral Interface (SPI), Universal Asynchronous Receiver Transmitter (UART). Off board communication interfaces: RS232, Universal Serial Bus (USB), BLUE TOOTH, WIFI, ZigBee.

1-Wire Interface, GPRS

10 Hours

Unit III

Hardware and firmware development

Embedded firmware design approaches and development languages, Embedded C, Fundamental Issues in Hardware and Software Co-Design, Hardware software tradeoffs, Integration of Hardware and Firmware. CAD and hardware Translation tools. Pre-processors, Interpreters, Compilers, Linkers. Debugging tools, Simulators and Laboratory tools. Features of Real-Time Operating System.

Assembler, Features of General Purpose Operating System

11 Hours

Unit IV

Embedded target boards and Interfacing

Embedded target boards: Features of Arduino Board, Raspberry- pi and ESP8266. Sensors: temperature sensor, humidity and temperature sensor, light dependent sensor, touch sensor, ultrasonic sensor, soil moisture sensor. Actuators: DC Motor, Stepper Motor, Motor Driver L293D, Relay. I/O Devices: 7-Segment Display, LCD, Keypad. Interfacing of Embedded target board with sensors, actuators and IO devices.

Smoke detector, Rain detector

13 Hours

Total: 48 Hours

Textbook (s)

1. Shibu .K.V, Introduction to Embedded Systems, 1st Ed, Tata McGraw Hill Education Private Limited,
   2009.
2. Yogesh Misra, Programming and Interfacing with Arduino, CRC Press, 1st Edition, 2021

Reference (s)

1. Frank Vahid, Tony D. Givargis, Embedded System Design-A Unified Hardware/Software Introduction, Wiley Publications, 2002
2. Raj Kamal , Embedded Systems, TMS, Second Edition, 2008

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	85	60	--
Apply	--	25	100
Analyse	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Define embedded system.
2. List any three on board and off board communication interfaces.
3. List any two embedded development boards.

Understand

1. Exemplify the SPI protocol for on board communication interface.
2. Exemplify the I2C protocol for on board communication interface.
3. Demonstrate the purpose of compiler and linker in firmware design.
4. Illustrate the different components of Arduino UNO board.
5. Illustrate the working of capacitive touch sensor.

Apply

1. Construct an interfacing diagram of LCD with Arduino board.
2. Construct an interfacing circuit of 220 V ac operated bulb with Arduino board.
3. Interface a temperature sensor with Arduino UNO board.

21OE007 Remote Sensing and GIS

3 0 0 3

Course Outcome

1. Understanding the Remote Sensing fundamentals, platforms, and sensors involved in Remote Sensing.
2. Analyze Aerial Photographs
3. Familiar with GIS basics, spatial data analysis and planning of GIS projects.
4. Explore the Web sources for Satellite data products and analyze Satellite data using image processing techniques.
5. Apply Remote Sensing and GIS technologies in real-world scenarios.
6. Understand the advancements in Remote Sensing and GIS technology.

COs–POs Mapping

COs	PO1	PO2	PO5	PO7	PO10
1	3	2	1	1	1
2	3	3	2	1	3
3	3	2	3	2	3
4	3	2	3	2	3
5	3	3	3	3	3
6	3	2	3	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Basics of Remote Sensing

Electromagnetic Spectrum: wavelength regions important to remote sensing, Reflectance, Transmission, Absorption, Thermal Emissions, Scattering, Elements involved in Remote Sensing, Advantages and Disadvantages of Remote Sensing.

Platforms and Sensors: Types of platforms, orbit types, Sun-synchronous and Geosynchronous, Passive and Active sensors, resolution concept, Indian Remote Sensing Satellites and their features-Indian Space Program.

Photogrammetry: Definition, Types of Aerial photographs, Vertical Photographs – Geometry, Scale, problems on Flying height and scale.

12 Hours

Unit II

Basics of Geographical Information systems

GIS: Definition, Objectives, Components, Data Models and Data Structures, Introduction to DBMS.

Map: Types of Maps, Co-ordinate system, Introduction to Map projections.

Spatial Data Analysis: Buffer and Overlay operations, GIS Project Planning.

12 Hours

Unit III

Satellite Data Analysis

Exploration of web sources of satellite data products-Bhuvan, Basic Elements of Visual image Interpretation, Image classification techniques – Supervised and unsupervised, Vegetation indices, water related indices.

12 Hours

Unit IV

GIS Applications and Advancements

Remote Sensing and GIS Applications: Transportation, Water Resources, Environment, Geology, Emergency Management, Agriculture, Urban planning,

Advances in Remote Sensing and GIS: Introduction to Thermal, Microwave and Hyperspectral Remote Sensing. Introduction to Web and Mobile GIS, Google Earth Engine platform for satellite data processing.

12 Hours

Total: 48 Hours

Textbook (s)

1. Remote Sensing and Geographical Information systems, (4th edition) by M.Anji Reddy B.S. Publications, JNTU Kakinada, 2018.
2. Remote Sensing and GIS, (2nd edition) By Basudeb Bhatta Oxford Higher Education.

Reference (s)

1. Remote Sensing and Image Interpretation, Lillesand T.M & Kiefer R.W., John Wiely and Sons, 2015
2. Elements of Photogrammetry with Application in GIS, Wolf P. R., McGraw Hill International Book Company, Fourth Edition, 2014.
3. Introduction to Geographic Information Systems, 9th Edition, Kang Tsung Chang., Tata McGraw Hill Publishing Company Ltd, New Delhi, 2018.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book/Assignment Exam(%)
Remember	20	20	--
Understand	30	30	--
Apply	50	50	100
Analyze	--	--	--
Evaluate	--	--	-
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the wavelength regions important to remote sensing?
2. What are the types of aerial photographs?
3. Define overlay operations in GIS
4. Define GIS.
5. List the basic elements of visual image interpretation.

Understand

1. Explain the geometry of vertical photographs.
2. Explain the resolution concept in remote sensing
3. Compare between data models and data structures in GIS
4. Explain the difference between supervised and unsupervised image classification techniques.
5. Summarise the scientific approach of remote sensing data analysis

Apply

1. Utilize the given data to determine the photo scale of a vertical aerial photograph taken over flat terrain with a 152.4 mm focal-length camera from an altitude of 1830 m above ground.
2. Solve for the maximum scale, minimum scale, and average scale given that the highest terrain (h1), average terrain (havg), and lowest terrain (h2) are 610, 460, and 310 m above mean sea level, respectively. The flying height above mean sea level is 1800 m and the camera focal length is 152.4 mm.
3. Utilize RS and GIS techniques for the preparation of LULC.
4. Construct the flow chart for highway alignment using RS and GIStechniques
5. Apply RS and GIS techniques to evaluate the potential sites for artificial recharge of ground water.

21OE008 Big Data Analytics

3 0 0 3

Course Outcomes

1.Understand the Limitations in SQL.
2.Identify the Concepts and advantages of DDBMS.
3.Identify challenges of big data and its existing technologies.
4.Use UNIX and HDFS commands.
5.Analyze data using Map-Reduce frame work.
6.Exemplify Concept of R Programming.

Co – Po Mapping

COs	PO_1	PO_7
1	3	1
2	2	1
3	2	1
4	1	1
5	3	1
6	3	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I **12 Hours**

Concepts of DDBMS-Data Fragmentation; Replication; and allocation techniques for DDBMS; Methods for designing and implementing DDBMS, designing a distributed relational database Architectures for DDBMS; cluster federated, parallel databases and client-server architecture. Introduction to Big Data-Challenges of Conventional Systems, What is Business Analytics, Business Analytics life cycle, Why Big Data Analytics, Defining Big data, characteristics of Big Data(V's), Business Analytics Phases: Data Acquisition- Data cleaning-Data Manipulation-Data Analysis(Statistical and Analytical methods) to make sense of data-Data Visualization.

Querry Processing problem; objectives of Query Processing

Unit II **12 Hours**

Introduction to NoSQL-Overview, and History of NoSQL, Databases Definition of the Four Types of NoSQL. Database, value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key points, Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBase, Neo4j use and deployment, Challenges NoSQL approach, key-Value and Document Data Models, Column-Family stores, Aggregate-Oriented Databases

Replication and sharding, MapReduce on databases.

Unit III **12 Hours**

Introduction to HADOOP- Hadoop ecosystem components and uses, Hadoop storage: HDFS, Concept of Hadoop Distributed file system, Design of HDFS, Configuration of HDFS. HADOOP MapReduce Hadoop Data Types, Functional-Concept of Mappers, Functional-Concept of Reducers, MapReduce Execution Framework, Partitioners and Combiners, Hadoop Clusters component; Name Node, Secondary Name Node, and Data Node, Data flow (Anatomy of File Write and Read);

Challenges for processing Big Data, RDMS vs HADOOP, Accessing HDFS- CLI (command Line Interface)

Unit IV **12 Hours**

Statistics with R Programming-Introduction, How to run R, R Sessions, and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists,

Matrices, Arrays, Classes. R Programming Structures, Control Statements, Loops, - Looping Over Non-vector Sts, - If-Else, Arithmetic, and Boolean Operators and values, Default Values for Argument, Return

Values, Deciding Whether to call return explicitly- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Example: A Binary Search Tree.

Math sums, cumulative sums, and products

Total: 48 Hours

Textbook (s)

1. Distributed Databases: Principles and Systems paperback- 1 Jul 2017 by Stefano ceri, Giuseppe pelagatti, McGraw Hill Edition, ISBN-10: 0070265119, ISBN-13: 978-0070265110, 2017.
2. Tom White "Hadoop: The Definitive Guide "Fourth Edition, O'Reilly Media, 2015

Reference (s)

1. M. Tamer Ozsu and Patrick valduriez, "Prinples of Distributed Database Systems",Springer Science + Business Media, Third Edition, 2011.
2. Zikopoulos, P. Parasuram, K.Deutsch,T. Giles, J. & Corrigian, D.v Harness the Power of Big Data The IBM Big Data Platform. McGraw Hill Professional, 2012.
3. The Art of R Programming, Norman Matloff, Cengage Learning,1st Edition,2011.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	45	--
Understand	40	45	60
Apply	20	10	40
Analyze	--	--	
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1.List the Applications of BigData Analytics
2.Define Data fragmentation in detail

Understand

1.Illustrate Advanced Data structures in R programming?
2.Explain the concept of History of NoSQL

Apply

1.Apply A Binary Search Tree concept to your data base?

21OE009 Fundamentals of Cyber Security

3 0 0 3

Course Outcomes

1. Understand the fundamentals of security and cryptography.
2. Explain the different attacks and services of security.
3. Make use of cryptography types and techniques.
4. Interpret the functionalities of cyber crime and cyber law.
5. Demonstrates the functionalities of firewalls
6. Explain various non-cryptographic protocol vulnerabilities

CO–PO Mapping

CO	PO3	PO6	PO8
1	2	2	3
2	2	2	3
3	2	1	3
4	2	1	2
5	2	2	3
6	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I **12 Hours**

Introduction: What is Security, Data, Information, Attack, Hacker, Goals of Security, Security concerns in computer, web technology, World Wide Web, Internet, Data Transfer, Society, Banking, etc. Individual in information technology, Models for Network Security, Security Terminologies, CIA Traid, Security Attacks, Security Goals, Methods of Defence, Security Services, Security Mechanisms

Types of Hackers, hacking, network sniffing.

Unit II **12 Hours**

Basics of Cryptography: Introduction to cryptography, Cryptographic functions(Authentication, Nonrepudiation, confidentiality, integrity), Cryptanalysis. Types of Cryptography: Symmetric key and Asymmetric Key Cryptography, Principles of Private and Public Key System, Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Modes of Operations, Message Integrity, Encryption and Decryption Techniques, Digital Signatures.

Applications of Cryptography, cipher types, steganography

Unit III **12 Hours**

Cyber crime and Cyber law: Classification of cyber crimes, Common cyber crimes, cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India,

Cybercrime vs Computer Crime, *Case studies*.

Unit IV **12 Hours**

IDS and Firewalls: Intruders, Intrusion Detection, Password Management, Firewalls-Characteristics, Types of Firewalls, Placement of Firewalls, Firewall Configuration, Trusted Systems. **Non-cryptographic protocol Vulnerabilities:** DoS, DDoS, Session Hijacking and Spoofing, Software Vulnerabilities- Phishing, Buffer Overflow.

SQL Injection, Intellectual Property.

Total: 48 Hours

Textbook (s)

1. William Stallings, Lawrie Brown, Computer Security Principle sand Practice Third Edition,2015
2. Nihad A. Hassan, Rami Hijazi, Digital Privacy and Security Using Windows: A Practical Guide,
3. Apress, 2017
   William Stallings, “Cryptography And Network Security – Principles and Practices”, 7th edition, Pearson Education Limited 2017.

Reference (s)

1. Michael T. Goodrich and Roberto Tamassia, Introduction to Computer Security, Addison Wesley, 2011.
2. Ross Anderson, Security Engineering: A Guide to Building Dependable Distributed, 3rd Edition, John Wiley & Sons Inc, 2021.
3. Kozierok, Charles M. The TCP/IP guide: a comprehensive, illustrated Internet protocols reference, 2005
4. Cyber Crime Impact in the New Millennium, by R. C Mishra , Auther Press. Edition 2010.
5. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
6. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson , 13th November, 2001)
7. Harris, Shon, "CISSP all-in-one exam guide." Sixth edition (2013).
8. OWASP top ten security vulnerabilities: http://xml.coverpages.org/OWASPTopTen.pdf

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	--
Understand	40	40	--
Apply	30	30	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

SAMPLE QUESTION (S)

Remember

1. Mention any two security attacks
2. List any two goals of security
3. Define Cryptography

Understand

1. Differentiate between asymmetric and symmetric key cryptography
2. How do we achieve authentication?
3. Differentiate between Cyber Crime and Computer Crime.

Apply

1. Implement firewall using iptables command.
2. Can message encryption itself provide measure of authenctication?

Open Book Exam Questions

Question 1:

A man named Jones wanted to chat with his girlfriend Goldie. But he can see that all his family is around him and even his girlfriend is also with her parents. So, he thought to send a secret message to his girlfriend. They usually love to meet in the “Central Park”. Now jones wants to send a message to Goldie as “Hi Goldie. How are you. Because you are with your parents, and I am with my parents we cannot speak with each other. But I want to meet you at our favorite place central park tomorrow after your class”. Help jones to convert the message to unreadable format using the key of their favorite place. Also suggest him how would jones tell Goldie that the letter is originated from jones only.

Question 2:

You have decided to start a startup after graduation. But you alone cannot be doing this, so you have to ask help from your friends. Suggest what techniques you require and which sort of people you would select so that your company will be a huge success. Explain the techniques clearly to your friends and tell them what they have to do in detail.

21OE010-Smart Cities

3 0 0 3

Course Outcomes

1. Understand the definition of smart city , features and core infrastructure elements.
2. Understand the Smart Cities Mission in India and Global Context
3. Analyze Smart Technologies and Infrastructure
4. Evaluate Governance and Policy Frameworks
5. Assess the economic, social, and environmental impacts of smart city initiatives
6. Critically analyze and compare global and Indian smart city initiatives and projects through detailed case studies

COs – POs Mappings

COs	PO7	PO12
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction to smart cities

Definition and concept of Smart Cities, History and evolution of urbanization and smart cities, Key components of a smart city ,Global examples of smart cities,Challenges and opportunities in smart city development, Overview of the Smart Cities Mission in India,Goals and objectives of the Indian Smart Cities Mission

Environmental Sustainability Plan for smary cities **12 Hours**

Unit II

Technologies and Infrastructure in Smart Cities

Internet of Things (IoT) and its applications in urban environments, Smart infrastructure (transportation, energy, water management),Smart buildings and sustainable architecture,Role of data analytics and AI in smart cities, Cybersecurity and privacy issues in smart city infrastructures,Technological initiatives under the Indian Smart Cities Mission (e.g., smart grids, smart water management)

Benchmarks for Smart Cities

12 Hours

Unit III

Governance and Policy for Smart Cities

Policy frameworks for smart city development,Governance models and stakeholder engagement,Public-private partnerships (PPPs),Regulatory and ethical considerations,Financing smart city projects, Implementation framework of the Smart Cities Mission in India, Role of Urban Local Bodies (ULBs) and Special Purpose Vehicles (SPVs)

Smart City Reference Framework

12 Hours

Unit IV

Social and Economic Impacts of Smart Cities

Impact on urban mobility and transportation, Economic benefits and challenges, Social inclusion and equity, Environmental sustainability, Future trends and innovations in smart cities, Impact assessment of Indian Smart Cities Mission initiatives, Best practices and lessons learned from Indian smart cities with case studies.

Strategic components of Area-based development in the Smart Cities Mission

12 Hours

Total: 48 Hours

Textbook (s)

1.John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); “Remaking the city: Social science perspective on urban design”; State University of New York Press, Albany (ISBN: 0-87395-678-8)

2. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li

3.The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by NicosKomninos

Reference (s)

1.Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science

2. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines(1).pdf

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book/Assignment Exam(%)
Remember	30	30	-
Understand	70	70	70
Apply			30
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define smart city.
2. List out any four features of smart cities.
3. Define ITS.
4. Differentiate smart and green concepts.

Understand

1. Explain the core infrastructure elements of smart cities.
2. Describe the key components of smart city infrastructure.
3. Explain the process of water management in smart cities.
4. Illustrate the Implementation framework of the Smart Cities Mission in India.

Apply

1. Identify the challenges in adopting smart transportation intiatives from global smart cities.
2. Suggest the areas of improvement for a choosen case study of smart city in india.
3. Identify the best practices from global smart cities regarding water management.
4. Explain the adaptive role of artificial intelligence for smart city mission.

21OE011 Nano Materials and Thin Film Technology

3 0 0 3

Course outcomes

1. Explain the properties of nano-materials and their applications in relation to bulk materials
2. Apply various chemical and physical methods for the synthesis of nanomaterials
3. Describe the nano size effect on magnetic, electrical, optical, thermal and mechanical properties
4. Explore the various techniques to fabricate thin films.
5. Illustrate the structural, optical properties and its applications.
6. Review the applications of nanomaterials, especially semiconducting metal oxides for sensing and catalysis.

COs – POs Mapping

COs	PO_1	PO_{12}
1	3	1
2	3	1
3	3	1
4	3	1
5	3	1
6	3	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit 1: Basics of Nanomaterials

Definition and scope, Historical background, milestones in nanotechnology, properties at the nanoscale: quantum effects, surface area to volume ratio. Types of nanomaterials: 0-D nanoparticles, 1-D nanowires and nanotubes, 3-D bulk structured materials. Effect of particle size on dielectric, optical, thermal and mechanical properties. **(12 hours)**

Unit 2: Synthesis and Characterization of Nanomaterials

Bottom-up approaches: Chemical vapor deposition, hydrothermal process, combustion synthesis and sol get process. Top-down approaches: Grinding, planetary ball milling and comparison of particles. Characterization methods: X-ray diffraction, Atomic force microscopy, scanning electron microscopy, BET surface area analysis and XPS

(10 hours)

Unit 3: Fundamentals of Thin Film Technology

Basics of Thin Films: Definition and importance of thin films, Historical developments, Fundamentals of vacuum, basic definition and pressure regions of vacuum, kinetic theory of gases mean free path. **Deposition Techniques:** Physical Vapor Deposition (PVD): evaporation, DC/RF sputtering, and pulsed laser deposition; Chemical Vapor

Deposition (CVD): molecular beam epitaxy, atomic layer deposition, thermodynamics and kinetics of thin film growth, Nucleation models, Factors affecting thin film growth (substrate effects, temperature, pressure) **(14 hours)**

Unit 4: Characterization of Thin Films and applications:

Thickness measurement techniques (profilometry), Structural characterization (GI-X-ray diffraction, electron microscopy), Electrical and optical characterization (four-point probe, UV-Vis spectroscopy), Applications in microelectronics (integrated circuits, transistors), Applications in optoelectronics (LEDs, solar cells, photodetectors), Protective and decorative coatings, anti-reflection coatings, Flexible and wearable thin films.

Textbook (s)

1. S. K. Kulkarni, Nanotechnology: Principles & Practices, 3rd Ed., Springer, 2015
2. B. S. Murthy, P. Shankar, Baldev Raj, B.B. Rath, Ames Murday, Text book of Nanoscience and Nanotechnology, Springer & Universities Press (India) Pvt. Ltd., 2013.

Reference (s)

1. S. M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009
2. R. Kelsall, I. Hamley, M. Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005
3. G. L. Hornyak, H.F. Tibbals, J. Dutta, J. J. Moore, Introduction to Nanoscience and Nanotechnology CRC Press, 2008
4. J. H. Davies, The Physics of Low Dimensional Semiconductors: An Introduction, Cambridge University Press, 1998

SAMPLE QUESTION (S)

REMEBERING

1. Define nano structured material
2. List any four applications of nanotechnology
3. State Moore's first law and second law

UNDERSTANDING

1. What is the difference between nano particles and thin films?
2. Describe particle size on optical and electrical properties
3. Explain the sol-gel method of synthesis of nano powders

APPLICATION

1. Explain the principle behind protection of skin from UV radiation by sun screen lotion
2. Show that the surface area to volume ratio increases drastically as particle size comes down from micro to nano size.
3. Assess the fabrication of thin film fabrication with respect to deposition parameters
4. Show how the shape and size can be controlled in the formation of thin films using surfactants

ANALYSIS

1. Compare the bottom up & top-down approaches in preparation of nanomaterials
2. Outline how powder XRD technique can be used for characterization of a nano material
3. Electrical and magnetic properties vary for nano material compared to bulk material. Justify
4. Distinguish nanoparticles and thin films growth mechanism

Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book exam (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	60
Analyze			40
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

21CSMC1Cloud computing

3 0 0 3

Course Outcomes:

1. Understand the Fundamentals of Cloud Computing
2. Explain the principles of resource management and grasp the economic aspects of cloud computing through Service Level Agreements (SLAs) and cloudonomics.
3. Identify the security challenges in cloud computing and apply strategies for securing cloud marketplaces.
4. Utilize open source and commercial cloud platforms within the cloud ecosystem.
5. Understand Advanced Cloud Technologies including containerization with Docker, green cloud computing, IoT integration, and the role of virtual machine (VM) resource management.
6. Apply theoretical knowledge to real-world scenarios through case studies of commercial cloud platforms like Microsoft Azure and Google Cloud Platform

CO–PO Mapping

CO	PO2	PO3
1	2	2
2	2	2
3	3	2
4	2	2
5	2	3
6	2	2

7. 3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit 1: Comprehensive Overview of Cloud Computing **12 Hours**

Introduction to Cloud Computing: Cloud Computing Overview. **Cloud Computing Architecture and Technologies:** Cloud Computing Architecture – Deployment Models - Cloud Computing Virtualization - Cloud Computing XML Basics - Cloud Computing Web Services, Service-Oriented Architecture. **Service Management in Cloud Computing**: Service Level Agreement - Cloud Economics - Managing Data - Introduction to MapReduce – OpenStack.

Unit 2: Data Management, Resource Management, and Cloud Security **12 Hours**

Data Management in Cloud Computing : Cloud Computing Open Source - Cloud OpenStack - Cloud Computing Case Study with a Commercial Cloud (e.g., Microsoft Azure)- Cloud Computing Case Study - Google Cloud Platform. **Resource Management in Cloud:** SLA (Service Level Agreements)- Cloudonomics – MapReduce - Resource Management. **Cloud Security**: Cloud Computing Security- Security Issues in Collaborative SaaS Cloud - Brokers for Cloud Marketplace.

Unit 3: Open Source and Commercial Clouds, Cloud Simulation, Emerging Trends **12 Hours**

Open Source and Commercial Clouds, Cloud Simulator: Overview of Open Source and Commercial Clouds - Cloud Simulator - Mobile Cloud Computing - Fog Computing. **Research Trends in Cloud**

Computing, Fog Computing: Emerging Trends in Cloud Computing-Introduction to Docker Container - Green Cloud-Sensor Cloud Computing - IoT Cloud. **VM Resource Allocation, Management, and Monitoring**: Resource Management in Virtual Machines (VMs) - Cloud Federation

Unit 4: Advanced Cloud Technologies and Case Studies **12 Hours**

Cloud-Fog-Edge Enabled Analytics, VM Migration: Cloud-Fog-Edge Enabled Analytics, Basics of VM Migration and Migration Strategies, Docker Container and Components of Docker Architecture. **Serverless Computing and FaaS Model**: Dew Computing, Serverless Computing. Sustainable Cloud Computing. **Case Studies and Recent Advancements:** Real-world Case Studies, Recent Advancements in Cloud Computing

Total : 48 Hours

Course Link:
https://onlinecourses.nptel.ac.in/noc21_cs14/preview

Reference (s)

1. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011.
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010

21CSMC2 Ethical Hacking

3 0 0 3

Course Outcomes:

1. understand of the basics of ethical hacking, including the principles of networking, the TCP/IP protocol stack, and IP addressing and routing.
2. utilize security techniques involving information gathering, port scanning with NMAP.
3. understand and apply advanced cybersecurity techniques, including cryptographic hash functions, digital signatures, steganography, biometrics, and network-based attacks.
4. identify various cybersecurity threats such as password cracking, phishing, malware, WiFi hacking, and DoS/DDoS attacks, and apply appropriate countermeasures.
5. Understand Advanced Security Protocols and Tools
6. apply ethical hacking skills and tools in real-world scenarios, including conducting vulnerability scans, exploiting system software, and analyze network traffic for security assessments

CO–PO Mapping

CO	PO1	PO2	PO3
1	2	1	2
2	2	2	3
3	2	1	2
4	2	3	2
5	2	3	2
6	2	2	3

7. 3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit 1: Introduction to Networking and Ethical Hacking Fundamentals **12 Hours**

Foundations of Networking and Ethical Hacking: Introduction to Ethical Hacking **-** Basic Concepts of Networking **-** TCP/IP Protocol Stack. **Understanding Network Protocols :** IP Addressing and Routing - Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) - IP Subnetting. **Advanced Routing and IP Version 6** : Routing Protocols - IP Version 6 - Routing Examples

Unit 2: Security Techniques **12 Hours**

Information Gathering and NMAP: Information Gathering - Port Scanning Using NMAP - Features of NMAP. **Metasploit Exploitation and Advanced Attacks**: Metasploit Exploiting System Software and Privilege - Metasploit Social Eng Attack - MITM (Man in The middle) Attack. **Basic concepts of cryptography:** Private-key cryptography - Public-key cryptography.

Unit 3: Advanced Cybersecurity and Attack Techniques **12 Hours**

Cryptography and Applications: Cryptographic hash functions -Digital signature and certificate – Applications. **Steganography, Biometrics, and Network-Based Attacks**: Steganography – Biometrics - Network Based Attacks - DNS and Email Security. **Cybersecurity Threats and Countermeasures**: Password cracking - Phishing attack – Maloeware - Wifi hacking - Dos and DDos attack.

Unit 4: Advanced Security Protocols and Practical Tools **12 Hours**

Hardware Security and Side Channel Attacks: Elements of Hardware Security - Side Channel Attacks - Physical Unclonable Function - Hardware Trojan. **Web Application Security**: Web Application Vulnerability Scanning - SQL Injection Authentication Bypass - SQL Injection Error Based from Web Application – SQLMAP- Cross Site Scripting - File Upload Vulnerability. **Network Analysis:** The NMAP Tool: A Relook - Network Analysis using Wireshark.

Total : 48 Hours

Course Link: https://nptel.ac.in/courses/106105217

Reference (s)

1. Hacking: The Art of Exploitation, Jon Erickson, No Starch Press, 2nd Edition, 2008
2. Cryptography and Network Security: Principles and Practice, William Stallings, Pearson Publisher, 7th Edition, 2016.
3. Metasploit: The Penetration Tester's Guide, David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, No Starch Press Publisher, 1st Edition, 2011.
4. Applied Cryptography: Protocols, Algorithms, and Source Code in C, Bruce Schneier, John Wiley & Sons Publisher, 2nd Edition, 1996.
5. Security Engineering: A Guide to Building Dependable Distributed Systems, Ross Anderson, Wiley Publisher, 3rd Edition, 2020.
6. Practical Packet Analysis: Using Wireshark to Solve Real-World Network Problems, Chris Sanders, No Starch Press Publisher, 3rd Edition, 2017.

21CSMC3 Fundamentals of Web Development

4 0 0 4

Course Objectives:

1. Understand the evolution of the World Wide Web and the essential components of web browsers.
2. Demonstrate proficiency in creating and structuring web content using HTM.
3. Design interactive web forms and implement them into webpages, and apply page layout techniques such as resume formatting.
4. Apply Cascading Style Sheets (CSS) to enhance the presentation and layout of web content
5. Develop responsive and visually appealing website layouts through the integration of CSS techniques.
6. Acquire foundational knowledge in client-side scripting for dynamic web content.

CO–PO Mapping

CO	PO2	PO3	PO5
1	2	1	2
2	2	2	3
3	3	3	2
4	1	2	2
5	1	3	2
6	1	2	2

8. 3–Strongly linked | 2–Moderately linked | 1–Weakly linked

UNIT-I **15 Hours**

Internet Structures and an Introduction to HTML: History of the Web, The Tools of Internet Publishing, Browsers and Web Addresses, HTTP Requests, Meet Our Three Languages, The Basics of HTML HTML: HTML Elements (Inline vs. Box), and HTML Lists, UTF8 Characters, HTML Links and Images, HTML Tables

UNIT-II **15 Hours**

HTML Forms: Website Navigation (Simple HTML), HTML Forms, Page Layout: Resumes
Introduction to CSS: How CSS Talks to HTML, CSS Declarations, The Box Model, Box Sizing, CSS Resets

Unit-III **15 Hours**

CSS Floats and Positions: Introduction, CSS Fonts, CSS Floats, CSS Positions, Horizontal Navigation, Centered navigation
Website Layouts and Design: Standard Website Layouts, Responsive Design, CSS Transitions, Transformations, and Animations, CSS Pseudo-selectors, Full-site Demonstration

Unit-IV **15 Hours**

Introduction to Javascript: The Basics of JavaScript (JS), JS Language Features and Syntax, Google Maps API (Application Programming Interface), JavaScript Objects, Event Handling, and DOM (Document Object Model)
JQuery and Frameworks: JQuery Introduction to JQuery, Box Sliders

Total: 60 Hours

Course Link:

https://www.coursera.org/programs/faculty-development-program-biaop/learn/illinois-tech-fundamentals-of-web-development?source=search#modules

Text Book(s)

1. Programming the World Wide Web, 8th edition Robert W. Sebesta, Pearson.
2. Web Coding Development All In One for Dummies, Paul McFedries, Wiley.
3. Bootstrap: Responsive Web Development,1st Edition, jake spurlock foreword by davewiner, O'Reilly publications.
4. Advanced Java Script Speed up web development with powerful and benefits of Java Script, Zachary Shute, Packt Publishers.

Reference(s):

1. Web programming with HTML, XHTML and CSS, 2e, Jon Duckett, Wiley India
2. Web programming Bai, Michael Ekedahl, CENAGE Learning, India edition.
3. An Introduction to Web Design + Programming, Paul S.Wang, India Edition
4. Flask Web Development 2e Miquel Grinberg O'Reilly publications.

21OE012 Business Intelligence & Analytics

3 0 0 3

Course Outcomes:

1. Explain the fundamental concepts of Business Intelligence and Analytics.
2. Analyze and apply the technical architecture of Business Intelligence, data management fundamentals, and database design processes.
3. Utilize descriptive analytics and visualization techniques to analyze data, perform survival analysis.
4. Implement data mining processes and statistical learning techniques.
5. Apply clustering algorithms to perform cluster analysis, segmentation, profiling, and interpretation of actionable insights.
6. Develop and implement machine learning models, neural networks, and text mining processes.

CO–PO Mapping

CO	PO2	PO3	PO5
1	2	1	2
2	2	2	3
3	3	1	2
4	1	2	2
5	1	3	2
6	1	2	2

9. 3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I: Introduction to Business Intelligence and Analytics (BIA) 12 Hours

Introduction to Business Intelligence & Analytics (BIA):Introduction to Business Intelligence & Analytics (BIA)- Drivers of BIA-Types of Analytics: Descriptive to Prescriptive-Vocabulary of Business Analytics-Course Plan and Resources. **Technical Architecture of BIA**- Case Analysis of AT&T Long Distance - Fundamentals of Data Management - OnLine Transaction Processing (OLTP) -Design Process of Databases. **Relational Databases and Data Warehousing** :Relational Databases – Normalisation-SQL Queries-ShopSense Case of Management Questions-Data Warehousing-OnLine Analytical Processing (OLAP)-Data Cube

Unit II: Descriptive and Predictive Analytics 12 Hours

Descriptive Analytics and Visualization: Descriptive Analytics and Visualization-Customer Analytics-Survival Analysis-Customer Lifetime Value-Case Study. **Data Mining and Statistical Learning**: Data Mining Process-Introduction to Statistical Learning-Data Pre-processing-Data Quality-Overview of Data Mining Techniques-Case Study using Regression Analysis. Introduction to Classification -Classification Techniques-Scoring Models-Classifier Performance-ROC and PR Curves . **Classification Techniques and Decision Trees**: Introduction to Decision Trees-Tree Induction-Measures of Purity-Tree Algorithms-Pruning-Ensemble Methods.

Unit III: Advanced Data Mining and Clustering 12 Hours

Tree Implementation in Python: Problem of Targeted Mailing - **Cluster Analysis and Techniques**: Cluster Analysis **-** Measures of Distance - Clustering Algorithms - K-means and Other Techniques - Cluster Quality - **Case Study and Practical Applications**: A Store Segmentation Case Study using Clustering - Implementation in Python - Profiling Clusters - Cluster Interpretation and Actionable Insights - RFM Sub-segmentation for Customer Loyalty

Unit IV: Machine Learning, Neural Networks, and Text Mining **12 Hours**

Machine Learning and Neural Networks: Machine Learning-Artificial Neural Networks (ANN)-Topology and Training Algorithms-Back Propagation-Financial Time Series Modelling using ANN-Implementation in Python - **Text Mining**: Text Mining-Process and Key Concepts-Sentiment Scoring-Text Mining using R: The Case of a Movie Discussion Forum.

Total : 48 Hours

Course Link: https://onlinecourses.nptel.ac.in/noc24_cs65/preview

Reference (s)

1. Data Mining Concepts and Techniques, Han, J., Pei, J., & Tong, H., Elsevier, 4th Edition, 2023.
2. An Introduction to Statistical Learning with Applications in R, James, G., Witten, D., Hastie, T., & Tibshirani, R., Springer, 1st Edition, 2013..

Data sources

1. Adventure Works Cycles", SQL Server sample database
2. "Retail Sense transaction data", real life data of a fashion retailer
3. UCI Machine Learning Repository, http://archive.ics.uci.edu/ml/
4. Financial/capital market data: Yahoo! Finance
5. Text data: www.twitter.com
6. ISL resources: http://www-bcf.usc.edu/~gareth/isl/
7. Kaggle: www.kaggle.com

21OE013 Introduction to Industry 4.0 And Industrial Internet Of Things

3 0 0 3

Course Outcomes:

1. Understand the foundational concepts of Industry 4.0.
2. Evaluate advanced Industry 4.0 technologies and their integration into modern systems.
3. Comprehend cybersecurity principles and the basics of Industrial IoT.
4. Design and implement architectures for Industrial IoT, focusing on business models, reference frameworks, and various layers of IIoT.
5. Utilize big data analytics, software-defined networks, and security measures in Industrial IoT environments.
6. Analyze application domains and evaluate real-world case studies to understand the practical implementation and impact of Industrial IoT.

CO–PO Mapping

CO	PO2	PO3
1	2	3
2	2	2
3	3	3
4	1	2
5	1	3
6	1	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I: Introduction to Industry 4.0 and Basics of IoT **12 Hours**

Introduction: Sensing & Actuation- Communication - Networking . **Industry 4.0 Fundamentals:** Globalization and Emerging Issues-The Fourth Revolution-LEAN Production Systems-Smart and Connected Business Perspective-Smart Factories. **Advanced Industry 4.0 Technologies:-**Cyber Physical Systems and Next Generation Sensors-Collaborative Platform and Product Lifecycle Management-Augmented Reality and Virtual Reality-Artificial Intelligence-Big Data and Advanced Analysis. **Cybersecurity and Industrial IoT Basics :** Cybersecurity in Industry 4.0 - Basics of Industrial IoT -Industrial Processes -Industrial Sensing & Actuation -Industrial Internet Systems

Unit II: Industrial IoT Architecture and Layers **12 Hours**

IIoT Introduction and Business Models: IIoT Introduction-Industrial IoT Business Model and Reference Architecture-Business Models - Reference Architecture. **IIoT Layers - Sensing and Processing-**IIoT Sensing -IIoT Processing -IIoT Communication. **IIoT Layers - Communication and Networking:**IIoT Communication -IIoT Networking .

Unit III: Big Data Analytics and Security in IIoT **12 Hours**

Big Data Analytics and Software Defined Networks: IIoT Analytics – Introduction-Machine Learning and Data Science -R and Julia Programming-Data Management with Hadoop. **SDN and Security in IIoT:** SDN in IIoT - Data Center Networks- Cloud Computing in IIoT. **Fog Computing and**

IIoT Security : Fog Computing in IIoT-Security in IIoT -IIoT Application Domains: Factories and Assembly Line, Food Industry.

Unit IV: Application Domains and Case Studies in IIoT **12 Hours**

IIoT Application Domains: Healthcare-Power Plants-Inventory Management & Quality Control-Plant Safety and Security (Including AR and VR safety applications)-Facility Management. **IIoT Application Domains and Case Studies:**Oil, Chemical, and Pharmaceutical Industry-Applications of UAVs in Industries-Real Case Studies: Milk Processing and Packaging Industries, Manufacturing Industries, Student Projects ,Virtual Reality Lab, Steel Technology Lab.

Total : 48 Hours

Course Link: https://nptel.ac.in/courses/106105195

Reference (s)

1. Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist, Apress, 1st Edition, 2016.
2. Industrial Internet of Things: Cybermanufacturing Systems, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Springer, 1st Edition, 2017.
3. The Fourth Industrial Revolution, Klaus Schwab, Crown Business, 1st Edition, 2017.
4. Smart Manufacturing: The Lean Six Sigma Way, Anthony Tarantino, Wiley, 1st Edition, 2018.
5. Big Data Analytics for Internet of Things, Tausifa Jan Saleem, CRC Press, 1st Edition, 2019.

21OE014 Natural Language Processing

3 0 0 3

Course Outcomes:

1. Explain the basic concepts and techniques of Natural Language Processing.
2. Apply advanced smoothing techniques for language modeling and perform Part-of-Speech tagging.
3. apply various parsing techniques including MaxEnt and CRF for sequential tagging, as well as constituency and dependency parsing.
4. Comprehend concepts of distributional and lexical semantics, and perform topic modeling.
5. Implement Information Extraction Techniques
6. Analyze techniques for sentiment analysis and opinion mining, understanding their applications in real-world scenarios.

CO–PO Mapping

CO	PO2	PO3
1	2	1
2	2	2
3	3	1
4	2	2
5	2	3
6	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I: Foundations of Natural Language Processing **12 Hours**

Introduction and Basic Text Processing : Introduction to NLP - Basic Text Processing Techniques. Spelling Correction and Language Modeling: Spelling Correction Methods - Introduction to Language Modeling. Advanced Smoothing and POS Tagging: Advanced Smoothing Techniques for Language Modeling - Part-of-Speech (POS) Tagging.

Unit II: Parsing and Syntax **12 Hours**

Models for Sequential Tagging: MaxEnt and CRF.Syntax and Constituency Parsing: Introduction to Syntax - Constituency Parsing Techniques. Dependency Parsing: Fundamentals of Dependency Parsing - Techniques and Applications of Dependency Parsing.

Unit III: Semantic Analysis **12 Hours**

Distributional Semantics: Introduction to Distributional Semantics- Techniques and Applications of Distributional Semantics. Lexical Semantics: Introduction to Lexical Semantics- Techniques and Applications of Lexical Semantics.Topic Models: Introduction to Topic Modeling-Techniques and Applications of Topic Modeling-Week 10:

Unit IV: Information Extraction and Advanced Applications **12 Hours**

Entity Linking and Information Extraction-Fundamentals of Entity Linking-Techniques and Applications of Information Extraction. Text Summarization and Classification:Techniques for Text Summarization-Methods for Text ClassificationSentiment Analysis and Opinion Mining: Introduction to Sentiment Analysis - Techniques and Applications of Opinion Mining.

Total : 48 Hours

Course Link: https://onlinecourses.nptel.ac.in/noc23_cs45/preview

Reference (s)

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Dan Jurafsky and James Martin, Prentice Hall, Second Edition, 2009.
2. Foundations of Statistical Natural Language Processing, Chris Manning and Hinrich Schütze, MIT Press, Cambridge, MA, May 1999.9.

Audit Courses-AR 21

Audit Courses - Syllabus



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AUDIT COURSES

S.No.	Course Code	Course Name	Offering Dept.	Page No.
Common to All				
1.	**21ATX001**	Environmental Studies	**CIV/CHEM**	**1**
2.	**21ATX002**	Professional Ethics and Human Values	**BSH**	**2**
Any one from the following 15 courses				
1.	21AT001	Communication Etiquette in Workplaces	**ME**	**3**
2.	21AT002	Contemporary India: Economy, Policy and Society	**ME**	**4**
3.	21AT003	Design The Thinking	**ECE**	**5**
4.	21AT004	Ethics and Integrity	**CE**	**6**
5.	21AT005	Indian Heritage and Culture	**EEE**	**7**
6.	21AT006	Intellectual Property Rights and Patents	**ECE**	**8**
7.	21AT007	Introduction to Journalism	**CSE**	**9**
8.	21AT008	Mass Media Communication	**CSE**	**10**
9.	21AT009	Science, Technology and Development	**CHEM**	**11**
10.	21AT010	Social Responsibility	**CE**	**12**
11.	21AT011	The Art of Photography and Film Making	**IT**	**13**
12.	21AT012	Gender Equality for Sustainability	**BSH**	**14**
13.	21AT013	Women in Leadership	**IT**	**15**
14.	21AT014	Introduction to Research Methodology	**EEE**	**16**
15.	21AT015	Climate Changes and Circular Economy	**CHEM**	**17**

21ATX01 Environmental Studies

21ATX01 Environmental Studies

Unit I

Multidisciplinary Nature of Environmental Studies & Natural Resources

Definition, Scope and Importance, Multidisciplinary nature of Environmental Studies, Value of Nature - Productive, Aesthetic/Recreation, Option, Need for Public Awareness, Institutions (BNHS, BVIEER, ZSI, BSI) and People in Environment (Medha Patkar, Sundarlal Bahuguna, Indira Gandhi, Rachael Carson).

Natural Resources: Renewable and Non-renewable resources – Importance, uses, overexploitation/threats, and conservation of (i) forest (ii) water (iii) mineral (iv)food and (v) energy resources. (The topics include benefits and problems associated with dams, mining and case studies), role of an individual in conservation of natural resources.

Unit II

Ecosystem & Biodiversity

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Biogeological cycles (Energy flow, Carbon and Nitrogen Cycles), Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of the following ecosystems: a. Forest Ecosystem b. Aquatic Ecosystem

Biodiversity and its Conservation: Definition and levels of biodiversity, Bio-geographical classification of India, hot spots of biodiversity - India as a mega diversity nation, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation.

Unit III

Environmental Pollution & Social Issues

Environmental Pollution: Definition, Cause, effects, control measures and case studies of: Air pollution b. Water pollution c. Soil pollution

Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Disaster management (floods and cyclones)

Social Issues and the Environment: Sustainability, Urban problems related to energy, Water conservation and watershed management, Resettlement and rehabilitation of people; Environmental ethics: Issues and possible solutions, global warming, ozone layer depletion, Consumerism and waste products

Unit IV

Human Population and the Environmental Acts

Human Population and the Environment: Population growth, Affluence, Technology and Environmental Impact (Master Equation), Population explosion and Family Welfare Programme, Value Education, HIV/AIDS, Women and Child Welfare, Role of information Technology in Environment and human health.

Environment Protection Acts: Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act and Forest Conservation Act. Issues involved in enforcement of environmental legislation.

Text Book(s) and Reading Material (s)

1. T. E. Graedel, B. R. Allenby, Industrial Ecology and Sustainable Engineering, 1st Edition, Pearson Publications, 2009.
2. W. P. Cunningham, M.A. Cunningham, Principles of Environmental Science, 6th Edition, Tata McGraw Hill, 2008.
3. A. Kaushik, C. P. Kaushik, Perspectives in Environmental Studies, 4th Edition, New Age International Publishers, 2008.
4. T. E. Graedel, B. R. Allenby, Industrial Ecology and Sustainable Engineering, 1st Edition, Pearson Publications, 2009.
5. E. Bharucha, Textbook of Environmental Studies, 1st Edition, University Press (India) Pvt. Ltd., 2005.
6. H. S. Peavy, D. R. Rowe, G. Tchobanoglous, Environmental Engineering, 1st Edition, McGraw Hill Int. ed., 1984.
7. http://172.30.1.222/wbc/it/schedule.aspx.
8. http://172.30.1.8/wbc/it/coursepage.aspx.
9. https://www.edx.org/course/environmental-protection-and-sustainability.

21ATX02 Professional Ethics and Human Values

Unit 1

Human Values

Morals, Values and Ethics-Integrity-Work Ethics- Service Learning- Civic Virtues- Respect for Others- Living Peacefully-Caring-Sharing-Honesty-Courage-Valuing Time- Cooperation- Commitment- Empathy- Self Confidence- Spirituality

Unit 2

Professional Ethics

The History of Ethics-Consensus and Controversy- Professional Roles of an Engineer- Professional and Professionalism- Self Interest, Customs and Religion- Engineering and Ethics-Types of Enquiry

Unit 3

Responsibilities and Rights

Collegiality- Two Senses of Loyalty- Obligations of Loyalty- Professional Rights- Conflicts of Interest, Solving Conflict Problems- Self Interest, Customs and Religion- Ethical Egoism, Collective Bargaining- Confidentiality- Acceptance of Bribes/Gifts- Interests in other companies- Occupational Crimes- Industrial Espionage- Price Fixing- Endangering Lives- Whistle Blowing.

Unit 4

Global Issues

Globalization- Environmental Ethics-Computer Ethics- Weapons Development- Intellectual Property Rights (IPR)s

Suggested Books:

1. A Textbook On Professional Ethics and Human Values by R.S, Naagarazan, New Age International-2007

2. Professional Ethics and Human Values by M.P Raghavan, Scitech Publications-2013

3. A Foundation Course in Human Values and Professional Ethics by R.R. Gaur, R. Sangal, Excel Books - 2010

21AT001 Communication Etiquette in Workplaces

Unit- I

Introduction to Professional Ethics:

Ethics In Engineering Profession, Roles of Engineers, Professional Ethics of Engineers and other Roles Played.

Ethical Codes

Need for Ethical Codes, Prominence of ethical codes and benchmarking, Codes from Other Profession, Advertising Standards of India, Corporate Codes, Knowledge of ethical codes.

Unit- II

Workplace Ethics:

Introduction, Needs, Principles, Development of Personal Ethics, Workplace Ethics for Employees-Ethical behavior in workplace- Professionalism, Ethical violations by employees, Employee Attitude and Ethics, Employee Etiquettes. Benefits of ethics in Workplace employee commitment, investor loyalty, customer satisfaction, profits

Professionalism at Workplace:

Unethical Conduct for employees and employers. Factors leading to Unethical behaviours. Different unethical behaviors. Measures to control unethical behaviors. Rewarding ethical behavior.

Unit- III

Business Ethics:

Overview of Business Ethics, Corporate Governance, Ethical issues in human resource management- The principal of ethical hiring, Firing, worker safety, whistle blowing, Equality of opportunity, Discrimination, Ethics and remuneration, Ethics in retrenchment. Ethical Dilemmas at workplace, Ethical issues in global business, corporate responsibility of employers.

Workplace Privacy & Ethics:

Privacy at workplace, Hardware, Software and Spyware, Plagiarism and Computer Crimes, Convenience and Death of Privacy, Defence of employee privacy rights.

Unit- IV

Teamwork at Workplace:

Teams, Elements of team, Stages of team development, team meetings, team rules, and teams work and professional responsibility, rules of professional responsibility, ASME code of ethics. Discrimination, sexual harassment, creating awareness about workplace harassment, Vishaka Dutta vs. State of Rajasthan –Supreme Court directions, Compulsory workplace guidelines.

Managing Change in Workplace through Ethics: Introduction to Change Management, Models of change, the Ethics of Managing Change, the role of ethics and responsibilities in leading innovation and change, ethics-based model for change management, ethics and risks of change management

Textbook(s)

R.S. Naagarazan, A Textbook on Professional Ethics and Human Values, New Age International (P) Limited, Publishers, 5th Edition, 2019

Kurt Stanberry and Stephen M. Byars, Business Ethics Book, Tata Mc Graw Hill Publisher, 6th Edition 2020

Satish Babu Bachu, A Guide to Corporate Business Etiquette: How to Maintain Effective Communication at Work Paperback, 4th Edition, 17 July 2014.

Barbara Pachter, The Essentials of Business Etiquette and workplace through ethics, 5th Edition, 2018.

Reference(s)

The Etiquette Advantage in Business, Third Edition: Personal Skills for Professional Success, Daniel Post Senning, Peter Post, Anna Post, Lizzie Post, Peggy Post, 3rd Edition, 2010

Engineering Ethics & Human Values by: M.Govindarajan , S. Natarajan &V.S.Senthilkumar PHI Learning Pvt. Ltd.

Professional Ethics by- R. Subramanian

Business Etiquette: 101 Ways to Conduct Business with Charm & Savvy Book by Ann Sabath, 2011

The Unwritten Rules of Professional Etiquette Book by Ryan Sharma, 4th Edition, 2017

21AT002 Contemporary India: Economy, Policy and Society

Unit I

Indian Economy and Population Study

Basic features of Indian Economy - Trends in National Income – Role of Agriculture Sector – Problems, Remedial measures; Industry – Large scale, small scale – problems and remedial measures; a brief review of Industrial policies in India – Role of Public Sector in the context of globalization.

Population, Poverty, Unemployment, and Income Inequalities – Causes and Consequences – Remedies – Inflation - Causes and Remedies – Indian Tax Structure Globalization, Economic Reforms and their impact on Indian Economy.

Unit II

Indian Political System

Basic Characteristics of Indian Constitution - Indian Political System, emergence of All India Parties – Regional Parties – Coalition Politics. Centre – State relations – Emerging trends – Various commissions –Rajamannar Committee, Anandpur Sahib Resolutions, Sarcaria Commission. Indian Foreign Policy – Non – Aligned Movement – Local Self Governments in the light of 73rd , 74th Constitutional amendments. Right to Information Act – Governance – factors influencing Governance – Civil Society.

Unit III

Indian National Movement

Indian National movement - various Stages – Its legacy. Integration of Native States and Formation of Modern India. Formation of Andhra Pradesh.

Unit IV

Indian Society and Social Life

Salient features of Indian Social Structure, Social Groups: Primary and Secondary, Association – Institution. Status and Role – Norms, Values and Customs. Concept of Socialization – Agencies of Socialization. Gender Issues – Women Liberation Movements in India – Domestic Violence, Women empowerment – Entrepreneurship Programmes – Child labor. Human Rights – Importance and violation of Human rights.

Reference Book(s)

1. Chandhoke, N. and Priyadarshi, P., Contemporary India: Economy, Society, Politics, 1st Ed., Pearson Education India, New Delhi, 2009.
2. Vanaik, A. and Bhargava, R., Understanding Contemporary India: Critical Perspectives, Orient Blackswan, New Delhi, 2010.
3. Deshpande, S., Contemporary India: A Sociological View, Penguin Books, New Delhi, 2003.

21AT003 Design the Thinking

Unit I

Process of Design

Introduction – Product Life Cycle - Design Ethics - Design Process - Four Step – Five Step - Twelve Step - Creativity and Innovation in Design Process - Design limitation. History of Design Thinking, Multi-Whys, Design Thinking Empathize, Conflict of Interest, Multi-Whys, Elephant and Blind Men.

Unit II

Generating and Developing Ideas

Introduction - Create Thinking - Generating Design Ideas - Lateral Thinking – Analogies – brainstorming - Mind mapping - National Group Technique – Synectics -Development of work - Analytical Thinking - Group Activities Recommended.

UNIT III

Reverse Engineering

Introduction - Reverse Engineering Leads to New Understanding about Products - Reasons for Reverse Engineering - Reverse Engineering Process - Step by Step – Case Study.

UNIT IV

Basics of Drawing to Develop Design Ideas

Introduction - Many Uses of Drawing - Communication through Drawing – Drawing Basis – Line - Shape/ Form – Value – Colour – Texture - Practice using Auto CAD recommended. Perspective Drawing - One Point Perspective - Two Point Perspective -Isometric Drawing - Orthographic Drawing - Sectional Views - Practice using Auto CAD recommended.

Text Books:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) second Edition, 2013.

References:

2. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.

21AT004 Ethics and Integrity

Unit I

Ethics and Interface

Ethics, Determinants and Consequences of Ethics in - Human Actions; Dimensions of Ethics; Ethics -in Private and Public Relationships. Human Values - Lessons from the Lives and Teachings of Great Leaders, Reformers and Administrators; Role of Family Society and Educational Institutions in Inculcating Values, Human interface.

Unit II

Human Values

Morals, values and Integrity, Service learning, Civic virtue Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Self-confidence, Character, Spirituality

Unit III

Emotional Intelligence

Concepts, and their Utilities and Application in Administration and Governance. Contributions of Emotional Thinkers and Philosophers from India and World.

Unit IV

Risk Management and Issues

Engineering as Experimentation, Codes of Ethics, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Intellectual Property Rights (IPR), Discrimination, Multinational Corporations, Moral Leadership, Code of Conduct, Corporate Social Responsibility.

Reference Book(s)

1. R.Subramanian, "Professional Ethics", Oxford University Press, New Delhi, 2013.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering" Tata McGraw Hill, New Delhi, 2003.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

21AT005 Indian Heritage and Culture

Unit I

Fundamental Unity of India

Harappan and Vedic Culture- evolution of Caste system – Jainism and Buddhism Gandhara Art. Political unification of India under Mauryas and Guptas –Cultural achievements.

Cultural condition under the Satavahanas – Contribution of Pallavas and Cholas to Art and Letters. Cholas Administrative System. Influence of Islam on the India Culture. The SufiBhakti and Vishnavite movements.

Cultural achiements of Vijayanagara rulers Contribution of Shershah and Akbar to the evolution of Administrative system in India- Cultural Developments under Mughals.

Unit II

Westren Impact on India

Introduction of Western Education Social and Cultural awakening and social reform movements. Raja Rama Mohan Roy – Dayananda Saraswathi – Theosophical Society – Ramakrishna Paramahamsa and Vivekananda – Iswara Chandra Vidyasagar and Veeresalingam-Enancipation of women and struggle against caste – Rise of Indian Nationalism – Mahatma Gandhi – Nonviolence and Satyagraha – Education of untouchability – Legacy of British Rule.

Unit III

Culture and its salient features

Meaning, Definition and various inter relations of Culture.

The Vedic – Upanishadic Culture and society. Human aspirations inthose societies Values –

Chaturvidha Purusharthas – Chaturvarna Theory – Cheturasrama Theory.

The Culture in Artha Sastra, Kautilyan conception of the function of Philosophy, State, Religion and king.

Unit IV

Culture in Ramayana and Mahabharata

The Ideal Man and Woman, Concepts Maitri, Karuna, Seela, Vinaya, Kshama, Santi, Anuraga – as exemplified in the stories and anecodotes of the Epics.

The Culture of Jainism: Jaina conception of Soul, Kamma and liberation, Buddhism as a Humanistic culture. The four Noble truths of Bhuddhism.

Vedanta and Indian Culture. Religion and Ethical Practices: The Hindu View.

Suggested Books:

1. Indian Heritage and Culture by P R Rao, Sterling Publishers Pvt. Ltd.
2. Indian Heritage and Culture by D. Singh, APH Publishing Corporation.

21AT006 Intellectual Property Rights and Patents

Unit I

Intellectual Property

Introduction to Intellectual Property Law – The Evolutionary Past - The IPR Tool Kit- Para -Legal Tasks in Intellectual Property Law – Ethical obligations in Para Legal Tasks in Intellectual Property Law - Introduction to Cyber Law – Innovations and Inventions Trade related Intellectual Property Right

Unit II

Trade mark

Introduction to Trade mark – Trade mark Registration Process – Post registration procedures – Trade mark maintenance - Transfer of Rights - Inter parties Proceeding – Infringement - Dilution Ownership of Trade mark –Likelihood of confusion - Trademarks claims – Trademarks Litigations – International Trade mark Law

Unit III

Copyrights

Introduction to Copyrights – Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer and duration – Right to prepare Derivative works – Rights of Distribution – Rights of Perform the work Publicity Copyright Formalities and Registrations - Limitations

- Copyright disputes and International Copyright Law – Semiconductor Chip Protection Act.

Unit IV

Trade Secret

Introduction to Trade Secret – Maintaining Trade Secret – Physical Security – Employee Limitation - Employee confidentiality agreement - Trade Secret Law - Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law.

Textbook (s)

1. Deborah E. Bouchoux: “Intellectual Property”. Cengage learning, New Delhi.
2. Prabhuddha Ganguli: ‘ Intellectual Property Rights” Tata Mc-Graw –Hill, New Delhi.

Reference (s)

1. Richard Stim: “Intellectual Property”, Cengage Learning, New Delhi.
2. R. Radha Krishnan, S. Balasubramanian: “Intellectual Property Rights”, Excel Books. New Delhi.

21AT007 Introduction to Journalism

Unit I

Ingredients of News: meaning, definition, nature the news process: from the event to the reader Hard news vs Soft news, basic components of a news story attribution, embargo, verification, balance and fairness, brevity, dateline, credit line, byline.

Unit II

Journalism: A historical context Basic terminology, concepts in journalism organizing a news story, 5W's and 1H, Inverted pyramid Criteria for news worthiness, principles of news selection use of archives, sources of news, use of internet. Yellow journalism penny press jazz journalism, gonzo journalism alternative journalism

Unit III

Language and Principles of Writing: Basic differences between the print, electronic and online journalism, **Language of news Robert Gunning:** Principles of clear writing, Rudolf Flesch formula (www.lsrcollegejournalism.org)

Unit IV

Responsibility to Society: Press and Democracy, Relationship between the reader/viewer and media, Contemporary debates and issues relating to trial by media

Changing trends in Journalism: An overview (with special reference to India)

Textbooks:

1. Bruce D. Itule and Douglas A. Anderson, News Writing and reporting for today's media, McGraw Hill Publication, 2006.
2. M.L. Stein, Susan Paterno, R. Christopher Burnett, News writer's Handbook: An Introduction to Journalism, Blackwell Publishing, 2006.
3. George Rodmann, Mass Media In a Changing World, McGraw Hill Publication, 2011

21AT008 Mass Media Communication

Unit I

Introduction to Mass Communication:

Concept of Journalism and mass communication, mass communication in India, History, growth and development of print and electronic media; Major landmarks in print and electronic media in Indian languages. Media's role in formulation of states of India, Media criticism and media literacy, Press Council and Press Commissions of India, status of journalism and media education in India; Media policies of the Government of India since Independence.

Models and Theories of Mass Communication

Normative theories, administrative and critical traditions in communication, media and journalism studies, communication and theories of socio-cultural, educational and agricultural change, Technological determinism, critique of Marshall McLuhan's views on media and communication and Marxist approaches, Information and knowledge societies.

Indian traditions and approaches to communication from the Vedic era to the 21st century, Western and Eastern philosophical, ethical and aesthetic perceptions of communication – Aristotle and Plato, Hindu, Buddhist, and Islamic traditions.

Unit II

Media and Culture

Framework for understanding culture in a globalized world, Globalization with respect to politico-economic & socio-cultural developments in India.

Media Laws and Ethics

Concept of law and ethics in India and rest of the world, The Constitution of India, historical evolution, relevance; Concept of freedom of speech and expression in Indian Constitution; Defamation, Libel, Slanders-Sedition; Various regulatory bodies for print, TV, Advertising, PR, and Internet; Rules, regulations and guidelines for the media as recommended by Press Council of India; Information and Broadcasting ministry and other professional organizations, adversarial role of the media, human rights and media.

Unit III

Media Management and Production

Definition, concept of media management. Grammar of electronic media; Communication design theories and practice; Media production techniques – print and electronic; Digital media production techniques; Economics and commerce of mass media in India; Principles and management in media industry post liberalization.

Unit IV

ICT and Media

ICT and media – definition, characteristics and role. Effect of computer mediated communication. Impact of ICT on mass media. Digitization; Social networking; Economics and commerce of web enabled media; Mobile adaption and new generation telephony by media, ethics and new media; ICT in education and development in India, online media and e-governance; Animation – concepts and techniques

Textbooks:

1. D.S. Mehta, Mass Communication and Journalism in India, Allied Publishers, 2014
2. Keval J. Kumar, Mass Communication in India, Fifth Edition, JAICO Publishing House, Mumbai, 2021
3. B. K. Ahuja, Mass Media Communication, Lotus Press, 2010
4. Jack Rosenberry, Lauren A. Vicker, Applied Mass Communication Theory: A Guide for Media Practitioners, 2nd Edition, Routledge, 2017

References:

1. Peyton Paxson, Mass Communications and Media Studies: An Introduction, 2nd Edition, Bloomsbury Academic 2018.
2. Robert S. Fortner, P. Mark Fackler, The Handbook of Media and Mass Communication Theory, Wiley, 2014.
3. Vir Bala Aggarwal, V. S. Gupta, Handbook of Journalism and Mass Communication, Concept Publishing Company, New Delhi, 2002.

21AT009 Science, Technology and Development

Unit-1: Science

Earth System: Characteristic features – lithosphere, hydrosphere – Atmosphere, lithosphere-soil characteristic, texture, fertility and its control. **Hydrosphere** –hydrological cycle –water bodies –ponds, lakes, rivers and their Characteristics – water consumption at global level and regional level Management of water bodies. **Atmosphere**: Troposphere, stratosphere, ionosphere composition of air – Ozone - Ozone layer – its importance. **Life Science**: Concept of origin life – evolution and diversity of life- cell Molecular basis of life and living forms – Mendel Iean concept on inheritance Impact on society – Blood groups – transfusion – wild life and its

Unit II: Science

The definition, general awareness and importance of:

Drugs- Antibiotic, penicillin, tetracycline, sylphs drugs, Anti malarial, anti Pyretic, analgesics.

Soaps and Detergents – sources – mechanism of soap action – development of detergent -application – disadvantages of detergents

Plastics and Polymers- polyethylene, poly vinyl chloride (PVC),nylon 66-rubber and synthetic rubber

Agro Chemicals and Fertilizers- pesticides-Introduction-DDT, BHC, Marathon, parathion – Fungicides-Rodenticides, Weedicides. Nitrogen and phosphorus fertilizers-Micro fertilizers, Bio pesticides, Neem and bacillus thuringensis.. Bio Fertilizers- Applications and their effects on nature

Vitamins- Natural sources- importance- deficiencies

Unit III: Technology and Development

Communication: Definition, nature and concept of communication- role of communication in society

Types of Communication: Intrapersonal, Intrapersonal, group and mass communication. Traditional and folk of communication in India New Media technologies- Satellite, Cable and Internet.

Process of Communication: Functions of communication, elements and barriers of communication Mass Media- press, Radio, TV and Films, Functions of mass communication

Unit IV: Technology and Development

Transport: Wheel, steam Engine, Automobile, ship, Airplane. Comparison of Road, Rail, Water and Air transport in terms of infrastructure, speed, cost etc.

Energy: Sources –Renewable sources of energy – Non- renewable sources of energy –Conventional energy sources- Non Conventional energy sources wind ,water, tidal , solar, geothermal, atomic energy , bio-fuels – sources and their applications- Energy management – energy conservation – Future needs of energy

Health: problems – Sex education – venereal Diseases, AIDS, General protozoan, Bacterial & viral diseases

Bio-Technology: Introduction – Applications – health and Human Welfare- Agriculture – Mushroom culture - Medical plants

Green-Revolution: Introduction - Food processing – Methods of processing-Food preservation and methods of preservation

National Institutions (Science): Institutions Imparting Education- Institutions performing research and development – Role of Scientific Institutions in Research, Technology and development

Reference Book(s)

1. James Smith , "Science and Technology for Development", Radical International Publishing, 2009.
2. Atul Wad Science, technology and development. Westview press , 1990
3. http://www.math.buffalo.edu/mad/physics/allotey.science.technology.pdf
4. Rajeswari S. Raina., Science, technology and development in India: Encountering values. Orient Blackswan 2015
5. Shinn, Terry, Jack Spaapen, and V. V. Krishna, eds. Science and technology in a de*veloping world*. Vol. 19. Springer Science, 2013.

21AT010 Social Responsibility

Unit I

Introduction to Social Responsibility

Meaning and Definition, History of Social Responsibility, Concepts of Charity, Social philanthropy, Citizenship, Sustainability and Stakeholder Management, Environmental aspects of social responsibility.

Unit II

International framework for Social Responsibility

Millennium Development Goals, Sustainable Development Goals, Relationship between Corporate Social Responsibility and Millennium Development Goals. OECD corporate social responsibility policy tool.

Unit III

Drivers of Social Responsibility in India

Market based pressure and incentives, civil society pressure, the regulatory environment in India Counter trends, Review of current trends and opportunities in social responsibility, Review of successful corporate initiatives and challenges of social responsibility.

Unit IV

Identifying key stakeholders of Social Responsibility

Role of Public Sector in Corporate, government programs, Non-profit and Local Self Governance in implementing Social Responsibility, Global Compact Self-Assessment Tool, National Voluntary Guidelines by Govt. of India, Roles and responsibilities of corporate foundations.

Reference Book (s)

1. William B. Werther Jr. and David Chandler, Strategic Corporate Social Responsibility: Stakeholders in a Global Environment, Second Edition, Sage Publications, 2011
2. Sanjay K Agarwal, Corporate Social Responsibility in India, Sage Publications, 2008
3. Mark S. Schwartz, Corporate Social Responsibility: An Ethical Approach, Broadview Press, 2011

21AT011 The Art of Photography and Film Making

Unit I

Introduction

Development of Photography over the years: Brief History of Photography, early photography methods, switch from film to digital, difference between film and digital photography, formats of images in digital.
Cameras & Techniques: Types of camera, film cameras V/S digital cameras, lenses and their importance, Story Design and Development, Laws of Composition, Gestalt Law and Visual Perception, Semiotic photography.

Unit II

Lighting - Theory & practice: Sources of Lighting, 2 point lighting, 3 point lighting, creating contrast, outdoor natural lighting, related accessories for lighting.
Post production of Photos, Digital Image Editing – Photoshop: Processing of Raw images, Introduction to Adobe Photoshop and image ready software, how to enhance the photo digitally.

Unit III

Indian Cinema

History of Indian cinema, history of regional cinema, legends of Indian cinema, Hindi film industry, the Hindi film industry, music and choreography in Indian cinema, contemporary cinema.

Basics of Cinematography-1

Power of a Picture: Power of a still picture shooting a good Still picture Composition-Framing Understanding & Use of colour, Capturing the Drama, Black and white Photography.
Light: Role of light, Lighting techniques, Concept of lighting various planes, Understanding Various types: Tungsten lamps, Cool Lights, HMI, Cyclorama/background lights, Soft Box lights. Use of cutter stand, black cloth and Camera filters, barn doors, use of reflectors, Three point lighting, Ratio lighting: 1:2, 1:3, 1:4.

Unit IV

Lenses: Type of Lenses, Power of Lenses, Understanding the shot requirement and usage of a lens, Idea of perspective: Depth Of Field, Depth of focus, Critical understanding of Fixed Lens Vs. Zoom Lens, Focus pulling, 18% grey card, Metering, Colour temperature meter.
Camera Movements: Basic grammar of shots, Camera Movement: Pan, Tilt, Zoom, Character Movement, Usage and need of Track and trolley, Crane, jimy gip, Poll Cam, Managing Movements, Single camera Setup, Multi camera setup, Continuity Exercise, Do's and don'ts of camera movements, Aesthetics and Psychological.

Textbooks:

1. Camera Terms and Concepts by David Elkins
2. The Camera Assistant by Doug Hart
3. Motion Picture Camera and Lighting Equipment by David Samuelson
4. The Art of Photography; by Bruce Barnbaum.
5. Creative Nature & Outdoor Photography; Brenda Tharp.
6. Chasing the Light by Ibarionex Perello.

Reference Books:

1. Motion Picture Camera Techniques by David Samuelson
2. The 16mm Camera Book by Douglas Underdahl
3. The Hands On Manual for Cinematographers by David Samuelson
4. The Professional Lighting Handbook by Verne Carlson
5. The Filmmakers Pocket Reference by Blain Brown
6. The Camera by Larry Hills.
7. The Creative Black Book.
8. The Print by Ansel Adams, Robert Baker.
9. 500 poses for Photographing Women by Michelle Perkins.
10. Creative Landscapes: Digital Photography Tips & Techniques by Author: Davis, Harold.

21AT012 Gender Equality for Sustainability

Unit I

Understanding Sustainability

The UN 2030 Agenda for Sustainable Development Goals (SDGs); Interrelating SDG 5 (Gender equality) with other SDGs; Economics and Gender: Issues and Concerns; Women and Education: Role of Education in enhancing gender equality--A Case Study of Malala Yousafzai; Need for Gender Equality for Ensuring Sustainability: Why gender equality must be integral to sustainable development; Empowering women and promoting gender equality; Technology and gender equality

Unit II

Gender Equality: Dimensions

Women and Health: Importance of good health for gender equality; Women and Governance: promoting equal rights, opportunities and responsibilities for men and women; Women Empowerment: Inevitable foundation for a peaceful, prosperous and sustainable world; Women and Poverty Reduction: Elimination of socioeconomic inequalities and sustainable production by women; Women and Sustainable Consumption: Strategies to make women play a crucial role for and in a circular economy .

Unit III

Gender and Economic Growth

Role of Women in Economic Growth: productivity, economic diversification, and income equality;
Women and Sustainable Production: Role of women as natural resource managers and in waste management;
Women and Poverty Eradication through Government Schemes: National/Government and intergovernmental schemes and frameworks to reduce poverty and enhance socioeconomic status of women; Women and Poverty Eradication through Entrepreneurship: Developing and enabling women to be entrepreneurs; Women and Self-Help Groups: Case Studies.

Unit IV

Gender Equality and Public Policy

Role of Women in Governance: Gender equality in public employment and decision-making process in governance; United Nations and Gender Inclusiveness: UN General Assembly discussions; Role of Local Self Government in Inclusive Growth: Panchayati Raj system in India and women representation; Gender equality and environmental sustainability: gender equality for sustainable ecosystem management; Project-based Leadership and Gender Equality

Textbooks:

1. *Gender Equality and Sustainable Development* by Melissa Leach (ed), 1st Edition, Routledge, 2015.
2. *Gender Equality in a Global Perspective*, Eds: Anders Ortenblad, Raili Marling, Snjezana Vasiljevic; Routledge; 1st edition (January 24, 2017).
3. *Transitioning to Gender Equality* by Christa Binswanger and Andrea Zimmermann (Eds.), MDPI, 2021. https://www.mdpi.com/books/pdfdownload/edition/1296
4. *Gender Equality and Public Policy: Measuring Progress in Europe* by Paola Profeta, Camridge University Press, 2020.
5. *Gender and Sustainable Development*. OECD: https://www.oecd.org/social/40881538.pdf

Reference Materials:

1. *Gender equality handbook* by Swedish Civil Contingencies Agency (MSB);2009; https://www.msb.se/siteassets/dokument/publikationer/english-publications/gender-equality-handbook.pdf
2. *Turning promises into action: Gender equality in the 2030 Agenda for Sustainable Developmen*t, UN Women Headquarters, 2018. https://www.climateinvestmentfunds.org/sites/default/files/sdg-report-gender-equality-in-the-2030-agenda-for-sustainable-development-2018-en.pdf
3. GENDER EQUALITY AS AN ACCELERATOR FOR ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS. Discussion Paper by The United Nations Development Programme (UNDP), 2018.
4. 2021 Report on Gender Equality in the EU. European Commission, 2021. https://ec.europa.eu/info/sites/default/files/aid_development_cooperation_fundamental_rights/annual_report_ge_2021_en.pdf
5. Global Gender Gap Report 2021. World Economic Forum, 2021. https://www3.weforum.org/docs/WEF_GGGR_2021.pdf

21AT013 Women in Leadership

UINT-I

Education, Employment and Empowerment

Higher education for women, strategies to implement women's education in rural areas - Women's reservation in education sector, Formal and non-formal ways to education, National Literacy Mission, Traditions, maintaining family honour as strategies to curb financial independence

Unit-II

Roles of Women in Family and Society

Archaeology of the evolution of women's role - Gender roles in the domestic sphere - Kitchen space feminism - Gender roles in the social sphere - Matriarchy and Matrilineal societies

Unit-III

Women in Sports

Physical and Psychological effects of Sports on women - Socio-cultural and economic factors that deter Women's talent in Sports - Against all the odds- Narratives of Women athletes and Sport Stars – Serena Williams, Saina Nehwal, Sania Mirza, Deepika Palikal, Mary Kom - Gender testing, Drug tests and other issues related to sex determination process in sports

UNIT-IV

Women Entrepreneurship

Significance of women entrepreneurship, Challenges faced by Women Entrepreneurs, - Relationship between Entrepreneurship and empowerment, Evolution of women entrepreneur development programme, Trends and Patterns of Women Entrepreneurship

Text Books:

1. Haque, T. 2015. Empowerment of Rural Women in Developing Countries: Challenges and Pathways. New Delhi: Concept Publishing Company. Sen, Amartya. Development and Freedom. New Delhi: Oxford University Press, 2000.
2. Agarwal, Suresh. 2015. Social Problems in India. New Delhi: Rajat Publications. Daly, Mary. Beyond God the Father.

Reference Text Books:

1. Drinkwater, Barabara, Ed. 2000. Women in Sport. Oxford: Blackwell Science.
2. Hisrich, Robert D.,Michael Peters and Dean Shepherded-" Entrepreneurship " 9th Tata McGraw Hill 2012.
3. Peter F.Drucker "Innovation and Entrepreneurship", Reprint Heinemann 2006.

21AT014 Introduction to Research Methodology

Unit I

Introduction to Research Methodology

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research-descriptive vs. analytical research, applied vs. fundamental research, quantitative vs. qualitative research, conceptual vs. empirical research, Research Approaches, Significance of Research

Unit II

Defining the Research Problem

What is a Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Research Questions, Research Methods vs. Research Methodology

Unit III

Hypothesis

Literature Review-Review Concepts and Theories, Formulation of Hypothesis-Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis, Tests of Hypothesis-Research Design, Sampling Design, Data Collection, Observation Method, Interview Method, Current trends in Research- Mono-disciplinary Research, Trans-disciplinary Research, Inter-disciplinary Research

Unit IV

Interpretation and Report Writing

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Use of Ms-word and Latex for writing technical report.

Suggested Books:

1. C.R. Kothari and Gaurav Garg, "Research Methodology-methods and techniques", New Age International (P) Limited, 3rd Edition, 2012.
2. R. Panneerselvam, "Research Methodology", PHI Learning, 2nd Edition, 2014.

21AT015 Climate Changes and Circular Economy

Unit I

Introduction: Climate in the Spotlight, -The Spectrum of Scientific Opinion, -Pundits, Advocates and Apocalypse, - The Earth's Natural Greenhouse Effect -,-Why the Earth is a Nice Place to Live,-The Radioactive Balance,-The Importance of Water-Greenhouse Gases-The Role of Carbon Dioxide, -The Role of Methane, -Major Uncertainties CO2 Emissions -Human Emissions of CO_2, -How Much Carbon in the Ground?, -Different Concerns of Rich and Poor Countries, the Earths Carbon Reservoirs -What is Biogeochemistry?, -Why is the Atmospheric Carbon Reservoir so Small?, -Breathing of Gaia, -The Missing CO_2 Sink Carbon Cycling: Some Examples -The Physical Carbon Pump, -The Biological Carbon Pump, -The Marine Carbon Cycle, -The Terrestrial Carbon Cycle Climate and Weather -Climate and Weather: Some Definitions, -The Earth's Climate Machine.

Unit II

Global Wind Systems: Trade Winds and the Hadley Cell,-The Highs and Lows of the Westerlies, -The Vital Importance of Monsoon Rains, -Why are there Seasons, Clouds, Storms and Climate -Cloud Formation and Climate,-Hurricanes and Global Warming Global Ocean Circulation -Introduction and Overview, -Strawberries in Norway, -The Icelandic Whirlpool,-Origin of the Gulf Stream,-The Deep Atlantic Conveyor : El Niño and the Southern Oscillation -El Niño and its Effects,-Upwelling and Climate Outlook for the Future -Introduction to Climate Change,-Advances in Computer Modelling,-Physics versus Fudge Factors.

Unit III

Introduction to circular economy: Purpose of circular economy, Circular sustainability, Challenges for circular economy Concept of sustainable development, Sustainable processes technologies and Critical assessment on current sustainable technologies. Circular bio economy, Circular Business Models. Circular business models to create economic and social value.

Unit IV

Circular economy policy framework: Universal circular economy policy goals, role of governments and networks and how policies and sharing best practices can enable the circular economy. Circular economy towards zero waste: circular economy and waste sector, waste management in the context of circular economy **LCA :** An Introduction to Sustainability Concepts and Life Cycle Analysis , Environmental Data Collection and LCA **Methodology Life Cycle Assessment** – Detailed Methodology and ISO Framework Life Cycle Inventory and Impact Assessments, Factors for Good LCA Design for Sustainability.

Reference Book(s)

1. Webster, K. Circular Economy: A Wealth of Flows. Ellen MacArthur Foundation, 2nd Edition, 2016.
2. McDonough, William, and Michael Braungart. Cradle to Cradle: Remaking the Way We Make Things. New York: North Point, 2002.
3. Raworth, K. Doughnut Economics. Seven Ways to Think Like a 21st -Century Economist. Random House, 2017. Print.
4. Ellen MacArthur Foundation, "Delivering the Circular Economy: A Toolkit for Policymakers" Ellen MacArthur Foundation. 2015.
5. A. Tukker, et al, "The Impacts of Household Consumption and Options for Change," Journal of Industrial Ecology, Vol. 14: 13-39, 2010.

Honor Courses-AR 21

Honor Courses Syllabus



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21CEH11 Advanced Concrete Technology

4 0 0 4

Course Outcomes

1. Understand various concreting methods, including underwater concreting, shotcrete application, high-volume fly ash concrete, and concrete utilizing construction and demolition waste.
2. Understand the concept, constituent materials and properties for self-compacting concrete (SCC)
3. Understand the behavior of Fiber-Reinforced Concrete (FRC) and ferrocement under compression, tension flexure, and shear, comprehending its structural characteristics and performance.
4. Recall the fundamental material properties associated with different concrete types, including lightweight, high-density, and high-performance concrete.
5. Understand the impact of different end conditions of concrete specimens, capping techniques, and the height-to-diameter (H/D) ratio on the accuracy and reliability of test
6. Evaluate the reliability and applicability of Non-Destructive Testing (NDT) in assessing concrete properties and integrity.

COs–POs Mapping

COs	PO1	PO12
1	2	1
2	3	2
3	2	2
4	2	3
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

RMC concrete and Self-compacting concrete

Manufacture, transporting, placing, precautions, Methods of concreting, under water concreting, shotcrete, High volume fly ash concrete, concrete with construction & demolition waste - concept, properties, typical mix Self-compacting concrete concept-materials, tests, properties and typical mix.

Pumping, Applications of Self-compacting concrete

16 Hours

Unit II

Fiber reinforced concrete and Ferro cement

Fibers types and properties, Behaviour of FRC in compression, tension including pre-cracking stage and post-cracking stages, behaviour in flexure and shear Ferro cement - materials, techniques of manufacture, properties and application.

Nylon fiber, Bamboo fiber

16 Hours

Unit III

Light weight concrete and high performance concrete

Materials properties, Typical light weight concrete mix High density concrete High performance concrete-sustainable materials, properties, typical mix.

Applications, Types

16 Hours

Unit IV

Test on Hardened concrete and NDT tests

Effect of end condition of specimen, capping, H/D ratio, Compression, tension and flexure tests. Tests on composition of hardened concrete-cement content, original w/c ratio. NDT tests concepts-Rebound hammer, pulse velocity methods.

Rate of loading, Moisture condition

Total: 64 Hours

Textbook (s)

1. Neville A.M., "Properties of Concrete", 5th Edition, Trans-Atlantic Publications, Inc.; 2012
2. Concrete Technology, Gambhir M.L, Tata McGraw Hill Fifth edition, 2013.
3. Shetty M. S., Concrete Technology", S. Chand & Co.,8th Edition, 2019.
4. Job Thomas., "Concrete Technology", Cenage learning, 2015.
5. R. Santhakumar „ Concrete Technology", Oxford Universities Press, 2018.

Reference (s)

1. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2010
2. Lea, Chemistry of Cement and Concrete", Butterworth-Heinemann Ltd, 5e, 2017
3. Bungey, Millard, Grantham – Testing of Concrete in Structures- Taylor and Francis, 2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	---
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Classify the fibers.
2. List out various test conducted on RMC.
3. What is meant by placing?
4. What is meant by self-compacting concrete?
5. Define Ferro cement.

Understand

1. Explain about the behaviour of FRC in compression.
2. Explain about various properties of Ferro cement.
3. What do you understand by lightweight of concrete and explain briefly the test to be conducted for light weight concrete?
4. Explain about the composition of hardened concrete.
5. Explain the Cracking behaviour for beam with the help of different types natural fiber as per the aspect ratio (OBE).

21CEH12 Advanced Structural Analysis

4 0 0 4

Course Outcomes

1. Analyze the determinate beams for practical moving load combinations using Influence Line diagram.
2. Determine the shape factor for various types of beam cross sections.
3. Evaluate the plastic moment capacity for beams.
4. Analyse the indeterminate beam subjected with different loading condition using flexibility matrix method with and without settlement of supports.
5. Analyse the indeterminate beam subjected with different loading condition using stiffness matrix method without settlement of supports.
6. Analyse the indeterminate beam subjected with different loading condition using flexibility matrix method with settlement of supports.

COs–POs Mappings

COs	PO1	PO12
1	3	2
2	2	3
3	2	3
4	3	2
5	3	1
6	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Influence Lines and Moving Loads

RLD and ILD for statically determinate beams subjected to single & several point loads, UDL longer than the span and shorter than the span – Maximum positive, negative shear force, Maximum bending moment and absolute maximum bending moment.

ILD for pratt truss, ILD for Warren truss

16 Hours

Unit II

Plastic Analysis

Determination of shape factor for rectangular, triangular, circular, T and I sections – Lower bound and upper bound theorems – Plastic Moment analysis for statically determinate and indeterminate beams.

Shape factor for rhombus, Shape factor for trapezium

16 Hours

Unit III

Flexibility Matrix Method

Equilibrium and compatibility – Continuous beam with simply supported end, fixed support end & end span overhanging with and without support settlements.

Flexibility method for determinate beam, rigid jointed plane frames

16 Hours

Unit IV

Stiffness Matrix Method

Equilibrium and compatibility – Continuous beam with simply supported end, fixed support end & end span overhanging with and without support settlements.

Stiffness method for determinate beam, rigid jointed plane frames

16 Hours
Total: 64 Hours

Textbook (s)

1. V.N. Vazirani, M.M Ratwani and S.K. Duggal, ‗Analysis of Structures-Vol I', 17th Ed.,, Khanna Publishers, New Delhi,2015
2. V.N. Vazirani, M.M Ratwani and S.K. Duggal, ‗Analysis of Structures-Vol II', 16th Ed., Khanna Publishers, New Delhi,2015

3. S.S. Bhavikatti, Structural Analysis II, 5th Ed.,Vikas Publishing House Pvt Ltd, 2013

Reference (s)

1. S.B.Junnarkar, Mechanics of Structures Vol.I, 31st Ed., Charotar Publishing House, 2015.
2. S.B.Junnarkar, Mechanics of Structures Vol.II, 24th Ed., Charotar Publishing House, 2015
3. T.S. Thandavamoorthy, Analysis of Structures, 1st Ed., Oxford University Press, New Delhi, 2011.
4. B.C. Punmia, Strength of Materials and Mechanics of Solids,5th Ed., Vol-2Laxmi Publications, New Delhi, 2010
5. C.S. Reddy, Structural Analysis, 11th Ed.,Tata McGhill Publications, New Delhi, 2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	10	10	--
Understand	10	10	--
Apply	80	80	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define influence line.
2. What are the basic unknowns in stiffness matrix method?
3. What is the equilibrium condition used in the stiffness method?

Understand

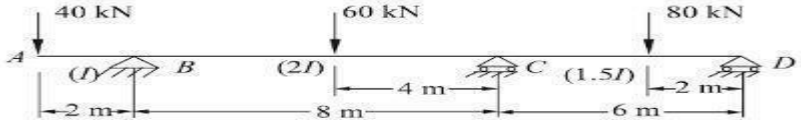
1. Differentiate upper bound theorem and lower bound theorem.
2. Contrast between Statically determinate structures and Indeterminate structures?
3. What are degrees of freedom?

Apply

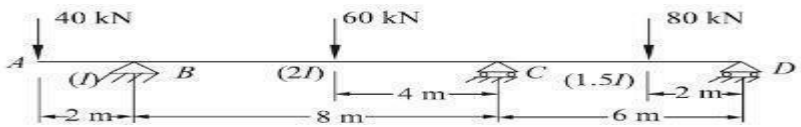
1. A system of concentrated loads role a simply supported beam of span 10 m from left to right with10 KN load leading. Calculate the absolute maximum positive and negative shear in the beam. Also Calculate the absolute max BM?



2. A live load of 15 kN/m, 5 m long moves on a girder simply supported on a span of 13 m. Find the maximum shear force that can occur at a section 6 m from the left end.Also find the maximum bending moment that can occur at a section 6 m from the left end.
3. Analyze the Portal Frame ABCD shown in the figure below by Flexibility Method. EI is constant.



4. Analyze the Continuous Beam ABCD shown in the figure below by Stiffness Method. EI is constant.



21CEH13 Design of Industrial Structures

4 0 0 4

Course Outcomes

1. Discuss the planning and functional requirements of industrial structures.
2. Explore design concepts, and constructional aspects of industrial structures
3. Gain an understanding of the various loads and configurations of industrial structures
4. Perform the design and detailing of industrial reinforced concrete structures under various loading conditions
5. Conduct the design and detailing of industrial chimneys under various loading conditions
6. Gain insight into the use and design steps involved in cooling towers

COs-POs Mappings

COs	PO3	PO5	PO12	PSO2
1	1	3	3	3
2	2	2	3	3
3	3	3	3	3
4	3	3	3	3
5	2	2	3	2
6	3	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Planning and Functional Requirements

Classification of Industries and Industrial Structures – General requirements for Industries like cement, chemical and steel plants – Planning and layout of buildings and components
Lighting – ventilation - Acoustics – Fire safety – Guidelines from factories act.

Electrical installations – substations

16 Hours

Unit II

Loads on Industrial Buildings and Various Configurations

Loads on Industrial structures – Gravity load, Live load, wind load and Earthquake load - Configuration of various Industrial buildings, Need for large column free areas - Various types of floors.

Roofs, Roof coverings

16 Hours

Unit III

Industrial RC Structures

Structural design and detailing of corbels, bunkers, silos

Function of Bunker, Function of Silos

16 Hours

Unit IV

Industrial Steel Structures

Structural design and detailing of Chimneys and Cooling towers

Requirement of Chimney, Requirement of Cooling towers

16 Hours
Total: 64 Hours

Textbook (s)

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2016
2. A. R. Santhakumar and S. S. Murthy, Transmission Line Structures, Tata McGraw Hill, 1992

Reference (s)

1. P. Dayaratnam, Design of Steel Structures, A.H. Wheeler & Co., Ltd., Allahabad, 2008
2. S. N. Manokar, Tall Chimneys – Design and Construction, Tata McGraw Hill, 1986

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	20	20	--
Apply	60	60	--
Analyse	--	--	--
Evaluate	--	--	--
Create	--	--	100
Total (%)	100	100	100

Sample Question (S)

Remember

1. Write down the important guidelines from Factories act with reference to planning of industrial buildings
2. Enumerates the points to be considered for providing natural lighting and ventilation.
3. Enlist the types of fire extinguishers.

Understand

1. Analyse the functions of Transmission line Towers.
2. Explain about Specific requirements for Industries
3. Generalize the causes for fire in Industrial Buildings.

Apply

1. An industrial building is to be provided with a hand operated 50 kN crane facility. The details of the building and the gantry girders are: Longitudinal spacing of columns = 6m, Centre to centre distance of gantry girders = 12m, Wheel spacing = 3m, Edge distance = 1m, Weight of crane girder = 40 kN, Weight of trolley car = 10 kN. Design the gantry girder for bending and shear.
2. Explain the difference between bunkers and silos in various aspects.
3. Design a Bunker. Assume suitable data. **(For Open Book Examination and not for semester end examination)**

21CEH14 Bridge Engineering

4 0 0 4

Course Outcomes

1. Apply the principles, procedures, and current Indian code requirements for the analysis and design of bridge elements
2. Develop an understanding of the general considerations and specifications for road bridges
3. Build knowledge on the various types of loads induced on road bridges
4. Extend your knowledge on key design parameters for the design of culverts
5. Design and check the stability of piers
6. Design and check the stability of abutments

COs–POs Mapping

COs	PO1	PO12	PSO2
1	3	1	2
2	3	2	2
3	2	1	1
4	3	1	2
5	3	3	2
6	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Bridges

Introduction – Classification of bridges - Site selection – Soil exploration for site – Selection of bridge type – Economical span – Number of spans – Determination of HFL – General arrangement drawing.

Linear water way, Afflux

16 Hours

Unit II

Standard Specifications for Road Bridges

Width of carriageway- Clearances - Loads to be considered - Dead load – I.R.C standard live loads - Impact effect - Review of I.R.C loadings - Application of live loads on deck slabs – Wind load – Longitudinal forces - Centrifugal forces - Horizontal forces due to water currents.

Buoyancy effect, Earth Pressure

16 Hours

Unit III

Design of Culverts

Introduction, analysis and design of – pipe culverts -- slab culverts - box culverts - Reinforcement detailing.

Skew slab culvert, Skew angle

16 Hours

Unit IV

Design of Substructures

Introduction to pier and abutments – Types of pier and abutments - Forces acting on Piers and Abutments -Analysis and Design of Abutments and pier

Types of Foundations, Bearings

16 Hours

Total: 64 Hours

Textbook (s)

1. Johnson Victor D , Essentials of Bridge Engineering, 6th Ed., Oxford & IBH Publishing Company, 2015
2. B. C. Punmai, Jain & Jain , Design of RC Structures, 10th Ed., Lakshmi publications, 2016

Reference (s)

1. R.P.Pama & A.R.Cusens, Bridge Deck Analysis, 1st Ed., John Wiley & Sons, 1975
2. T.R. Jagadish & M.A. Jairam, Design of Bridge Structures, 2nd Ed., Prentice Hall of India, N. Delhi, 2004
3. Aswani, Vazirani & Ratvani, 4th Ed., Bridge Engineering, 2014

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book Exam (%)
Remember	10	10	-
Understand	10	10	-
Apply	80	80	100
Analyze	--	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	--	--	100

Sample Question (S)

Remember

1. List the different components of a bridge.
2. List any four types of loads to be considered in the design of road bridges.
3. Write an expression to calculate the centrifugal force when a road bridge is situated on a curve.
4. What is economical span of a bridge?

Understand

1. What are the characteristics of an ideal site for a major bridge across a river?
2. What is the significance of impact factor and how it is estimated?
3. Differentiate culvert and a bridge.
4. Sketch a typical well foundation indicating clearly its component parts and also discuss their functions.

Apply

1. Design a R.C. Slab culvert for a national highway to suit following data:
   Clear span = 5.5m
   Carriage way width = Two Lane
   Wearing coat = 100mm
   Width of bearings = 400mm
   Foot Path = 1m on either side
   Loading = IRC Class A-A tracked vehicle
   Materials M35 grade concrete and Fe415 steel
   Sketch the details of reinforcement in the cross section of slab.
2. Check the adequacy of the dimensions of the pier with the given data:
   Top Width of Pier = 1.5m with semicircular ends
   Bottom Width of Pier = 2.4m with semicircular ends
   Length of pier = 7m excluding the semicircular part
   Height above footing = 10m
   HFL above the top of footing = 8m
   Total DL reaction = 2000kN
   Total LL reaction = 1100kN
   Braking Force = 130kN
   C/C distance of bearing on either side of centre line of pier = 0.45m
   Material for pier M20 & Fe 415
   Live Load: IRC Class A-A tracked vehicle
   Velocity of water current = 4m/s
3. Design a pipe culvert through a road embankment of height 5m. The width of the road is 7.5m and the formation width is 12m. The side slope of the embankment is 2:1. The maximum discharge is $5m^3/s$. The safe velocity is 3m/s. Class A wheeled vehicle is to be considered as live load. Assume sharp edged entry. Given $C_e = 1.5$, $C_s = 0.010$ and the unit weight of the soil is $20kN/m^3$.
4. Design a Reinforced concrete slab culvert for a two lane national highway with M35 grade concrete and Fe 415 steel. Assume the necessary data and follow all the standard specifications as per IRC. **(For Open Book Examination and not for semester end examination)**

21CEH21 Rural Road Technology

4 0 0 4

Course Outcomes:

1. Comprehend the necessity and significance of rural road networks.
2. Develop knowledge in the geometric design of rural roads.
3. Select appropriate materials for the construction of rural road pavements.
4. Acquire skills in pavement design and construction for rural roads.
5. Understand the importance of green roads and their impact on the ongoing infrastructure growth in India.
6. Explore the utilization of various waste materials for constructing rural roads and transforming them into green roads.

COs – POs Mappings

COs	PO2	PO3	PSO1
1	1	2	2
2	1	3	2
3	2	3	3
4	3	3	3
5	3	2	1
6	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Introduction

Importance of Rural roads, Classification of rural roads, Terrain classification, Socio-economic impact of rural roads. Planning and Alignment: Data base for master plan, Concept of network planning, Rural Roads plan, Road alignment, Governing factors for route selection, Factors controlling alignment, Surveys.

Detailed project report, Environmental issues

16 Hours

Unit II

Geometric Design

Introduction, Design speed, Basic principles of geometric design, Elements, Horizontal and vertical alignment, Alignment compatibility,. Materials for bituminous pavement construction, semi-rigid pavement, rigid pavement and special pavements.

Lateral and vertical clearances

16 Hours

Unit III

Pavement Design

Introduction, Design parameters, Pavement components, Design of flexible pavement for low volume roads, Design of rigid pavement for low volume roads, Method of construction bituminous pavements, Semi-rigid pavements, Concrete pavements, special pavements.

Equipment required for earthwork

16 Hours

Unit IV

Green Road Concept and Use of Waste Materials

Introduction, Significance of green roads, Fly ash for road construction, Iron & steel and copper slags, Lime, rice husk ash concrete, Recycled concrete aggregate, other waste materials.

RAP, cold mix technology

16 Hours
Total: 64 Hours

Textbook (s)

1. R. Srinivasa Kumar, Pavement Design, Universities Press, 2013
2. IRC: SP 19-2002 ''Rural Roads Manual' Indian road congress, New Delhi, 2002

Reference (s)

1. IRC: SP 62-2015 'Guidelines for the Design and Construction of Cement Concrete Pavements for Rural Roads'
2. IRC: SP 72-2015 'Guidelines for the Design of Flexible Pavements for Low VolumeRuralRoads'
3. IRC 'Specifications for Rural Roads', MoRD, 2004
4. Handbook of Transportation Engineering by Myer Kutz, Editor, McGraw-Hill Publishers,2000.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	50
Understand	40	40	50
Apply	30	30	--
Analyze			--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)
Remember

1. Explain the socio economic impact of rural roads.
2. Discuss the salient features of flexible pavement design for rural roads in India as per the guideline of IRC: SP:72.

Understand

1. Discuss the factors controlling the alignment of rural roads.
2. What are the various elements considered in pavement curve design for different terrains? Say the importance of each element and mention the draw back in absence of those for flexible and rigid pavement.
3. Why mostly Indian road network is laid with Asphalt, what are all the limitations with Asphalt Pavement in line to environmental issues? Detail the alternatives developed to overcome those. **(For Open Book Examination and not for semester end examination)**

21CEH22 Evaluation and Strengthening of Pavements

4 0 0 4

Course Outcomes

1. Grasp the impact of various factors on pavement design.
2. Analyze structural and functional stresses affecting pavements.
3. Recognize different types of distress in pavements.
4. Apply modern tools to assess the surface condition of pavements.
5. Understand the BBD and FWD tests used in the evaluation of pavements.
6. Evaluate the structural condition of pavements. measures

COs–POs Mappings

COs	PO3	PO12	PSO2
1	3	2	2
2	3	3	3
3	3	3	1
4	2	2	2
5	2	2	2
6	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Stresses and Deflections in Flexible & Rigid Pavements

Highway pavement: Types and components, Factors affecting design and performance of pavements. Stresses and deflections, factors influencing the stresses.

KENPAVE, IIT PAVE

16 Hours

Unit II

Distresses In pavements

Pavement distress; different types of failures in flexible and rigid pavements and its causes, structural and functional safety, repair and retrofitting of road structures.

Types of Pavement maintenance, recycling of pavements

16 Hours

Unit III

Evaluation of Surface Condition

Methods of measurement of skid resistance, unevenness, ruts and cracks. Pavement surface condition evaluation by physical measurements, their applications.

Stone polishing value, Road Profiling Van

16 hours

Unit IV

Evaluation of Pavement Structural Condition

Evaluation by non-destructive tests such as FWD, Benkelman Beam rebound deflection using BBD for flexible overlay design, Plate load test.

LIDAR survey, Area under pavement profile

16 hours
Total: 64 Hours

Textbook (s)

1. Principles of Pavement Design' by Yoder, E.J., and Witczak, 2nd ed. John Wiley and Sons, 2011.
2. The design and performance of road pavements by Croney, D. and P. Croney, McGraw-Hill Book Company, London, UK, 1997.

Reference (s)

1. Pavement Management System' by Haas and Hudson McGraw Hill Book Co., New York, 1994.
2. Pavement Design and Materials by Papagiannakis, A.T. and E.A. Masad, John Wiley and Sons, New Jersey, USA, 2008.

3. Pavement Engineering Principles and Practice by Mallick, R.B. and T. El-Korchi CRC Press, Taylor and Francis Group, Florida, USA, 2009.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	19	19	--
Understand	30	30	50
Apply	50	50	50
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. What are the factors that affect pavement design?
2. List the types of distresses.

Understand

1. Explain Benkelman beam rebound deflection test at evaluation and strengthening of pavement.
2. Explain FWD test at evaluation and strengthening of pavement.

Apply

1. Due to increased traffic a thickness of 20Cm of concrete pavement is required overlay. Calculate the thickness of the rigid overlay when, (i) existing pavement is 10cm thick and is in good condition and (ii) existing pavement is 10cm thick but is badly cracked**.**
2. Plate bearing tests were conducted using 30cm diameter plate on soil subgrade and over a base course of thickness 45 cm. The pressure yielded at 0.5cm deflection on the subgrade and base course were 1.25kg/cm2 and 8 kg/cm2 respectively. Design the thickness requirement of flexible pavement for a wheel load of 5300kg. With tyre pressure of 7 k/cm2 for an allowable deflection of 0.5cm using Burmister's two layer deflection factor chart.
3.

21CEH23 Traffic Engineering and Management

4 0 0 4

Course outcomes

1. Understand the interrelationships between traffic volume, speed, and density and Apply the moving observer method and statistical techniques for speed data analysis.
2. Identify parking parameters and analyse parking survey data for informed decision-making in parking infrastructure design.
3. Understand traffic capacity concepts, LOS, factors influencing capacity and Apply analysis techniques to assess capacity in urban/rural highway scenarios.
4. Design fixed-time signals, determining optimum cycle length and Understand warrants for signals, saturation flow rate, and coordination strategies.
5. Analyze traffic accidents and implement road safety auditing.
6. Devise strategies for improving vehicular flow, including one-way streets, signal optimization, and transit stop relocation.

COs–POs Mappings

COs	PO3	PO12
1	2	2
2	3	3
3	3	3
4	3	3
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Traffic Studies

Basic tenets of traffic: Volume, Speed and Density; Definitions and their interrelationships; Moving observer method, statistical methods for speed data Analysis, Presentation of speed data. Parking Studies: parameters of parking, definitions; Analysis of Parking Survey data. Delay Studies: Head ways and Gap Studies.

PCE, Desire lines

16 hours

Unit II

Capacity, LOS Analysis

Introduction to Traffic capacity, Analysis concepts, Level of Service, Basic definitions, Factors affecting Capacity and LOS, Capacity of Urban/Rural Highway, With or without access control, Basic freeway segments: Service flow rate of LOS, Lane width or Lateral clearance adjustment; Heavy vehicle adjustment; Driver population adjustment.

Vertical clearances, Peak hour factor

16 hours

Unit III

Signal Designing and Road Accident Studies

Fixed Time signals, Determination of Optimum Cycle length and Signal setting for Fixed Time signals, Warrants for Signals, Saturation flow rate, and Adjustment factors, Vehicle Actuated Signals, Signal Coordination. Accident analysis and modelling, Road Safety Auditing, Measures to increase Road safety.

Conflict Points, Chi-square test

16 hours

Unit IV

Transportation System Management

Measures for Improving vehicular flow, one-way Streets, Signal Improvement, Transit Stop Relocation, Parking Management, Reversible lanes; Reducing Peak Period Traffic; Strategies for working hours.

Congestion pricing, Geofencing

16 hours
Total: 64 hours

Textbook (s)

1. L.R. Kadiyali, Khanna Publishers, Traffic Engineering and Transportation Planning. 1999.
2. C.S. Papacostas, Prentice Hall India, Fundamentals of Transportation Engineering. 3rd edition 2002.
3. S. K. Khanna, C. E. G. Justo, A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros., 2019
4. Louis J. Pignataro, Prentice Hall Publication, Traffic Engineering – Theory & Practice. 1973.

Reference (s)

1. L. R. Kadiyali, N. B. Lal, Principles of Highway Engineering, 7th Edition, Khanna Publishers, 2018.
2. Roger P. Roess, William R. Mc. Shane, Elena S.Prassas, Traffic Engineering, Prentice Hall, 1977
3. Highway Capacity Manual -2010

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	40	40	50
Apply	40	40	50
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. List the two factors considered by HCM in LOS.
2. List traffic signals coordination systems.

Understand

1. Derive the relationships between the following and represent diagrammatically.
   (i) Flow and concentration. (ii) Speed and flow. (iii) Speed and concentration
2. Indicate the factors effecting level of service.
3. Indicate the warrants for traffic signals installation.

Apply

1. Twenty-five spot speed observations were taken and are as 50 40 60 54 45 31 72 58 43 52 46 56 4365 33 69 34 51 47 41 62 43 55 40 49 calculate(i)Time mean speed. (ii) Space mean speed and verify between the two.
2. Predict Design standards of Multi Story Car Parking Facility
3. A fixed time 2-phase signal is to be provided at an intersection having a north-south and an east west road where only straight-ahead traffic is permitted. The design hour flows from the various arms and the saturation flows for these arms are as following

	North	South	East	West
Design hour flow in PCU/hr	800	400	750	600
Saturation flow in PCUs/hour	2400	1900	3000	3000

   Calculate the optimum cycle time and green times for the minimum overall delay. The time lost per phase due to starting delays can be assumed to be 2 seconds. The value of the amber period is 2.
4. Inspection of a freeway data set reveals a free flow speed of 60 mph, a jam density of 180 vehicles per mile per lane, and an observed maximum flow of 1900 vehicles per hour. Determine the linear equation for velocity for these conditions, and determine the speed and density at maximum flow conditions. How do the theoretical and observed conditions compare?

21CEH24 Planning and Design of Airport

4 0 0 4

Course Outcomes

1. Understand the airport elements and aircraft components
2. Build knowledge on airport components capacity and delays
3. Explain the basic principles of geometric design of runway
4. Summarize the concept of the terminal service facilities
5. Build knowledge on critical factors considered in airport drainage
6. Develop knowledge on air traffic control aids

COs–POs Mapping

COs	P03	P012	PSO2
1	3	2	1
2	3	1	2
3	3	2	3
4	3	2	1
5	3	3	2
6	1	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Growth and Characteristics of Airport and Aircraft

Growth of air transport, Airport organization and associations, Classifications of airports airfield components, airport traffic zones and approach areas. Aircraft Components, size turning radius, speed, airport characteristics.

Zones, turning radius

16 Hours

Unit II

Design of Airport Components

Factors affecting capacity, Determination of runway capacity related to delay, gate capacity, and Taxiway Capacity Airport Site Selection, Orientation of runways, Runway length and width, longitudinal and transverse grades, runway intersections, taxiways, clearances, noise control, Problems.

Runway numbering, Sight distances

16 Hours

Unit III

Planning of Airport Terminal

Airport terminal building facilities, Operational concepts, space relationships and area requirements, vehicular traffic, parking at airports, aprons, Grading of airport area, Clinometer, hydrology.

Hanger, Blast fences

16 Hours

Unit IV

Airport Drainage & Traffic Control Aids

Design of drainage systems, construction methods, layout of surface drainage and subsurface drainage system, Problems. Runways and taxiways markings, day and night landing aids, airport lighting and other associated aids.

Landing information system, ILS

16 Hours
Total: 64 Hours

Textbook (s)

1. Khanna, Arora and Jain. “Airport Planning and Design", Sixth Ed., Nem Chand and Bros., Roorkee, 2017
2. Rangwala, “Airport Engineering”, 17th Ed, Charotar Publishers, Gujarat, 2018

Reference (s)

1. Virender Kumar and Satish Chandra, "Airport Planning and Design", First Ed., Galotia Publication, 2012
2. Robert Horenjeff, “Planning and Design of Airports", 5th Ed., McGraw Hill Book Co. 2010

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	30	--
Understand	40	60	70
Apply	40	10	30
Analyze			--
Evaluate	--		--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Differentiate between basic and design runway length.
2. What are the design factors to be considered for determining the thickness of airport pavements?

Understand

1. What are the functions of taxiway and hanger in airport layout?
2. What do you understand by littoral drift?
3. Describe how the optimum runway orientation is determined. (**For Open Book Examination and not for semester end examination)**

Apply

1. Discuss the application of wind rose diagram based on site condition.
2. The length of a runway under standard conditions is 2100m. The airport is to be provided at an elevation of 500 m above mean sea level. The airport reference temperature is 20◦C. The construction plan provides gradients of +1.00 %,-0.5%, +0.5%, +0.4 % and -0.1% at chainages 300, 800, 1200, 1600 and 2000 to 2500 m from one end. Determine the actual length of runway to be provided based on ICAO recommendations. **(For Open Book Examination and not for semester end examination)**
3. Design a runway pavement section for a wheel load of 27000kg with a tire pressure of 11kg/cm^2. For this purpose the plate bearing test with 75cm diameter was carried out on soil subgrade and the plate yielded a pressure of 2kg/cm ^{2} at 0.5cm deflection after ten load repetitions. **(For Open Book Examination and not for semester end examination)**

21CEH31 Elements of Rock Mechanics

4 0 0 4

Course Outcomes

1. Foundational understanding of rock properties
2. Proficiency in rock strength analysis and failure modes
3. Comprehensive knowledge of wave propagation in rock bodies
4. Discuss the stress- strain relationships in rocks and deformability of rocks
5. Demonstrate the importance of grouting in rocks
6. Practical application of rock engineering principles

COs – POs Mappings

COs	PO2	PO12	PSO1
1	3	1	2
2	3	2	2
3	3	1	1
4	2	2	2
5	3	3	2
6	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Index Properties of Rocks

Introduction – Physical and Mechanical Properties of Rocks – Elastic Parameters of Rocks – Dynamic Properties of Rocks – Static and Dynamic Module.

Importance of rock mechanics, application of rock mechanics

16 Hours

Unit II

Rock Strength

Types of Waves – Theory of Wave Propagation – Factors influencing Wave Velocity in Rock Mass – Modes of Rock Failure – Strength of Rock – Shear – Tensile – Compressive – Measurements.

Principal stresses and strains, Wave Velocity

16 Hours

Unit III

Deformability of Rocks and Stress

Stress - Strain behaviour – Initial Stress – Influence of Joints – Distribution of Stresses – Measurements of Initial Stresses.

Stresses and strains in rock, Principal stresses

16 Hours

Unit IV

Rock Grouting and Introduction to Rock Engineering

Introduction – Grouting – Types of Grouting – Rock Bolt – Types – Systems – Rock Engineering: Introduction – Merits and Demerits – Tunneling – Rock Openings – Rocks for Mining Subsidence, Dam, Road Cuts, Slabs and Foundations.

Testing of Rock Bolts, Application of rock engineering,

16 Hours

Total: 64 Hours

Textbook (s)

1. Jaeger .C, Rock Mechanics and Engineering, 2nd Ed., Cambridge University Press, 2011.
2. Verma.B.P, Rock Mechanics for Engineers, 3rd Ed., Khanna Publication, 1997.

Reference (s)

1. Goodman .P.E, Introduction to Rock Mechanics, 2nd Ed., John Wiley and Sons, 1989.
2. Stillburg, Professional User Handbook for Rock Bolting, Tran Tech Publications, 1989.
3. Brow .E.T, Rock Characterisation, Testing and Monitoring, 4th Ed., Pergman Press, 1981.
4. Hock and Bray.J, Rock Slope Engineering, Institute of Mining and Metallurgy, 2004.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	--	--
Understand	30	20	--
Apply	50	80	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

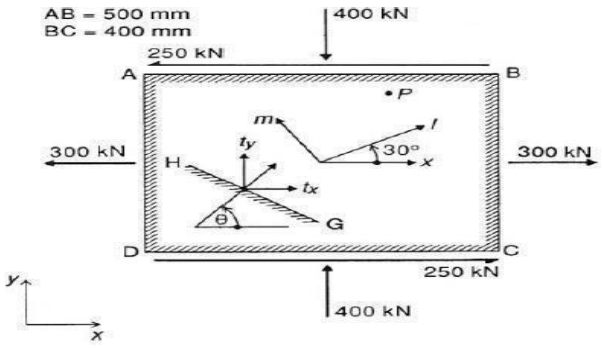
1. Define Hardness of Rocks.
2. Define Creep in rocks.
3. Define porosity and permeability of rocks.
4. Write Tergaghi's Rock mass Classification.

Understand

1. Explain about the use of information on elasticity and plasticity of a rock mass help in designing structures over them.
2. Discuss Mohr's Scale of Hardness.
3. Explain the factors that are responsible for rock strength.
4. Explain static and dynamic moduli of elasticity.
5. Explain swelling and anisotropy in rocks.
6. Explain the cable jacking test.

Apply

1. The rectangular plate shown in the figure below has the given loads uniformly distributed over the edges. The plate is 50 mm thick, AB is 500 mm and BC is 400 mm.
   (a) Determine the shear forces which must operate on the edges BC, DA, to maintain the equilibrium of the plate.
   (b) Relative to the *x, y* reference axes, determine the state of stress at any point P in the interior of the plate.
   (c) For the *l, m* axes oriented as shown, determine the stress components o*ll* , o*mm,* o*lm*.
   (d) Determine the magnitudes of the principal stresses, and the orientation of the major principal stress axis to the *x* axis
   (e) For the surface GH, whose outward normal is inclined at θ° to the *x* axis determine expressions for the component tractions, t_x , t_y , operating on it as a function of o *xx* , o *yy,* o *xy* and θ. Determine values of t_x , t_y for θ = 0°, 60°, 90° respectively. Determine the resultant stress on the plane for which θ = 60◦. **(For Open Book Examination and not for semester end examination)**



21CEH32 Construction in Expansive Soils

4 0 0 4

Course Outcomes

1. Comprehensive understanding of clay mineralogy
2. Understand the behaviour of expansive soils
3. Analysis and prediction of swelling characteristics of the soils
4. Proficient application of foundation practices
5. Suggest the suitable methods of stabilization for expansive soils
6. Competent analysis of shear strength in expansive soils

COs – POs Mappings

COs	PO2	PO12	PSO2
1	3	2	1
2	3	2	1
3	3	2	2
4	3	3	2
5	3	3	3
6	3	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Clay mineralogy

Introduction, Classification of Clay Minerals, Clay Mineral Groups, Crystal Structure of Clay Minerals, Clay Mineral Properties, Thermal Methods, Base Exchange Capacity, Industrial Applications, Clay Mineral Equilibrium.

Formation of Soil, Origin of Clay

16 Hours

Unit II

Swelling characteristics

Swelling - factors effecting swelling - swell potential- methods of determination of swell pressure – factors affecting swelling potential and swell pressure – Heave - methods of determination of heave.

Properties of expansive soils, factors affecting heave

16 Hours

Unit III

Foundation Practices in Expansive Clays

Sand cushion – Belled Piers – CNS layer technique – Under – reamed pile foundations – Construction techniques – design specifications – Load -carrying capacity in compression and uplift of single and multi – under reamed piles in clays and sands – granular pile Anchors. Lime soil columns – Vertical and Horizontal Moisture Barriers. Methods of stabilization.

Preponding, Lime slurry pressure injection

16 Hours

Unit IV

Shear strength of expansive soils

Kattis concept of bilinear strength envelope- Stress state variables in partly saturated soils- Fredlunds strength parameters- determination of matrix suction by axis translation technique- field suction measurement.

Shear strength parameters, Tests to determine Shear strength parameters

16 Hours

Total: 64 Hours

Textbook (s)

1. F.H.Chen, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York, 1988
2. J. D. Nelson and D. J. Miller, "Expansive Soils: Problems and Practice in Foundation and Pavement Engineering," John Wiley and Sons Inc., New York, 1992.
3. Gopal Ranjan and AS Rao, 3rd Ed. Basic and Applied Soil Mechanics, New Age International Publishers, New Delhi. 2016.

Reference (s)

1. D.G. Fredlund and H.Rahardjo, Soil Mechanics for Unsaturated Soils, 1 st Ed. WILEY Inter science Publication, John Wiley & Sons, Inc. 1993
2. D.R. Katti, AR Katti, Behaviour of Saturated Expansive Soils and Control methods, 1 st Ed. Taylor and Francis. 2002
3. Hand Book on Under reamed and Bored Compaction Pile Foundations – CBRI, Roorkee.
4. IS: 2719(Part XLI) – 1977 Measurement of Swelling Pressure of Soils.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	30	30	
Understand	50	50	
Apply	20	20	100
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is an expansive soil and its general characteristics?
2. Define swelling potential.
3. What is an underreamed pile?
4. Define collapse potential.

Understand

1. How do you identify an expansive soil from its index properties?
2. What are the effects of swelling on buildings?
3. Explain the design of a drilled pier in an expansive soil.

Apply

1. How do you identify a collapsible soil from its liquid limit and dry unit weight?
2. How would you design a foundation on an expansive not susceptible to wetting?
3. If an expansive soil susceptible to wetting, what are the alternatives would you recommend. A structure is constructed over expansive soil without investigation, how you examine the safety of structure and if it is prone to uncertainties what are the loss mitigation methods you would adopt. **(For Open Book Examination and not for semester end examination)**

21CEH33 Geosynthetics in Soil Structures

4 0 0 4

Course Outcomes

1. Develop and understand the fundamental concepts that govern the behaviour of soils reinforced with geosynthetics
2. Explain the types of geosynthetic products, functions, application and suitability in different applications
3. Examine and design the reinforced earth retaining walls
4. Design the reinforced embankments
5. Analyze and design the reinforced soil beds
6. Analyze and design the reinforced pavements

COs – POs Mappings

COs	PO2	PO3	PO12	PSO1
1	2	2	2	2
2	2	2	2	3
3	3	3	2	3
4	3	3	2	3
5	3	3	2	3
6	3	3	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I
Reinforced Earth

Concept, Effects of Reinforcement on soils – Equal Confining and Psuedo Cohesion Concepts, Materials, Friction Coefficient – Definition, Laboratory determination, Factors affecting friction coefficient;
Geosynthetics: Types, Functions, Tests on Geosynthetics, Durability aspects

Application of Reinforced Earth, Application of Geosynthetics

16 Hours

Unit II
Reinforced Earth Retaining Walls

Introduction, Stability Mechanisms, Design of Reinforced Earth Retaining Wall, Reinforced slope & design, Advantages over conventional Retaining Walls.

Failure Mechanisms, Cost benefit ratio

16 Hours

Unit III
Reinforced Embankments and Soil Beds

Introduction, Design of Reinforced Embankment, Foundation mattress below the embankment, Design of Reinforced Mattress
Soil Beds: Introduction, Factors affecting the Behaviour of Reinforced Soil Beds, Analysis and Design.

Embankments over soft soils, BC analysis of Reinforced soil beds

16 Hours

Unit IV
Reinforced Pavements

Benefits of placing reinforcement in flexible pavement layers, design of reinforced pavements by Groud and Noiray approach and modified CBR Method.

Field identification of CBR value, geosynthetic stabilisation of roads on expansive soils

16 Hours
Total: 64 Hours

Textbook (s)

1. An Introduction to Soil Reinforcement and Geosynthetics" by G.L. Siva Kumar Babu (2006), University Press, Hyderabad.
2. Reinforced Soil and Its Engineering Applications" by Swami Saran (2017), I.K. International Pvt Ltd, New Delhi.

3. Designing with Geosynthetics" by Robert M Koerner (2012), Xlibris, United States of America.

Reference (s)

1. Venkatappa Rao, G. and Suryanarayana Raju, G.V.S. (1990), "Engineering with Geosynthetics", Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Construction and Geotechnical Engineering using Synthetic Fabries" by Robert M. Koerner and Joseph P. Welsh (1980), John Willey and Sons, New York.
3. BS 8006:1910, "Code of practice for strengthened/reinforced soils and other fills
4. FHWA-NH1-00-043, (2014) "Mechanically stabilized earth walls and reinforced soil slopes design and construction guidelines".

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	20	20	-
Understand	40	40	-
Apply	40	40	50
Analyze	-	-	50
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What are the effects of reinforcement on soil?
2. What is RERW?
3. What are the advantages of placing reinforcement in flexible pavement**?**

Understand

1. Explain the concept of Psuedo Cohesion. Derive expressions for its determination.
2. Explain different application of Geosynthetics.
3. Discuss the advantages of RERW over conventional Retaining Walls.
4. Discuss in brief about modified CBR Method.

Apply

1. Demonstrate stability mechanisms and its importance in designing Reinforced Earth Retaining Wall.
2. Classify various types of geosynthetics according to their suitability and application.
3. Illustrate with an example factors affecting the Behavior of Reinforced Soil Beds.

Analyze

1. It is required to design the reinforcement for a steep embankment resting on a competent soil. The height of the slope is 8 m and constructed with a slope angle of 70^o.The properties of the soil are c=0, c=0, $\phi=35^o$ and $\gamma=20kN/m^3$. A uniform surcharge of 25 kPa acts on top of the slope. What is the total resistance force to be provided by the reinforcement layers to increase the factor of safety to 1.5. Perform the analysis by planar wedge method.
2. Reinforced soil retaining wall is constructed of steel strips. The details of the system are as follows: Height of the wall = 8 m with horizontal backfill soil. Properties of backfill and reinforced soil are c=0, $\phi=30\circ$,$\gamma=20kN/m^3$, c=0, $\phi=30\circ$, $\gamma=20kN/m^3$. Assume that the allowable bearing pressure on the foundation soil is 300 kPa. The steel strips are 50 mm wide and 6 mm thick. The yield strength of the steel is 415 N/mm^2. Apply a reduction factor of 1.1 on the yield strength of steel strips. The design life of the structure is 119 years. Assume that the steel strips are galvanized and the structure is a land based structure. The steel strips are placed at horizontal spacing of 0.5 m c/c. There are totally 11 number of reinforcement layers at the following depths from the surface (z): 0.25, 1.0, 1.75, 2.5, 3.25, 4, 4.75, 5.5, 6.25, 7.0, 7.75m. The permanent surcharge on the wall is 25 kPa and the live load surcharge is 18 kPa. A bridge abutment is supported on the wall with a footing width of 2m, placed at a front distance of 1.5m. The vertical load on the footing is 500 kN (treat it as permanent load) and the horizontal load is 45 kN/m.

   (a) What is the cross-sectional area of the steel strips at the end of design life
   (b) What is the vertical pressure due to bridge abutment load at a depth of 1m
   (c) What is the factor of safety against rupture of the reinforcement

21CEH34 Soil Dynamics

4 0 0 4

Course Outcomes

1. Identify scope and significance of soil dynamics
2. Explain the basic dynamic properties of soils
3. Summarize the dynamics of Continuous system (Wave Propagation)
4. Analyze the dynamic Response Analysis
5. Demonstrate liquefaction of soils and related phenomena
6. Explain the basic theory of vibrations

COs – POs Mappings

COs	PO2	PO3	PO12
1	1	2	2
2	1	3	1
3	2	1	1
4	2	3	2
5	3	2	2
6	1	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Fundamentals of Vibration

Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Logarithmic decrement, Determination of viscous damping.

Transmissibility, Vibration measuring instruments.

16 Hours

Unit II

Wave Propagation

Longitudinal and torsional waves in infinitely long rod; Solution for one-dimensional and three-dimensional equations of motion; Earthquake waves – P-wave, S- wave, Rayleigh wave and Love wave; Locating earthquake's epicentre.

Waves in semi-infinite body, Waves in layered medium;

16 Hours

Unit III

Dynamic soil properties

Laboratory and field testing techniques (Seismic Reflection and MASW methods), Elastic constants of soils. Evaluation of Liquefaction using simple methods and methods for mitigating liquefaction of soils.

Elastic constants of soils, Introduction to Liquefaction of soils.

16 Hours

Unit IV

Vibration Analyses

Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation. Introduction to the design of reciprocating, impact, turbo generator machine foundations.

Definition of Allowable soil pressure, Definition of Vibration isolation

16 Hours

Total: 64 Hours

Textbook (s)

1. Swami Saran, Soil Dynamics and Machine Foundation, 3rd Ed., Galgotia Publications Pvt. Ltd., 2016
2. Prakash. S., Soil Dynamics, 3rd Ed. McGraw Hill, 1981
3. Kramer S. L., Geotechnical Earthquake Engineering, 1st Ed. Prentice Hall, 2003

Reference (s)

1. Das, B. M., Principles of Soil Dynamics, 2nd Ed. PWS KENT publishing Company, Boston, 2014.
2. Richart, F. E. Hall J. R and Woods R. D., Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
3. Bharat Bhushan Prasad, Advanced Soil Dynamics and Earthquake Engineering, 1st Ed., PHI Learning Pvt. Limited, New Delhi, 2010.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	30	20	-
Understand	40	30	-
Apply	10	10	40
Analyze	20	40	60
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is 'Logarithmic Decrement'?
2. What is viscous damping? Explain the effect of damping on amplitude of vibrations.
3. What are the considerations involved in design of pile foundations subjected to dynamic loads?
4. Describe cyclic plate load test used in determination of coefficient of elastic uniform compression of soils.

Understand

1. Explain the terms, damped natural frequency, magnification factor and logarithmic decrement.
2. Explain the Pressure bulb concept used in determination of mass of co-vibrating soil for determination of natural frequency of foundation-soil system.
3. Derive expressions for its determination.
4. Explain the different types of waves that propagate through semi-infinite elastic medium.
5. Explain dynamic bearing capacity theory of soils.

Apply

1. From first principles obtain the equation of motion for over damped, critically damped and under damped systems.
2. Describe the development of mass spring dashpot model from elastic half space theory.

Analyze

1. In a block test according to Indian standards, resonant frequency of 18 Hz was observed in the vertical direction. The base size of concrete test block was 1.5m X 0.75m. The thickness of the block was 0.75m. Unit weight of concrete = 24kN/m^3. Determine Cu. If a machine weighing 100kN is to be supported on a rigid block 6m X 8m X 2.5m, what is the natural frequency in the vertical direction?
2. Distinguish between Longitudinal and torsional vibrations of elastic rods.
3. A foundation block of weight 30 kN rests on soil for which stiffness may be assumed as 25000 kN/m. The machine is vibrated vertically by an exciting force of 3Sin 30t kN. Find the natural frequency, period, natural circular frequency and the amplitude of vertical displacement.
4. Determine the natural frequency of a machine foundation that has a base area of 6m^2 and a weight of 175kN including weight of machine. The coefficient of elastic uniform compression of soil is 4 x 10^4 kN/m^3. Use Barkan's method.
5. A block vibration test was performed on a concrete block of size 1m x 1m x 1m using vertical excitation. The results are tabulated. Assuming unit weight of concrete as 24kN/m^3, determine the value of damping Factor (D). **(For Open Book Examination and not for semester end examination).**

Frequency (rpm)	500	600	700	750	850	950	1000	1190
Amplitude (mm)	0.2	0.6	1.5	2.5	3.2	2.5	1.5	0.6

21CEH41 Modern Construction Material

4 0 0 4

Course Outcomes

1. Understand the use of special concretes in construction
2. Understand the behaviour of different variety concretes
3. Apply knowledge of modern materials in production of variety of concrete
4. Apply knowledge of composites and chemicals in production of modern concrete
5. Use modern smart and intelligent materials in constructions
6. Understand the special features of the smart materials

COs–POs Mapping

COs	PO1	PO7	PO12
1	1	1	1
2	2	2	2
3	3	2	2
4	2	3	3
5	3	2	3
6	1	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Special Concretes

Behaviour of concretes – Properties and Advantages of High Strength and High-Performance Concrete – Properties and Applications of Fiber Reinforced Concrete, Self-compacting concrete, Alternate Materials on high performance & high Strength concrete.

Ternary Blend Concrete, Temperature Controlled Concrete

16 Hours

Unit II

Metals

Types of Steels – Advantages of new alloy steels – Properties and advantages of aluminium and its products – Types of Coatings & Coatings to reinforcement – Applications of Coatings.

Manufacturing process of steel, Fusion Bonded Epoxy Coated Rebars (FBEC)

16 Hours

Unit III

Composites

Types of Plastics – Properties & Manufacturing process – Advantages of Reinforced polymers – Types of FRP – FRP on different structural elements- Applications of FRP.

Carbon Fiber reinforced polymer, Metal matrix composite.

16 Hours

Unit IV

Smart and Intelligent Materials

Types & Differences between Smart and Intelligent Materials – Special features –Case studies showing the applications of smart & Intelligent Materials.

Applications of Photovoltaic materials, Temperature-responsive polymers

16 Hours
Total: 64 Hours

Textbook (s)

1. Santhakumar.A.R., "Concrete Technology", Oxford University press, 2018
2. Shan Somayaji, "Civil Engineering Materials", Prentice Hall Inc., 2001
3. Shetty M.S, "Concrete Technology: Theory and Practice", S.Chand & Company Ltd., 2019,Eighth revised edition
4. Ashby, M.F. and Jones.D.R.H.H. “Engineering Materials 1: An introduction to Properties, applications and designs”, Elsevier Publications, 2005.

Reference (s)

1. ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.
2. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, "Materials for civil and Highway Engineers", Prentice Hall Inc., 1998.
3. Mamlouk, M.S. and Zaniewski, J.P., "Materials for Civil and Construction Engineers", Prentice Hall Inc., 1999.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Write down about Self-compacting concrete.
2. Enumerates the list of different types of Plastics.

Understand

1. Explain about applications of FRP.
2. Differentiate between Smart and Intelligent Materials. **(For Open Book Examination and not for semester end examination).**

21CEH42 Construction Planning and Project Management

4 0 0 4

Course Outcomes

1. Identify the various phases of a project life cycle and select appropriate professionals
2. Apply strategic planning principles and Detailed Project Reports to assess the potential challenges of construction projects
3. Explain the various activities of construction management and project risk analysis
4. Illustrate the various scheduling procedures and techniques
5. Demonstrate proficiency in the organization and utilization of project information
6. Explain the different databases that can be maintained in a construction industry using computers.

COs–POs Mappings

COs	PO1	PO12
1	2	1
2	3	1
3	3	1
4	3	3
5	1	3
6	1	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Project Management

Project life cycle, Types of construction, Selection of professional services, Construction contractors, Financing of constructed facilities, Legal and regulatory requirements, Role of project managers, Strategic planning, Feasibility studies, DPR, Techno Economic analysis, Environmental and Social impact analysis, Project clearance procedures and documentation for major works.

Organization of Project Participants, Owner Builder Operations

16 Hours

Unit II

Construction Planning and Management

Basic concepts in the development of construction plans, Choice of technology and Construction method, defining work tasks, Work breakdown structure, Definition, precedence relationships among activities, estimating activity durations, Estimating resource requirements for work activities, coding systems. Site mobilization, demobilization aspects, resources management, Project Risk analysis.

Design and Construction as an Integrated System, Simulation models for project risk analysis.

16 Hours

Unit III

Scheduling Procedures and Techniques

Construction schedules, Critical path method, Scheduling calculations, Float, presenting project schedules, Scheduling for Activity-on-Node and with Leads, Lags, and Windows, Scheduling with resource constraints and precedence's, use of advanced scheduling techniques, Scheduling with uncertain durations, Crashing and Time/Cost Trade-offs, Improving the Scheduling process.

Scheduling of a small construction project using tools like MS project, Virtual progress tracking of small construction project using Navisworks.

16 Hours

Unit IV

Organization and Use of Project Information

Types of project information, Accuracy and Use of Information, Computerized organization and use of Information, Organizing information in databases, relational model of data bases, Other conceptual Models of Databases, Centralized database Management systems, Databases and application programs, Information transfer and Flow.

Design of a simple equipment information system for a construction project, Introduction to Building information Modelling (BIM) – Demo only

16 Hours
Total: 64 Hours

Textbook (s)

1. P S Gahlot & B M Dhir, Construction Planning & Management, New Age International Limited Publishers (India) 2018.
2. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA, 2017.
3. Chitkara K K., Construction project management, planning, scheduling and control, McGraw Hill (INDIA) publishers, New Delhi, third edition 2014.

Reference (s)

1. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
2. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.
3. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remembering	40	25	--
Understanding	50	40	70
Application	--	25	30
Analysis	--	--	--
Evaluate	10	10	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. Identify the various resources used for construction project.
2. Define construction planning.
3. How will you create an activity node and activity event?
4. Define DBMS
5. Define Project Life cycle.

Understand

1. Differentiate financial and managerial accounting.
2. Distinguish between PERT & CPM.
3. Discuss about the constraints in scheduling.
4. Describe the significance of choice of technology
5. Explain, why time cost trade-off is necessary?

Evaluate

1. Evaluate survey-based demand forecasting methods with appropriate examples.
2. Prepare a generalized report on stages of planning by different agencies.
3. Create a MIS on residential project for safety elements which is carried out on the site.
4. The logical sequence of management functions cannot be subordinated even by one function. Do you agree? Support your answer **(For Open Book Examination and not for semester end examination)**

21CEH43 Quality Control and Assurance in Construction

4 0 0 4

Course Outcomes

1. Identify the requirement of quality management guidelines and quality system standards in construction
2. Apply the quality concepts, ergonomics and methods in construction industry
3. Discuss and model the statistical techniques and construction programming and its processes
4. Apply the quality assurance and control techniques in construction
5. Explain the major failure aspects and failure mode analysis of a structure
6. Apply the various quality improvement techniques, life cycle costing and Value engineering.

CO-PO Mapping

COs	PO1	PO3	PO12	PSO1
1	3	1	3	2
2	3	2	2	2
3	1	3	3	1
4	2	2	1	3
5	2	3	2	1
6	1	2	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Quality Management and System

Introduction – Definitions and objectives – Factors influencing construction quality – Responsibilities and authority – Quality plan – Quality Management Guidelines – Quality circles. Introduction - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification.

Factors influencing construction quality, Implementing a Quality system

16 Hours

Unit II

Quality Planning

Quality Policy, Objectives and methods in Construction industry - Consumer's satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi's concept of quality – Codes and Standards – Documents – Contract and construction programming – Inspection procedures - Processes and products – Total QA / QC programme and cost implication.

Statistical tolerance, Inspection procedures

16 Hours

Unit III

Quality Assurance and Control

Objectives – Regularity agent, owner, design, contract and construction-oriented objectives, methods – Techniques and needs of QA/QC – Different aspects of quality – Appraisals, Factors influencing construction quality – Critical, major failure aspects and failure mode analysis, – Stability methods and tools, optimum design – Reliability testing, reliability coefficient and reliability prediction.

contract and construction-oriented objectives, Stability methods and tools

16 Hours

Unit IV

Quality Improvement Techniques

Selection of new materials – Influence of drawings, detailing, specification, standardization – Bid preparation – Construction activity, environmental safety, social and environmental factors – Natural causes and speed of construction – Life cycle costing – Value engineering and value analysis.

Selection of new materials, Natural causes and speed of construction

16 Hours

Total: 64 Hours

Textbook (s)

1. Hutchins.G, ISO 9000 : A Comprehensive Guide to Registration, Audit Guidelines and Successful Certification, Viva Books Pvt. Ltd., 1994.
2. James, J.O' Brian, "Construction Inspection Handbook" – Total Quality Management, Van Nostrand, 1997

Reference (s)

1. John L. Ashford, "The Management of Quality in Construction", E & F.N.Spon, 1989.
2. Juran Frank, J.M. and Gryna, F.M. "Quality Planning and Analysis", McGraw Hill, 2001
3. Kwaku.A., Tena, Jose, M. Guevara, "Fundamentals of Construction Management and Organisation", Reston Publishing Co., Inc., 1985.
4. Steven McCabe, "Quality Improvement Techniques in Construction", Addison Wesley Longman Ltd, 1998.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define the term quality management
2. List the Factors influencing construction quality
3. What is the main objectives of quality assurance?
4. Define life cycle costing.
5. What do you mean by third party Certification?

Understand

1. Discuss the various requirement of ISO9000.
2. Explain briefly about Taguchi's concept of quality.
3. Describe the term reliability testing.
4. Explain the quality related training programme.
5. Elaborate the total quality management in construction. **(For Open Book Examination and not for semester end examination)**

21CEH44 Safety in Construction

4 0 0 4

Course Outcomes

1. Understand construction industry, hazards, causes, activities and relate with BOCW act
2. Identify types of excavation, scaffold hazards and suggest adequate control measures
3. Discuss different types of Hazards in Construction and Prevention
4. Understand Operation and maintenance of Earth moving machinery and investigate accidents
5. Formulate Demolition, types and safe demolition activity in industrial site
6. Formulate Demolition, types and safe demolition activity in domestic site

COs–POs Mapping

COs	PO2	PO11	PSO2
1	3	3	3
2	1	3	3
3	1	3	3
4	1	3	3
5	2	3	3
6	2	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Accidents Causes and Management Systems

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – the building and other construction workers act and rules 1996- Pre contract activities, preconstruction meeting - design aids for safe construction – permits to work – tool box meeting- quality assurance in construction – compensation.

Recording of accidents and safety measures – Education and training.

Industrial Accidents,
Classification of Accidents,
Need for the Analysis of Accidents,
Accidents Reports,
Methods Adopted for Reducing Accidents,
Investigation of Accidents,
Safety Slogans,

16 Hours

Unit II

Hazards of Construction and Prevention

Excavations, basement and wide excavation,– scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunnelling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings.

Trenches, shafts

16 Hours

Unit III

Construction Machinery

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder's hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.

Drills, grinding tools

16 Hours

Unit IV

Safety in Demolition Work

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition -– first aid – fire hazards and preventing methods – Case studies.

Indian standard trusses, girders and beams

16 Hours
Total: 64 Hours

Textbook (s)

1. Davies V J and Tomasin K "Construction Safety Hand Book", Thomas Telford Ltd., London, 1990.
2. Sharma S C and Vineet kumar," Safety, Occupational Health and Environmental Management in Construction", Khanna Publishers, 1 st Edition,2013.

Reference (s)

1. Charles D Reese and James V Edison, "Handbook of OSHA Construction Safety and Health", CRC press,2006
2. King R W and Hudson R, "Construction hazard and Safety Hand book", Butter Worth- Heinemann, 1985.
3. Bhattacharajee S K, "Safety Management in Construction", Khanna Publishers, 2013.
4. Health and Safety in Construction ,HSE publications,3rd Edition,2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	50	--
Understand	50	50	100
Apply	--	--	--
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. List the types and causes of construction accidents.
2. Define false work.
3. Define demolition.
4. List the various construction machinery.
5. Compare pre blast and post blast inspection techniques.

Understand

1. Explain the safety scenario of the modern Indian construction industry, mentioning the problem areas
2. Write a note on the occupational health issues common to construction site workers.
3. Explain the factors that affect productivity in a construction site.
4. Explain the different types of demolition techniques.
5. Discuss the roles of various groups or agencies related to construction so far as they influence safety in construction works. **(For Open Book Examination and not for semester end examination)**

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Minor Courses-AR 21

Minor Courses Syllabus



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MINOR COURSES

Sl.No.	Course Code	Course Name	Offering Dept.
Energy Science & Technology			
1	21CHM11	Foundation of Energy Science and Technology	**CHEM**
2	21CHM12	Energy Generation from Waste	
3	21CHM13	Energy Storage Systems	
4	21CHM14	Hydrogen Energy and Fuel Cells	
Nano Science & Technology			
5	21CHM21	Introduction and Characterization of Nano Materials	**CHEM**
6	21CHM22	Carbon Nanostructures and Applications	
7	21CHM23	Energy, Environment & Biomedical Nanotechnology	
8	21CHM24	Industrial Applications of Nano Technology	
Environment Engineering			
9	21CEM11	Watershed Management	**CIVIL**
10	21CEM12	Industrial Pollution Control and Engineering	
11	21CEM13	Solid and Hazardous Waste Management	
12	21CEM14	Ecology and Environmental Assessment	
Artificial Intelligence & Machine Leaning			
13	21CSM11	Fundamentals of AI & Machine Learning	**CSE**
14	21CSM12	Feature Engineering for Machine Learning	
15	21CSM13	Exploratory Data Analytics	
16	21CSM14	Deep Learning	
Cyber Security			
17	21CSM21	Fundamentals of Security	**CSE**
18	21CSM22	Management of Information Security	
19	21CSM23	Cyber Security	
20	21CSM24	Cloud Security	
Data Science & Analytics			
21	21CSM31	Data Cleaning	**CSE**
22	21CSM32	Data Engineering	
23	21CSM33	Text Analytics	
24	21CSM34	Social Network and Semantic Analysis	
Computer Systems Programming			
25	21CSM41	Programming Fundamentals	**CSE**
26	21CSM42	Data Structures & Algorithms	
27	21CSM43	Fundamentals of Databases	
28	21CSM44	Fundamentals of Computer Networks & Operating Systems	
Digital IC Design			
29	21ECM11	Fundamentals of VLSI Design	**ECE**
30	21ECM12	Digital Design using HDL	
31	21ECM13	FPGA Technology	
32	21ECM14	Analog and Mixed Signal Design	
Industrial Automation			
33	21ECM21	Microcontrollers and Interfacing	**ECE**
34	21ECM22	Sensors and Data Acquisition System	
35	21ECM23	Fundamentals of Labview	
36	21ECM24	Medical Robotics	
Communications and Networking			
37	21ECM31	Principles of Communications	**ECE**
38	21ECM32	Coding Theory and Practice	
39	21ECM33	Ad-hoc and Wireless Sensor Networks	
40	21ECM34	Fundamentals of Multimedia Networking	
Avionics			
41	21ECM41	Principles of Aerodynamics	**ECE**

42	21ECM42	Aircraft Electrical Systems	
43	21ECM43	Aircraft Instrument Systems	
44	21ECM44	Aircraft Communication and Navigational Systems	
Geographic Information System			
45	21ECM51	Sensors and Sensing Technology	**ECE**
46	21ECM52	Geographic Information Systems	
47	21ECM53	Digital Image Processing	
48	21ECM54	Lidar Systems	
Electric Vehicles Technology			
49	21EEM11	Introduction to Electric Vehicles Technologies	**EEE**
50	21EEM12	Electrical Drives and Controllers for Electric Vehicles	
51	21EEM13	Charging Technology in Electric Vehicles	
52	21EEM14	Computer Vision in Electric Vehicles	
Smart City Management			
53	21EEM21	Fundamentals of Smart City	**EEE**
54	21EEM22	Smart City Infrastructure	
55	21EEM23	Computational Methods for Smart City Management	
56	21EEM24	Communication Technologies and Mobility for Smart City	
Industrial Applications and Control			
57	21EEM31	Modelling and Simulations of Industrial Applications	**EEE**
58	21EEM32	Industrial Sensors and Actuators	
59	21EEM33	Programmable Logic Controllers	
60	21EEM34	Control Design for Industrial Applications	
Cloud Application Development			
61	21ITM11	Introduction to Cloud Computing	**IT**
62	21ITM12	Introduction to Web Development with HTML, CSS, JavaScript	
63	21ITM13	Developing Cloud Native Applications	
64	21ITM14	Developing Cloud Apps with Node.js and React	
Robotics and Automation			
65	21MEM11	Introduction to Robotics	**MECH**
66	21MEM12	Drives and Sensors	
67	21MEM13	Control Systems for Robotics	
68	21MEM14	Machine Learning for Robotics	
Industrial Systems Engineering			
69	21MEM21	Industrial Management	**MECH**
70	21MEM22	Fundamentals of Operations Research	
71	21MEM23	Enterprise Resource Planning	
72	21MEM24	Production Planning and Control	

DEPARTMENT OF CHEMICAL ENGINEERING

AR21 MINOR COURSES

Minors for other Departments offered by Chemical Engineering

Minor Track 1: ENERGY SCIENCE & TECHNOLOGY

Preamble

Energy transformation and energy frameworks have molded and will keep on forming the advancement of humankind. In various ways, they are totally essential for the human life. The minor program in Energy Science and Technology gives an elite instructive climate to prepare understudies accountable for creating future advances in the field of energy designing.
The Minor program "Energy Science and Technology" manages present day innovations for energy change and capacity and with the logical standards fundamental these advances.
There is an earnest need to create and market innovations for the practical change and utilization of energy. This minor gets ready understudies for professions that require preparing in energy science and innovation, proficiency, and strategy. Clean advances and green advances including energy are probably the quickest developing business sectors for new ventures. The minor obliges people of different foundations with instructive interests in regions that might incorporate designing, science, strategy, financial matters, arranging, and the board.

Prospectus

People in the future will depend on energy sources made accessible by enormous sustainable power assets. The innate idea of these assets is presenting exceptional specialized and the board difficulties to engineers. With a normal development of 150% of the energy designing position market by 2130 and solid interest for people with assorted ranges of abilities, the program handles these difficulties via preparing fantastic understudies to become top experts in this field with the target of driving industry, science, and market advancements.
This program aims to give students a scientific understanding of energy and energy conversions. Students will develop the self-confidence to use and manipulate the governing equations of energy. In this context the broader issues will be discussed. The program will give a detailed explanation of the energy conversion system, energy storage systems and energy generation from waste, their importance and future contribution to anthropogenic energy uses.

Placement Opportunities:

There are many organisations that employ energy engineers, including:

- International oil companies like Saudi Arabian Oil Company (Saudi Aramco),Exxon Mobil Corporation, Reliance Industries, Chevron Corporation, Nextera Energy
- Indian Oil Companies like HPCL, ONGC, IOCL, BPCL, MRPL GPCL
- Thermal power plants like NHPC Ltd, NTPC Ltd, GMR Energy
- EMV companies like Tesla, TATA motors, Volks Wagon, Chevrolet, BMW, Hero
- Battery and mobile manufactures
- Nuclear Power Corporation of India Ltd.
- Power Grid Corporation of India Ltd.
- Manufacturing companies
- Government departments.
- R&D in the area of alternative sources, such as wind, solar, tidal and geothermal power.

Track 1: Energy Science & Technology

No	Course Code	Course	POs	Contact Hours			
				L	T	P	C
01	21CHM11	Foundation of Energy Science and Technology	1,2,3,5,7,12	4	-	-	4
02	21CHM12	Energy Generation from Waste	1,2,3,4,5	4	-	-	4
03	21CHM13	Energy Storage Systems	1,2,3,6,7	4	-	-	4
04	21CHM14	Hydrogen Energy and Fuel Cells	1,2,3,7	4	-	-	4

21CHM11 Foundation of Energy Science and Technology

4 0 0 4

Course Outcomes:

1. Develop the concepts of basic energy systems and its conversion processes
2. Acquire knowledge on different types of energy sources, its types and utilization
3. Formulate techniques for the process of production and treatment of solid, liquid and gaseous fuel.
4. Explore the various types of non-conventional energy systems and its utilization
5. Demonstrate the basic mechanism of generation, collection and storage of ono-conventional energy systems
6. Understand the environment and energy correlation and its impact on climate change

COs-POs Mapping

COs	PO_1	PO_2	PO_3	PO_5	PO_7	PO_{12}
1	2	2	2			
2	2	2	1			
3	2		3	3		2
4	2		2	2		
5	2		3	3		
6	2		1		3	2

Unit I

Basics of energy

Different forms of energy, energy conversion process, indirect and direct energy conversion; Different energy sources; Units and scales of energy use, Mechanical energy and transport, Heat energy, Electromagnetic energy: Storage, conversion, transmission and radiation

Laws of heat transfer, Entropy and temperature

15 Hours

Unit II

Conventional energy source

Solid Fuels: Biomass, Wood and Charcoal. Classification & Rank of Coal, Peat, Lignite, Sub-Bituminous coal, Bituminous coal, Anthracite coal, Cannel &Bog head coal. Physical Properties of coal, Proximate & Ultimate Analysis of Coal, Cleaning, washing & Storage of coal. Carbonization: Low Temperature carbonization (LTC), High Temperature Carbonization (HTC),

Liquid Fuels: Constitution of petroleum, theory of formation of crude petroleum oil. Characterization of crude oil & petroleum fuels. Thermal & catalytic cracking and reforming processes, coking, visbreaking, Parameters and testing logistics of petroleum products

Gaseous Fuels: Classification of gaseous fuel, Calorific Value, Wobbes index, and flame speed. Flow sheet & operation of Producer gas, Water gas, Carburetted water gas, oil gas, coke-oven gas, blast furnace gas, Natural Gas and LPG.

Liquid fuel from coal, Coal Bed Methane

15 Hours

Unit 3

Non- conventional energy source

Non-conventional (alternative energy) resources, Production &consumption pattern in India.

Solar Energy: Devices for measurement of solar flux. Different types of Solar collectors (Flat plate, parabolic, concentric & heliostat), solar Pond, Photovoltaic cells, Chemical storage, Geothermal Energy & Wind Energy: Utilization of Geo thermal Energy; Operating principles of different types of Wind Energy Mills, Nuclear energy: Sources of Nuclear fuels, Nuclear reactions and power generation by Nuclear reactors, Breeder reactor- reaction &operation.

Energy from Ocean, Exploration of geothermal energy

15 Hours

Unit-4

Systems and Synthesis

Energy and environment correlations, Environmental degradation due to energy production and utilization, global warming; Environmental Impact Assessment, Life cycle analysis (LCA) and sustainability issues, Overview of World Energy Scenario, Climate change, Concept of Green Building and Green Architecture; Energy Audit of facilities and optimization of energy consumption.

Circular economy, SWOT analysis

15 Hours

Total: 60 Hours

Text Book(s)

1. S. Sarkar, Fuels & Combustion: Universities Press; 3rd Ed., 2009
2. O.P .Gupta, Elements of Fuels. Furnace and Refractories, Khanna Publishers, 1989
3. A. E. Dessler, Introduction to Modern Climate Change, Cambridge University Press, 2019

Reference Book(s)

1. G. D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 1998
2. D.S. Chauhan and S.K. Srivastava, Non-Conventional Energy Resources, New Age International Pvt. Ltd., 2012
3. D. Mukherjee and S. Chakrabarti, Fundamentals of Renewable Energy Systems, New Age International, 2004
4. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000
5. Boyle, Renewable Energy: Power for a Sustainable Future, 3rd Ed, Oxford University Press. 2012
6. Stephen Peake, Renewable Energy: Power for a Sustainable Future,, 4th Edition, Oxford University Press, 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book Examination (%)
Remember	20	20	--
Understand	30	20	--
Apply	25	30	40
Analyze	25	20	40
Evaluate	--	10	20
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)
Remember

1. What are the different types of ovens available for high temperature carbonization of coal to obtain coke? Also explain with a neat flow sheet how the waste heat can be utilized which is formed during the process in the ovens.
2. What do you mean by weathering of coal? What are the various precautions to be taken during coal storage?
3. What are the important operating parameters in thermal cracking of petroleum feedstocks?
4. Mention the characteristics of a good fuel.
5. What is gross calorific value? How does it differ from net calorific value?
6. What is Wobbe's Index?

Understand

1. What are the criteria for judging the suitability of a thermochemical reaction for solar application?
2. Explain the functions of the following elements in a nuclear reactor.
   (i) Fuel (ii) Control rods (iii) Moderator (iv) Radiation Shield (v) Coolant
3. Enumerate the significance of flash point and pour point in transport and handling of petroleum products.
4. Write down the various steps required for the recovery of by-product during high temperature carbonization of coal.
5. What is the function of two glass cover in a solar flat plate collector?
6. Write down the benefits and drawbacks of geothermal energy source on the basis of:
   (i) Installation cost (ii) Direct usability (iii) Environmental considerations (iv) Job creation and economic status (v) Suitability of site

Apply

1. Enumerate with the help of a flow diagram of a crude oil refining process mentioning production in order of boiling range
2. Enumerate the process of catalytic reforming operation mentioning the reactions involved, influence of different parameters on each reaction, catalyst used, and operating conditions maintained using a neat flow diagram.

3. Find the stored energy per unit volume and mass of the pebble bed to store heat for a air tight solar heating system when the temperature is to be raised by 20°C. The bed is required to store 25KWH. The density of the pebble (ρ) =3000 kg/m^3 and the specific heat capacity (C_P) = 800 J/kg°C.
4. The coal obtained from Raniganj coal field gave the following proximate analysis:- Moisture – 1.6%; Ash - 15.7%; Volatile matter – 27.8% and Fixed Carbon – 54.9%.
   Calculate its ash on a dry basis and volatile matter on d.a.f (dry ash free) and d.m.m.f (dry and mineral matter free) bases
5. Calculate the Wobb's index of natural gas comprising of 89% CH_4, 8% C_2H_6, 2% C_3H_8 and 1% C_4H_{10} by Volume. The calorific values (K-cal/N-m^3) of the constituents are as given below: CH_4 = 9500, C_2H_6 = 16644, C_3H_8 = 23688, C_4H_{10} = 30714

Analyze

1. Differentiate between extraneous and inherent mineral matter of the coal and how they can be removed.
2. Differentiate between the proximate and ultimate analysis of a Lignite and Bituminous coal.
3. What are the different types of catalytic cracking processes? Explain Houndry's fixed bed catalytic cracking process with a neat flow sheet.

Open Book Question(s)

1. Calculate the volume of cow dung based biogas plant to meet cooking requirement of 5 persons (250 l/day) and lighting of four 100 CP mantle lamps consuming 125 l/h for 5 hrs. Also calculate the required number of cows to run the plant in case cow dung produced is 10 kg/day and collection efficiency is 80%, percentage of solid is 20% and production of gas from solid is 375 l/kg.
2. A school in a remote place has the following energy requirements.
   i. 10 lamps each of 100 cp that operate for 4 hrs daily
   ii. 6 computers, each of 250 W, that operate 6 hrs. daily by a duel fuel engine driven
   iii. 2 HP water pump driven by duel fuel engine for 2 hrs daily

   Calculate size of the biogas plant and the no. of cows required to feed the plant. Assuming standard values of data where required.
3. A propeller type aero turbine of turbine diameter of 120 m and turbine operating speed of 40 rpm at maximum efficiency is operating at 1 standard atmospheric air pressure and 15^0 C. The wind velocity is 15 m/s. Calculate
   i) The total power density in the wind stream.
   ii) The maximum obtainable power density
   iii) A reasonable obtained power density
   iv) The total power
   v) The torque and axial thrust
4. A flat plate collector is made up of a copper absorber plate, copper tubes fixed on the underside and one glass cover. The following data is given:

Length of collector	: 2.08 m
Width of collector	: 1.07 m
Length of absorber plate	: 2.00 m
Width of absorber plate	: 0.98 m
Plate to cover spacing	: 2.5 cm
Thermal conductivity of plate material	: 350 W/m-K
Plate thickness	: 0.15 mm
Plate absorptivity for solar radiation	: 0.94
Plate emissivity for re-radiation	: 0.14
Outer diameter of the tube	: 13.7 mm
Inner diameter of the tube	: 12.5 mm
Tube centre to centre distance	: 11.3 cm
Glass cover emissivity/absorptivity	: 0.88
Extinction coefficient of glass	: 19.0 m^{-1}
Thickness of glass cover	: 4 mm
Refractive index of glass relative to air	: 1.526
Location of collector	: Pune ($18^0$32/ N, $73^0$51/ E)
Date	: May 15
Time	: 12 noon (IST)
Collector tilt	: latitude angle
Surface azimuth angle	: 0^0
Intensity of beam radiation (I_b)	: 725 W/m^2
Intensity of diffuse radiation (I_d)	: 230 W/m^2
Adhesive resistance	: Negligible
Fluid to tube heat transfer coefficient	: 205 W/m^2-K

Water flow rate	: 70 kg/h
Water inlet temperature	: 60^0C
Ambient temperature	: 25^0C
Wind speed	: 3.1 m/s
Back insulation thickness	: 5 cm
Insulation thermal conductivity	: 0.04 W/m-K
Reflectivity of the surrounding surface	: 0.2

Assume that the side loss coefficient is 10% of the bottom loss coefficient.
Calculate,

i. The angle of incident of beam radiation on the collector
ii. The total solar flux incident on the collector
iii. $(\tau\infty)b$ and $(\tau\infty)d$
iv. The incident flux absorbed by the absorber plate
v. The collector heat removal factor and overall loss coefficient
vi. The water outlet temperature
vii. The instantaneous efficiency

21CHM12 Energy Generation from Waste

4 0 0 4

Course Outcomes

1. Understand the sources of waste and its characterization
2. Understand the basic principles of waste management
3. Understand the knowledge about the operations of Waste to Energy Plants
4. Apply the various aspects of Waste to Energy Management Systems
5. Carry out Techno-economic feasibility for Waste to Energy Plants
6. Apply the knowledge in planning and operations of Waste to Energy plants

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_4	PO_5
1	1	3	2	3	2
2	1	3	3	3	2
3	1	2	3	3	2
4	1	2	3	3	2
5	1	3	3	3	2
6	1	3	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Waste Sources and Characterization

The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source.

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous).

Characterization of waste for energy utilization. Waste Selection criteria.

15 Hours

Unit II

Technologies for Waste to Energy

Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; *Plasma Arc Technology and other newer technologies*. **15 Hours**

Unit III

Waste to Energy options

Landfill gas, collection and recovery.

Refuse Derived Fuel (RDF) – fluff, briquettes, pellets.

Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers.

Conversion of wastes to fuel resources for other useful energy applications. Energy from Plastic Wastes – Non-recyclable plastic wastes for energy recovery.

Energy Recovery from wastes and optimization of its use, benchmarking and standardization.

Energy Analysis **15 Hours**

Unit IV

Chromatography and Spectroscopy

Environmental standards for Waste to Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources.

Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms.

15 Hours

Total: 60 Hours

Textbook (s):

1. Rogoff, M.J. and Screve, F., Waste-to-Energy: Technologies and Project Implementation,3rd Ed., Elsevier Store, 2019
2. Mondal, P. and Dalai, A.K. eds., Sustainable Utilization of Natural Resources. CRC Press, 2017
3. Report of the task Force on Waste to Energy, Niti Ayog, 2014
4. Waste-to-Energy in Austria – White Book – Figures, Data Facts, 2nd Ed., 2010

Reference (s):

1. Breeze, P., Energy from waste, 1st Ed., Elsevier, 2017.

2. Rogoff, M. J. and Screve, F., Waste-to-Energy technologies and project implementation, 3rd Ed., Elsevier, 2019.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	60
Analyze	-	-	40
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is composting? Distinguish between aerobic and anaerobic composting?
2. What is leachate?
3. List the five important components of HPLC

Understand

1. What is Incineration? With the help of a neat sketch, explain incineration process.
2. Explain the 3Ts of Incineration process.
3. Discuss the governing factors considered in design of an incinerating system.
4. Enumerate and discuss the factors affecting aerobic composting.
5. Explain the area method of landfilling technique.

Apply

1. Determine the landfill area required for a population of 50000, given the following data.
   i) Solid waste generation: 1.5 kg/person/day
   ii) Compacted density of solid waste in landfill: 500kg/m^3
   iii) Average compacted depth of solid waste:
2. Estimate the moisture content, density and energy content (on dry basis and on ash free dry basis) of the solid waste sample using the data given below. Assume ash content as 5%.

Component	% by mass	Moisture content,%	Density*, Kg/m^3	Energy**, kJ/kg
Food waste	12	70	290	4000
Paper	40	06	85	16000
Card board	08	05	50	16000
Plastics	04	02	65	32000
Grass trimmings	15	60	105	6500
Wood	05	20	240	18000
Tiin cans	16	03	90	700

Open book questions

1. You are asked to segregate the various wastes that are generated from the college canteen. Segregate the wastes from which the energy can be generated? What are the methods that can be adopted for the conversion of these wastes into bioenergy, electrical energy, etc? Also, suggest a proper flow sheet for such wastes to energy conversion.
2. A poultry farm has a capacity to produce 20000 boilers every day. However, it also has the capacity to produce 10 tons of litter every week. How to dispose of such 10 tons of litter? Further, suggest any methods can be adapted for reuse of such a huge quantity of litter generation. Also whether such litter waste can be converted into methane and bioelectricity to meet such huge generation? If yes, propose the conversion method with a neat flow sheet.

21CHM13 Energy Storage Systems

4 0 0 4

Course Outcomes:

1. Understand the need for storage of energy and various technologies available.
2. Understand the working principle of advanced batteries, supercapacitors and fuel cells.
3. Learn sizing of battery, battery management system and state-of-charge estimation.
4. Study battery testing methods and performance curves.
5. Learn safety features of storage devices and operational requirements.
6. Various codes and standards for batteries and electrification of vehicles.

COs – POs Mapping

COs	PO1	PO2	PO3	PO6	PO7
1					2
2		3	3		
3	3				
4	2				
5				3	
6				2	

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to energy storage systems (ESS)

Introduction: Alternative energy sources and sustainability-Introduction to electric based transportation-Other applications of ESS; Renewable and nonrenewable energy sources

Electric and Hybrid electric vehicles (HEV)-Electric vehicle (EV) configuration-Energy and power requirement of various systems in EVs. Introduction to different types of ESS-Advantages and disadvantages.

Extended range hybrid vehicles. Full electric vehicles.

15 Hours

Unit II

Battery testing methods and performance curves

Types of batteries and their applications: Lead Acid, Lithium ion, Nickel Metal Hydride; Fuel Cells; Supercapacitors; Solar cell; Hybridization of ESS.

Battery charger and testing procedures: Constant current and constant voltage methods; Hybrid methods; Inductive chargers; Battery power testing for various vehicles; Battery testing for fast and deep discharge applications.

Life cycle test; Failure modes; Overcharging and water loss

15 Hours

Unit III

Battery management system (BMS), sizing and design

Fundamentals of BMS and controls, Thermal Management-Active cooling-liquid and air systems; passive cooling-PCM systems. Flat plate and Tubular batteries; Design of battery power rating; Importance of battery dimensions and connector specifications; Design aspects of automotive and industrial application batteries. Charging current calculations.

Difference between automotive and industrial batteries, Deep discharge; recent advances in Battery Technology

16 Hours

Unit IV

Safety and regulatory requirements

Safety aspects of high voltage batteries, Safety handling of Fuel cells and Batteries

Code and standards; Technology and economic aspects of battery recycling;

Recycling of batteries; Role of government to control unorganized sector.

14 Hours

Total: 60 Hours

Textbook (s)

1. Amlan Chakrabarti, Energy Engineering and Management, 2nd Ed., PHI Learning Pvt. Ltd., 2018.
2. J. Jensen and B. Sorenson, Fundamentals of Energy Storage, Wiley-Inter-science, 1984.

Reference (s)

1. R. Narayan and B. Viswanathan, Chemical and Electrochemical Energy System, Universities Press, 1998.
2. C. D. Rahn and C. Wang, Battery Systems Engineering, John Wiley and Sons, 2013

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	60
Analyze	-	-	40
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any two types of energy storage devices and their applications.
2. Define self-discharge and sulphation.
3. List the role of battery in automotive application.

Understand

1. Explain the performance curve during discharge of a lead acid battery.
2. Explain with suitable diagram, the charging circuit in a hybrid electric vehicle.
3. Discuss the effects of unauthorized disposal of lead acid batteries on environment.

Apply

1. Justify the role of government in controlling unorganized sector for batteries in India.
2. Differentiate between the application of flat plate and tubular batteries.
3. Differentiate between constant current and constant voltage charging characteristics.

Analyze

1. Which of the following battery is more suitable for deep discharge application and why?
   (a) Flat plate (b) Tubular plate
2. Which is the most economically viable energy storage system? Give reasons.
3. How do you increase the efficiency of a Fuel Cell?

Open book Question(s)

1. Estimate the backup time provided by the UPS graphically assuming nominal battery characteristics of Voltage: 3.7 V and Capacity: 2800 mA.h. The UPS is supplying power to a unit of 12 V requiring current of 0.8 Amps. The battery discharge characteristics are given below:

21CHM14 Hydrogen Energy and Fuel Cells

4 0 0 4

Course Outcomes

1. Understand the need of hydrogen production & hydrogen energy systems
2. Design and develop suitable hydrogen storage system to be used along with fuel cell system
3. Minimize environmental hazards associated with the use of hydrogen storage and fuel cell technology
4. Summarize the different types of fuel cells, its components and characterization
5. Evaluate the performance of fuel cells under different operating conditions
6. Select and defend appropriate fuel cell technology for a given application

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_7
1	3	-	-	3
2	-	-	3	3
3	2	2	1	3
4	2	-	-	3
5	-	-	3	3
6	-	-	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Hydrogen Production & Hydrogen energy systems

Properties of hydrogen as fuel, Hydrogen pathways introduction-current uses, general introduction to infrastructure requirement for hydrogen production, hydrogen production plants.

Thermal-Steam reformation, thermo chemical water splitting, gasification-pyrolysis, nuclear thermal catalytic and partial oxidation methods. Electrochemical-Electrolysis, photo electro chemical method.

Hydrogen Economy-Hydrogen fuel for transport

15 Hours

Unit II

Hydrogen storage and safety

Physical and chemical properties, general storage methods, compressed storage-composite cylinders, metal hydride storage, carbon based materials for hydrogen storage. Hydrogen safety aspects, backfire, pre-ignition, hydrogen emission NOx control techniques and strategies, Hydrogen powered vehicles.

Hydrogen safety codes and standards

15 Hours

Unit III

Fuel Cells

History, Working principle of fuel cells, Fuel cell thermodynamics, fuel cell electrochemistry - Nernst equation, Electrochemical kinetics, Butler-Volmer equation, performance evaluation of fuel cells, Types of Fuel Cells: AFC, PAFC, SOFC, MCFC, DMFC, relative merits and demerits.

High & low temperature proton exchange membrane fuel cells

15 Hours

Unit IV

Fuel cell characterization and applications

In-situ and ex-situ characterization techniques, V-I curve, frequency response analyses; Fuel cell system integration Application of Fuel Cells Fuel Cell usage for domestic power systems, large scale power generation, Automobile, environmental analysis. Future trends in fuel cells, portable fuel cells, laptops, mobiles, submarines.

Faraday's law, Open circuit voltage, ohomic resistance, limiting current

15 Hours

Total: 60 Hours

Textbook(s)

1. Barbir, Frano. PEM fuel cells: Theory and Practice, 1st Ed., Academic press, 2012
2. O' Hayre R. P., Cha S. W., Colella W., and Prinz F. B., Fuel cell fundamentals, John Wiley, 2008
3. Larminie J., Dicks A. and McDonald M. S., Fuel cell systems explained. Vol. 2, Wiley, 2003
4. Gupta R. B, Hydrogen Fuel: Production, Transport and Storage, CRC Press, 2008

Reference (s)

1. Vielstich W., Lamm A., and Gasteiger H. A, Handbook of Fuel Cells: Fundamentals, Technology, Applications, Vol (1-4), Wiley, 2003
2. Gupta R. B, Hydrogen Fuel: Production, Transport and Storage, CRC Press, 2008

3. Bard A. J., Faulkner L. R., Leddy J., and Zoski, C. G, Electrochemical methods: fundamentals and applications (Vol. 2), Wiley, 1980

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	--
Understand	30	30	40
Apply	50	50	60
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any two types of fuel cells and their uses.
2. What is open circuit voltage?
3. Define limiting current.
4. Define glass transition temperature.

Understand

1. Distinguish high temperature fuel cell and low temperature fuel cells.
2. Explain in detail hydrogen production plants.
3. Explain about fuel cell characterization.
4. Discuss about portable energy storage systems.

Apply

1. A company is developing a new car powered by a fuel cell system that runs on H_2. You have been asked to consider generating the H_2 by electrolysis with a fuel cell. The H_2 tank to be used is 10 liters in volume and a fill-up requires a pressure of 34 atm.

Open Book Question(s)

1. Consider the following specifications of the system. 60% conversion of H_2O Eo = 1.172 V The cathode pressure is maintained at 1 atm. The anode pressure is maintained at 1 atm Membrane thickness = 100 μm Membrane conductivity (σ) = 0.1 S/cm (S = 1/Ω) Electrolysis T = 373 K (assume water is in the gas phase) H2 storage tank T = 298 K
   a) Calculate the current required to operate at a voltage of 1.8V.
   b) Calculate the rate of hydrogen production per membrane area and the total membrane area required to fill the tank in 2 minutes.
   c) How the fuel cell car is viable than a diesel or petrol car. Justify?

Department of Chemical Engineering

Minor Track 2: Nano Science & Technology

Preamble

Nano science and Nanotechnology is the science of dealing with atoms with only a few nanometres in dimensions. As the size of objects is scaled down to the nanometre regime, the material properties undergo a transformation, presenting a great potential for promising applications. Nanotechnology is one of the continuously emerging scientific areas combining knowledge from the fields of Physics, Chemistry, Biology, Medicine, Informatics and Engineering. Nanostructured materials and Nano systems are fabricated and fully characterised by Nano technological tools and techniques, at sizes below 100 nm. Although there are restrictions related to Nano scale size, it is the handling and processing of matter at this scale that leads to the development of new and novel materials which may have the same bulk composition but widely varying properties. The diverse applications of nanomaterials ranging from electronic and engineering systems and devices, to optical and magnetic components, Nano devices in medicine, cosmetic merchandise, agricultural and food products are believed to pave the way and have a significant economical and societal impact.

Prospectus

Beginning of the 21st century has witnessed a tremendous upsurge of scientific activity in the field of Nano science and Nanotechnology, whose seeds were sowed in the last century. Scientists, technocrats and even governments of many countries all over the world are convinced that it is the technology of 21st century. The main applications in engineering field are catalysts, sensor, coating, adsorption, and drug delivery. Despite of many advantages, preparation and maintaining the proper size of nanomaterials are the crucial job. Engineers play a vital role in the development of such nanomaterials over catalyst synthesis, sensors and nanocoating materials. Further, as Engineers also need to trained in the field of synthesis of graphene and carbon nanotubes for its various applications like drug delivery. Moreover, chemicals engineers with specialized in Nano science and nanotechnology are responsible for develop drugs that target specific cells in the body or building materials that can grow in artificial organs. Nanotechnology can also be used to improve sustainability and access to natural resources with inventions such as molecular water filtration and self-cleaning materials. Simultaneously, the nanotech catalysts are widely used for clean-up the air pollution, specifically the greenhouse gases like carbon dioxide from the air and flue gas and then reconfigure into valuable chemicals those can be used in many industries.

Employability Opportunity

The nanotechnology professionals will have ample of career options like medical, healthcare, industry research, environment industries, pharmaceutical, agriculture, product development and advising, communication and media. Even the nanotechnology is used by the engineers to develop computer components and microscopic sensors. The demand of nanotechnology is increasing day by day because of widen applicability in the day to day life. Further, the aspirants with nanotechnology can have choice for pursuing higher studies owing to ample opportunities in research studies. Candidates with specialization with Nano science and nanotechnology can have opportunities in the following areas.

1. Electronics and semiconductor industries
2. Textiles, polymer industries
3. Environmental monitoring and control
4. Agriculture
5. Geosciences
6. Energy capture and storage
7. Auto and aerospace industries
8. Medical field and pharmaceuticals
9. Forensics
10. Military and national security
11. Biotechnology
12. Food science including quality control and packaging

Track 2: Nano Science & Technology

No	Course Code	Course	POs	Contact Hours			
				L	T*	P	C
01	21CHM21	Introduction and Characterization of Nano-Materials	1,2,3,7	4	-	-	4
02	21CHM22	Carbon Nanostructures and Applications	1,3,4,5	4	-	-	4
03	21CHM23	Energy, Environmental and Biomedical Nanotechnology	1,2,3,7	4	-	-	4
04	21CHM24	Industrial Applications of Nanotechnology	2,3,5,,7	4	-	-	4

21CHM21 Introduction and Characterization of Nano Materials

4 0 0 4

Course Outcomes

1. Apply various chemical and physical methods for the synthesis of nanomaterial's
2. Understand the properties of nano-materials and their applications in relation to bulk materials
3. Describe the synthesis of nano materials
4. Characterize nano materials by Spectroscopic and microscopy techniques.
5. Characterize nano materials by Thermal methods.
6. Characterize nano materials by Magnetic Microscopy & Mechanical Properties.

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_7
1	3	-	-	3
2	-	-	3	3
3	2	2	1	3
4	2	-	-	3
5	-	-	3	3
6	-	-	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Material Science and Nano Science & Technology

Crystal Systems – Unit Cells – Bravias Lattices – Crystallographic Planes – Miller Indices – Space Groups – Crystalline and Amorphous Materials Bonds in the Materials: Metallic, Ionic- Covalent and Van-der-Waals Bonds – Crystal Defects – Basics of Nanoscience and Nanotechnology – Scientific Revolutions – Nanosized Effects – Surface to Volume Ratio – Energy at the Nanoscale - Quantum Confinement Effects – Classifications of Nanosystems - 1D- 2D- 3D Nanomaterials – Top-down and Bottom-up approach

Size Dependent Properties of Nanomaterials.

15 Hours

Unit II

Synthesis of Nanomaterials

Top down approach–Ball milling-Types of balls; Types of milling- parameters- Nnaolithography techniques- Bottom-up approach- physical routes- Thermal evaporation, sputtering, pulsed laser deposition Arc discharge method.; Chemical vapor deposition; liquid phase methods- Polyol route–Colloidal precipitation–Sol-Gel process– Chemical precipitation Hydrothermal–Salvothermal–Sonochemical–Microbial routes– Biosynthesis– Template route: DC and Pulsed electrodeposition and Electroless deposition

Combustion route.

15 Hours

Unit III

Characterization of Nano Materials by Spectroscopy and Microscopy

Basic principles and applications of UV-Vis-NIR, FTIR, FT-Raman, Photoluminescence- Microscopy: Scanning Electron Microscopy: SEM -Transmission Electron Microscopy (TEM) – Atomic Force Microscopy AFM-Thermal Properties: TG-DTA Analysis- X-ray diffraction- X-Ray Photoelectron Spectroscopy

Particle size- DLS and Zeta potential

15 Hours

Unit IV

Nano Materials: Characterization by Magnetic Microscopy & Mechanical Properties

Magnetic measurements using vibrating sample magnetometer (VSM)- magnetic force microscopy (MFM) - Electron Paramagnetic Resonance (EPR)-Nuclear Magnetic Resonance (NMR) spectroscopy – Mechanical properties-micro hardness - nano indentation- I-V/C-V

Hall - Quantum Hall effects - Kelvin-probe measurements

15 Hours

Total: 60 Hours

Textbook(s)

1. B. Bhushan, Handbook of Nanotechnology,1st Ed., Springer-Verlag, 2004
2. A. Roth, Vacuum Technology, ., 2nd Ed., North- Holland Pub., 1982
3. C.N.R. Rao, A. Muller, A. K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications, 1st Ed., Wiley-VCH Verlag,2004
4. B. S. Murthy, P. Shankar, Baldev Raj, B.B. Rath, Ames Murday, Text book of Nanoscience and Nanotechnology, Springer & Universities Press (India) Pvt. Ltd., 2013

Reference(s)

1. Encyclopaedia of Materials Characterization by C. Richard Brundle Charles A. Evans, Jr.Shaun Wilson ,Butterworth-Heinemann, 1992

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	--
Understand	30	30	40
Apply	50	50	60
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any two types of fuel cells and their uses.
2. What is open circuit voltage?
3. Define limiting current.
4. Define glass transition temperature.

Understand

1. Distinguish high temperature fuel cell and low temperature fuel cells.
2. Explain in detail hydrogen production plants.
3. Explain about fuel cell characterization.
4. Discuss about portable energy storage systems.

Apply

1. A company is developing a new car powered by a fuel cell system that runs on H_2. You have been asked to consider generating the H_2 by electrolysis with a fuel cell. The H_2 tank to be used is 10 liters in volume and a fill-up requires a pressure of 34 atm.

Open Book Question(s)

1. Consider the following specifications of the system. 60% conversion of H_2O Eo = 1.172 V The cathode pressure is maintained at 1 atm. The anode pressure is maintained at 1 atm Membrane thickness = 100 μm Membrane conductivity (σ) = 0.1 S/cm (S = 1/Ω) Electrolysis T = 373 K (assume water is in the gas phase) H2 storage tank T = 298 K

   a) Calculate the current required to operate at a voltage of 1.8V.

   b) Calculate the rate of hydrogen production per membrane area and the total membrane area required to fill the tank in 2 minutes.

   c) How the fuel cell car is viable than a diesel or petrol car. Justify?

21CHM22 Carbon Nanostructures and Applications

4 0 0 4

Course Outcomes:

1. Understand the graphite derivatives, fullerenes and its type, nano-diamond, grapheme
2. Understand the various method of synthesis of the carbon nanostructures and their mechanism
3. Understand the various structures of carbon nanotubes and its growth mechanisms
4. Understand the different the physical and chemical synthesis methods of graphene
5. Precisely characterize the developed carbon nanotubes and graphene using various characterization techniques
6. Understand the application of the carbon nanotubes and graphene

COs – POs Mapping

COs	PO_1	PO_3	PO_4	PO_5
1	1	2	2	3
2		2		3
3	1		3	
4	1		3	
5	1	3		3
6			2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I:

Allotropes of carbon and their derivatives

Allotropes of Carbon: Diamond – Graphite – Graphene – Fullerenes – Metallofullerenes – Solid C60 – Bucky onions – Carbon nanotubes (CNT): Single walled carbon nanotubes, Multi-walled carbon nanotubes – Carbon dots – Carbon nanocones – Carbon nanohorns –Nanodiamond *Stability of carbon phases at nanolevel: Phase diagram.*

15 Hours

Unit II:

Synthesis of carbon nanostructures

Synthesis of Carbon Nanostructures: Ultra high vacuum chamber: Pumps- Gauges – Arc discharge method: CNT-fullerene- Chemical vapor deposition: Graphene- CNT- various gases precursors – Pulsed laser deposition: CNT Laser pulse-target interactions – Thermal flash deposition

Mechanical-chemical- thermal exfoliation of graphene.

15 Hours

Unit III:

Structure, characterization and applications of carbon nanotubes

The Structure of Carbon Nanotubes- Nomenclature, Structure of Single-Walled Carbon Nanotubes and Structure of Multiwalled Carbon Nanotubes; Structure and Production of Further Tubular Carbon Materials- Spectroscopic Properties of Carbon Nanotubes- Raman and Infrared Spectroscopy of Carbon Nanotubes, Absorption and Emission Spectroscopy of Carbon Nanotubes, ESR-Spectroscopic Properties of Carbon Nanotubes. Mechanical, Thermal Applications

Electronic Applications and biological Applications of CNTs.

15 Hours

Unit IV:

Structure, characterization and applications of graphene

Structure of graphene; Preparation of graphene – synthesis of graphene by various physical and chemical methods and Purification; Electronic Properties Band Structure of Graphene - Mobility and Density of Carriers - Quantum Hall Effect - Spectroscopic Properties of graphene - Raman, Application of Fullerene, CNT, Graphene and other carbon nanomaterials Mechanical, Thermal Applications,

Electronic Applications and biological Applications- Graphene.

15 Hours

Total: 60 Hours

Textbook (s):

1. Morris, J.E. and Iniewski, K., Graphene, Carbon Nanotubes, and Nanostructures: Techniques and Applications, CRC Press, 2013
2. Kelker, A.D., Herr, D.J.C. and Ryan, J.G., Nanoscience and Nanoengineering: Advances and Applications, CRC Press, 2014
3. Guldi, D.M. and Martin, Carbon Nanotubes and Related Structures: Synthesis, Characterization and Applications, Wiley-VCH Verlag, 2010
4. Reich, S., Thomsen, C. and Maultzsch, J., Carbon Nanotubes: Basic Concepts and Physical Properties, Wiley-VCH Verlag, 2004

References

1. James E. Morris, Krzysztof Iniewski, Graphene, Carbon Nanotubes, and Nanostructures: Techniques and Applications, CRC Press, 2013
2. Ajit D. Kelkar, Daniel J.C. Herr, James G. Ryan,Nanoscience and Nanoengineering: Advances and Applications, CRC Press, 2014
3. Dirk M. Guldi, Nazario Martín, Carbon Nanotubes and Related Structures: Synthesis, Characterization and Applications, Wiley, 2010
4. Stephanie Reich, Christian Thomsen, Janina Maultzsch, Carbon Nanotubes: Basic Concepts and Physical Properties, Wiley, 2004
5. R Saito, G Dresselhaus, M S Dresselhaus, Physical Properties of Carbon Nanotubes, World Scientific, 1998
6. M. S. Dresselhaus, G. Dresselhaus, P. Avouris, Carbon Nanotubes: Synthesis, Structure, Properties, and Applications, Springer, 2000

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	100
Analyze	-	-	-
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)
Remember

1. Define a nanomaterial. List any four naturally occurring/synthetically prepared nanomaterils used in daily life.
2. Differentiate between nano materials & bulk materials in terms of physical properties.
3. List two methods of preparing nanomaterials in bottom up approach & top down approach.

Understand

1. Explain the sol-gel method of preparing nano materials. What kind of materials can be prepared by this method in nano form.
2. How will the electrical, magnetic & optical properties vary for nano amterials compared to bulk. Explain with an example for each.
3. What are the various carbon nano materials available? Describe one methos of producing Carbon nano tubes.

Apply

1. How is SEM used for characterization of nano materials? Describe the principle and working of instrument.
1. Based on the optical properties of Nano TiO_2 and ZnO, describe the design & construction of nano sensors.
2. Describe the functions and applications of Carbon nano tubes and gaN nano wires.

Open Book Questions

1. How is the size of nanomaterials characterized? Assess the advantage of using SEM & TEM instead of powder XRD for size of particle, grain size characterization.
2. For a semiconductor, as the materials is sized down to nano, the electronic band structure is found to vary from bulk material. Explain the changes in electronic band structure for a direct band gap material.
3. Calculate the changes in surface to volume ratio (S/V ratio) for a particle of 1 micrometer cube divided into 10 nanometer cubes by top down approaches. Comment on its impact in catalysis

21CHM23 Energy, Environmental and Biomedical Nanotechnology

4 0 0 4

Course Outcomes

1. Illustrate the basic principles of energy environmental and biomedical nano technology.
2. Classify various treatment methods for toxic metals and industrial waste water.
3. Summarize the different types of solar cells, Electro chemical energy systems.
4. Explain nano based materials and applications of biosensors.
5. Utilize the biomedical nano particles for pharmaceutical industry.
6. Explain biodegradable polymers for biomedical applications.

CO-PO Mapping

COs	PO1	PO2	PO3	PO7
1	1	2	3	1
2	2	-	3	2
3	3	3	-	2
4	-	2	3	2
5	-	-	3	1
6	-	3	2	1

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit-1

Introduction to Solar Energy-Nanotechnology in Energy Conversion and Storage

Principles of photovoltaic energy conversion (PV), Types of photovoltaic Cells-Organic photovoltaic cell cells, thin film Dye Sensitized Solar Cells, Quantum dot (QD) Sensitized Solar Cells (QD-SSC), Organic- Inorganic Hybrid Bulk Hetero Junction (BHJ-SC) Solar cells- Perovskite solar cells-Nanostructured Materials for electrochemical Energy Storage Systems, Primary and Secondary Batteries (Lithium ion Batteries), Cathode and anode materials, Capacitor Electrochemical super capacitors, electrical double layer model, Principles and materials design, Nanostructured Carbon based materials, Nano-Oxides, Novel hybrid electrode materials-Nanostructured Materials for electrochemical Energy, Conversion Systems, Fuel Cells.

Applications of solar energy-Types of fuel cells

15 Hours

Unit II

Environmental and Biomedical Nanotechnology

Nano membrane process nanosorbants – Mesoporous materials – Ground water remediation – Air purifier – Nano photo catalysis - Pt nanoparticles for sulphur removal – Ge nano particles for lead removal- Nano materials for waste water treatment- organic and pharmaceutical waste treatment- Nano sensor for environmental applications-Environmental protection – Food processing & packaging –Bioremediation- removal of bacteria and microbes for food products-Nano Biosensors for Pesticide Detection and degradation-Nano Biosensors for Plant Pathogen Detection.

Nano membranes for water purification-Types of nano biosensors

15 Hours

Unit III

Applications of Biosensors

Biosensors using CNT- FET; DNA detection – glucose detection, CNT based electrochemical biosensor – optical biosensor with metal nanoparticles. Quantum dot based sensors-Dendrimer based biosensor, regent biosensor based on nanoparticles. Gold Nanocages for Cancer Imaging and Therapy-Photo thermal therapy with Gold Nano cages invitro and invivo- Gold Nano rods.

Applications of gold nano particles for biomedical industries

15 Hours

Unit IV

Applications of Biomedical nanoparticles

Biomedical nanoparticles – Liposome's – Dentrimers – Different types of drug loading and release – Biodegradable polymers –Development of nano medicines – Nano shells – Nano pores – Tectodendrimers – Nanoparticle drug system for oral administration.

Structure of nano shells-Types of biodegradable polymers

15 Hours

Total: 60 Hours

Textbook(s)

1. Wilson, M., Nanotechnology: Basic Science and Emerging Technologies. CRC press, 2002
2. O' Hayre R. P., Cha S. W., Colella W., and Prinz F. B., Fuel cell fundamentals, John Wiley, 2008

3. David J. Lockwood, Nanostructured Materials for Electrochemical Energy Production and Storage, Springer, 2009
4. Lens, Piet, Nanotechnology for water and wastewater treatment. Iwa Publishing, 2013

Reference (s)

1. Hornyak, Gabor L., et al. Fundamentals of nanotechnology. CRC press, 2018.Gupta R. B, Hydrogen Fuel: Production, Transport and Storage, CRC Press, 2008
2. Mendelson, Mel I. Learning Bio-micro-nanotechnology. CRC Press, 2019
3. Madou, Marc J. Manufacturing techniques for microfabrication and nanotechnology. Vol. 2. CRC press, 2011

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	--
Understand	30	30	40
Apply	50	50	60
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any two types of Biodegradable polymers.
2. What is Perovskite solar cell?
3. Define limiting current.
4. Define glass transition temperature.

Understand

1. Explain in detail Nano Biosensors for Plant Pathogen Detection.
2. Distinguish high temperature fuel cell and low temperature fuel cells.
3. Explain about fuel cell characterization.
4. Discuss about Electrochemical super capacitors.

Apply

1. A company is developing a new car powered by a fuel cell system that runs on H_2. You have been asked to consider generating the H_2 by electrolysis with a fuel cell. The H_2 tank to be used is 10 liters in volume and a fill-up requires a pressure of 34 atm.
   Consider the following specifications of the system. 60% conversion of H_2O Eo = 1.172 V The cathode pressure is maintained at 1 atm. The anode pressure is maintained at 1 atm Membrane thickness = 100 µm Membrane conductivity (σ) = 0.1 S/cm (S = 1/Ω) Electrolysis T = 373 K (assume water is in the gas phase) H2 storage tank T = 298 K
   a) Calculate the current required to operate at a voltage of 1.8V.
   b) Calculate the rate of hydrogen production per membrane area and the total membrane area required to fill the tank in 2 minutes.

Open Book Examination

1. In problem number 1. (Mentioned above), with the same parameter specifications how the fuel cell car is viable than a diesel or petrol car. Justify?

21CHM24 Industrial Applications of Nanotechnology

4 0 0 4

Course Outcomes:

1. Learn different aspects of application of nanotechnology in industry
2. Learn present and future scope of nanoscience in electronics industry
3. Learn preparation, characterization and application of nanomaterials in electromechanical devices
4. Study the application of nanoscience in sensor technology
5. Study the role of nanotechnology in healthcare
6. Study the safety aspects of using nanotechnology in body-implants and biosensors

COs – POs Mapping

COs	PO2	PO3	PO5	PO7
1	3	2		
2			2	
3			3	
4	3			
5		2		
6		3		2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to various applications

Optoelectronic Devices Different types of semiconductor Nanostructures Devices - Semiconductor Quantum dots (QDs) – QD LASER- Quantum cascade LASER-QD. White LEDs - LEDs based on nanorods. Silicon horizontal and vertical core shell Nanowires. Electro optical devices - Optical memory - Present and future trends - Nanomaterials as Electrolytes - Nanoscale Electronic and Ionic Transport – Energy Conversion and Storage in Electrochemistry – Industrial applications of energy devices.

White LEDs - LEDs based on nanorods

15 Hours

Unit II

Nano based electromechanical systems

Magnetic and Electro Mechanical Materials Near field optical recording- holographic data storage- AFM based recording technology. Storing and reading device – current trends of spin based electronic devices. Nano Electro Mechanical Systems: Overview- Nano-Electromechanical systems - fabrication process - choice of materials-performance of different structures - advantages and disadvantages of different approaches. Applications in sensors - Micro actuators - Extension to the nanoscale.

Applications in sensors - Micro actuators - Extension to the nanoscale

15 Hours

Unit III

Nanotechnology enabled sensors

Sensors Applications Inorganic Nanotechnology Enabled Sensors - Nanotechnology Enabled Mechanical Sensors - Thermal energy sensors - temperature sensors - Electromagnetic sensors- electrical resistance sensors-electrical current sensors- electrical voltage sensors- electrical power sensors - liquid flow sensors- position sensors - chemical sensors - radiation sensors – organic nanotechnology enabled sensors - nanosensors based on nucleotides – glucose sensors.

Nanosensors based on nucleotides- glucose sensors

15 Hours

Unit IV

Nanotechnology in biomedical applications

Biomedical and Healthcare Nanoparticles and Micro–organism- Nano-materials in bone substitutes & Dentistry-Food and Cosmetic applications- Catalysis- Drug delivery and its applications- Biochips- analytical devices-Biosensors and Biomass energy. Improved diagnostic products and techniques- in vivo imaging- plaque- genetic defects and other disease states- Nanobot medical deviceslogic and intelligence embedded medical devices-standalone sensing and computing devices. Toxicity of Nanoparticles - Future Perspectives.

Toxicity of Nanoparticles - Future Perspectives

15 Hours

Total: 60 Hours

Textbook (s):

1. Parag Diwan and Ashish Bharadwaj, Nano Electronics, Pentagen Press, 2006.
2. C. W. Turner and Van Duzer. T, Principles of Superconductive Devices and Circuits, Prentice Hall, 1999

Reference (s):

1. Yariv, Principles of Optical Electronics, John Wiley and sons, 1984.

2. M. C. Petty, M. R. Bryce, D. Bloor (eds.), Introduction to Molecular Electronics, Oxford University Press, 1995.
3. Rainer Waser, Nano Electronics and Information Technology, John Wiley and sons, 2003.
4. Kourosh Kalantar-Zadeha and Benjamin Fry, Nanotechnology Enabled Sensors, Springer, 2008.
5. David J. Lockwood, Nanostructured Materials for Electrochemical Energy Production and Storage, Springer, 2009.
6. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices and Applications, CRC Press, 2007

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	-
Understand	60	60	-
Apply	20	20	60
Analyze	-	-	40
Evaluate	--	-	-
Create	--	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any two applications of nanomaterials in each of pharmaceuticals and cosmetics.
2. What are nanobots?
3. Name few naturally occurring nanomaterials.

Understand

1. Explain the parameters affecting the efficiency of nanomaterials.
2. Explain the precautions to be taken during the application of nanomaterials for bio-implants.
3. Discuss the safety or environmental concerns with the present-day usage of nanomaterials.

Apply

1. Explain the process of corrosion resistant coating of ceramics using nanocrystals.
2. Justify that the ayurvedic preparations contain biologically prepared nanomaterials.
3. Explain the importance of compressive strength of nanotubes and methods to estimate the same with corresponding inferences.

Analyze

1. Explain with suitable examples why some conductors exhibit insulator properties at nanoscale?
2. Explain the statement: “There is plenty of room at the bottom”-Robert Feymann.
3. Distinguish between magnetic force microscopy and atomic force microscopy.

Open book problem example:

1. Compare various lithographic techniques. Demonstrate using limitations and specific suitability of each technique for various industrial applications

DEPARTMENT OF CIVIL ENGINEERING

AR20 MINOR COURSES

Minors for other Departments offered by Civil Engineering

Stream (Environmental Engineering)

Preamble: B.Tech. – Minors in Environmental Engineering focuses on the application of science and engineering in the area of air, water and soil. It focuses on providing wholesome water for the public, controlling air pollution and rehabilitating polluted soil. Furthermore, it focuses on providing the appropriate solution for pollution, providing solutions for improving water quality and quantity and enforces laws and regulations for controlling pollution. In recent years the world is facing many environmental-related problems and it had become a major challenge for society. It starts from local problems like groundwater depletion, water pollution and solid water management to global problems like climate change. So, it is very important that all engineering graduates need to focus on these global and local challenges. The contribution of environmental engineers is focused on sustainable development. The major scope of environmental engineering is the management of natural resources, protecting biodiversity and controlling various pollutions.

Key Features: This Minor degree covers a spectrum of courses ranging from foundations to modern techniques of watershed management, Industrial pollution control methods, solid and hazardous waste management and Environmental risk assessment

Career Prospects: The major scope of environmental engineering is the management of natural resources, protecting biodiversity and controlling various pollutions. Nowadays the major opportunity that an environmental engineer can play an important role are in industries where they need to comply with rules and regulations, consultancy, Research and Development, Academics, Green Marketing, Green Media, Green Advocacy and role in various international NGOs. In the mere future, career and opportunities in the area of environmental engineering will be very high. Students can also purse multi-disciplinary research-oriented studies at eminent institutes.

Track 1: Environment Engineering							
No	**Course Code**	**Course**	**POs**	**Contact Hours**			
				L	**T***	**P**	**C**
01	21CEM11	Watershed Management	6,7	4	-	-	4
02	21CEM12	Industrial Pollution Control and Engineering	3,6,7,12	4	-	-	4
03	21CEM13	Solid And Hazardous Waste Management	1,3,6,7	4	-	-	4
04	21CEM14	Ecology And Environmental Assessment	1,3,6,7	4	-	-	4

21CEM11 Watershed Management

4 0 0 4

Course Outcomes

1. Analyze the characteristics of watershed
2. Summarize the various types of Erosion and Sedimentation process
3. Understand the principles or measures to control Erosion
4. Analyze the various Water Harvesting methods
5. Evaluate Ecosystem Management and its practical implications
6. Assess the current status of the watershed at field, by taking up accurate investigation measures and conduct survey

COs–POs Mapping

COs	PO6	PO7
1	3	1
2	3	2
3	2	2
4	2	3
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction and Characteristics of Watershed

Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management. Characteristics of Watershed: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds.

Watershed Improvements- Another Approach of Watershed Management

12 + 3 Hours

Unit II

Principles of Erosion and Measures to Control Erosion

Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation. Measures to Control Erosion: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rockfill dams, brushwood dam, Gabion.

Difficulties for Development of Watershed

11 + 4 Hours

Unit III

Water Harvesting and Land Management

Rainwater Harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks. Land Management: Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils.

Improvement Techniques for soil Strength- Advanced Techniques for Prevention of Soil Erosion

11 + 4 Hours

Unit IV

Ecosystem Management & Planning and Administration

Role of Ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, sustainable agriculture, bio-mass management, dry land agriculture, Silvipasture, horticulture, social forestry and afforestation. Planning and Administration: Planning of watershed management activities, peoples participation, preparation of action plan, administrative requirements.

EcoSystem Development.

11 + 4 Hours

Total: 45+15 Hours

Text Book (s):

1. Murthy, V.V.N. and M.K. Jha Land and Water Management, Kalyani Publishers, 2015
2. Watershed Management by Madan Mohan Das and M.D. Saikia, Prentice Hall of India, 2013
3. Watershed Management Muthy, J. V. S., , New Age International Publishers, 2098

Reference Book(s):

1. Watershed Hydrology by P E Black, Prentice Hall Englewood Cliffs, 2091
2. Watershed Hydrology by R Suresh, Standard Publishers and Distributors, Delhi, 2007

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	50
Understand	70	70	50

Apply	--	--	
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is the function of watershed?
2. List all the types of erosion.
3. What are the consequences of erosion?
4. Write a short note on land grading operation?
5. Small Water System Operation and Maintenance in Andhra Pradesh (OBE)

Understand

1. Explain classifications of land use and land capability.
2. Explain in detail inter, mixed and strip cropping
3. Discuss the importance of watershed management in India
4. Explain the causes of erosion
5. Explain the detailed procedure to protect the surface water sources based on the Andhra Pradesh Water, Land and Trees act. (OBE)

21CEM12 Industrial Pollution Control and Engineering

4 0 0 4

Course Outcomes

1. Outline industrial wastes and discuss about the basic theories of industrial waste water management
2. Explain characteristics, sources, sampling of wastewater
3. Explain different treatment techniques for industrial wastewater treatment
4. Identify the problems of joint treatment and industrial waste water discharges, recirculation and use of municipal waste water in industries
5. Explain about common effluent treatment plants (CETP) and effluent disposal methods.
6. Explain the manufacturing processes and design origin of liquid waste from different industries

COs-POs Mapping

COs	PO_3	PO_6	PO_7
1	2	2	3
2	2	2	3
3	3	2	3
4	2	2	3
5	2	2	3
6	2	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction to Industrial Pollution

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables

Toxicity of industrial effluents and Bioassay tests; Major issues on water quality management

11+4 Hours

Unit II

Industrial Wastewater Treatment

Equalisation - Neutralisation – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – carbon adsorption - Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange.

Membrane Technologies – Nutrient removal.

11+4 Hours

Unit III

Wastewater Reuse and Residual Management

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse, Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning and dewatering

Disposal of sludge; Management of RO reject

12+3 Hours

Unit IV

Case Studies

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Diaries - Textiles – Tanneries – Pulp and paper – Sugar and Distilleries - metal finishing.

Oil Refining; Pharmaceuticals.

11+4 Hours

Total: 45+15 Hours

Textbook (s)

1. Eckenfelder, W.W., 'Industrial Water Pollution Control', Mc-Graw Hill, 1901.
2. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 1901.
3. Metcalf & Eddy/ AECOM, "water reuse Issues, Technologies and Applications", The Mc Graw- Hill companies, 1907.

Reference (s)

1. Nelson Leonard Nemerow, “Industrial waste treatment – contemporary practice and vision for the future”, Elsevier, Singapore, 1907
2. "Industrial wastewater management, treatment & disposal, Water Environment" Federation Alexandria Virginia, Third Edition, 1908.
3. World Bank Group, ‘Pollution Prevention and Abatement Handbook – Towards Cleaner Production’.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	30	--
Understand	70	70	--
Apply	--	--	100
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

1. List sources of industrial wastewater.
2. List any four characteristics of industrial effluent.
3. What is the method used to remove oil and grease from wastewater?
4. What is mean by common effluent treatment plant.
5. Draw the treatment flowchart for dairy industries.

Understand

1. What are the important chemical parameters of industrial wastewater? Write the methods of estimation for any three parameters.
2. Explain in detail about basic theories of industrial waste management and explain in detail about volume reduction.
3. Explain in detail about various methods for neutralizing acid and alkaline waste.
4. Explain in detail about problems arising when industrial wastewater is mixed in ocean.
5. Explain in detail about treatment methods for the wastewater discharged from tannery industries.

21CEM13 Solid and Hazardous Waste Management

4 0 0 4

Course Outcomes

1. To understand the sources of solid and hazardous wastes
2. To understand methods of solid and hazrdous waste disposal
3. To realize the significance of solid and hazardous waste management in today life
4. To understand the processes involved in solid and hazardous waste management
5. To comprehend the techniques for various waste management
6. To appreciate the role of common/integrated waste management plants

COs – POs Mappings

COs	PO_1	PO_3	PO_6	PO_7
1	3	1	3	3
2	3	2	2	3
3	2	3	3	2
4	3	3	3	2
5	1	3	1	3
6	2	2	2	3

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Solid Waste Management

Introduction: Definition of solid waste – waste generation, sources and types of solid waste – sampling and characterization – Determination of composition of Municipal Solid Waste

Collection and Transport of Solid Waste:Type and methods of waste collection systems, analysis of collection system Optimization of collection routes– alternative techniques for collection system. Transfer and Transport: Need for transfer operation, transport means and methods, transfer station types and design requirements. Separation and Processing and Transformation of Solid Waste- Waste as a Resource Economics, Disposable Materials, Recycling Collection, Processing, Potential for Reuse

Onsite storage and handling of solid waste

16 Hours

Unit II

Solid Waste Handling and Processing

Processing and disposal: Unit operations used for separation and processing, Materials Recovery facilities, Source reduction and waste minimization, Metal Separation & Recovery Waste transformation through combustion and composting, anaerobic methods for materials recovery and treatment – Energy recovery – biogas generation and cleaning– Incinerators. Landfills: Site selection, design and operation, drainage and leachate collection systems.

Designated waste landfill remediation

15 Hours

Unit III

Hazardous Waste Management

Hazardous Waste Management:Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport, e-waste - sources, collection, treatment and reuse.

Hazardous waste regulations

14 Hours

Unit IV

Technologies in Hazardous waste treatment

Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation.

Remediation of hazardous waste disposal sites

15 Hours

Total 60 Hours

Textbook (s)

1. Rao, M.N., R. Sultana, S. H. Kota,, Solid and Hazardous Waste Management: Science and Engineering,, Elsevier, Butterworth-Heinemann, 2016
2. Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous , Hilary Theisen, Samuel A Vigil. McGraw-Hill Series in Water Resources and Environmental Engineering

References

1. Environmental Engineering by Howard S.Peavy, Donald R.Rowe and George Tchobanognous, McGraw Hill Publishing Company.
2. Hazardous Waste Management, Charles A. Wentz; McGraw Hill Publication
3. Municipal Solid Waste Management by P Jayaramireddy, BSP Books PVT Ltd.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	60	40	50
Understand	40	60	50
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define solid waste.
2. List various unit operations used for separation and processing.
3. List the types of solid waste.
4. What is meant by incineration?
5. What are the requirements of leachate collection systems?
6. A landfill area of (150 m x 100 m) is available for handling 25 years' municipal solid waste (MSW) for a town of 5,00,000 people. Out of the total landfill area only 80% is
   actually available for land fill and other is used for auxiliary services. Assuming that average per capita MSW discard per year in town is 0.05 tonne, landfill density is 500 kg/m^3, and that the 15 percent of the actual landfill cell volume is used for soil cover, estimate
   (a) the landfill lift in one year.
   (b) number of years for which the land fill can be used if the landfill can't be increased
   beyond 25 m. (Open Book Examinations)

Understand

1. Explain the necessity Solid Waste Management.
2. Discuss in breif about Site selection for a Landfill.
3. Explain in detail about handling and storage of hazardous waste.
4. Differentiate between encapsulation and incineration.
6. Outline the process for identification of hazardous wastes.
7. To maximize the life span of the landfill, local waste management agency has proposed to set up a waste combustion facility next to the existing landfill which has 1.500.000 m3 remaining capacity.

   i. Determine how many days the life span of the landfill is increased by combusting the MSW instead of landfilling it directly.
   ii. 1900 tons/day MSW will be combusted assuming 82% weight reduction and the combustion residue (ash) will be landfilled.
   iii. Specific weights of combustion residue and compacted MSW in the landfill are 600 and 800 kg/m3, respectively. **(For Open Book Examination not for end examination)**

21CEM14 Ecology and Environmental Assessment

4 0 0 4

Course Objectives:

1. To understand the basics of Ecology
2. To know the Environmental Education and Assessment
3. To prepare the Environmental Impact Assessment Statement and Management Plan
4. To know the Strategic Environmental Assessment and Life cycle assessment
5. To understand the EIA regulations in India
6. To prepare the Risk assessment for a project and hazard identification and assessment

COs – POs Mappings

COs	PO1	PO3	PO6	PO7
1	3	2	2	2
2	3	2	1	2
3	2	3	3	1
4	2	3	3	1
5	3	2	2	2
6	3	3	2	1

3-Strongly linked | 2-Moderately linked | 1-Weakly linked

Unit I

Basics of Ecology & Environmental education

Basics of Ecology: Concept and ideas on environment: Definition, Components;
Environmental education: Primary objectives, Types and guiding principles; Environmental ethics,
Environmental awareness in India

15 Hours

Unit II

Environmental impact assessment (EIA)

Environmental impact assessment (EIA): definitions, introduction and concepts; rationale and historical development of EIA; Impact identification and prediction; baseline data collection; Environmental Impact Statement (EIS), Environmental Management Plan (EMP): principles, problems and strategies
Scope and methodologies of EIA

15 Hours

Unit III

Strategic Environmental Assessment

Strategic Environmental Assessment; Social Impact Assessment; Cost-Benefit analysis; Life cycle assessment; environmental appraisal; environmental planning; environmental audit; Principles of Internal Standard Organization
EIA regulations in India; status of EIA in India; current issues in EIA; case study of hydropower projects/ thermal projects
Characterization of Internal Standard Organization

15 Hours

Unit IV

Risk assessment

Risk assessment: Introduction and scope; Project planning; exposure assessment; toxicity assessment; hazard identification and assessment; risk characterization; risk communication; environmental monitoring; legal and regulatory framework; human and ecological risk assessment
Community involvement in Risk assessment

15 Hours
Total: 60 Hours

Textbooks:

1. Fundamentals of Ecology: M C Dash, McGraw Hill Publishers
2. Elements of Ecology: Smith and Smith, Pearson Publishers
3. Barrow, C.J. 1900. Social Impact Assessment: An Introduction. Oxford University Press.

References:

1. Glasson, J., Therivel, R., Chadwick, A. 1994. Introduction to Environmental Impact Assessment.
2. London, Research Press, UK. 3. Judith, P. 1999. Handbook of Environmental Impact Assessment.
3. Blackwell Science. 4. Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGraw-Hill, New York, USA.
4. Environmental Studies—Prof S.V.S Rana. --Rastogi Publication.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2(%)	Open Book Exam (%)
Remember	60	40	50
Understand	40	60	50
Apply	-	-	-
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is Ecology?
2. What are the objectives of Environmental education?
3. Define EIA.
4. Define Life cycle Assessment.
5. List the principles of EMP.
6. Prepare a detailed impact assessment for new (planned) 350 MW gas fired plant (gas/steam turbine) which will supply up to 250 MW of district heat. With an efficiency of up to 86% (power and heating combined), it will be one of the most modern and efficient plants in operation: older power plants reach an efficiency of around 40%.The new block complements the existing blocks in three major power stations, including Simmering (5 blocks with a total of 1050 MW electrical, and heat capacity of up to 630 MW) and with 155 MW electrical and 170 MW thermal.**(For Open Book Examination not for end examination)**

Understand

1. Discuss guiding principles of Environmental education.
2. Explain Cost-Benefit analysis.
3. Explain about legal and regulatory framework in Risk assessment
4. Discuss principles/characterization of Internal Standard Organization.
5. Explain in detail about Impact identification and prediction.
6. Prepare the assessment process of project area of wetland with effect to ecological balance, details listed in table with necessary screening and evaluation of environmental impact potentiality and the proper mitigation measurements

Land Use	Area (in hectare)
Substantially water body	5852.14
Agricultural area	4718.56
Productive farming area	602.78
Urban/rural settlement area	1326.52 (91.53 ha urban + 1234 ha rural)
Total area	12,500

(For Open Book Examination not for end examination)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

AR20 MINOR COURSES

Minors for other Departments offered by Computer Science and Engineering

Stream I (Artificial Intelligence & Machine Leaning)

Preamble: B.Tech. – Minors in Artificial Intelligence and Machine Learning (AI&ML) focusses on integrating AI and Machine Learning skills to all core engineering students to enhance their employability skills. The prime objective of this Programme is to develop students to excel in Machine Learning specific areas by exposing them to understand mathematical, statistical, and biologically inspired computational models with engineering and scientific principles to devise solutions for societal and business problems. As the business world witnesses the power of data-driven decision making, there is a lot of demand for professionals who can build and execute mathematical and statistical models/algorithm. To harness the power of data, effective methodologies are required for extracting hidden patterns from the data. This Programme focusses more on algorithmic aspects of AI and Machine Learning where students study various statistical and machine learning algorithms, neural network architectures, methods to build ML stack, and required technologies for building and hosting ML models. The courses in this Minor degree designed to introduce the students to core skills such as foundations of Artificial Intelligence, Machine learning, Feature Engineering for ML, Data Analytics and Deep learning architectures and its applications.

Key Features: This Minor degree covers a spectrum of courses ranging from foundations to modern techniques of AI and Machine Learning, Feature Engineering for ML , Data Analytics and Deep Learning & its applications

Career Prospects: The undergraduates of this Minor degree can aspire for portfolios where they need to build and execute business intelligent tasks like, Machine Learning Engineer, Data Scientist, Data Engineer, ML Architect, MLOps Engineer and etc. Students can also purse multi-disciplinary research-oriented studies at eminent institutes.

Artificial Intelligence & Machine Learning							
No	Course Code	Course	POs	Contact Hours			
				L	T*	P	C
1	21CSM11	Fundamentals of AI & Machine Learning	1,12	4	-	-	4
2	21CSM12	Feature Engineering for Machine Learning	1,2,3	4	-	-	4
3	21CSM13	Exploratory Data Analytics	1,4	4	-	-	4
4	21CSM14	Deep learning	1,2, 4	4	-	-	4

Stream II (Cyber Security)

Preamble: This course aims at providing skills to all core engineering students to enhance their employability skills with respect to security domain. The prime objective of this Programme is to develop students to excel in Cyber Security specific areas by exposing them to understand information security, network security, web security, forensics, cryptography, secure protocols, authentication and scientific principles to devise solutions for societal and business problems. As the cyber security domain expands and develops further, there is a lot of demand for cyber security professionals in every organization due to the prior importance of data security. This course helps the students implement technical strategies, tools, IT Infrastructure and techniques to secure data and information for the organization. The course enlightens the students to analyze and monitor the potential threats and attacks, devising security architecture and implement the security solutions. Also, the students will gain the knowledge towards the information security from national, legal perspective and security in cloud computing architecture in depth.

Key Features: This Minor degree covers a spectrum of courses ranging from foundations to modern techniques of Cyber Security i.e. Fundamentals of security, Management of Information Security, Cyber Security and Cloud Security

Career Prospects: The undergraduates of this Minor degree can aspire for portfolios where they need to build and execute business intelligent tasks, like, Security Analyst, Security Engineer, Security Architect, Security Software Developer, Cryptographer, Cyber Security Consultant, Computer forensics , Penetration tester, Security code auditor and Security Administrator.

Cyber Security							
No	Course Code	Course	POs	Contact Hours			
				L	T*	P	C
1	21CSM21	Fundamentals of Security	1,2	4	-	-	4
2	21CSM22	Management of Information Security	3,6,7	4	-	-	4
3	21CSM23	Cyber Security	1,3,4	4	-	-	4
4	21CSM24	Cloud Security	2,3	4	-	-	4

Stream III (Data Science & Analytics)

Preamble: B.Tech. – Minors in Data Science and Analytics focuses on integrating AI and Data Analytics to all core engineering students to enhance their employability skills. The prime objective of this minor degree is to develop students to excel in Data Science specific areas by exposing them to understand mathematical and

statistical models with engineering and scientific principles to devise solutions for societal and business problems. As the business world witnesses the power of data-driven decision making, there is a lot of demand for the workforce with data modelling and analytics skills. The curriculum of this Programme is designed to introduce the students to data-oriented skills like programming languages, data structures and algorithms for data science, data analytics and predictive analytics frameworks for intelligent decision making etc.

Key Features: This Programme covers a spectrum of courses ranging from foundations to modern techniques of Data Science with strong emphasis on Data Analytics i.e. Fundamentals of Data Science, Data Cleaning, Data Engineering, Text Analytics, Social Networks Analytics

Career Prospects: The undergraduates of this degree can aspire for portfolios where they need to build and execute business intelligent tasks like, Data Scientists, Data Engineer, Data Warehouse Architect, Business Intelligent Analysts, Big Data Architects etc. Students can purse multidisciplinary research-oriented studies at eminent institutes.

No	Course Code	Course	POs	Contact Hours			
				L	T*	P	C
1	21CSM31	Data Cleaning	2,3,4	4	-	-	4
2	21CSM32	Data Engineering	1,2,3,4	4	-	-	4
3	21CSM33	Text Analytics	1,2,4	4	-	-	4
4	21CSM34	Social Network and Semantic Analysis	2, 4	4	-	-	4

Stream IV (Computer Systems Programming)

Preamble: B.Tech. – Minors in Computer Systems Programming helps the non CSE and IT students to understand the fundamentals of some of the core subjects of Computer Science. It enhances the coding skills in programming languages such as C and Python. It also introduces the concepts in Data Structures & Algorithms, Database Management Systems, Computer Networks and finally Operating Systems which are key components in Computer System Programming. In effect, by undergoing this Minors in B. Tech, the student is equipped with fundamentals of Computer System Programming, and it enhances the Placements opportunities in IT Industries. In other words the students who are not from CSE/IT can easily compete with CSE/IT students for their placements in IT industries, which is the major source of placements in Engineering.

Key Features: This Programme covers a spectrum of fundamental courses from programming languages to some core courses of Computer Science and Engineering, i.e. Programming Fundamentals (C & Python), Data Structures and Algorithms, Fundamentals of Database, Fundamentals of Computer Networks and Operating Systems.

Career Prospects: The undergraduates of this Minor degree can be easily placed in MNCs such as TCS, Wipro, CTS, HCL, Infosys etc. It also makes easier to pursue higher studies in Computer Science.

No	Course Code	Course	POs	Contact Hours			
				L	T*	P	C
1	21CSM41	Programming Fundamentals	1,2,3	4	-	-	4
2	21CSM42	Data Structures & Algorithms	1,2,3,4	4	-	-	4
3	21CSM43	Fundamentals of Databases	1,4	4	-	-	4
4	21CSM44	Fundamentals of Computer Networks & Operating Systems	1,2,3	4	-	-	4

21CSM11 Fundamentals of Artificial Intelligence and Machine Learning

4 0 0 4

Course Outcomes

1. Illustrate the scope of Artificial Intelligence in the real world
2. Demonstrate various machine learning algorithms and its preliminaries
3. Summarize and learn various supervised learning algorithms
4. Describe and apply the concepts of classification and regression
5. Summarize and learn various unsupervised learning algorithms
6. Demonstrate and resolve complex clusters using ML Algorithms

CO-PO Mapping:

COs	PO1	PO12
1	3	2
2	3	2
3	1	3
4	1	2
5	1	3
6	1	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit -I: **14 Hours**

Artificial Intelligence Foundation to AI, Problem Solving- State Space Search, Constraint Satisfaction Problems, AI Problems and Agents, Expert Systems – Rule based system, Model & Hybrid Based System. Reasoning in uncertain environment. Math for Machine Learning- Linear Algebra, Multi-Variable Calculus and Vectors
AI Models and Types AI Bots, Applications of AI, Applied AI

Unit -II: **15 Hours**

Machine Learning Foundation for Machine Learning – Types of Machine Learning, Machine Learning Process, Preliminaries of Machine Learning, Data Pre-processing- Importing Libraries, Importing Datasets, Missing Data and Dependent Variables, Feature Selection, Machine Learning Applications.
Rules of Probability, Bayes Theorem, Bias, Variance and Co-variance.

Unit -III: **16 Hours**

Supervised Learning Classification- Naïve Bayes, Support Vector Machines, Extension to SVM, K-Nearest Neighbours. Decision Tree- Classification and Regression Tree, Linear Regression and Logistic Regression
Margins and Vectors, Continuous and Discrete variables

Unit -IV: **15 Hours**

Unsupervised Learning Clustering- Iterative Distance based Clustering, Association Rule Learning, K- Means Clustering and Hierarchical Clustering, Measure of Quality Clustering.
Similarity and Distance Measures, Gaussian and Normal Deviation

Total: 60 Hours

Text Book (s)

1. Russel and Norvig, Artificial Intelligence A modern Approach, 4th Edition, Pearson Education 2021
2. Stephen Marsland- Machine Learning – An Algorithmic Perspective – 2nd Edition – Chap Man & Hall CRC Press, 2015
3. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3rd Edition, Packt Publishing., 2019
4. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Reference (s)

1. E. Rich K. Knight and B.Nair – Artificial Intelligence– Third Edition – Tata McGraw Hill, 2017
2. Sebastian Rascchka, Vahid Mirjaalli -- Python Machine Learning – Third Edition –Packt, 2019

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam [5] (%)
Remember	25	20	-
Understand	35	40	30
Apply	40	40	40
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Sample Question (s)

Remember

1. Define entropy.
2. What is pruning?
3. Define hypothesis

Understand

1. What is Machine Learning?
2. How KNN is different from K- means Clustering?
3. Explain confusion matrix with an example

Apply

1. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
2. Apply *k*-Nearest Neighbour algorithm to classify the iris data set and print both correct and wrong predictions in it.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
4. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.

Analyze

1. Implement the non-parametric locally weighted regression algorithm in order to fit data points.
2. Select appropriate data set for your experiment and draw the relevant graphs
3. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using *k*-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program

Open Book Question(s)

1. The issue of the possibility of self-improvement of the system of artificial intelligence, which gained autonomy, got out of human control and by downloading data from the Internet it is becoming an increasingly powerful and threatening system for humans since the 1990s in science fiction literature and film. With each subsequent year, the technology of artificial intelligence is developed and improved.
   a) Justify the detailed steps involved for getting the above scenario w.r.t. human brain and computer vision.
   b) Is it possible now or in the future to create an artificial intelligence that will draw knowledge directly from the analysis of Internet resources and learn this knowledge?
2. A large room is filled with mousetraps, arranged in a grid. Each mousetrap is loaded with two ping-pong balls, carefully placed so that when the mousetrap goes off they will be flung, land on other mousetraps and set them off. The walls of the room are sticky, so any balls that hit the walls of the room are effectively absorbed. Every mousetrap that gets hit sends the two ping-pong balls in the same way: their movement is determined by a X and Y displacement relative to the launching mousetrap. You then decide to launch a single ping-pong ball into the room. It hits a mousetrap, setting it off, and launching its two balls. These two balls then set off two more mousetraps, and now four balls fly off... When the dust settles, many of the mousetraps have been set off, but some have been missed by all the flying balls.
   a) Identify the attributes and the mousetraps which are involved in this process
   b) Justify and predict the common set offs in the process and identify which learning suits the above scenario.

21CSM02 Feature Engineering in Machine Learning

4 0 0 4

Course Outcomes

1. Outline the fundamental concepts of feature engineering
2. Develop models that Deals with missing values
3. Develop models that Deals outliers using various techniques
4. Explain various types of Feature Selection Techniques
5. Apply various feature transformation techniques for the dimensionality reduction
6. Choose suitable algorithm for feature extraction from Text and Images.

CO–PO Mapping

CO	PO1	PO2	PO3
1	3	2	2
2	2	2	3
3	2	2	3
4	2	2	3
5	2	2	3
6	2	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit 1: **15 Hours**

Introduction to Feature Engineering: Why feature engineering, feature understanding, feature improvement, feature selection, feature construction, feature transformation, feature learning, feature extraction., Evaluation Metrics, cross validation, ML Cycle, Feature Engineering Cycle, Exploratory data analysis, Error analysis,

Unit 2: **16 Hours**

Data Preparation: Problems with data, types of data features, standardizing and Normalizing Features using different techniques, Discretization and Binning, Descriptive Features, Dealing with missing values and outliers using various techniques, Imputing categorical features, Encoding categorical variables.

Unit 3: **13 Hours**

Feature Selection: Measuring correlations, types of feature selection, Feature selection using various types of filters, wrappers and embedded techniques, feature transformation: dimensional reduction, PCA, LDA

Unit 4: **16 Hours**

Feature Extraction: Representing images as matrices and image processing techniques, feature detection and extraction from images, feature extraction from text: Bag of words, count vectorizer, TF-IDF vectorizer; tokenization and visualizing frequency distributions, creating feature vectors from text data, images, extracting features from images, detecting key points and descriptors from to perform image matching, extracting text from images using OCR, extracting features from dates, working with geospatial features

Text Books:

1. Sinan Ozdemir and Divya Susarla, Feature Engineering Made Easy, Packt Publishing Ltd.,2018
2. Pablo Duboue, The Art of Feature Engineering, Cambridge University Press,2020
3. Alice Zheng & Amanda Casari, Feature Engineering for Machine Learning, O'Reilly Media, Inc,2018

Reference Books:

1. Guozhu Dong and Huan Liu, Feature Engineering For Machine Learning And Data Analytics, CRC Press,2018
2. Soledad Galli, Python Feature Engineering Cookbook, Packt Publishing Ltd,2020
3. Max Kuhn, Kjell Johnson, Feature Engineering and Selection, CRC Press,2020.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam [5] (%)
Remember	25	20	-
Understand	35	40	30
Apply	40	40	40
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

21CSM13 Exploratory Data Analysis

4 0 0 4

Course Outcomes

1. Explain the Data Analysis Fundamentals
2. Illustrate various data Visual aids
3. Categorise different data transformation and descriptive statistics
4. Identify different Correlation and Inferences from statistical tests
5. Make use of the concept Hypothesis Testing
6. Classify different Multivariate Analysis techniques

CO–PO Mapping

CO	PO1	PO4
1	3	2
2	3	3
3	3	2
4	2	3
5	3	3
6	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Exploratory Data Analysis Fundamentals **15 Hours**

Understanding data science, significance of EDA, steps in EDA. types of analysis (univariate, bivariate, multivariate). Making sense of data: Numerical data-Discrete&continuous data,categorical data, Measurment scales-Nominal, Ordinal,Interval, Ratio. Comparing EDA with classical and Bayesian analysis, getting started with EDA: Numpy, Pandas,Scipy, and Matplotlib.

Grouping data: groupby mechanics, rearranging, reshaping data structures, data aggregation methods, and cross-tabulation methods.

Unit II

Visual aids for EDA **16 Hours**

Line chart, Bar charts,Box plot,residual plot, Scatter plot-bubble chart, scatterplot using seaborn, Area plot, stacked plot, and stem-and-leaf plot, pie chart, table chart, polar chart, histogram, lollipop chart, choosing the best chart.

Data transformation and descriptive statistics

Transformation techniques- performing data deduplication,replacing values, handling missing data, renaming axis indexes, outlier detection and filtering. Permutation and random sampling, computing indicators/dummy variables, string manipulations.

Descriptive statistics: Understanding statistics, distribution function (uniform, normal, exponential, binomial), cumulative distribution function, measure of central tendenacy, measure of dispersion (standard deviation, variance, skewness, kurtosis, percentiles, quartiles)

Unit III

Correlation and Inferences from statistical tests : **16 Hours**

Introducing correlation, covariance, Pearson's Correlation, Spearman's Rank Correlation.

Hypothesis Testing: Testing a difference in mean, testing a correlation, chi-squared tests, errors, power. Model development and evaluation with regression techniques.

Unit IV **13 Hours**

Multivariate Analysis: overview, Factor Analysis, Cluster Analysis, Discriminant analysis, EDA Case Study

Total: 60 Hours

Textbook (s)

1. Daniel J. Denis: Univariate, Bivariate, and Multivariate Statistics Using R: Quantitative Tools for Data Analysis and Data Science, Wiley,2020
2. Mukhiya Suresh Kumar Mukhiya, Ahmed Usman Ahmed: Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data, Packt, 2020
3. Downey, Allen. Think stats: exploratory data analysis. " O'Reilly Media, Inc.", 2014.
4. Neil H. Spencer: Essentials of Multivariate Data Analysis, CRC Press,2014

Reference (s)

1. Wes McKinney : Python for Data Analysis 2nd Edition,Wiley,2013.
2. Glenn J. Myatt, Wayne P. Johnson: Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, Wiley, 2014.

3. Wendy L. MartinezAngel R. MartinezJeffrey L. Solka: Exploratory Data Analysis with MATLAB, 2nd Edition,CRC Press,2011.
4. Radhika Datar, Harish Garg : Hands-On Exploratory Data Analysis with R , Packt,2019.
5. Joseph F Hair, Barry J. Babin, Rolph E. Anderson, William C. Black: Multivariate Data Analysis Cengage, 2018.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	40	--
Understand	30	40	--
Apply	20	20	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. What is data science.
2. Define purpose of different data visualization aids
3. List any two steps involved in EDA.

Understand

1. Explain different data representation
2. Explain the role of various data grouping methods
3. Explain purpose of hypothesis testing in detail

Apply

1. Apply various visual aids to identify behaviour of data
2. Make use of Multivariate Analysis methods for data analysis
3. Examine data with various distribution function

Analyze

1. Compare and contrast various data grouping methods.
2. Distinguish various methods to address problems with dummy variables
3. Examine various string handling methods

Evaluate

1. Evaluate the statistics of a given dataset
2. Justify the importance of data skewness
3. Measure data dispersion methods on a dataset

Open Book Exam Questions

Question 1:

Perform below analysis on a house price prediction dataset.

a. Univariate Analysis
    i. Analysis of a numerical feature
    ii. Analysis of a categorical feature
b. Bivariate Analysis
    i. Relationship of a numerical feature with another numerical feature
    ii. Relationship of a numerical feature with a categorical feature

Question 2:

Perform below analysis on weather prediction dataset.

a. Correlation Analysis
    i. Correlation Heat Map
    ii. Zoomed Heat Map
b. Investgation of missing values
    i. What's missing? to what extent?
    ii. Visualizing missing values in a dataframe.

21CSM21 Fundamentals of Security

4 0 0 4

Course Outcomes

1. Explain the fundamental concepts of information security
2. Illustrate the use of cryptography and its functions
3. Identify different types of Cryptography methods
4. List out different types of Security Threats and Vulnerability
5. Make use of the concept of network security
6. Outline transport and network layer security

CO–PO Mapping

CO	PO1	PO2
1	3	1
2	3	3
3	1	2
4	2	3
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Security concepts **15 Hours**

What is security, Data vs Information vs Cyber security, Goals of Information Security, Computer Security Concepts, threats, attacks and assets, security functional requirements, fundamental security design principles, computer security strategy, networking, benefits of networking.

Unit II

Cryptography **15 Hours**

Introduction to cryptography, Cryptographic functions(Authentication, Nonrepudiation, confidentiality, integrity), Cryptanalysis. Types of Cryptography: Symmetric key and Asymmetric Key Cryptography, Message Integrity, Encryption and Decryption Techniques, Digital Signatures, Email Standards: MIME and PGP

Unit III

Security Threats and Vulnerabilities **15 Hours**

Overview of Security Threats and Vulnerability: Types of attacks on Confidentiality, Integrity and Availability, Types of malware, Buffer Overflow

Security Counter- Measures: Passwords, Access Control (Authenticating users, Handling User Access), Antivirus Software, Firewalls, Intrusion Detection Systems and IPS.

Unit IV

Network Security **15 Hours**

TCP/IP Suite, DNS, MITM, Attacks on TCP and DNS, VPN, Application layer security (PGP, S/MIME), Transport layer security (TLS), Network layer security (IPSec) Anonymous networks: Tor,I2P.

Total: 60 Hours

Textbook (s)

1. William Stallings, Lawrie Brown, Computer Security Principle sand Practice,3rd Edition,2015
2. Nihad A. Hassan, Rami Hijazi, Digital Privacy and Security Using Windows: A Practical Guide, Apress, 2017

Reference (s)

1. Michael T. Goodrich and Roberto Tamassia, Introduction to Computer Security, Addison Wesley, 2011.
2. Ross Anderson, Security Engineering: A Guide to Building Dependable Distributed, 3rd Edition, John Wiley & Sons Inc, 2021.
3. Kozierok, Charles M. The TCP/IP guide: a comprehensive, illustrated Internet protocols reference, 2005
4. Harris, Shon, "CISSP all-in-one exam guide." Sixth edition (2013).

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	40	--
Understand	30	40	--
Apply	20	20	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

SAMPLE QUESTION (S)

Remember

1. What is security?
2. Define cyber security.
3. List any four computer security concepts.
4. Define threat.
5. Define intrusion.

Understand

1. Explain Cryptographic functions.
2. Explain the role of Symmetric key cryptography.
3. Illustrate hashing techniques.
4. Outline the purpose of digital signatures.

Apply

1. RSA algorithm with example.
2. Digital signature.
3. Build a firewall mechanism to protect laptop.

Analyze

1. Compare and contrast RSA and ECC.
2. Distinguish differences between Symmetric and Asymmetric key cryptography.
3. Examine the key sharing techniques in both Symmetric and Asymmetric key cryptography techniques

Evaluate

1. Justify the ECC is best public key cryptosystem than other public key approaches.
2. Explain the importance of IPSec protocol.
3. Explain the importance of I2P protocol

Open Book Exam Questions

Question 1:

In a public-key system using RSA, you intercept the ciphertext C=10 sent to a user whose public key is e=5, and n=35. What is the plaintext M? and Perform encryption and decryption using the RSA algorithm for the following: 1. P=3; q=11, e=7; M=5. 2. P=17; q=31, e=7; M=2.

Question 2:

Suppose we have a set of blocks encoded with the RSA algorithm and we don't have the private key. Assume n=pq, e is the public key. Suppose also someone tells us they know one of the plaintext blocks has a common factor with n. Does this help us in any way?

21CSM22 Management of Information Security

4 0 0 4

Course Outcomes:

1. Explain the basic requirement of managing security
2. Outline the strategies of planning of security system
3. Define the Security policies.
4. Develop and implement the security programs in an organization
5. Identify a proper framework of security management
6. Define the risk management and ethics of the security management for an organization.

COs–POs Mapping

COs	PO3	PO6	PO7
1	3	1	
2	3	2	3
3	2	2	
4	3	1	2
5	1	1	1
6	1	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

UNIT-1 **16 Hours**

Introduction to ISMS: what is Security and management definition, Principles of information security management; Project management, applying project management to security; Project management tools.

Planning for Security*:* Introduction, the role of planning; Precursors to planning; Strategic planning; Information security governance; Planning for information security implementation.

UNIT-2 **14 Hours**

Planning for contingencies: Introduction, Fundamentals and Components of contingency planning.
Information Security Policy: I*ntro*duction, Why policy? EISP; ISSP, SSSP, Guidelines for effective policy.

UNIT-3 **16 Hours**

Developing the Security Program: Organizing for security: Placing for information security within an organization, Components of the security program; Information security roles and titles; Implementing Security Education, Training and Awareness Programs.
Security Management Models: Blueprints, Frameworks, and Security Models**,** Access Control Models, Security Architecture, and management Models.

UNIT-4 **14 Hours**

Risk-Management: Risk management, Identification and assessment, Documenting the Results of Risk Assessment*;* Risk control strategies, managing risk; Feasibility and cost benefit analysis, Recommended risk control practices.
Laws and Ethics: InfoSec and the Law, Ethics in InfoSec, Professional Organizations and their Codes of Ethics, Organizational Liability and the Need for Counsel, Managing Investigations in the Organization.

Total: 60 Hours

Text Book:

1. Management of Information Security, Fourth Edition, Michael E. Whitman and Herbert J. Mattord, Cengage Learning.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	--
Understand	50	40	--
Apply	10	20	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

21CSM23 Cyber Security

4 0 0 4

Course Outcomes

1. Explain the fundamental concepts of Cyber security
2. Demonstrate the web security and different attacks
3. Identify different network scanning and security measures
4. List out different types of Intrusion detection.
5. Model different types of Intrusion prevention systems
6. Outline different cybercrimes, IT laws and acts.

CO–PO Mapping

CO	PO1	PO3	PO4
1	3	3	1
2	3	3	1
3	1	2	3
4	3	1	1
5	1	3	3
6	1	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Cyber Security **14 Hours**

What is Cyber Security, its need, cyber-threats, Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, Career Growth, Statistics, Inferences, Need for a Comprehensive Cyber Security Policy, Classification of Cyber Crimes, kinds of cybercrimes, Reasons for Cyber Crimes, Cyber Security Tools : Nmap, Metasploit, wireshark, tcpdump, snort.

Unit II

Web security **15 Hours**

Same origin Policy, Cross Origin Resource Sharing, DDOS, SQL Injection, XSS, Homograph, Generating and storing session tokens.

Networking Scanning & Security Measures: Packet Sniffing and spoofing, Network scanning types, port scanning & its tools, and Network Architecture

Security Measures : IPtables(firewalls) , Webservers (Nmap & Metasploit for securing webservers), Cyber Threats and Attacks (Malware, DOS, MITM, Social engineering attacks, Spoofing, Phishing)

Unit III

Intrusion Detection System **15 Hours**

Intruders, Intrusion Detection, Analysis Approaches, Network-Based IDS, Host-Based IDS, signature based IDS, anomaly based IDS, advantages and disadvantages of NIDS and HIDS

Intrusion Detection Tools, snort architecture, snort rules, case studies of intrusion detection systems, Intrusion detection exchange format.

Honeypots, different types of honeypots, benefits and dangers of honeypots

Unit IV

Cyber Laws and Digital Forensics **16 Hours**

Digital Forensics: Introduction to Digital Forensics, historical background of digital forensics, Forensic Software, and Hardware, need for computer forensics science, special tools and techniques digital forensic life cycle, challenges in digital forensic.

Law Perspective: Introduction to the Legal Perspectives of Cybercrimes and Cybersecurity, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Cybercrime Scenario in India, Digital Signatures and the Indian IT Act.

Total: 60 Hours

Textbook (s)

1. Wenliang Du, Computer & Internet Security: A Hands-on Approach, (2019)
2. William Stallings, Lawrie Brown, Computer Security Principle sand Practice,3rd Edition,2015

3. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, Wiley India Pvt. Ltd, 2011.
4. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi

Reference (s)

1. Pande, Jeetendra. "Introduction to Cyber Security.", (2017)
2. Pavan Duggal, Cyber frauds, cybercrimes & law in India.
3. Ali A. Ghorbani, Network intrusion detection and prevention concepts and techniques, Springer, 2010
4. Roberto Di Pietro, Luigi V. Mancini (2008), Intrusion Detection System, Springer
5. Dafydd Stuttard and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Wiley Publication

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	40	--
Understand	30	40	40
Apply	20	20	40
Analyze	--	--	20
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	--

SAMPLE QUESTION (S)

Remember

1. What is cyber security?
2. Define security policy.
3. List classification in cyber security.
4. Define network scanning.
5. What is digital forensics?

Understand

1. Explain security policy for password protection.
2. Explain reasons for cybercrime.
3. Outline SQL injection attack.
4. Classify different approaches for packet filtering using firewall.
5. Explain IP Spoofing.

Apply

1. Apply IPS methods to prevent introduter.
2. Apply snort rules to detect intrusion
3. Identify open ports in a network using namp.
4. Plan to filter unauthorized packets using iptables
5. Build host based IPS.

Analyze

1. Compare and contrast iptables and snort.
2. Compare and contrast different tools to address DOS.
3. Examine different post scanning methods.
4. Distinguish nmap and metasploit.
5. Compare different tools related to digital forensics

Open Book Exam Questions

Question 1:

	Source Address	Source Port	Dest Address	Dest Port	Action
1	Any	Any	192.168.1.0	> 1023	Allow
2	192.168.1.1	Any	Any	Any	Deny
3	Any	Any	192.168.1.1	Any	Deny
4	192.168.1.0	Any	Any	Any	Allow
5	Any	Any	192.168.1.2	SMTP	Allow

6	Any	Any	192.168.1.3	HTTP	Allow
7	Any	Any	Any	Any	Deny

The above table shows a sample of a packet filter firewall ruleset for an imaginary network of IP address that range from 192.168.1.0 to 192.168.1.254. Describe the effect of each rule.

Question 2:

Perform following activities using nmap tool:

a. Write an nmap command to check/find list of open ports for "gmrit.org" website.
b. Nmap to reveal open services and ports by IP address as well as by domain name(Note: IP number is of your choice).
c. Nmap command to scan multiple hosts at once.
d. Nmap command to find OS information of a host(host IP address is of your choice).
e. Nmap command to check firewall settings of a host(host IP address is of your choice).

21CSM31 Data Cleaning

4 0 0 4

Course Outcomes:

1. Explain workflow of data cleaning
2. Compare various Outlier Detection methods
3. Illustrate various data Deduplication techniques
4. Utilize ETL tools for performing Data Transformation
5. Choose an appropriate normalization and visualization techniques for the given data
6. Make use of data cleaning in Machine Learning applications

COs–POs Mapping

COs	PO2	PO3	PO4
1	3	1	1
2	3	1	2
3	3	3	3
4	3	3	3
5	3	3	3
6	3	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit 1: **15 Hours**

Introduction, Data Cleaning Workflow, Outlier Detection: Statistics-Based Outlier Detection, Distance-Based Outlier Detection, Model-Based Outlier Detection, Outlier Detection in High-Dimensional Data.

Unit 2: **16 Hours**

Data Deduplication: Similarity Metrics, Predicting Duplicate Pairs, Clustering, Blocking for Deduplication, Distributed Data Deduplication, Record Fusion and Entity Consolidation, Human-Involved Data Deduplication, Data Deduplication Tools.

Unit 3: **16 Hours**

Data Transformation: Syntactic Data Transformations, Semantic Data Transformations, ETL Tools. Data Cleanup: Normalizing and Standardizing Your Data, Data Formatting, Visualization of data.

Uni4: **13 Hours**

Machine Learning and Probabilistic Data Cleaning: ML for Data Deduplication, ML for Data Repair, Data Cleaning for Analytics and Machine Learning.

Total: 60 Hours

Textbooks:

1. Ihab F. Ilyas and Xu Chu, Data Cleaning, ACM, 2019
2. Jacqueline Kazil & Katharine Jarmul, Data Wrangling with Python, O'Reilly Media, Inc, 2016.

References:

1. Tye Rattenbury, Joseph M. Hellerstein, Jeffrey Heer, Sean Kandel, Connor Carreras, Principles of Data Wrangling, O'Reilly Media, Inc, 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	--
Understand	50	40	--
Apply	10	20	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

21CSM32 Data Engineering

4 0 0 4

Course Outcomes

1. Explain the stages of KDD process and detailed architecture of Data Warehouse and data preprocessing
2. Discover and measure interesting patterns from different kinds of databases
3. Use association rule mining algorithms to generate association rules
4. Select an appropriate classification technique for a given dataset
5. Choose a clustering technique for a given dataset
6. Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques

COs–POs Mapping

COs	PO1	PO2	PO3	PO4
1	2	3	1	1
2	3	3	1	2
3	2	3	3	3
4	2	3	3	3
5	2	3	3	3
6	2	3	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I **15 Hours**

Introduction to Data Mining and Warehousing

Overview of Data Warehouse-Data Warehouse Architecture-Introduction to Data Mining-Basic Data Mining Tasks Data Mining Issues-Data Mining Metrics-Different sources of Data Mining-Data Mining and KDD-Types of Data, Data Pre-processing-Statistical Perspective on Data Mining-Similarity Measures-Examples of Proximity Measures Issues in Proximity Calculations-Selection of the Right Proximity Measure

Unit II **16 Hours**

Mining Association Rules in Large Databases

Association Rule Mining-Mining Single-Dimensional Boolean Association Rules from Transactional Databases-Mining Multilevel Association Rules from Transaction Databases-Mining Multidimensional Association Rules from Data sources-From Association Mining to Correlation Analysis-Constraint-Based Association Mining

Unit III **13 Hours**

Classification of Data

Preliminaries-General Approach to Solving Classification Problem-Decision Tree Induction-Rule-based ClassifierNearest-Neighbor Classifiers-Bayesian Classifiers-Artificial Neural Network

Unit IV **16 Hours**

Cluster analysis

Cluster analysis – types of clustering – Types of clusters - K-means-Agglomerative Hierarchical Clustering– DBSCAN-Prototype-based Clustering-Cluster Evaluation-Characteristics of Data, Clusters and clustering algorithms – Prototype clustering – Density based clustering

Total: 60 Hours

Textbook (s)

1. Pang, Ning Tan, Michael Steinbach, Vipin Kumar Introduction to Data Mining, 1st Edition, Pearson Addison Wesley, 2005
2. Jiawei Han & Micheline Kamber, Data Mining Concepts and Techniques, 2nd Edition, Morgan Kaufmann, 2006

Reference (s)

1. Margaret H Dunham, Data Mining Introductory and advanced topics, 2nd Edition, Pearson Education, 2004
2. Arun K Pujari, Data Mining Techniques, 2nd Edition, University Press, 1999.
3. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining:Practical Machine Learning Tools and Techniques,3rd Edition, Morgan Kaufmann Publishers, 2011

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Internal Test 1 (%)	Internal Test 2 (%)	Open Book Examination (%)
Remember	35	15	--
Understand	30	25	--
Apply	20	30	50
Analyze	15	30	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. What are the steps in the data mining process?
2. What is Descriptive and predictive data mining?
3. What is Data Generalization?
4. What is clustering?
5. Define Spatial Databases.

Understand

1. What are the requirements of clustering?
2. How is association rules mined from large databases?
3. What is the classification of association rules based on various criteria?
4. Explain the various OLAP operations.
5. Explain data reduction
6. Explain Data mining Primitives
7. Explain the data mining functionalities

Apply

1. Find some of the data mining applications
2. Show the various social impacts of data mining?
3. Demonstrate the different types of data repositories on which mining can be performed
4. Choose some specific application-oriented databases.

Analyze

1. Identify the different types of data repositories on which mining can be performed
2. Compare the parametric methods and non-parametric methods of reduction
3. Differentiate the types of data in cluster analysis.
4. Justify Additional themes in data mining
5. Criticize over the data quality is so important in a data warehouse environment

21CSM33 Text Analytics

4 0 0 4

Course Outcomes

1. Explain the basics of Natural languages, text corpora
2. Explain concepts related to Natural Language Processing
3. Explain the processing of text through text tokenization
4. Illustrate the concepts of text syntax and structure
5. Understand and Apply Text classification algorithms on sample data
6. Outline the process of feature extraction

CO–PO Mapping

CO	PO1	PO2	PO4
1	3	2	2
2	3	2	3
3	3	2	2
4	2	2	3
5	3	2	3
6	3	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I **15 Hours**

Introduction to Natural Language Basics

Natural Language: What Is Natural Language? The Philosophy of Language, Language, Acquisition and Usage. Linguistics, **Language Syntax and Structure:** Words, Phrases, Clauses, Grammer, Word Order Typology, **Language Semantics:** Lexical Semantic Relations, Semantic Networks and Models, Representation of Semantics, **Text Corpora:** Corpora Annotation and Utilities, Popular Corpora, Accessing Text Corpora,

Natural Language Processing: Machine Translation, Speech Recognition Systems, Question Answering Systems, Contextual Recognition and Resolution, Text Summarization, Text Categorization, Text Analytics.

Unit II **15 Hours**

Processing and Understanding Text

Text Tokenization: Sentence Tokenization, Word Tokenization.

Text Normalization: Cleaning Text, Tokenizing Text, Removing Special Characters, Expanding Contractions, Case Conversions, Removing Stopwords, Correcting Words, Stemming, Lemmatization

Understanding Text Syntax and Structure: Installing Necessary Dependencies, Important Machine Learning Concepts, Parts of Speech (POS) Tagging, Shallow Parsing, Dependency-based Parsing, Constituency-based Parsing

Unit III **15 Hours**

Text Classification: What Is Text Classification? Automated Text Classification, Text Classification Blueprint, Text Normalization, Feature Extraction, Bag of Words Model, TF-IDF Model, Advanced Word Vectorization Models

Classification Algorithms: Multinomial Naïve Bayes, Support Vector Machines; Evaluating Classification Models, Building a Multi-Class Classification System, Applications and Uses.

Unit IV **15 Hours**

Text Summarization: Text Summarization and Information Extraction , Important Concepts: Documents , Text Normalization, Feature Extraction , Feature Matrix ,Singular Value Decomposition. Text Normalization, Feature Extraction, Key phrase Extraction: Collocations , Weighted Tag–Based Phrase Extraction.

Topic Modeling: Latent Semantic Indexing, Latent Dirichlet Allocation, Non-negative Matrix Factorization, Extracting Topics from Product Reviews, **Automated Document Summarization**: Latent Semantic Analysis, Text Rank, Summarizing a Product Description.

Total: 60 Hours

Textbook (s)

1. Dipanjan Sarkar, Text Analytics with Python, A Practical Real-World Approach to Gaining Actionable Insights from Your Data,, by Apress, 2016.

Reference (s)

1. Murugan Anandarajan Chelsey Hill Thomas Nolan, Practical Text Analytics, Maximizing the Value of Text Data, by Springer, Volume 2, 2019.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	--
Understand	50	40	--
Apply	10	20	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (s)

Remember

4. List any two types of energy storage devices and their applications.
5. Define self-discharge and sulphation.
6. List the role of battery in automotive application.

Understand

4. Explain the performance curve during discharge of a lead acid battery.
5. Explain with suitable diagram, the charging circuit in a hybrid electric vehicle.
6. Discuss the effects of unauthorized disposal of lead acid batteries on environment.

Apply

4. Justify the role of government in controlling unorganized sector for batteries in India.
5. Differentiate between the application of flat plate and tubular batteries.
6. Differentiate between constant current and constant voltage charging characteristics.

Analyze

4. Which of the following battery is more suitable for deep discharge application and why?
   (a) Flat plate (b) Tubular plate
5. Which is the most economically viable energy storage system? Give reasons.
6. How do you increase the efficiency of a Fuel Cell?

Open book Question(s)

2. Estimate the backup time provided by the UPS graphically assuming nominal battery characteristics of Voltage: 3.7 V and Capacity: 2800 mA.h. The UPS is supplying power to a unit of 12 V requiring current of 0.8 Amps. The battery discharge characteristics are given below:

21CSM41 Programming Fundamentals

4 0 0 4

Course Outcome(s)

1. Explain and illustrate the aspects of the problem-solving using algorithms and flowcharts
2. Demonstrate the conditional, iterative statements, arrays and pointers to write programs
3. Illustrate and utilize the concepts of structures, unions, strings and functions
4. Demonstrate the basic Concepts of Data Structures
5. Compare and utilize the concepts of list, tuples to write programs
6. Utilize the concepts of strings, dictionaries, and sets

COs – POs Mapping

CO	PO1	PO2	PO3
1	2	2	3
2	2	2	3
3	3	2	3
4	2	2	3
5	2	2	3
6	2	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

UNIT -1 **15 Hours**

History of C, Definition of algorithm, flowchart, program, syntax, compiler vs. interpreter, header files, main method, input and output, Data Types, Variables, Declaration, Keywords, Type casting, Operators. **Conditional statements:** If, if else, else if, switch, ternary. **Iterative statements:** while, do while, for. **Arrays:** Definition, one-dimensional array initialization, accessing arrays, modifying, looping arrays, nested arrays (multi–dimensional).

UNIT – 2 **15 Hours**

Functions: Definition, creation, parameters and return type, global and local scope, 4types of functions, Recursion. **Pointers:** Definition, Types of pointers and its usage. **Structures and Unions:** Definition, Declaration, Accessing. Dynamic Memory Allocations, **Strings:** Definition, Declaration, Initialization, Applications, and Built in methods.

UNIT -3 **15 Hours**

Introduction of Python**, Basics of Python:** Variables, Data types, input and output, Operators, Control statements, Functions, Default argument functions. **Python Data structures: Lists**: Initialization, Negative indexing, looping lists, appending, removing, modifying, slicing and sorting of lists, List comprehension, and nested lists. **Tuples:** List vs. Tuple, accessing, updating, unpacking and tuple methods. Immutability.

Unit – 4 **15 Hours**

Python Data structures**, Strings:** initialization, modifying, concatenation, slicing, formatting and string methods, lists with strings, **Dictionary:** definition, creation, accessing, modifying and removing elements, looping dictionaries, dictionary methods, dictionaries with list, tuples and strings, nested dictionaries. **Sets:** definition, creating, union, intersection, difference, list to sets, sets methods.

Total: 60 Hours

Text Books

1. Byron Gottfried, Programming with C, 3rd Ed., Tata McGraw Hill, 2017
2. R. G. Dromey, How to Solve it by Computer, Pearson Education India, 2008
3. Richard L. Halterman, Fundamentals of Python Programming, Southern Adventist University, 2019
4. Kenneth A. Lambert, Fundamentals of Python: First Programs, 2nd Edition, Publisher: Cengage Learning, 2018

Internal assessment pattern:

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book (%)
Remember	30	30	„
Understand	50	40	30
Apply	20	30	40
Analyze	-	-	30
Evaluate	-	-	-
Create	-	-	-
Total (%)	100	100	100

Remember

1. Define Algorithm
2. List any four types of operators of C – Language
3. What are the benefits of using Python?
4. What is an Interpreted language?

Understand

1. What is Structured programming?
2. Differentiate linear and nonlinear data structures
3. List any four string handling functions
4. What are lists and tuples? What is the key difference between the two?
5. What are Dict and List comprehensions?

21CSM42 Data Structures and Algorithms

4 0 0 4

Course Outcomes

1. Understand the fundamentals for analyzing time and space complexity of algorithms
2. Describe the operations and implementation of List ADT (Understand)
3. Comprehend the operations and implementation of Stack and Queue (Understand)
4. Illustrate the applications of linear data structures (Apply)
5. Describe the operations and implementation of hash table (Understand)
6. Comprehend the operations and implementation of tree data structure (Understand)

CO–PO Mapping

CO	PO1	PO2	PO3	PO4
1	3	2	2	2
2	3	2	2	2
3	2	3	3	2
4	2	3	3	2
5	3	2	2	3
6	2	3	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Linear Data Structures – List **13 Hours**

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation –Singly linked lists- Circularly linked lists- Doubly-linked lists – Applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal) - Searching - Linear Search – Binary Search

Unit II

Linear Data Structures – Stack and Queue **16 Hours**

Stack ADT – Array implementation – Linked list implementation – Applications of Stack – infix to postfix conversion, evaluation of postfix expression – Queue ADT – Array implementation – Linked list implementation – Application of Queue – Ticket counter

Unit III

Sorting, Hashing Techniques and Trees **15 Hours**

Sorting – Bubble Sort – Selection Sort – Insertion Sort – Shell Sort – Radix Sort – Quick Sort – Merge Sort - Hashing - Hash Functions – Separate Chaining – Open Addressing – Rehashing

Trees: Introduction, Terminology, Binary Trees, Representation of Binary Trees using arrays and linked lists, Binary tree traversals

Unit IV

Introduction to Algorithms **16 Hours**

Fundamentals of algorithmic problem solving – Analysis framework - Performance Analysis: - Space complexity, Time complexity - Growth of Functions: Asymptotic Notation- Big oh notation, Omega notation, Theta notation, little oh, little omega. Mathematical Analysis of Non-recursive algorithms – Mathematical Analysis of Recursive algorithms - Brute Force: Bubble sort – Sequential search – String Matching

Total: 60 Hours

Textbook (s)

1. Introduction to The Design and Analysis of Algorithms, 3rd Edition, Anany Levitin, Pearson Education, 2017
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education, 2002.
3. Michael Main, Walter Savitch, Data Structures and other objects using C++, 4th Edition, Addison Wesley, 2018.

Reference (s)

1. Design and Analysis of algorithms, Aho, Ullman and Hopcroft,Pearson education.
2. S. Tanenbaum, Y. Langsam and M.J. Augenstein,, Data Structures using C and C++, 2nd Edition, Pearson Education, 2015
3. R. F. Gilberg, B. A. Forouzan, Data Structures A Pseudocode Approach with C, 2nd Edition, CENGAGE Learning, 2005.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	40	--
Understand	40	40	--
Apply	20	20	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. What are abstract data types?
2. List any 2 disadvantages of array.
3. Define linked list.
4. Define data structure.
5. List any 2 applications of queue.

Understand

1. Compare linked list with array.
2. Explain Bubble Sort Process with an example.
3. Demonstrate with neat diagram and algorithm to insert a node before the given key.
4. Explain Deletion process using an example binary search tree.
5. Explain why the selection sort is more efficient than the bubble sort.
6. Explain with suitable example of LL rotation after inserting a new node into an AVL tree.
7. Demonstrate the application of singly linked lists for the addition of the polynomials P_1 and P_2

Apply

1. Develop an algorithm to concatenate two single linked lists.
2. Construct a priority queue and implement all basic operations to demonstrate priority queue.
3. Build a recursive procedure to count the number of nodes in a binary tree.

Open Book Exam Questions

Apply

1. Select appropriate data structure to simulate the operations of a Music Player – Songs in music player are linked to previous and next song. you can play songs either from starting or ending of the list.
2. You are given a stack of N integers such that the first element represents the top of the stack and the last element represents the bottom of the stack. You need to pop at least one element from the stack. At any one moment, you can convert stack into a queue. The bottom of the stack represents the front of the queue. You cannot convert the queue back into a stack. Your task is to remove exactly K elements such that the sum of the K removed elements is maximized.
3. Vikas is given a bag which consists of numbers (integers) blocks, Vikas has to organize the numbers again in the same order as he has inserted it into the bag, i.e. the first number inserted into the bag by Vikas should be picked up first followed by other numbers in series. Help Vikas to complete this work in O(n) time complexity with the condition to use one extra bag to complete the work (assume that the

21CSM43 Fundamentals of Database Systems

4 0 0 4

Course Outcomes:

1. Explain the fundamental concepts of data base and data models
2. Illustrate the use of Relational Algebra and integrity constraints in databases
3. Design a Database using ER Modelling and SQL
4. Select normalization on database design to eliminate anomalies
5. Make use of the concept of transaction management and recovery system in databases
6. Choose ACID properties to control database transactions

CO–PO Mapping

CO	PO1	PO4
1	3	2
2	3	3
3	3	2
4	2	3
5	3	3
6	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I **15 Hours**

Introduction to DBMS and ER Model

Introduction-Database System Applications, Purpose of Database Systems, View of Data - Data Abstraction, Instances and Schemas, Data Models, Database Languages - DDL, DML, Database Architecture, Database Users and Administrators, History of Data base Systems.

Introduction to Data base design , ER diagrams, Beyond ER Design, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.

Unit II **16 Hours**

Introduction to Relational Model and Basic SQL Queries

Relational data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQl Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries.

Unit III **16 Hours**

Normalization and Transaction Management

Aggregate Functions: Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus;

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design.

Unit IV **13 Hours**

Transactions and Recovery

Transaction Management - Transaction Concept - Transaction State - Implementation of Atomicity and Durability - Concurrent - Executions - Serializability - Recoverability - Implementation of Isolation - Anomalies Associated with Concurrent Schedules (RW - WR - and WW Conflicts) - Testing for serializability.

Total: 60 Hours

Textbook (s)

1. Raghurama Krishnan & Johannes Gehrke, Database Management Systems, TATA McGraw-Hill, 3rd Edition, 2003
2. Silberschatz Korth, Database System Concepts, McGraw hill, 7th Edition, 2019

Reference (s)

1. Elmasri & Navatha, Fundamentals of Database Systems, Pearson Education, 7th Edition, 2016
2. C.J.Date, An Introduction to Database Systems, Pearson Education, 8th Edition, 2006

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	50	40	--
Understand	40	50	70
Apply	10	10	30
Analyze	--	--	--
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. List any four applications of DBMS.
2. Define data model.
3. List any four applications for triggers.
4. Define functional dependency.
5. List the 4 properties of Transaction.

Understand

1. Explain E-R Model with suitable example.
2. Explain the role of integrity constraints in database design.
3. Illustrate the working principle of 'write a head log' protocol.
4. Differentiate 3NF and 4NF.
5. Explain the importance of Locking in DBMS.

Apply

1. When multiple transactions are being executed by the operating system in a multiprogramming environment, there are possibilities that instructions of one transaction are interleaved with some other transaction. Apply the suitable concept to overcome the problem.
2. Classify various normal forms according to their applicability.
3. Give some real-world applications of Normalization.
4. Illustrate the Commit and Rollback operations of Transaction Control.
5. Give some real-world applications for Database transactions.

Open Book Exam Questions

Question 1: Anitha has a large CD collection. Her friends like to borrow her CD's, and she has to keep track of who has what. She maintains a list of friends, identified by unique FID's and a list of CD's, identified by CID's. With each friend are the name and telephone numbers which she can call to get the CD back. With each CD is actor name and title. Whenever a friend borrows a CD, She will enter that fact into her database along with the date borrowed. Whenever the CD gets returned that fact, too, gets noted along with the date returned. Anitha wants to keep a complete history of her friends' borrowing habits so that she can ask favors of the heavy borrowers.

Draw an ER diagram to figure out the above situation and identify types of attributes and cardinality. Represent this database as a collection of 3NF relational tables.

Question 2: The relational scheme R(A, B, C, D, E, F) and set of functional dependencies AB -> D, E -> C, AF -> B. From this, find out all super keys for this relation, and which of these super keys form a key.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

AR20 MINOR COURSES

Minors for other Departments offered by Electrical and Electronics Engineering

Digital IC Design

Preamble:
This course provides an introduction to the design and implementation of VLSI circuits for complex digital systems and the focus is on CMOS technology. In this course, students will get exposure to the fundamental concepts and structures of designing digital VLSI systems that include CMOS devices and circuits, Combinational Circuit Design, Sequential circuits and design, CMOS chip layout, simulation and testing, low power techniques, design tools and methodologies, VLSI architecture & VHDL.

Prospects:
The electronics industry worldwide is rapidly approaching another revolutionary leap in the global market scenario. Semiconductor technology has crossed the quarter-micron threshold, making tens of millions of transistors available on a single chip equipped with the powerful arm of VLSI design. This imparts the electronics industry a potential to create designs of incredible densities and lightning speeds while utilizing batteries to power them. This has had a phenomenal impact on widespread applications ranging from consumer electronics, communications, and defense to just about everything. As part of Electronics India program by Govt. of India, most of the electronic products and semiconductor ICs are planning to make in India.

Placement Opportunities:
The course is designed to help you gain the essential skills to have a successful career in VLSI design industry. VLSI Physical Design Engineer to enable new Electronics graduates/post graduates or working engineers in electronic industries to the concepts used in IC Design, which involves processing, Layout, System Design Methods using Cadence tool. The course will benefit VLSI Engineers seeking lateral shift to a back end job. Engineers looking to work for Block level Physical Design Implementation, Place and Route job domains. This will take VLSI Engineers to a new level known as Physical Design Engineer. The Physical Design Engineer is responsible for converting the circuit design to a geometric representation for manufacturing the integrated circuit (IC).

21ECM11 Fundamental of VLSI Design

Course Outcomes **4 0 0 4**

1. Explain the operation and characteristics of MOS transistor
2. Interpret various MOS transistor fabrication techniques
3. Implement Boolean functions in CMOS technology and realize the same in layout diagrams
4. Summarize the effects of parasitics and scaling
5. Classify various programmable ASICs
6. Interpret different levels of testing of IC

COs – POs Mapping

COs	PO1	PO2	PO3
1	2	-	-
2	2	-	2
3	3	2	2
4	2	2	-
5	2	2	-
6	2	2	1

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I
Introduction to IC technology and Basic Electrical properties of MOS circuits

Introduction to RTL, DTL, TTL, ECL logic families, Introduction to IC technology, Basic MOS transistors, Enhancement and depletion modes of transistor action, Ids-Vds relationships, Aspects of MOS Transistor,

Threshold voltage, MOS Transistor conductance and output conductance, MOS transistor figure of merit, Pass transistors, nMOS inverter , Determination of pull up to pull down ratio for an nMOS inverter driven by another nMOS inverter and for an nMOS inverter driven through one or more pass transistors, Alternate forms of pull up, CMOS inverter, BiCMOS Inverters.

Static power dissipation, Dynamic Power dissipation in CMOS circuits

16 Hours

Unit II

IC Fabrication process and Gate level Design

MOS and CMOS Fabrication processes, Bi-CMOS Technology, comparison between CMOS & Bipolar technologies, Latch up in CMOS circuits, MOS Layers, Stick diagrams (nMOS design style), CMOS design style, Design rules, Layout diagrams of CMOS inverter, NAND & NOR gates

Realization of gates using CMOS technology, other complex gates, Switch logic (pass transistor and transmission gates) and design examples using transmission gates.

Layout diagram of 10T full adder and CMOS full adder

14 Hours

Unit III

Basic circuit concepts and Scaling of MOS Circuits

Sheet resistance , Sheet resistance concept applied to MOS transistors and inverters, Area capacitance of layers , standard unit of capacitance, some area capacitance calculations, The delay unit , inverter delays, Driving large capacitance loads, Propagation delays, wiring capacitances, Fan-in and Fan-out characteristics, Choice of layers,CMOS steady state electrical behavior, CMOS dynamic electrical behavior

Scaling of MOS Circuits, Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling (qualitative treatment only).

Drain Induced Barrier Lowering (DIBL) effect, Sub threshold conduction

15 Hours

Unit IV

Programmable ASICs & IC testing

Introduction, FPGA Design flow, ASIC Design flow ,Types of ASICs-Full custom, standard cell based Asics, Gate array based ASICs, PLDs, FPGAs, Programmable ASICs- anti-fuse, SRAM, EPROM and EEPROM technology

Manufacturing test principles, Design for testability (DFT) - Adhoc testing, Scan design, Built in self-test (BIST).

Xilinx3000Series, FPGAarchitecture, Boundaryscan

15 Hours
Total: 60 Hours

Textbook (s)

1. Kamran eshragian, Douglas.A.Pucknell and Sholeh Eshragian, Essentials of VLSI circuits and systems,Prentice Hall of India Private Ltd, 3rd Edition, 2005
2. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 3rd Edition, 1999
3. Michael john Sebastian smith, Application specification integrated circuits, Addition Wesley,1st Edition,1997
4. John.P.Uyemura, Introduction to VLSI Circuits & Systems, John Wiley 1st Edition, 2009

Reference (s)

1. Wayne Wolf, Modern VLSI Design, Pearson Education, 3rd Edition, 1997
2. Jan M Rabaey, A. Chandrakasan, B.Nikolic, Digital Integrated Circuits, Pearson, 3rd Edition, 2008
3. Richa Jain, Amrita Rai , Principles of VLSI and CMOS Integrated Circuits, S.Chand & Co Ltd, 1st Edition, 2012
4. John F. Wakerly, Digital Design Principles & Practices, PHI/ Pearson Education Asia, 3rd Ed., 2005

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	30	30	--
Understand	40	40	--

Apply	30	30	70
Analyse	--	--	30
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. What are the scaling models?
2. Why switch logic is better than pass transistor logic?
3. Show that pull up to pull down ratio of an nMOS inverter driven by another nMOS inverter is 4:1
4. How the delay varies with number of inputs for different fabrication processes?
5. Show that 11 is the best test vector for AND gate if there is a SA0 fault on one node

Understand

1. Explain briefly about nMOS pass transistor
2. Compare Stick diagram and Layout
3. Explain about based design rules in detail
4. Classify possible wiring capacitances in VLSI fabrication process
5. Explain about programming technologies of SPLD and CPLDs

Apply

1. Construct CMOS inverter having pull up to pull down ratio of 1:1 if n channel sheet resistance is 10k and pchannel sheet resistance is 25k
2. Construct layout for 2-input NAND gate
3. Classify ASICs with neat sketch
4. Demonstrate your answer , If the disturbance is created at the output then there exist low resistancepath between supply rails of CMOS inverter, is that disturbance creates problem in the CMOS inverter,
5. Construct Enhancement load and depletion load nMOS inverters
   [Open Book Question]

Analyze

1. Distinguish ASICs and PLDs with examples
2. Contrast CMOS and Bipolar technologies
3. Analyse CMOS inverter with the help of transfer characteristics
4. Differentiate FPGA with Programmable ASICs
5. Justify why scaling factors are greater than unity?
   [Open Book Question]

21ECM12 Digital Design using HDL

4 0 0 4

Course Outcomes

1. Interpret the concepts of Verilog HDL constructs
2. Implement gate level Verilog HDL models for combinational and sequential circuits
3. Execute dataflow and switch level models for combinational and sequential circuits
4. Organize behavioral level Verilog HDL models for combinational and sequential circuits
5. Choose appropriate Verilog HDL constructs for RTL coding
6. Implement the combinational and sequential circuits in FPGA

COs – POs Mapping

CO	PO1	PO2	PO3
1	1	-	-
2	3	2	2
3	3	2	2
4	3	2	2
5	3	2	2
6	3	2	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Verilog Language Constructs and Gate Level Modeling

Verilog as HDL, Levels of design description, Concurrency, Simulation and Synthesis, Functional verification, System tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis tools, Test benches, Keywords, Identifiers, White space characters, Comments, Numbers, Strings, Logic values, Strengths, Data types, Scalars and Vectors, Parameters, Memory, Operators, System tasks, AND gate primitive, Module structure, Other gate primitives, Tristate gates, Array of instances of primitives, Delays, Strengths and Contention Resolution, Net Types, Design of basic circuits.

Design of Flip-flops with Gate Primitives, adders

15 Hours

Unit II

Behavioral, Data Flow and Switch Level Modeling

Operations and Assignments, Functional Bifurcation, Procedural constructs: Initial, Always, Assignments with delays, Wait, Multiple always blocks Designs at Behavioral level, Blocking and Non-blocking assignments, Case statement, Simulation flow, Conditional statements and loops- if, if-else, repeat, for, while, forever, parallel blocks, force-release, Event, Continuous assignment structures, Delays and Continuous assignments, Assignment to Vectors, Operators, Basic transistor switches, CMOS switch, Bi-directional gates, Time delays with switch primitives, Instantiations with Strengths and Delays, Strength contention with Tri-reg Nets.

Behavioral level modeling of all flip-flops, 4 bit counter

15 Hours

Unit III

System Tasks, Functions and UDP Introduction, Parameters, Path delays, Module parameters, System Tasks and Functions, File based tasks andFunctions, Compiler directives, Hierarchical access, User-Defined Functions, Tasks and Primitives-Introduction, Function, Tasks, User- Defined Primitives.

Implementation of two bit multiplication using tasks and functions

15 Hours

Unit IV

Verilog HDL Models: Decoders, encoders, multiplexers and de-multiplexers, comparators, adders & subtractors, Latches and flip-flops, counters, shift register, Internal structure of ROM, Static RAM.

Design examples (using Verilog HDL) - Barrel shifter, floating point encoder

15 Hours

Textbook (s) **Total: 60 Hours**

1. T.R. Padmanabhan and B. Bala Tripura Sundari, Design through Verilog HDL, Wiley-IEEE Press, 2004
2. John F. Wakerly, Digital Design Principles & Practices, PHI/ Pearson Education Asia, 3rd Edition,2005

Reference (s)

1. Stephen. Brown and ZvonkoVranesic, Fundamentals of Logic Design with Verilog, TMH, 2005

2. Michael D. Ciletti, Advanced Digital Design with Verilog HDL, PHI, 2005
3. J. Bhaskar, A Verilog Primer, BSP, 2nd Edition, 2003
4. Charles H Roth, Digital Systems Design using VHDL, Jr. Thomson Publications, 2004

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	--
Understand	55	40	--
Apply	25	40	60
Analyze	--	--	40
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Define the Verilog Syntax for the case, for loop and if-else statements
2. List out the tri-state gate primitives with syntax
3. List out the Verilog operators
4. List out bidirectional gates with their syntax in Verilog
5. List out two system tasks with syntax
6. State the Procedural Constructs in Verilog

Understand

1. Illustrate the strengths and contention in Verilog HDL
2. Explain the following
   i) Simulation and synthesis ii) Functional verification
3. Explain the concept of concatenation of vectors with an example
4. Illustrate Verilog primitives. Explain Verilog gate level primitives with suitable example
5. Explain User-Defined Primitives with syntax. Give an example of 4-to-1 multiplexer using UDPs

Apply

1. Implement all logic gates using Verilog HDL
2. Design a nibble adder using Verilog HDL
3. Implement the half Subtractor in different levels of design description
4. Design an OR gate using multiplexer
5. Implement one bit comparator using Verilog
6. Construct the RTL design to implement digital circuit (with minimum gates and flip flops) that could control a coin operated vending machine to dispenses a candy under following conditions:
   (a) The machine accepts only Rs. 5 coin and other than Rs. 5 coin it should not accept.
   (b) It takes Rs. 15 for a piece of candy to be released from the machine
   i. Develop a state table and state diagram.
   ii. Draw the architecture in terms of control path and data path.
   iii. Construct the RTL to implement the above architecture.

21ECM13 FPGA Technology

4 0 0 4

Course Outcomes

1. Illustrate design metrics for various IC technologies and PLDs
2. Explain the general architecture, routing resources and programming elements of FPGA and FPGA design flow using CAD tools
3. Demonstrate the implementation of logic in FPGA
4. Summarize the architecture of Xilinx SRAM programmable FPGA
5. Illustrate the architecture of Actel Anti-Fuse programmable FPGA
6. Outline the techniques to implement an application

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	2	-
3	3	2
4	3	2
5	2	-
6	3	-

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Introduction to Programmable Logic Devices

Design metrics, merits and demerits of various IC technologies, Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex Programmable Logic Devices, various programing elements i.e mask ROM, ROM, EPROM, EEPROM.

16 Hours

Unit II

Field Programmable Gate Arrays

Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated specialized Components of FPGAs, and Applications of FPGAs. Front end design tools for FPGA and FPGA design flow.

14 Hours

Unit III

SRAM and Anti-Fuse Programmable FPGAs

SRAM and Anti-Fuse Programmable FPGAs: Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 And XC4000 Architectures.

Anti-Fuse Programmable FPGAs: Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

18 Hours

Unit IV

Design Applications

General Design Issues, Counter Examples, vending machine using One-Hot design method, A position Tracker for a Robot Manipulator, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

12 Hours

Total: 60 Hours

Text Book (s):

1. Stephen M. Trimberger, "Field Programmable Gate Array Technology", Springer International Edition, 1st Edition, 1994.
2. John V. Oldfield, Richard C. Dorf, "Field Programmable Gate Arrays", Wiley India Pvt. Ltd,1995

Reference Book (s):

1. Pak K. Chan, Samiha Mourad, "Digital Design Using Field Programmable Gate Arrays", Pearson Low Price Edition, 1st Edition, 2009
2. Wayne Wolf, "FPGA based System Design", Prentice Hall Modern Semiconductor Design Series, 2004.

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	50	50	--
Apply	30	30	50
Analyse	--		50
Evaluate	--	--	
Create	--	--	--
Total (%)	100	100	100

Remember

1. Recall the full form of (a) ASIC (b) VHDL
2. List are the outputs generated by Synthesis tool and Place & Route tool?
3. Recognize the plane which is programmable in PLA?

Understand

1. How parallel processing can be useful in the reduction of power dissipation of a circuit?
2. Explain the switching power dissipation in CMOS circuits.
3. Illustrate various sources of power dissipation in CMOS circuits.
4. Why leakage power dissipation has become an important issue in deep submicron technology?
5. Explain charge recycling in low power VLSI.

Apply

1. Implement the logic of two input XNOR gate in a FPGA having three input LUTs only.
2. "A system can perform the operation of two input XOR logic as well as two input XNOR logic. A switch is used to select the XOR and XNOR logic operation. If the switch is at '0' then XOR operation is to be performed and when the switch is at '1' then XNOR operation is to be performed". Implement the required system in PLA.
3. Implement the given function in two input LUT
   $Y = (A \cdot B) \cdot (C + D)$
4. Determine the reduced state table and corresponding state diagram of state table shown in Table Implement the logic of reduced state table by using one-hot encoding.

Present -State	Next-State		Output(Y)	
	X =0	X = 1	X = 0	X = 1
A	F	B	0	0
B	D	C	0	0
C	F	E	0	0
D	G	A	1	0
E	D	C	0	0
F	F	B	1	1
G	G	H	0	1
H	G	A	1	0

Table (i)

[Open Book Examination Question]
Analyze

1. Compare and contrast the SRAM and Anti-Fuse Programmable FPGAs technologies.
2. Designing a controller for an elevator. The elevator can be at one of three floors: Ground, First or Second. There are two buttons S1 and S0 that control the elevator. Also, there are three lights in the elevator that indicate the current floor. At each time step, the controller checks the current floor and current input, changes floors and lights in the obvious way. During designing make suitable assumptions.

21ECM14 Analog and Mixed Signal Design

4 0 0 4

Course Outcomes

1. Explain the mixed signal processing fundamentals
2. Outline the MOS models and differential amplifiers
3. Organize the Op-amp internal circuits using current mirrors
4. Demonstrate the switched capacitor circuits
5. Organize continuous and discrete time filters
6. Outline the data conversion circuits

COs – POs Mapping

COs	PO1	PO2
1	2	-
2	3	2
3	3	2
4	2	-
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Basics of Analog and Mixed Signal Design

Introduction analog and discrete-time signal processing, MOS device models, Second order effects, Differential amplifiers: single ended differential amplifier, basic differential pair, common mode response, and differential pair with MOS loads

Advanced MOS Modelling, Single Stage Amplifiers

14 Hours

Unit II

Design of Current mirrors and op-amp

Current Mirrors: simple CMOS current mirrors, Cascode and active current, high output impedance current mirrors. Operational Amplifiers: one stage and two stage op-amps, gain boosting, comparison,common mode feedback, input range limitation, slew-rate, power supply rejection, noise in op-amp, fully differential Op-amp, Frequency compensation in Op amp

Time and frequency domain noise analysis of amplifiers

16 Hours

Unit III

Switched capacitors and filters

Introduction to the switched capacitor circuits, Non-idealities in switched-capacitor filters, Basic building blocks, basic operation and analysis, sampling switches, Filters: Introduction Analog continuous time filters, passive and active filters; Basics of analog discrete-time filters, First order, Bi- quad, charge injection, Gain circuits

Switched-capacitor filter applications

16 Hours

Unit IV

Data converters

Basics of data converters; Analog to Digital converters: Integrating, Algorithmic, Two step, Folding,Pipeline, Interpolating ADCs; Decoder based DACs, Hybrid DACs

Basics of PLL, Analog PLLs, Digital PLLs

14 Hours
Total: 60 Hours

Textbook (s)

1. Tony Chan Carusone, David Johns, Kenneth Martin: Analog Integrated Circuit Design, 2nd Edition, John Wiley Publications, 2011.

2. Behzad Razavi , Design of Analog CMOS Integrated Circuits, 2nd Edition, McGraw-Hill, 2017
3. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008
4. Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005

Reference (s)

1. Philip E. Allen & Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, 2002
2. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford university press, first Indian edition, 2008
3. R. Jacob Baker, CMOS circuit design, layout and simulation, Revised second edition, IEEE press, 2008
4. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981
5. R. Schauman, Design of analog filters, Prentice-Hall, 1990

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	--
Understand	50	50	--
Apply	30	30	50
Analyse	--		50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Recall the analog signal processing.
2. Recall the discrete-time signal processing
3. Reproduce the sampling theory
4. Reproduce the basic differential pair
5. List any two analog continuous time filters
6. Recall the basics of analog discrete-time filters.

Understand

1. Explain the single ended differential amplifier circuit.
2. Abstract the second order effects in MOS FET.
3. Explain the basic differential amplifier
4. Illustrate the MOS models
5. Illustrate the MOS modelling

Apply

1. Construct a cascode current mirror using CMOS
2. Demonstrate the non-idealities in switched capacitor circuits
3. Demonstrate high output impedance current mirrors
4. Demonstrate the applications of switched capacitor filter.
5. Demonstrate a simple CMOS current mirror circuit.

Analyze

1. Outline the circuit for Successive approximation ADCs.
2. Outline the circuit for Dual slope ADCs.
3. Organize the Flash ADCs.
4. Outline a Pipeline ADC circuit.
5. Organize the High-resolution DACs

Industrial Automation

Preamble:
B.Tech minors in industrial automation is consisting of four courses namely Microcontrollers and Interfacing, Sensors and Data Acquisition System, Fundamentals of Labview and Medical Robotics. At the end of the course, the learners will be able to demonstrate the microcontrollers application for the industrial application. The learners will understand the role of sensors and data acquisition system in tracking different signals, operating principles, and their coordination. The learner will be able use Labview programming skills for various applications. Also, the learners can understand the preliminaries concepts of robotics in medical industry.

Prospects:
Industrial automation is on the threshold of a new revolution, moving through rapid technology changes, adoption of new systems, networking architectures, and looking toward interoperability of devices and systems. The industrial space has been impacted with incremental technology changes, rapid adoption of new systems and augmented networking architectures over the last decade. Industrial technologies such as Microcontrollers and Interfacing, Sensors and Data Acquisition System, Fundamentals of Labview and Medical Robotics are becoming increasingly pervasive. Given the proliferation of large-scale, continuous and parameterized industrial devices digitization has fostered, this need will turn into an obligation.

Placement Opportunities:
The course is designed to help you gain the essential skills to have a successful career in industry. You will get to work alongside our experts on some of the most advanced technology used for industrial automation. The course will enhance the chances to get selected in Manufacturing, Process Industries, Chemical, Food and Beverages, Oil Gas, Transport, Machine Tools, Automobile, Textile, IT and Design, etc.

21ECM21 Microcontroller and Interfacing

4 0 0 4

Course Outcomes

1. Explain the architecture of 8051 microcontroller
2. Explain the pin details of 8051 microcontroller
3. Implement assembly language programs of 8051 microcontroller
4. Implement assembly language programs for in-built peripherals of 8051 microcontroller
5. Explain the working of various I/O peripherals
6. Carry-out the interfacing of I/O peripherals with 8051 microcontroller

COs – POs Mapping

COs	PO_1	PO_2	PO_3
1	2	-	-
2	3	2	2
3	3	2	2
4	2	-	-
5	3	2	2
6	3	2	3

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I
8051 Microcontroller
Comparison between microprocessor and microcontroller, 8051 family microcontroller, RAM architecture of 8051, Integrated Development Environment (IDE), Pin description of 8051 microcontroller, Machine cycle.
Hex file **14 Hours**

Unit II
Instruction Set of 8051 Microcontroller
Instruction set of 8051: Data transfer instructions, Arithmetic instructions, Logical Instructions, Stack related instructions and Branching instructions, Addressing Modes, assembly language programming examples.
Study of LST file **16 Hours**

Unit III
Internal Peripherals of 8051 Microcontroller
Timers programming and applications, Interrupts programming and applications, Universal Asynchronous Receiver Transmitter (UART) programming and applications.
Features of ARM processor
14 Hours

Unit IV

External Peripheral Interfacing with 8051 Microcontroller
Interfacing with 8051 microcontroller with: Keypad matrix, LCD, Seven segment displays, L293D Motor driver, Stepper motor, Analog to Digital Converter (804), Digital to Analog Converter (808), sensors.
Interface LM35 with 8051 microcontroller

Textbook (s)

16 Hours
Total: 60 Hours

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, The 8051 Micro controller and Embedded systems: using assembles and C, Pearson, 2nd Edition,2007
2. Kenneth J Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Thomson Publishers, 3rd Edition, 2004

Reference (s)

1. N. Sentil Kumar, M Sarvanan, S Jeevananthan, Microprocessors and Microcontrollers, Oxford University Press, 1st Edition, 2010

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	50	50	--
Apply	30	30	50
Analyse	--		50
Evaluate	40	40	--
Create	--	--	--
Total (%)	--	--	100

Remember

1. State the significance of Reset pin of 8051 microcontroller.
2. List four differences between 8051 family of microcontroller.

Understand

1. Explain the consequences of execution of MOV IP, #14H instruction of 8051 microcontroller.
2. Explain the structure of internal RAM of 8051 microcontroller.
3. Explain the significance of each bit of TMOD register of 8051 microcontroller.

Apply

1. Write a program for 8051 microcontroller in assembly language to generate a square wave of 10KHz from pin P2.1. Assuming frequency of crystal attached to the microcontroller is 12MHz.
2. Develop a program in assembly language for 8051 microcontroller using interrupt to generate a 10KHz square wave from pin P2.0 and 25KHz square wave from pin P2.1 of 8051 microcontroller. Make suitable assumptions.
3. Interface a seven-segment display with 8051 microcontroller and develop a program in assembly language to display even numbers from 0 to 9.
4. Interface a LCD with 8051 microcontroller and develop a program in assembly language to display a message in 1st row of LCD.

[Open Book Examination Question]

21ECM22 Sensors and Data Acquisition System

4 0 0 4

Course Outcomes

1. Illustrate various digital data acquisition systems
2. Assess various data transfer techniques
3. Demonstrate the working principle of serial interface
4. Demonstrate the working principle of various digital instruments
5. Interpret various signal condition techniques
6. Outline various Remote data Acquisition techniques

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	3	2
3	3	2
4	3	2
5	2	-
6	3	3

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Data Acquisition systems & control

Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition, Instrumentation systems: Types of Instrumentation systems, Components of an analog Instrumentation Data – Acquisition system. Multiplexing systems, Uses of Data Acquisition Systems, Use of Recorders in Digital systems, Digital Recording systems, Modern Digital Data acquisition system, Analog Multiplexed operation, operation of sample Hold circuits.

sample & hold circuits- specifications and design considerations.

15Hours

Unit II

Data Transfer Techniques:

Interfacing To PC: Expansion Buses- ISA Bus, EISA Bus, PCI Bus. Plug in data Acquisition and Control Boards: Functions of Plug in DAQ boards, Design of General purpose DAQ boards, Design of DAQ boards for PCI Bus. Data Acquisition using Serial Interface: Serial Interface Standards Rs 232, USB-Features of USB, USB system, USB Transfer, USB Descriptors, GPIB/IEEE-488, LAN, Universal serial bus, HART protocol, Zigbee and Bluetooth.

Foundation Field bus, ModBus **15Hours**

Unit III

Digital Instruments

Digital voltmeters (DVMs): working principle, construction, operation, salient features, range selection– Ramp type, dual slope integrating type, successive approximation type, Digital Frequency Meter: working principle, construction (block diagram), range selection and operation of, time period meter, frequency ratio meter, Recorders: The working principle, construction, operation and salient features of X-t strip chart recorder, Introduction to PLC

X-Y strip chart recorder and Magnetic type recorder. **15Hours**

Unit IV

Sensors

Resistive Sensors, Inductive Sensors, Capacitive Sensors, Optical Sensors, Electro Magnetic Sensors, *Thermal Sensors*

15 Hours

Text Books **Total: 60 Hours**

1. Di Paolo Emilio, Maurizio , "Data Acquisition Systems From Fundamentals to Applied Design", Springer; 2013.
2. S. Gupta, J.P. Gupta, PC Interfacing for Data Acquisition and Process Control, ISA, 1994, 2nd Edition
3. Bell David A, "Electronic Instrumentation and Measurement", PHI, Inc, New Delhi (1994).
4. Tocci Ronald J , "Digital Systems Principles and Applications", PHI, New Delhi (2002)

Reference Books

1. A. D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1st Edition, 2015.
2. R. K. Jain , "Mechanical & Industrial Measurements", Khanna pub.
3. Chennakesava R Alavala, "Principles of Industrial Instrumentation and control systems", Cengage publ.

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open book Examination (%)
Remember	20	20	--
Understand	50	50	--
Apply	30	30	50
Analyse	--		50
Evaluate	--		--
Create	--		--
Total (%)	100	100	100

Remember

1. List the Converter Characteristics and explain them
2. Discuss the objectives of DAS.
3. Explain the following terms in detail (i) Resolution (ii)Non-linearity (iii)settling time (iv) Monotonicity

Understand

1. Draw the circuit diagram of Polynomial converter and explain its operation in detail
2. Explain the concept of Digital signal processing system in Digital Acquisition System along with circuit diagram
3. Define Error? Explain the different Error sources present in ADC and DAC systems in detail

Apply

1. Design a digital Voltmeter of range 0 to 20 v
2. Determine the working principal of HART protocol
3. Construct a digital frequency meter
4. Analyze various data loggers
5. Justify the working principal of Machine vision-based inspection system. IC engine data
6. Compare Various Remote data Acquisition using Internet

[Open Book Examination Question]

21ECM23 Fundamentals of Labview

4 0 0 4

Course Outcomes

1. Interpret basic building blocks of virtual instrumentation
2. Execute various graphical programming environment in virtual instrumentation
3. Asses various applications based on loops and error handling techniques
4. Execute various functions and I/O files
5. Implement Various applications on DAQ
6. Assess various real communications and interfacing

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	3	2
3	3	2
4	3	2
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Introduction of LabVIEW and Basic Programming:

LabVIEW Environment, Parts of VI, Front panel designing and working environment, Definitions of Control and Indicators, Types of Control and Indicators, Explanations of Controls Palette, Explanations Block Diagram and its working, Terminals, Functional Platte, Status Bar or Window tool bar, How to use Numerical functions, Designing of Boolean operations, Comparator applications

15 Hours

Unit II

Implementing a VI and Programming Loops

About For loops, How to use Shift registers, while loop designing, Flat Sequences, Applications based on Loops-Average Temperature VI, Temperature Multiplot VI, Square root VI, Arrays, Auto-Indexing of arrays, Array Functions and different array operations, Polymorphism and Polymorphic Vis, Clusters & Cluster Functions, creating cluster, bundle and unbundle operations on Cluster, Error Clusters to capture and merge errors while running a VI, String Functions for formatting and manipulating strings

15 Hours

Unit III

File I/O and Customizing Vis

File I/O VIs and Functions, High-Level File I/O Vis , Low-Level File I/O VI and Functions , Formatting Spreadsheet Strings Configuring the Appearance of Front Panels, Opening Sub VI Front Panels when a VI Runs, Keyboard Shortcuts for Controls, Editing VI Properties, Customizing the Controls and Functions Palettes

` **15 Hours**

Unit IV

Data Acquisitions Process and Instrument Control based on Embedded Controllers:

MAX and VISA explanations, GPIB communications, Serial communications and interfacing methods, acquiring the real time digital data to the LabVIEW User interface, controlling the LED operations, Acquiring of real time analog sensor values, controlling the Motors.

15 Hours
Total: 60Hours

Textbook (s)

1. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.
2. Lisa K Wells, Lab view for Everyone||, Prentice Hall of India.

Reference (s)

1. Barry Paton, —Sensor, transducers and Lab view||, Prentice Hall of India 2000.
2. Buchanan, W. —Computer buses||, CRC Press 2000

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1(%)	Int. Test 2 (%)	Open book Examination
Remember	25	10	--
Understand	40	45	--
Apply	35	45	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Draw and explain the graphical and VI models with design flow
2. Explain the essential need for Virtual Instrumentation and compare it with the traditional instruments.
3. Explain the role of different hardware's and software's in VI.

Understand

1. Explain the three parts of LabVIEW with three floating palette.
2. Discuss in detail about While and For Loops with Examples
3. Discuss in detail about different structures with examples
4. Describe in detail about various file types and File I/O functions

Apply

1. What are the NI-IMAQ and IMAQ vision functions used to acquire and display images?
2. Show the process how DAQ Assistant is used to acquire and generate signals with procedure for creating, configuring, Test and generate Lab VIEW code using DAQ Assistant.
3. Design a VI for pulse rate measuring in LabVIEW
   [Open Book Examination Question]

21ECM24 Medical Robotics

4 0 0 4

Course Outcomes

1. Describe the types of medical robots and the concepts of navigation and motion replication
2. Discuss about the sensors used for localization and tracking
3. Summarize the applications of surgical robotics
4. Outline the concepts in Rehabilitation of limbs and brain machine interface
5. Classify the types of assistive robots
6. Explore various applications of Robots in Medicine

COs – POs Mapping

COs	PO_1	PO_2	PO_3
1	2		
2	2		
3	3	2	2
4	3	2	2
5	2		
6	2		

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Introduction to medical robots

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare limit. Localization And Tracking - Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic - Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking systems .

Hybrid systems

14 Hours

Unit II

Control Modes and Rehabilitation

Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery – case studies. Rehabilitation for Limbs - Brain-Machine Interfaces

Steerable Needles – case studies

16 Hours

Unit III

Robots Vision in Medical Care

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Assistive robots –types of assistive robots – case studies.

Camera calibration

16 Hours

Unit IV

Design of Medical Robots and Applications

Characterization of gestures to the design of robots- Design methodologies- Technological choices - Security. Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics,

Neurosurgery

14 Hours

Total: 60 Hours

Text Book (s):

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Modeling and Control”, Wiley Publishers, 2006.
2. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall, 2003.

Reference Book (s):

1. J.J.Craig, Introduction to Robotics, Pearson Education, 2005.
2. Paula Gomes, "Medical robotics- Minimally Invasive surgery", Woodhead, 2012.
3. AchimSchweikard, Floris Ernst, “Medical Robotics”, Springer, 2015.
4. Jocelyne Troccaz, “Medical Robotics”, Wiley-ISTE, 2012.
5. VanjaBonzovic, ”Medical Robotics”, I-tech Education publishing,Austria,2008.
6. Daniel Faust, “Medical Robots”, Rosen Publishers, 2016.
7. Jocelyne Troccaz, “Medical Robotics”, Wiley, 2013

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember			--
Understand	70	25	--
Apply	30	75	50
Analyse	--		50
Evaluate	--	--	
Create	--	--	--
Total (%)	100	100	100

Understand

1. Explain about different types of medical robots.
2. Explain the Localization And Tracking in medical robots.
3. Illustrate Fiber optic tracking systems in in medical robots..
4. Why camera calibration has become an important issue in robotic surgery?
5. Explain Brain-Machine Interfaces.

Apply

1. Access the importance robotic surgery?
2. Assess the Assistive robots performance in surgeries.
3. Demonstrate Interactive Therapy with the help of suitable example.
4. Design a Bio Engineering Biologically Inspired Robots logically.
5. Implement the Bionic Arm.

[Open Book Examination Question]

Analyse

1. Compare and contrast various gestures to the design of robots .
2. Organize different approaches to design a Assistive robots.
3. Differentiate between Shrink operators and Swell operators.
4. Outline the Urologic Surgery and Robotic Imaging?
5. Outline the impact of Steerable Needles in robotic surgery.

[Open Book Examination Question]

Communications and Networking

Preamble:

B.Tech minors in Communications and Networking is consisting of four courses namely Principles of communications, Coding Theory and Practice, Ad-hoc and wireless sensor Networks, Fundamentals of Multimedia networking. At the end of the course, the learners will be able to demonstrate the Multimedia networking and communication for the real time application. The learners will understand the role of the field of networking and communication which includes the analysis, design, implementation, and use of local, wide-area, and mobile networks that link computers together.

Prospects:

Communications and Networking is on the threshold of a new revolution, moving through rapid technology changes, adoption of new systems and networking architectures. Coding theory is the study of the properties of codes and their respective fitness for specific applications. Codes are used for data compression, cryptography, error detection and correction, data transmission and data storage. Ad hoc networks are multi-hop networks consisting of wireless autonomous hosts, where each host may serve as a router to assists traffic from other nodes. Sensors provide service to monitoring stations.

Placement Opportunities:

The course is designed to help you gain the essential skills to have a successful career in industry opportunities. You will get to work alongside our experts on some of the most advanced technology used for Communications and Networking. The course will enhance the chances to get selected in in variety of sectors such as Telephone Industries, Civil Aviation, Defence, NPHIL, Railways, Power Sector, Hardware Manufacturing Industries, Television Industries, Research and Development Organisations with job titles as Service Engineers, Software Analyst, Technical Director, Field Test Engineer, Network Planning Engineer, Customer Support Engineer, Electronics and Communication Consultant, Research and Development Software Engineer and so on.

21ECM31 Principles of Communications

4 0 0 4

Course Outcomes

1. Understand the sampling and quantization
2. Understand waveform coding techniques to represent digital data
3. Explain source coding techniques
4. Explain error detection and correction codes
5. Demonstrate transmission of digital data over a baseband channel
6. Outline the techniques to combat the inter symbol interference

Cos - POs Mapping

COs	PO1	PO2
1	2	-
2	2	-
3	2	-
4	2	-
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit – I

Model of Digital Communication Systems

Digital Representation of Analog Signal, Certain Issues in Digital Transmission, Advantages of Digital Communication Systems, Sampling Theorem, Types of Sampling – Impulse Sampling, Natural Sampling , Flat – Top Sampling. Introduction to Baseband Sampling. Waveform Coding Techniques: PCM Generation and Reconstruction, Quantization Noise, Non Uniform Quantization and Companding, DPCM, Adaptive DPCM, DM and Adaptive DM

Noise in PCM, Noise in DM.

16 Hours

Unit – II

Information theory

Information and Entropy, Conditional Entropy and Redundancy, Shannon-Fano Coding Mutual information, Information Loss due to Noise, Source coding Huffman Code, Variable Length Coding, Lempel-ziv coding, Source coding to increase average information per bit, Lossy Source coding, Hartley Shannon Law.

Bandwidth-S/N Trade off, Mutual Information

14 Hours

Unit-III

Error Control Codes

Linear Block Codes: Matrix Description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes. Cyclic Codes: Algebraic Structure, Encoding, Syndrome Calculation, Decoding. Convolution Codes: Encoding, Decoding

Receiver design of linear block codes, convolutional codes

16 Hours

Unit – IV

Baseband Pulse Transmission

Introduction, Matched Filter, Error Rate Due to Noise, intersymbol interference Nyquist's criterion for Distortionless Baseband Binary Transmission, Correlative -Level Coding Baseband M-Array PAM Transmission PAM Transmission, Digital subscriber Lines, Optimal Liner Receiver

Adaptive Equalization, Eye patterns

14 Hours

Total: 60 Hours

Text book(s)

1. S. Haykin, Communications system, Wiley, 4th Edition, 2009
2. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley, 2005.

Reference(s)

1. Herbert Taub, Donald L Schiling, Goutam Saha, Principles of Communication Systems, 3rd Edition, McGraw-Hill, 2008
2. Wayne Tomasi, Electronic communication systems, Pearson, 5th Edition, 2008
3. R. P. Singh , S. Sapre, Communication Systems, Analog and Digital, McGraw-Hill Education, 2012
4. John G. Proakis, Masoud Salehi , Digital Communications, 5th Edition, McGrawHill, 2008

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam(%)
Remember	10	10	
Understand	50	40	
Apply	40	50	50
Analyse			50
Evaluate			
Create			
Total (%)	100	100	100

Remember

1. Define PCM
2. List the two advantages of sampling
3. Define DPCM

Understand

1. Explain how encoding is done by convolution codes with a suitable example
2. Explain matched filter and derive the expression for probability of error
3. Explain tree diagram, trellis diagram and state transition diagram of convolution codes

Apply

1. Implement a (2, 1) convolutional coder with constraint length 6. Draw the tree diagram, state diagram and trellis diagram for the assumed coder. Find the (7,4) linear systematic block code word corresponding to 1101.Assume a suitable generator matrix **[Open book question]**
2. Predict the parameter which is called a figure of merit of a digital communication system and why?
3. Execute the channel synchronization method in PCM systems

Analyze

1. Consider the convolutional code with g (1) = (111) and g(2) = (110):

   (i) Draw the encoder block diagram.

   (ii) Draw the Code Tree and state diagram.

   (iii) Decode the following sequence 00001110 using Viterbi Decoding Algorithm

   [Open Book question]

2. A TV signal with bandwidth of 4.2 MHz is Transmitted using binary PCM .The number of quantization levels is 512. Calculate (i) Code word length (ii)Final bit rate (iii)S/N Outline Convergence of the weight vector of LMS Algorithm

   [Open book question]

3. Outline the signal space diagram of quadrature amplitude modulation and its differences with respect to QPSK. Analyze different ways of increasing the efficiency of steam power plant by giving appropriate justification

21ECM32 Coding Theory and Practice

4 0 0 4

Course Outcomes:

1. Exemplify the basic communication process.
2. Explain the information theory concepts and Shannon theorem.
3. Demonstrate channel capacity and discrete memoryless channels.
4. Construct various source coding techniques.
5. Summarize the channel coding techniques.
6. Outline the encoding and decoding structure of convolutional codes.

COs-POs Mapping

COs	PO1	PO2
1	2	1
2	2	1
3	3	2
4	2	1
5	2	1
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Communication process

The communication process, primary communication resources, sources of information, communication networks, communication channels, modulation process, analog and digital types of communication, sampling process, pulse-amplitude modulation, digital communication problem.

Noise, Gaussian process

15 Hours

Unit II

Fundamental limits in Information theory

Uncertainity, Information, Entropy: marginal, conditional, joint and relative entropies, relation among entropies, Mutual information, information rate, channel capacity, redundancy and efficiency of channels, Discrete memoryless channels, Shannon's theorem.

Probability of error, Matched filter

15 Hours

Unit III

Source coding

Need for encoding, Instantaneous codes, construction of instantaneous codes, Kraft's inequality, coding efficiency and redundancy, source coding theorem. construction of basic source codes, Shannon Fano coding, Huffman coding and examples.

Rate-distortion function, Quantization

15 Hours

Unit IV

Channel coding

Examples of the use of error control codes, basic notions, coding gain, comparison of uncoded and coded systems. Linear block Codes, Cyclic Codes, Convolution Codes: Convolution encoders, structural properties of convolution codes, Trellis Diagrams, Viterbi Algorithm, Applications: Concatenated Codes, Interleavers, The Compact Disc, Codes for Magnetic recording

BCH Code, RS code

15 Hours

Total: 60 Hours

Textbook (s)

1. Stephen.B.Wicker, Error Control Systems for Digital Communication and storage, Prentice Hall,1995.
2. Bernard Sklar, Digital communications: Fundamentals and applications, 2nd Edition, Prentice Hall,2001.
3. Simon Haykin, Communication Systems, 4th Edition, John Wiley and Sons, 2001.

Reference (s)

1. John G.Proakis, Digital communication, 4th Edition, McGraw Hill, 2001.
2. R.P. Singh, SP Sapre, Communication Systems, 3rd Edition, TMH, 2017.

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	25	20	--
Understand	50	40	--
Apply	25	25	80
Analyse	--	15	20
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Define sampling
2. State information
3. List any two block codes
4. List any two source code techniques
5. Define maximum likelihood probability
6. List any two applications of convolutional codes

Understand

1. Explain various types of error channels.
2. Illustrate the structure of Shannon fano coding.
3. Compare Shannon fano and Huffman coding.
4. Illustrate the detection of cyclic codes.
5. Represent the Viterbi decoding algorithm and explain the steps in decoding.
6. Explain the applications of convolutional codes.

Apply

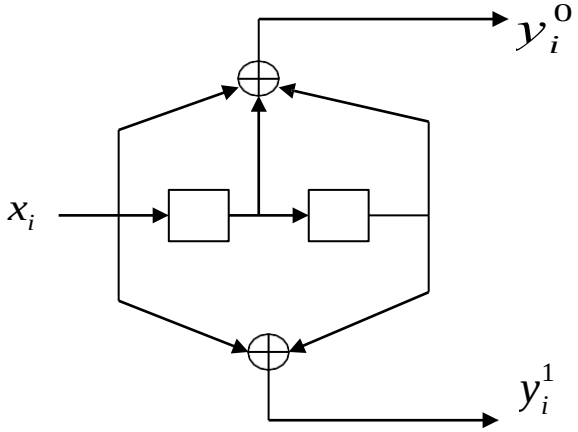
1. A source emits a sequence of symbols having probabilities given below.
   {0.4, 0.2, 0.12, 0.08, 0.08, 0.08, 0.04}.
   a) Using Shannon-fano algorithm find out the average code word length, entropy and efficiency of the source for single-partitioning.
   b) Determine the same by performing Huffman-coding algorithm
2. Consider a (7, 4) Code whose Generator matrix is given below.
   a) Find all the codewords of the code. What is $d_{\min}$?
3. A discrete memoryless source has an alphabet of seven symbols having probabilities of occurrence as {0.25,0.25,0.125,0.125,0.125,0.0625,0.0625}.Compute the Huffman code for this source, moving a "combined" symbol as high as possible. Show that the efficiency of source code is 100 percent.
   [Open Book Examination Question]
4. Design a feedback shift register encoder for an (8, 5) cyclic code with a generator. Use the encoder to find the codeword for the message 10101 in systematic form.

   [Open Book Examination Question]

Analyse

1. For the convolutional encoder shown below, determine the following:
   a) Output sequence for message sequence x_i ={1 0 0 1 1} in both time domain and transform domain approach.
   b) Construct the state diagram for corresponding encoder.
2. Prove the Statement "The mutual information of a channel is related to the joint entropy of the channel input and channel output"
3. a) The generator polynomial of a (15,11) hamming code is defined by g(X) =1+X+X^4 develop the encoder and syndrome calculator for the code.
   b) Encode the 1 0 1 in systematic form using polynomial division and the generator g(X) = 1+X+X^2+X^4.
   [Open Book Examination Question]

4. For the convolutional encoder shown below, determine the following:
   a) Output sequence for message sequence x_i ={1 0 1 0 1} in both time domain and transform domain approach.
   b) Draw the state diagram for corresponding encoder.



[Open book Examination Question]

21ECM33 Ad-hoc and Wireless sensor networks

4 0 0 4

Course Outcomes

1. Exemplify wired and wireless networks for real time applications.
2. Summarize sensor network architectures for various application.
3. Interpret various operations in sensor node and transceiver design.
4. Classify suitable medium access protocols, routing protocols, security protocols and radio hardware.
5. Implement Prototype sensor networks using commercial components.
6. Differentiate various infrastructure management and sensor network platform tools

COs – POs Mapping

COs	PO_1	PO_2	PO_3
1	2	-	-
2	2	-	-
3	3	2	2
4	3	2	2
5	2	-	-
6	2	-	-

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Power Dissipation in CMOS

Key definitions of WSN, Advantages of sensor Networks, Unique constraints and challenges, Driving Applications, Enabling Technologies for WSNs. Single node architecture – Hardware Components, Energy consumption of sensor nodes, Operating system and execution environment, Network architecture-Sensor network scenarios. Optimization goals.

Gate way concepts, Figures of merits **14 Hours**

Unit II

Power Optimization Using Special Techniques

Physical layer, Transceiver design considerations, Personal area Networks (PANs), Hidden Node and Exposed node Problem, Topologies of PANs, Topologies of MANETs, Topologies of WANETs. Issues in designing a MAC protocol for WSNs, Design goals of a MAC protocol for WSNs.

Classification of MAC Protocols, Contention based protocols **16 Hours**

Unit III

Design of Low Power Circuits

Introduction, Issues in designing a routing protocol for ad-hoc wireless networks, Classification of routing Protocols, Table-driven routing protocols, On-demand routing protocols, Hybrid routing Protocols, Routing Protocols with efficient flooding mechanism, Hierarchical routing protocols , Power aware routing Protocols, Proactive routing. Issues in designing Transport layer for ad-hoc wireless Networks, Design goals of Transport layer for ad-hoc wireless Networks.

Classification of transport layer solutions, TCP over ad-hoc wireless networks

16 Hours

Unit IV

Power Estimation

Topology control, Clustering, Time Synchronization, Localization, Positioning, Sensor Tasking and Control, Security in ad-hoc wireless networks, Network security requirements, Issues and Challenges in security provisioning, Network security attacks, Key management, Security Routing in ad-hoc wireless networks. Sensor node hardware-Berkely motes, Programming challenges, Node level software platforms.

Node level simulators, State centric programming

14 Hours

Total: 60 Hours

Text Book (s):

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI
2. Wireless Ad- hoc and Sensor Networks: Protocols. Performance and Control – Jagannathan Sarangapani, CRC Press
3. Holger Karl & AndreasWillig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.

Reference Book (s):

1. KazernSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols and Applications", John Wiley, 2007.

2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, c.K. Toh ,Ied, Pearson Education.
4. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam,2004, Springer
5. Wireless Sensor Networks - S Anandamurugan , Lakshmi Publications

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. List any three advantages of wireless sensor networks
2. List any two Enabling Technologies for WSNs

Understand

1. Explain the sensor network architectures for various applications
2. Illustrate various operations in sensor node and transceiver design

Apply

1. Implement Prototype sensor networks using commercial components.
   [Open Book Examination Question]

Analyze
1. Differentiate various infrastructure management and sensor network platform tools
[Open Book Examination Question]

21ECM34 Fundamentals of Multimedia Networking

4 0 0 4

Course Outcomes

1. Explain the basics of multimedia
2. Demonstrate the digitization of sound
3. Summarize the fundamental concepts in video
4. Classify lossy and lossless data compression
5. Outline the transform coding techniques
6. Demonstrate multimedia networks

COs – POs Mapping

COs	PO_1	PO_2	PO_3
1	2	-	-
2	2	-	-
3	3	2	2
4	3	2	2
5	2	-	-
6	2	-	-

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Introduction to Multimedia

Components of Multimedia, Multimedia and Hypermedia, World Wide Web: History of the WWW, Hyper Text Transfer Protocol (HTTP), Hyper Text Markup Language (HTML), Extensible Markup Language (XML), Synchronized Multimedia Integration Language (SMIL), Graphics/Image Data Types: 1-Bit Images, 8-Bit Gray-Level Images, Image Data Types.

24-Bit Color Images, 8-Bit Color Images

14 Hours

Unit II

Basics of Digital Audio, Image and Video

Digitization of Sound: Digitization, Nyquist Theorem, Signal-to-Noise Ratio (SNR), Signal-to-Quantization-Noise Ratio (SQNR), Linear and Nonlinear Quantization, Audio Filtering, Audio Quality versus Data Rate, Synthetic Sounds. Fundamental Concepts in Video: Types of Video Signals, Component Video.

Composite Video, S-Video

16 Hours

Unit III

Multimedia Data Compression

Lossless Compression Algorithms: Basics of Information Theory, Run-Length Coding, Variable-Length Coding (VLC), Shannon-Fano Algorithm, Huffman Coding. Lossless Image Compression: Differential Coding of Images, Lossless JPEG. Lossy Compression Algorithms: Distortion Measure, The Rate-Distortion Theory.

Transform Coding: Discrete Cosine Transfonn (DCT), Karhunen-Loeve Transform

14 Hours

Unit IV

Computer and Multimedia Networks

Basics of Computer and Multimedia Networks: OSI Network Layers, TCP/IP Protocols. Multiplexing Technologies: Basics of Multiplexing, Integrated Services Digital Network (ISDN), Synchronous Optical NETwork (SONET), Asymmetric Digital Subscriber Line (ADSL). LAN and WAN: Local Area Networks (LANs), Wide Area Networks (WANs), Asynchronous Transfer Mode (ATM).

Gigabit and 10-Gigabit Ethernets

16 Hours

Total: 60 Hours

Text Book (s):

1. Ze-Nian Li and Mark S. Drew “Fundamentals of Multimedia”, Pearson Education, 2004.
2. Fred Halsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Pearson publication, 2009.

Reference Book (s):

1. Multimedia Communication Systems- K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Pearson Education, 2004. ISBN -9788120321458.
2. Multimedia over IP and Wireless Networks: Compression, networking, and Systems, by Mihaela vander Schaar. And Philip Chou, Academic Press, 2007.

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	30	20	--
Understand	60	70	--
Apply	10	10	50
Analyse	--		50
Evaluate	--	--	
Create	--	--	--
Total (%)	100	100	100

Remember

1. Define Cognitive System in human communication model.
2. Define Signal-to-Quantization-Noise Ratio (SQNR).
3. List any two Lossless Compression Algorithms.

Understand

1. Explain the different types of video signals.
2. Compare Shannon-Fano coding and Huffman Coding
3. Interpret ITU-T standardization.
4. As a variation of FDM, WDM is used for multiplexing over fiber-optic channels. Compare WDM with FDM.

Apply

1. Suppose eight characters have a distribution A:(1), B:(l), C:(l), D:(2), E:(3), F:(5), 0:(5), H:(lO). Draw a Huffman tree for this distribution.
2. Both ISDN and ADSL deliver integrated network services, such as voice, video, and so on, to home users or small-office users. Assess the advantages of ADSL over ISDN?
3. Your task is to think about the transmission of smell over the Internet. Suppose we have a smell sensor at one location and wish to transmit the Aroma Vector (say) to a receiver to reproduce the same sensation. You are asked to design such a system. List three key issues to consider and two applications ofsuch a delivery system. Hint: Think about medical applications.

[Open Book Examination Question]

Avionics

Preamble:

B.Tech minors in Avionics consists of four courses namely Principles of Aerodynamics, Aircraft Electrical Systems, Aircraft Instrument Systems and Aircraft Communication & Navigational systems. Avionics means Aviation Electronics, which deals with aircraft dynamics integrated with various systems. At the end of the course, the learners will be able to understand basics of aerodynamics staring from lift production and ending with an overall view of flight dynamics. The learners will understand the basic concepts of electrical systems including tracing of wiring diagram which helps to lay a foundation for snag rectification. Operating principles of various instruments of aircraft are also dealt in this course to make the learners to understand overall operation. Also the learner will be able to appreciate the communication and navigation systems integrated with the instrumentation.

Prospects:

In India, Aviation industry is the most popular field and there are great career prospects for students willing to pursue this course and make their careers in Avionics. As there is an expectation for rise in demand for Air services in future, career opportunities will be more for the students. It is one of the fastest developing streams and has great opportunities to offer to qualified professionals both in India and abroad. As there are wide varieties of jobs in aviation industry, this course will be used as a bridge course for further courses.

Placement Opportunities:

The course is designed to help the learners to gain the basic and essential skills to have a successful career in aviation industry. As the jobs in aviation industry demands specialized knowledge, this course will fulfill the pre requisite knowledge to get a wide range of job opportunities such as Technical Manager, Avionics Engineer, Test Engineer and Engineering Trainees

21ECM41 Principles of Aerodynamics

4 0 0 4

Course Outcomes

1. Explain air flow characteristics aero foils
2. Predict the operation of primary and secondary flight controls
3. Explain the operation of different types of flight control systems
4. Explain aircraft performance and stability
5. Explain aircraft stability
6. Select appropriate type of wings for transonic and supersonic flights.

COs – POs Mapping

COs	PO_1	PO_2
1	3	-
2	3	2
3	3	-
4	3	-
5	3	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Air flow characteristics

International Standard Atmosphere, Division of atmosphere, variation of properties of air with altitude, pressure, density, temperature. Aero foils – Parts, types and features, Pressure distribution over aerofoils. Stagnation, centre of pressure, angle of attack, wash in, wash out, fineness ratio, aspect ratio.

Bernoulli's theorem, Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, vortices, Types of drags – profile (parasite) drag, induced drag. Thrust, Weight, Generation of lift and drag, Lift coefficient, Drag coefficient, polar curve, separation point, stalling angle, stalling speed, Types of wings.

up wash and downwash, Aerodynamic Resultant

15 Hours

Unit II

Primary and Secondary Flight Controls

Primary flight control – ailerons, elevators, rudder, Secondary Flight controls – Flaps, slats, spoilers, Movement and operation of the controls giving control about the axes of an aircraft, trim systems, Operation of a manually operated flight control system, Operation of electro-mechanically operated flight control system, Operation of hydraulically operated flight control system, Operation of a fly by wire control flight system

Trimming methods – trim tabs, variable incidence tail place, mach trim

15 Hours

Unit III

Aircraft Performance and Stability

Forces involved - Take off, climbing, leveling, descent and landing, radius of turn, rate of turn, rate of climb, Influence of load factor. Types of flight - steady, gliding, turning and climbing. Limitations on turn, pull up and push over, V-N diagrams.

Aircraft control and manoeuvres, Types of stability – Longitudinal stability, lateral stability and directional stability (active and passive), Dutch Roll, Divergence – Spiral divergence, directional divergence. side slip, Forces and moments and their effects

flight envelope and structural limitations

15 Hours

Unit IV

Transonic Flight and supersonic flight

Effects of wing fences; saw tooth leading edges; Boundary layer control using - vortex generators, Stall ,wedges or leading edge devices; Speed of sound, subsonic& transonic flight

Mach number, critical Mach number, compressibility buffet, area rule; Factors affecting airflow in engine intakes of high speed aircraft; Effects of sweepback on critical Mach number , delta wings, wind tunnels

shock wave, aerodynamic heating

15 Hours

Total: 60 Hours

Text Book (s):

1. Fundamental of Flight: Basic Aerodynamics Vol -I Lalit Gupta EBS
2. Flight without Formulae A.C. Kermode Pearson

Reference Book (s):

1. Understanding Flight David F Anderson and Scott Eberhardt Mc Graw Hill
2. Aircraft Engineering Principles L Dingle & M Tooley Elsevier publisher

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. Define aspect ratio.
2. State Bernoulli's theorem.
3. Recall wash in and washout.
4. State types of drags.

Understand

1. Explain pressure distribution over an aerofoil.
2. Explain centre of pressure of an aircraft.
3. Explain types of wings.
4. Compare profile drag and induced drag.

Apply

1. Show how the lift is generated.
2. Assess the performance of different types of wings.
3. Assess the aircraft performance during takeoff.
4. Select the appropriate flight controls required for turning of an aircraft.
5. As a pilot of the aircraft, select the appropriate publication to know the operating flight strength limitations and discuss about those diagrams.
   [Open Book Examination Question]

21ECM42 Aircraft Electrical Systems

4 0 0 4

Course Outcomes

1. Explain about DC power supplies of an aircraft
2. Explain different AC power supplies of an aircraft
3. Select appropriate circuit controlling and protection devices
4. Explain power distribution in the aircraft
5. Explain different power utilization systems
6. Carryout snag analysis with the help of circuit tracing

COs – POs Mapping

COs	PO_1	PO_2
1	3	-
2	3	-
3	3	2
4	3	-
5	3	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

DC and AC Power Supplies

Principle of DC Generator, Interpoles and Compensating windings, Auxiliary interpoles, Spark suppression, Brush wear at high altitude, Vibrating contact regulator, Carbon pile voltage regulation, Solid state voltage regulator, Paralleling and load sharing, Indications of fully charged batteries, Thermal runaway, Parallel and series connection of batteries, Battery charger control circuit

Operation of CSD unit, under drive phase , overdrive phase, Excitation of Frequency wild generator, Constant frequency generator, Voltage regulation, Real load sharing, Reactive load sharing, Synchronization between generators, Power conversion equipment

Battery charging from external power, In situ battery charging system

15 Hours

Unit II

Circuit Controlling and Protection Devices

Switches- types (Toggle switch, Push switch, Rocker button switch, Rotary switch, Micro switch, Time switch, Pressure switch, Thermal switch,) Relays, Attracted- core heavy duty relay, Polarized armature relay, Slugged relay, Breakers, Three pin receptacle system, Fuses, Limiting resistors, Current Limitters, Circuit Breakers, Protection against reverse current, Reverse current cut out relay, Switched reverse current relay, Reverse current circuit breaker, Over voltage protection dc generating system, Over voltage protection ac generating system, Differential current protection.

External ac power receptacle and control panel

15 Hours

Unit III

Power Distribution and Measuring Instruments

GPU, Multiple DC bus bar system, APU, Split bus bar system, Combinations of Parallel operation, Wires and Cables, Pressure bung Assembly, Earthing, Cable terminations, Crimped terminals, Inline connectors, Polarizing key positions, Static discharge vicks.

Ammeters – Types and extension of range, Volt meters – types and extension of range, Ohm meters – types, Watt meters, Instrument transformers, Magnetic indicators, CRO – constructional details and applications

Screening, Bonding **15 Hours**

Unit IV

Power Utilization Systems and Circuit tracing

Lighting system, Engine starting system, Magneto Ignition System, High Energy Ignition System, Fire detection and extinguishing system, Ice and rain protection system, Anti skid control system, Types of bus bars, Inter connection of bus bars, Bus tie contactors, Main systems, Stand by systems, Emergency systems, Circuit protection, Circuit tracing

Wind shield Wiper system, Rain Repellent system **15 Hours**

Total: 60 Hours

Text Book (s):

1. Aircraft Electrical Systems EHJ Pallet Himalayan Books
2. Basic Electricity Dale Crane

Reference Book (s):

1. Aviation Electronics Vol.1 by John M. Ferrara
2. Aircraft Electricity and Electronics by Bent Mekinley

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. State indications of fully charged batteries
2. Define real and reactive load sharing
3. Recall any four types of switches
4. State the purpose of bonding

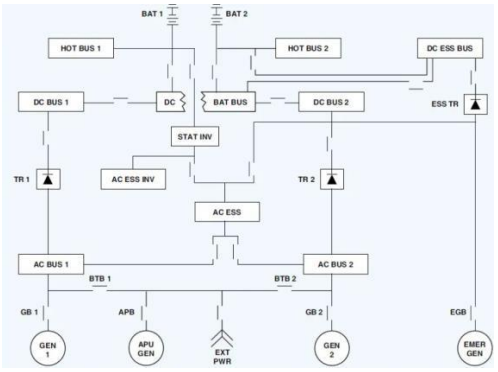
Understand

1. Explain reverse current cut-out relay
2. Explain anti-skid control system
3. Explain different types of bus bars in the aircraft
4. Explain insitu battery charging system

Apply

1. Show how the power is distributed inside the aircraft with schematic diagram
2. Predict the consequences in case of complete ac power failure
3. Assess the performance of multiple DC bus bar system
4. Predict the probable causes for failure of fire detection system
5. After going through the given split bus power distribution system, find the relevant actions during normal and emergency flight

[Open Book Examination Question]



21ECM43 Aircraft Instrument Systems

4 0 0 4

Course Outcomes

1. Explain air data instruments and their settings
2. Explain gyroscopic instruments
3. Find appropriate instruments for engine parameters
4. Explain cockpit pressurization and air-conditioning system
5. Explain inertial navigation system
6. Select the appropriate instruments for navigation

COs – POs Mapping

COs	PO_1	PO_2
1	3	-
2	3	-
3	3	2
4	3	-
5	3	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Air data and Gyroscopic instruments

Pitot static system, Altimeter, Air speed indicator, Vertical speed indicator, Types of Airspeeds, Mach indicator, Air temperature indicator, Barometric pressure setting, Q code for altimeter setting, Cabin altimeter
Introduction to gyroscopic theory, Directional gyro, Gyro horizon, Remote reading artificial horizon, Electrical type artificial horizon, Turn and slip indicator
Air speed indicator color coding, outside air temperature gauge

15 Hours

Unit II

Propulsion system instruments

Engine RPM indicator, Measurement of temperature, Fuel and oil system, Thermocouple, Engine oil pressure indicating system- Pressure gauge, Remote reading pressure gauge, Vibration monitoring system, Fuel pressure warning instruments, EPR measurement, Torque monitoring, EICAS – Engine data display
Engine oil temperature indicating system, torque indicator

15 Hours

Unit III

Cockpit pressurization Oxygen Equipments

Introduction to cockpit pressurization system, Cockpit pressurization and air conditioning system
Oxygen installation, Introduction to Oxygen equipment set, Introduction to Emergency oxygen system, Engine oxygen system, Introduction to liquid oxygen system, Oxygen charging regulator Methods of Oxygen Supply ; Testing and servicing of one oxygen system
Safety precautions during the servicing of oxygen system and during installation

15 Hours

Unit IV

Navigation Instruments

Inertial Navigation System Units of INS, navigation fundamentals, navigation terms, Transport and earth rate compensation
Liquid compass, Magnetic influence of various elements in aircraft, Compass swinging, Flight directional system, Compass error, Horizontal situation indicator, Radio magnetic indicator, Automatic direction finder
Drawbacks of liquid compass and magnetic compass

15 Hours
Total: 60 Hours

Text Book (s):

1. Aircraft Instruments by EHJ Pallet Himalayan Books
2. Aircraft Instruments by C.A. Williams

Reference Book (s):

1. Aviation Electronics Vol.1 by John M. Ferrara
2. Aircraft Electricity and Electronics by Bent Mekinley
3. Civil Aviation Inspection Procedures (CAP 459) PartI: Basic, Part II: Aircraft (2Vols)
4. Aircraft Oxygen System by Robert Scheppler and Dale Crane

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. State the purpose of ASI and altimeter
2. State the different colours of the scale of ASI as a part of standard colour coding
3. Recall any four types of air data instruments
4. State the difference between calibrated air speed and true air speed

Understand

1. Explain the principle of operation of Air speed indicator
2. Explain the construction of Altimeter
3. Explain safety precautions during the servicing of one oxygen system
4. Explain EICAS- Engine data display

Apply

1. Find the reasons for failure of a pitot static system
2. Find the list of instruments effected by blockage of static system
3. Find the instruments which makes use of earth's magnetic field
4. Carryout the corrections for variation and deviation in the correct sequence
5. Select the instruments which are very important for flying and discuss the steps to be taken by the pilot in case of failure of these instruments
   [Open Book Examination Question]



21ECM44 Aircraft Communication and Navigation Systems

4 0 0 4

Course Outcomes

1. Explain HF and VHF communication
2. Explain navigation equipment
3. Select appropriate landing system
4. Explain different types of navigation
5. Explain FMS system
6. Find appropriate equipment required for ATC system

COs – POs Mapping

COs	PO_1	PO_2
1	3	-
2	3	-
3	3	2
4	3	-
5	3	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

HF and VHF communication

DSB modulation, SSB modulation, Channel spacing, Depth of modulation, Compression, Squelch HF range and propagation, SELCAL, HF data link, HF radio Equipment, HF antennas and coupling units, VHF range and propagation, ACARS, VHF radio equipment, PA System, HF and VHF system description, Flight interphone system, voice recorder, ELT

Frequency range spectrum, types of wave propagation

15 Hours

Unit II

Navigation Equipment and Landing Systems

Navigation terminology, ADF – Introduction, Principle, Equipment, Operational aspects, VOR – Principle, Airborne equipment, Operational aspects, DME – Operation, Equipment

ILS – System overview, Ground equipment, Airborne equipment, Low range radio altimeter, Operational aspects of ILS; MLS – System overview, Principles, Aircraft Equipment, Ground equipment

Types of landing systems, types of transponders

15 Hours

Unit III

Types of Navigation

Doppler Effect, Doppler navigation principles, Airborne equipment, Hyperbolic position fixing, LORAN-C operation, LORAN airborne and ground equipment

RNAV overview, RNAV equipment, INS- principle, operation, Alignment, Accuracy GPS – Satellite navigation principles, GPS Segments, Operation

Types of navigation systems, significance of waypoints

15 Hours

Unit IV

FMS and ATC systems

FMS – Over view, System Initialization, FMCS and its operation

ATC systems – ATCRBS, ATS basic principle, ATC transponder – modes, dual control panel, mode S replies, System block diagram, Operation, TCAS equipment and operation, TCAS overview.

IFF and different types of advisories

15 Hours

Total: 60 Hours

Text Book (s):

1. Aircraft Communications and Navigation Systems by Mike Tooley and David Wyatt - Butterworth-Heinemann publishers

Reference Book (s):

1. Aircraft Radio Systems by Powell
2. Aviation Electronics Vol.1 by John M. Ferrara

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

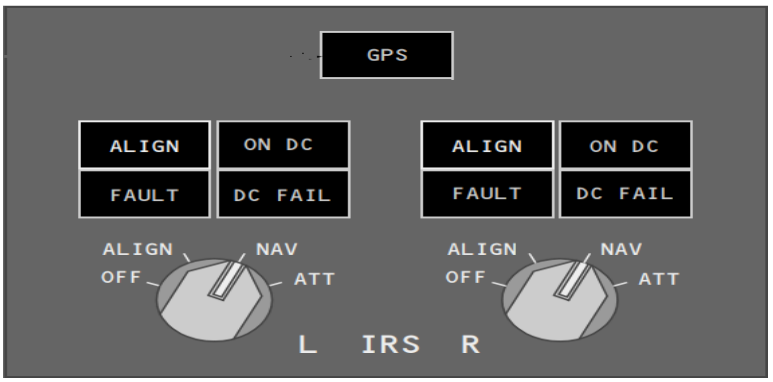
1. State the purpose of ELT
2. State the purpose of voice recorder
3. Recall types of landing systems
4. State the difference between TCAS and ACAS

Understand

1. Explain LORAN-C operation
2. Explain the operation of DME
3. Explain GPS segments
4. Explain the Doppler effect

Apply

1. Select appropriate ground equipment for ILS
2. Select appropriate ground equipment for MLS
3. Find the instruments responsible for navigation
4. Predict when the following lights will illuminate
   [Open Book Examination Question]



Geographic Information System

Preamble:

A geographic information system (GIS) is a conceptualized framework that provides the ability to capture and analyse spatial and geographic data. GIS applications (or GIS apps) are computer-based tools that allow the user to create interactive queries (user-created searches), store and edit spatial and non-spatial data, analyze spatial information output, and visually share the results of these operations by presenting them as maps. Geographic information science (or, GIScience)-the scientific study of geographic concepts, applications, and systems is commonly initialized as GIS, as well.

Geographic information systems are utilized in multiple technologies, processes, techniques and methods. They are attached to various operations and numerous applications that relate to: engineering, planning, management, transport/logistics, insurance, telecommunications, and business. For this reason, GIS and location intelligence applications are at the foundation of location-enabled services that rely on geographic analysis and visualization.

Placement Opportunities:

People working in many different fields use GIS technology. GIS technology can be used for scientific investigations, resource management, and development planning. Many retail businesses use GIS to help them determine where to locate a new store. Marketing companies use GIS to decide to whom to market stores and restaurants, and where that marketing should be. Scientists use GIS to compare population statistics to resources such as drinking water. Biologists use GIS to track animal-migration patterns. There is no limit to the kind of information that can be analysed using GIS technology.

21ECM51 Sensors and Sensing Technology

4 0 0 4

Course Outcomes

1. Explain properties of semiconductor as sensors
2. Illustrate the working principle of different sensors
3. Demonstrate the characteristics of sensors
4. Explain the challenges in biomedical sensors
5. Illustrate the challenges in textile sensors
6. Outline the biomedical and textile sensors

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	2	-
3	3	2
4	2	-
5	2	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit – I

Introduction to Sensors

Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs. Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors.

14 Hours

Unit-II

Principle of Sensors

Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magneto strictive sensors. Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer Flow sensors: pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. microflow sensor, coriolis mass flow and drag flow sensor

15 Hours

Unit – III

System Design using Sensors

Introduction-Systems design - Challenges in chemical and biochemical sensing - Application areas -Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors - Practical considerations for wearable inertial sensor - Application in clinical practice and future scope

15 Hours

Unit – IV

Textile Sensors

From fibers to textile sensors - Interlaced network -Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications. FBG sensor in Intelligent Clothing and Biomechanics. Introduction, Components of RFID systems, hardware and software components, RFID standards, RFID applications.

16 Hours

Text Book (s):

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland
3. Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", 201, 1st Edition , Apress Media LLC, New York.
4. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, 2011, 1st Edition, Springer, New York.
5. Finkenzeuer Klaus, "RFID Handbook", 2011, 3rd edition, John Wiley and Sons, New Jersey

Reference Book (s):

1. Gerd Keiser,"Optical Fiber Communications", 2012, 4th edition, McGraw-Hill Science, Delhi.
2. John G Webster, "Measurement, Instrumentation and sensor Handbook", 2014, 2nd edition, CRC Press, Florida.
3. Eric Udd and W.B. Spillman, "Fiber optic sensors: An introduction for engineers and scientists", 2013, 2nd edition, Wiley, New Jersey

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. List any three sensors
2. State the purpose of ultrasonic sensor

Understand

1. Explain the working of pressure sensor
2. Explain the operation of inductive sensor

Apply

1. Demonstrate the characteristics of optical sensor
2. Demonstrate the characteristics of biochemical sensor

[Open Book Examination Question]

Analyze

1. The biomedical and textile sensors

[Open Book Examination Question]

21ECM52 Geographic Information Systems

4 0 0 4

Course Outcomes

1. Explain the Fundamentals of GIS
2. Identify the components of GIS
3. Demonstrate the Spatial data models
4. Illustrate different data input formats of GIS
5. Represent different topologies used in GIS
6. Outline the applications of GIS

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	2	-
3	3	2
4	2	-
5	2	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Fundamentals of GIS

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

16 Hours

Unit II

Spatial data models

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality. **14 Hours**

Unit III

Data input and topology

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser –Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping **16 Hours**

Unit IV

Applications

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

14 Hours

Total: 60 Hours

Text Book (s):

1. Kang – Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

Reference Book (s):

1. Lo.CP., Albert K.W. Yeung, Concepts and techniques of Geographic Information systems, Prentice hall, India, 2006.

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. List any three components of GIS
2. State the types of GIS data

Understand

1. Explain the Database Structures of GIS
2. Represent different topologies used in GIS

Apply

1. Demonstrate the Spatial data models
2. Demonstrate the characteristics of biochemical sensor

[Open Book Examination Question]

Analyze

1. Outline the applications of GIS

[Open Book Examination Question]

21ECM532 Digital Image Processing

4 0 0 4

Course Outcomes

1. Interpret fundamental concepts of digital image processing
2. Infer image transforms
3. Exemplify image enhancement and color image processing
4. Assess image restoration techniques
5. Summarize line, point, threshold and region based segmentation for digital images
6. Attribute various compression models and compression techniques for digital images

COs – POs Mapping

COs	PO 1	PO 2
1	2	-
2	2	-
3	2	-
4	3	2
5	2	-
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Digital Image Fundamentals

Fundamental steps in Digital image processing, Components of an Image processing system, Elements of visual perception, Image sampling and quantization, basic relationships between pixels, An introduction to mathematical tools in digital image processing.

Image transforms**:** 2D DFT and its properties, Discrete cosine transform, Discrete Wavelet Transform.

Walsh Transform, Hadamard Transform

17 Hours

Unit II

Image Enhancement and Color Image Processing

Enhancement in spatial domain: Intensity transformations, Histogram Processing, smoothing and sharpening, ImageEnhancement in Frequency Domain: Smoothing and Sharpening Filters

Color fundamentals, Color models, Pseudo color Image Processing, Full Color Image Processing, color transformations.

Color Image Enhancement in spatial and frequency domain

17 Hours

Unit III

Image Restoration

Image Degradation/Restoration model, Noise models, Restoration using spatial filtering, Periodic noise reduction byfrequency domain filtering, Linear Position-Invariant Degradations, Inverse filtering, Minimum Mean Square Error Filtering, Constrained Least squares filtering.

Estimating the degradation function, Geometric Mean filter

12 Hours

Unit IV

Image Segmentation and Compression

Image segmentation: Fundamentals, point, Line and Edge detection, Thresholding, Region based Segmentation, Image Compression: Fundamentals, Image Compression Models, Lossless Compression, Lossy Compression,Transform coding and JPEG compression standard.

Watershed algorithm

14 Hours

Total: 60 Hours

Textbook (s)

1. Rafel C.Gonzalez and Richard E.Woods, Digital Image Processing, Pearson Education, 3rdEdition 2011
2. S.Sridhar, Digital Image Processing, Oxford publishers, 2nd Edition, 2016

Reference (s)

1. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson Education, 1st Edition, 2015
2. S.Jayaraman, S.Esakirajan, T.Veerakaumar, Digital Image Processing, McGraw Hill publishers, 2011
3. M.Sonka,V. Hlavac, R. Boyle, Image Processing, Analysis and Machine Vision, Vikas Publishing House, 2001

Sample Question (S)
Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyse	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. List the 6 components of digital image processing system
2. Define image enhancement
3. Define image segmentation
4. State the lossy compression
5. List out the 3 color models

Understand

1. Interpret the process of image sampling and quantization
2. Summarize the fundamental steps in digital image processing
3. Represent RGB color model
4. Explain the properties of 2D Discrete Fourier Transform
5. Illustrate contrast stretching transformation function to increase the dynamic range of the gray levels in theimage

Apply

1. Consider the image segment shown below. Compute N4, N8 distances

   3 1 2 1 (q)
   2 2 0 2
   1 2 1 1
   (p) 1 0 1 2
2. Compute histogram equalization for a given 8x8 image
3. Compute the efficiency of Huffman Coding for the given symbols

Symbol	a1	a2	a3	a4	a5	a6
Probability	0.1	0.4	0.06	0.1	0.04	0.3

   [Open Book Examination Question]

4. Implement segmentation on given image using bimodal thresholding
5. Show that a linear, spatially –invariant degradation system with additive noise can be modeled in the spatialdomain as the convolution of the degradation function with an image followed by addition of noise

Analyse

1. Differentiate between image enhancement and restoration in terms of processing and applications
2. Compare lossy and lossless compression methods in terms of entropy, applications and transforms used
3. Is image enhancement a subjective approach? Justify your answer
4. Is lossless compression preferred to lossy compression? Justify your answer
5. Differentiate region based segmentation and thresholding based segmentation in terms of approach andapplications
   [Open Book Examination Question]

21ECM54 Lidar Systems

4 0 0 4

Course Outcomes

1. Interpret fundamental concepts of Lidar
2. Demonstrate the architecture of Lidar
3. Illustrate the data inversion and error analysis procedure
4. Illustrate the Aerosol/Cloud and Constituent Measurements using Lidars
5. Assess the applications of Lidar
6. Outline Lidar Performance Analysis

COs – POs Mapping

COs	PO_1	PO_2
1	2	-
2	3	2
3	2	-
4	2	-
5	3	2
6	3	2

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit I

Fundamentals of Lidar Remote Sensing

Concept and classification of remote sensing , Overview of lidar remote sensing , Laser Basics , General picture of lidar remote sensing , General lidar equation , Physical processes involved in different lidars , General lidar architecture, Classification of lidars.

20 Hours

Unit II

Lidar Equation, Data Inversion and Error Analysis

General solutions of lidar equation, physical parameters using lidar equation , General data inversion procedure, General error analysis procedure

10 Hours

Unit III

Topical Lidars and Their Applications

Lidars for Aerosol/Cloud Measurements ,Lidars for Constituent Measurements , Lidars for Temperature Measurements , Lidars for Wind Measurements, Lidars for Solid Target Detection , Laser Range Finding / Laser Altimeter , CW-Laser Imaging Lidars

16 Hours

Unit IV

Lidar Design and Performance Analysis

Overall Considerations, Transmitter Considerations , Receiver and Data Acquisition Considerations , Lidar Performance Analysis and Simulation

14Hours

Total: 60 Hours

Text Book (s):

1. Raymond M. Measures, "Laser Remote Sensing: Fundamentals and Applications, " WileyInterscience, 1984.
2. Takshi Fujii and Tetsuo Fukuchi, Published by CRC Press, "Laser Remote Sensing"Taylor & Francis Group, 2005. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998

Reference Book (s):

1. Claus Weitkamp "idar: Range-resolved optical remote sensing of the atmosphere" Springer, 2005

Sample Question (S)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	15	15	--
Understand	50	50	--
Apply	35	35	50
Analyze	--	--	50
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Remember

1. List any three applications of Lidar.
2. Recall the error analysis procedure.

Understand

1. Explain the fundamental concepts of Lidar
2. Illustrate the Aerosol/Cloud and Constituent Measurements using Lidars

Apply

1. Demonstrate the architecture of Lidar
2. Assess the General data inversion procedure

[Open Book Examination Question]

Analyze

1. Outline the applications of Lidar

[Open Book Examination Question]

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

AR20 MINOR COURSES

Minors for other Departments offered by Electrical and Electronics Engineering

Stream 1: Electric Vehicles Technology

Prospectus:
The Indian automotive industry is the fifth largest in the world, with a goal of becoming the third largest by 2030. The cost of oil imports, rising pollution, and international commitments to combat global climate change are just a few of the factors driving India's recent policies to accelerate the transition to electrical vehicle technology. Over the next few years, electric-based propulsion systems for commercial vehicles are likely to capture a significant share of the commercial vehicle market, threatening to displace internal combustion engines, today's dominant power source. This is the most revolutionary development in the automobile industry. The transition to electric power will almost certainly necessitate significant changes in adaptation on the part of current industry participants, while opening the door to new entrants.

Growth Prospects:
Electric mobility offers serviceability a distinct occasion to grow earnings through the increased trade of power. But, it's the posterior access to detailed consumption data for each connected charging and consumption point that can offer fresh paths for growth. Still, this combination of increased demand and data access can have significant goods on a mileage's trading geste as it seeks to optimize and hedge its portfolio, if gauged up.

Placement Opportunities:
In line with the growing relinquishment of electric vehicles, India is anticipated to have 30% of the vehicles on its roads to be electric vehicles by 2030. Presently India has about 23 crore vehicles. One third of the vehicles by 2030 could amount to about 10 crore vehicles. The increasing vehicle population means a huge ecosystem of original equipment manufacturers and component companies. Electric mobility can thus create millions of local, green, and highly skilled jobs. According to the estimate of the Ministry of Skill Development and Entrepreneurship, the EV industry alone will create one crore jobs by 2030.
IT/CSE: These engineers apply the theories of computer science and mathematical analysis to create and evaluate software applications and systems. Modern vehicles are extensively computer-controlled, and software developers create the software that controls these vehicles.
ECE: These engineers design, develop, and test electronic components and systems for vehicles along with control systems and additional electronic components for the vehicle.
Mechanical: These engineers design, develop, and test the tools, engines, machines, and other mechanical devices in electric vehicles and they also focus on engines, electric motors, or other mechanical devices, such as transmissions, drivetrains, or steering systems.
Chemical: These engineers apply the principles of chemistry to design or improve equipment or to devise processes for manufacturing chemicals and products. Because the batteries of electric vehicles store power through chemical processes, chemical engineers are responsible for developing new battery designs and improving current battery technologies.

21EEM11 Introduction to Electric Vehicles Technologies

4 0 0 4

Course Outcomes

1. Outline the challenges and architectures of electric vehicle
2. Analyze the different configurations of electric vehicle
3. Outline the different types of hybrid electric vehicle
4. Illustrate the safety Issues of electric vehicles
5. Outline the policies and regulations of electric vehicle
6. Outline various types of Energy Management Strategies

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	3	3
3	2	2
4	2	2
5	2	2
6	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit-I Introduction to EV **15 Hours**

History of Electric Vehicles, social and environmental importance of electric vehicles, benefits, overview of EVs and challenges, components of EVs, architecture of EVs, EV market and promotion, infrastructure needs.
Advantages and disadvantages of EVs

Unit-II Types and configurations of EV **15 Hours**

Configurations of Electric Vehicles, Pure Electric Vehicles (PEV), Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicles (PHEV), Configurations - Series and parallel HEV.
Performance of Electric Vehicles

Unit-III Environmental Impact and Safety Issues of Modern Transportation **15 Hours**

Environmental Impact- Air Pollution, Global Warming, Petroleum Resources, Importance and Development of Different Transportation technologies on environment, , Safety of the electrical system, Safety regarding the functioning of the systems, Battery safety, risks associated with hybrid and electric vehicles. Policies and Regulations, policies in India.
Payback and commercial model

Unit-IV Energy Management Strategies **15 Hours**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy, management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Electrification challenges

Total: 60 Hours

Textbook(s)

1. *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles* Mehrdad Ehsani, Texas A&M University Yimin Gao, Texas A&M University Sebastien E. Gay, Texas A&M University Ali Emadi, Illinois Institute of Technology.
2. Iqbal Hussein, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press, 2004.

Reference book(s)

1. *Electric Vehicle technology* by John Lowry and James Larminie.
2. James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2003.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	40	40	---
Understand	40	40	---
Apply	20	20	50
Analyze			50
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Remember

1. Outline the Electric vehicle characteristics
2. List out the challenges of Electric vehicle
3. List out the Environmental impact of Electrical vehicle

Understand

1. Explain in detail about layout of Electric vehicle
2. Explain the energy management strategies of Electric vehicle
3. Explain the plug in hybrid Electric vehicle

Apply

1. Develop the layout of Series hybrid electric vehicle
2. Develop the layout of Series hybrid electric vehicle
3. Identify the various strategies used in implementation of electric vehicle
4. Mr. Krishna, a businessman, needs to travel daily on an average covering 100km which consists of 70 km highway drive and 30 km city drive. He is currently using a diesel vehicle and wants to shift to non-polluting/less polluting vehicle. Help him identify which vehicle he can opt so that it would cater to his needs as well as reduce his vehicle carbon footprint. Justify your selection by giving a detailed layout of architecture of the proposed vehicle and by relating the driving requirements of Mr. Rahul with the operating characteristics of the vehicle.
   (For Open Book Examination and not for semester end examination)

Analyze

1. Analyze the factors and challenges in developing the less polluting vehicle

21EEM12 Electrical Drives and Controllers for Electric Vehicles

4 0 0 4

Course Outcomes

1. Outline the performance of Electric motor
2. Outline the various control strategies in Electric Vehicle
3. Analyze the performance of Electric vehicle drive system
4. Summarize the characteristics of Induction motor drive in EV application
5. Identify suitable drive for EV applications
6. Analyze the performance of BLDC motor drive in EV application

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	2	2
3	3	3
4	2	2
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Electric Motors and Control Strategies

Types of Motors, Selection and Sizing, RPM and Torque calculations of motor, Motor controllers and component sizing, physical locations, Mechanical and Electrical Connection of motor, Controller overview, switch controller, solid state controller, AC & DC controller.

Electronic controller **15 Hours**

Unit II

Electric Vehicle Drives

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor charterstics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.

Energy Consumption **15 Hours**

Unit III

Electric Propulsion System-I

DC Motor Drive- Introduction, Construction, Principle of operation, Performance charterstics and applications.

Induction Motor Drive- Introduction, Construction, Principle of operation, Performance charterstics and applications.

Various types of starters **15 Hours**

Unit IV

Electric Propulsion System-II

BLDC Motor Drive- Introduction, Construction, Principle of operation, Performance charterstics and applications.

PMSM Drive: Introduction, Construction, Principle of operation, Performance charterstics and applications.

Classification properties of PM material **15 Hours**

Total: 60 Hours

Textbook (s)

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, M. Eshani, CRC Press, 2005.
2. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
3. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.

Reference (s)

1. Modern Electric Vehicle Technology, C.C. Chan and K.T. Chau, Oxford Science Publication 2001.
2. Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	---
Understand	20	20	---
Apply	30	30	50
Analyze	30	30	50
Evaluate	---	---	---

Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any two types of motors
2. Define torque
3. List any two differences between AC and DC controllers

Understand

1. Outline the various characteristics of traction motor
2. Outline the construction and principle operation of Induction motor
3. Explain the electric connection of motor used in Electric vehicle

Apply

1. Identify the suitable drive system in Electric vehicle application
2. Make use of various control strategies in EV application
3. Develop the expression for tractive effort

Analyze

1. Examine the performance of various drives used in Electric Vehicle applications
2. Analyze various control strategies used in Electric Vehicle applications

21EEM13 Charging Technology in Electric Vehicles

4 0 0 4

Course Outcomes

1. Outline energy management principles in electrical vehicles
2. Identify the role of smart charging technologies in electrical vehicles
3. Examine the state of charge and depth of discharge
4. Outline various charging methods in electrical vehicles
5. Demonstrate the current and voltage measurement techniques
6. Illustrate the charging architecture for electrical vehicles

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	3	3
3	3	3
4	2	2
5	2	2
6	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Vehicle Electrification: Main Concepts, Energy Management, and Impact of Charging Strategies

Introduction and Definitions, PHEV Energy Management, Full-Electric Vehicles, PEV Charging Options and Infrastructure, Energy, Economic, and Environmental Considerations, The Role of Smart Charging Technologies and Applications

Impact of Charging Strategies

15 Hours

Unit II

Battery Technologies for Transportation Applications

Battery Parameters - Storage Capacity, Energy Density, Specific Power, Cell Voltage, Charge and Discharge Current, State of Charge, Depth of Discharge, Cycle Life, Self-discharge, Round-Trip Efficiency, over potentials. Battery Technologies - Lead Acid, Nickel-Cadmium (Ni-Cd), Nickel-Metal Hydride (Ni-MH), Lithium-Ion (Li-Ion), Fuel Cells

Super Capacitors

15 Hours

Unit III

Battery Charging

Charging Methods - Float Charge, Trickle Charge, Bulk Charge, Equalization Charge

Charging Techniques - Constant Current, Constant Voltage, Constant Current–Constant Voltage

SoC Estimation - Voltage Measurement, Specific Gravity Measurement, Current Measurement

Internal Impedance Measurement

15 Hours

Unit IV

Charging Architectures for Electric and Plug-In Hybrid Electric Vehicles

Onboard Chargers - Dedicated Converter (Slow Charging), Integrated Converter (Semi-fast Charging) Off-Board Chargers - Dedicated Off-Board DC Chargers (Fast Charging), Concept of Fast-Charging Stations, Challenges for Fast-Charging Stations

EV / PHEV charging Standards

15 Hours

Total: 60 Hours

Textbook (s)

1. Ottorino Veneri. "Technologies and Applications for Smart Charging of Electric and Plug-in Hybrid Vehicles". Springer International Publishing Switzerland 2017
2. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.
3. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013

Reference (s)

1. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012

2. Tariq Muneer and Irene IllescasGarcía, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017

Sample question (s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	25	---
Understand	20	25	---
Apply	30	50	60
Analyze	30	---	40
Evaluate	---	---	---
Create	---	---	
Total (%)	100	100	100

Remember

1. Define Float charge method of charging of electric vehicles**.**
2. List any four types of battery charging measurement techniques.

Understand

1. What are different modes of charging batteries? Compare them in detail
2. Classify and explain the basic principle of Rule based energy management system. Elaborate on any one of the Rule based energy management systems

Apply

1. In a parallel hybrid electric vehicle (HEV) of hybrid-ness = 25%, has an electrical traction motor and an IC engine, both engine and motor shafts are inputs to a three-way transmission system with a total tractive power of 100kW. Assuming 95% efficiency, find the minimum size of battery in Ah, for a 20Hr drive cycle. Select battery voltage as 120V.
2. A 12V battery pack is connected to series RL load with L=100mH. The battery pack has rated capacity of 120Ah. At t=0 switch is closed and the battery begins to discharge.
    a) Calculate the plot battery discharge current i(t), if the steady state discharge is C/5.Neglect voltage drop.
    b) Calculate the plot SoC, assuming at t=0, the battery is charging to rated capacity.

Analyze

1. Analyze fuel cell and flywheel as energy source elements in electric and hybrid electric vehicle
2. Compare Voltage and current measurement of SoC Estimation.

21EEM14 Computer Vision in Electric Vehicles

4 0 0 4

Course Outcomes

1. Summarize the strengths of computer vision in terms of accuracy, precision and robustness
2. Outline the terminology related to the computer vision pertaining to electric vehicles
3. Apply the available methods to estimate the object distance and tracking
4. Understand usage of cruise control and traffic jam assistance
5. Understand usage of head lamp control and night vision
6. Examine challenges for lane departure and parking assistance

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	2	2
3	3	3
4	2	2
5	2	2
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to computer vision

Traffic safety and comfort, strengths of computer vision, Generic and specific tasks, Multi module solutions, Accuracy, precision and, robustness, Comparative performance evaluation, Notation and basic definitions, Images and Videos, cameras and optimization, Visual tasks- Distance, motion, object detection and tracking. *semantic segmentation*. **15 Hours**

Unit II

Autonomous Driving

Level of autonomous, important research projects, outdoor vision challenges, Autonomous driving in cities-localization, stereo vision based perception in 3D, object recognition, Challenges- Increasing robustness. *Scene labelling, intent recognition* **15 Hours**

Unit III

Vision based advanced driver assistant systems

Forward assistance- cruise control (basic) and forward collision avoidance, traffic sign recognition, traffic jam assist (TJA), vulnerable road uses protection, intelligent headlamp control. *enhanced night vision, intelligent active suspension* **15 Hours**

Unit IV

Lateral Assistance

Lane departure warning and lane keeping system, Lane change assistance (LCA), Parking assistance, Inside Assistance- Driver monitoring and drowsiness detection, Application challenges from a birds eye view *Sewage line projects in Dehradun smart city*

15 Hours
Total: 60 Hours

Textbook (s)

1. Antonio M. López ,Atsushi Imiya Tomas Pajdla and Jose M. Álvarez, *Computer vision in vehicle technology*, Wiley international 2017.

Reference (s)

1. Achtelik M, Bachrach A, He R, Prentice S and Roy N. 2009. Stereo vision and laser odometry for autonomous helicopters in GPS-denied indoor environments. SPIE Conference on Unmanned Systems Technology, Orlando, FL, USA.
2. Achtelik MC, Doth KM, Gurdan D and Stumpf J. 2012. Design of a multi rotor MAV with regard to efficiency, dynamics and redundancy. AIAA Guidance, Navigation, and Control Conference.
3. Achtelik M, Weiss S and Siegwart R. 2011. Onboard IMU and monocular vision based control for MAVs in unknown in and outdoor environments. Proceedings of the IEEE International Conference on Robotics and Automation.

4. Adnriluka M, Roth S and Schiele B. 2008. People-tracking-by-detection and people-detection-by-tracking. Proceedings of the conference on Computer Vision and Pattern Recognition, Anchorage, AK, USA.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	---	---
Understand	50	25	---
Apply	25	50	50
Analyze	---	25	50
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample question (s)

Remember

1. Recall labelling function for optimization
2. List different types of cameras used in electric vehicle

Understand

1. Explain how distance is estimated using time of flight principle
2. Explain methods for object detection.

Apply

1. Analyze how the stereo is used for optical flow calculations
2. Develop a smart car system that allows for Autonomous Driving in designated areas, for example, valet parking, park and ride, and offers advanced driver support in urban environments

Stream 2: Smart City Management

Prospectus:
Smart Cities discover & polish their concepts until they attain the desired outcomes. The entire concept of these Smart Cities was implemented with a dream to improve quality of life. This improvement involves technological reforms, institutional engagements or managerial transformations and the engrossment of citizens. Ranging from Entrepreneurship to Hospitality and Engineering to Policy reform research, Smart City initiative propounds everything to get started on the path to fresh career dream.
Smart cities are an engine for job creation and economic growth. India is on the path of undertaking measures to enhance development. Creating jobs and incomes is crucial for development. Smart City initiative's innovations contribute to economic growth and employment and also promotes & contributes to sustainable development.
The contribution of Smart cities, to India's GDP will only increase. The cities accounted for 58% of the national GDP in 2008, which is expected to go up to 70% by 2030. The primary purpose behind promoting & developing smart cities is to enable the people to be more efficient and globally competitive. The need of the hour is to acquire deep insight into the character of the city and identify core economic potential that can be enhanced with the help of technology and advancement in urban infrastructure.

Growth Prospects: Growth opportunities would be immense in smart cities. As more and more construction, manufacturing and managerial workplaces are set up, need for jobs and chances of growth would keep on increasing as more and more projects are slated to be launched. With each new project, opportunities to grow and prosper would also rise.

Placement Opportunities:
Almost 1 million new jobs are expected to be created in all smart city projects combined, by the year 2030. Skilled and unskilled personnel for all departments would be required to make the projects a reality. These projects would be built across platforms that require both experience and new blood in its functioning. Experienced managers would be required to handle a team of young talents who would be the torch bearers of getting technology to work in the desired manner**.**
IT/CSE: All software-based systems (i.e., safety in cyber-attack to effective banking with various online Management and networking and IoT applications) in Smart City with proper management.
CIVIL: These engineers are working to harness the potential of latest technologies and data for our urban infrastructure, which is among the most complex system in the world. They provide sustainable, resilient and advanced means of transportation system, green building, better water management system and better waste management system. This not only develop physical infrastructure but also develop institutional & social infrastructure that enable our societies to function. Modelling these systems of systems will require managing data at an unprecedented scale.
ECE: ECE engineers' expertise in managing large scale research, conceptualizing, designing, developing and testing of the electronic equipment used in latest communication devices and other handy technological equipment, such as smartphones, tablets, processors, smart wrist watches, smart LED TV's, with Wireless Communication, Smart Communication, smart sensors applications etc.
Mechanical: Mechanical engineering plays a critical role in manufactured technologies, from automobiles sector to airplanes to refrigerators, various machinery aspects for construction design, maintenance of Smart City. It enables you to do many daily activities with ease, as it brings helpful technologies to our modern society.
Chemical: Chemical industry has a key role to play in the sustainable evolution of the smart cities. Additionally, chemistry is at the heart of all modern industries, including electronics, information technology, biotechnology and nanotechnology. Chemistry can make the smart cities project more sustainable, more energy efficient and more cost effective. There are six broad critical elements of any smart city: water management systems; infrastructure; transportation; energy; waste management and raw materials consumption. In all these elements chemistry and chemical engineering are deeply involved.

21EEM21 Fundamentals of Smart City

4 0 0 4

Course Outcomes

1. Summarize the role of smart cities in regard to sustainability goals in cities.
2. Identify the various trends in smart cities and homes.
3. Contrast the concepts related to sustainability in smart grids.
4. Survey the challenges of building smart home and smart building
5. Survey the smart initiatives for Chandigarh smart city
6. Identify the smart initiatives for Dehradun smart city

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	3	3
3	2	2
4	3	3
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Fundamentals of Smart Cities

Definition, challenges for smart grid architecture, technical challenges of creating, operating and maintaining a smart city, new digital ecosystem, community as a smart city, challenges of envisioning and planning a true smart city, innovative smart city solutions, trends in smart cities and homes, challenges in smart cities and homes,

Survey of major key enabling technologies **15 Hours**

Unit II

Sustainability in Smart Cities

Introduction, Sustainability assessment in our cities, sustainability in smart cities, achieving balanced sustainability, improving procedural balance, improving contextual and temporal balance, City blocks as a contextual variable, improving integrational balance, current developments: sustainability information modeling, platforms.

Institutional and Governing Aspect **15 Hours**

Unit III

Smart Building Application

Foundations—from automation to smart homes, from today's technologically augmented houses to tomorrow's, smart home: past, present, and future, cps-based smart home automation and its applications, decentralized coordination and cooperation & their applications, connecting smart homes and smart cities.

Application: Ambient Assisted Living (AAL) **15 Hours**

Unit IV

Case study of Indian smart cities

Case Study of Chandigarh smart city, Latest Projects: waste water & management, Public health and waste management, Energy reforms and ICT initiatives. Public services, Cycle 4 challenge concept.

Case Study of Dehradun smart city, ABD Projects, smart toilet, water supply augmentation, smart school, smart water meter, solar energy harvesting and rain water harvesting, tree plantation and CRECHE buildings, PAN city solutions,

Sewage line projects in Dehradun smart city **15 Hours**

Total: 60 Hours

Textbook (s)

1. JN Pelton, IB Singh, "*Smart cities of today and tomorrow*," Copernicus, Cham. 2019:45, Springer International Publishing AG, part of Springer Nature 2019. https://doi.org/10.1007/978-3-319-95822-4
2. H Song, R Srinivasan, T Sookoor, S Jeschke, "*Smart cities: foundations, principles, and applications*," John Wiley & Sons; Jul 12, 2017.

Reference (s)

1. Obaidat MS, Nicopolitidis P. "*Smart cities and homes: Key enabling technologies*," Morgan Kaufmann; May 17, 2016.
2. https://www.chandigarhsmartcity.in/
3. http://smartcitydehradun.uk.gov.in/
4. https://www.india.gov.in/spotlight/smart-cities-mission-step-towards-smart-india

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	---	---
Understand	50	25	---
Apply	25	50	50
Analyze	---	25	50
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample question (s)

Remember

1. Define smart city.
2. What are the critical elements of a smart city in the 21st century?

Understand

1. Explain cps-based smart home automation?
2. Interpret the difference between?

Apply

1. Identify the solutions for innovative smart city?
2. Build the model of CRECHE buildings?

Analyze

1. Analyze the waste water management in Chandigarh smart city?
2. Examine the rain water harvesting in Dehradun smart city?

21EEM22 Smart City Infrastructure

4 0 0 4

Course Outcomes

1. Summarize the concepts of smart city.
2. Outline the urban transportation methodologies in a smart city.
3. Examine the food management procedure in smart city.
4. Outline the concepts related to design of smart building.
5. Summarize the concepts related to design of smart energy scenario.
6. Explain the various waste management techniques in smart city.

COs – POs Mapping

COs	PO_2	PO_3	PO_5	PO_6	PO_7	PO_{11}
1	2	2	2	2	3	2
2	2	2	2	2	3	2
3	3	3	3	3	3	3
4	2	2	2	2	3	2
5	2	2	2	2	3	2
6	2	2	2	2	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Smart cities: State of the art policies, design &agriculture management

Definition of smart city, Evolution of smart cities, Policy framework for smart cities, common flaws in planning smart cities, Government Policies Initiatives and Project management- green policies, sustainable food production and consumption, monitoring and management.

Government Planning codes for smart city **15 Hours**

Unit II

Smart urban transportation

Need of smart urban transportation, components - Physical components, Emerging concepts and strategies, ICT support of smart mobility system- automated fare collection system, intelligent signalling system, real time traffic monitoring system, parking information system, automated vehicle location system, use of electric vehicles and autonomous vehicles.

CCTV Monitoring System **15 Hours**

Unit III

Smart Energy and building:

Definition of smart energy, use of renewable energy, Intelligent energy efficient buildings-definition and objectives, smart- lighting, heating, ventilation and air conditioning, energy monitoring, metering and management system, fire safety and emergency warning systems.

Key Challenges for Smart City **15 Hours**

Unit IV

Smart waste management

Waste management changing approaches- waste collection and handling, IoT and ICT based systems for waste collection and management, automated waste collection system, indicators of solid waste management performance-core indicators and supporting indicators.

Rain water Harvesting system **15 Hours**

Total: 60 Hours

Textbook (s)

1. Sirajuddin Ahmed, S. M. Abbas, Hina Zia, "Smart Cities—Opportunities and Challenges", springer Publisher, ISBN-13: 978-9811525445, ISBN-10: 9811525447
2. Smart Infrastructure and Applications (Foundations for Smarter Cities and Societies), Springer, ISBN 978-3-030-13705-2

Reference (s)

1. Dr. N. Mani, "Smart Cities & Urban Development in India", ISBN-13 978-8177084320.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	25	---
Understand	50	50	---
Apply	25	25	50
Analyze	---	---	50
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample question (s)

Remember

1. Define Smart City
2. Find the key challenges for becoming smart city

Understand

1. Compare the transportation system in normal and smart city
2. Explain the need of smart city in developing India

Apply

1. Build the smart infrastructure which is required for a smart and energy efficient building
2. Identify the government Initiatives have been taken for smart cities

Analyze

1. Analyze the waste management scenario in smart cities as municipal waste and health waste.
2. Classify the various tools utilize to develop the smart cities

21EEM23 Computational Methods for Smart City Management

4 0 0 4

Course Outcomes

1. Outline the Importance of Artificial Intelligence
2. Outline the Importance of Explainable AI
3. Identify areas where we can use data mining
4. Illustrate the machine learning for STS
5. Make use of Machine learning for Smart traffic System
6. Construct the Smart Urban Traffic Management

COs – POs Mapping

COs	PO_3	PO_5
1	2	2
2	2	2
3	3	3
4	**2**	**2**
5	**3**	**3**
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Explainable Artificial Intelligence for Services Exchange in Smart City

Introduction, Explainable AI and Decision-Making, Big Data, and ICT for XAI Services in the Context of Smart Cities, The Smart Environment with XAI- Proposed Smart City Main Pillars and Architecture Benefits of Using XAI in Smart Cities, Addressed Challenges for XAI

Data Creation in Smart Cities **15 Hours**

Unit II

Data Mining Techniques for smart cities

Introduction, Literature Review, Methodology- Overview, KDD Process, Data Mining Methods and Implementation, Classification, Application of Internet of Things-Based Smart Cities, Explainable Artificial Intelligence for Smart Cities. Smart Model for Medical Waste Management, Architecture of Smart Solution.

Current Medical Waste Disposal Process in Morocco **15 Hours**

Unit III

An Analysis of Machine Learning for Smart Transportation System (STS)

Introduction, Evolution of Smart Transport System (STS), Process of Smart Transport System- Importance of Smart Transportation System, Working of Smart Transportation System Work, Intelligent Transportation System User Functions, Need for ML Techniques in STS, Integration of ML with IoT in Autonomous Vehicles

DL Techniques for Autonomous Vehicle Decision Making **15 Hours**

Unit IV

Smart Urban Traffic Management for an Efficient Smart City

Introduction, Smart Transport in Smart City Environment, Related Works on Urban Traffic Management UTM, Network for Urban Data Collection, Project Architecture, Approach for Urban Traffic Flow Management,

Impact of UTM on Urban Supply Chain **15 Hours**

Total: 60 Hours

Textbook (s)

1. Mohamed LahbyUtkuKose Akash Kumar Bhoi, "Explainable Artificial Intelligence For Smart Cities", First Edition published 2022 by CRC Press.
2. Stan Geertman, Qingming Zhan, "Computational Urban Planning and Management for Smart Cities", Spinger.

Reference (s)

1. Bob McQueen, "Big Data Analytics for Connected Vehicles and Smart Cities", 2017.
2. Waleed Ejaz, AlaganAnpalagan "Internet of Things for Smart Cities Technologies, Big Data and Security" Spinger.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	---	---	---
Understand	20	40	40
Apply	80	60	60
Analyze	---	---	---
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Understand

1. Outline the importance of Explainable AI
2. Illustrate the use Artificial Intelligence
3. Explain any three types of AI techniques.

Apply

1. Make use of explainable Artificial Intelligence for smart environment with any application
2. Identify the suitable Machine learning technique for the Smart Transport System.

21EEM24 Communication Technologies and Mobility for Smart City

4 0 0 4

Course Outcomes

1. Identify the communications and measurement technologies.
2. Outline the architecture and characteristics of smart grids for smart cities.
3. Contrast machine-to-machine communications.
4. Summarize transportation and environment management
5. Choose the wireless charging and methods
6. Demonstrate modes for wireless power transfer in EVs

COs – POs Mapping

COs	PO_2	PO_3
1	3	3
2	2	2
3	1	1
4	2	2
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Smart city Communications And Measurement Technology

Characteristics of smart city communication technology and communication techniques, Smart Meters, and Measurements Technologies, Wide Area Monitoring Systems (WAMS), Latest wired and wireless technologies, Introduction to Phasor Measurement Units (PMU), and Advanced Metering Infrastructure (AMI).

GIS and Google Mapping Tools Multi agent Systems (MAS) Technology **15 Hours**

Unit II

Smart grid prospective for Smart City Communications

Introduction, Architecture and Characteristics of Smart Grids for Smart Cities, Definition, Standardization, Smart Energy Sources, and consumers, Energy Service Providers, Intelligent Machine-to-Machine Communications in Smart Grids, Reference Architecture of Machine-to-Machine Interactions, Communication Media and Protocols, Layered Structure of Machine-to-Machine Communications

Interoperability Reference Model **15 Hours**

Unit III

5G and D2D Communications at the Service of Smart Cities

Introduction, Smart City communication Scenarios: Public Health, Transportation and Environment, Energy Efficiency, Smart Grid, Water Management, Disaster Response and Emergency Services Public Safety and Security, Multiple Radio Access Technologies (Multi-RAT), Virtualization, Distributed/Edge Computing, D2D Communication, Security and Privacy

Big Data for smart city communication **15 Hours**

Unit IV

Wireless Charging for Electric Vehicles in the Smart Cities:

Introduction, Review of the Wireless Charging Methods, Technologies Supporting Wireless Power Transfer for EVs, Operation Modes for Wireless Power Transfer in EVs, Electrical Effect of Charging Technologies on the Grid, Harmonics Control in EV Wireless Chargers, Power Factor Control in EV Wireless Chargers, Implementation of Bidirectionality in EV Wireless Chargers,

Scheduling Considering Charging Technologies **15 Hours**

Total: 60 Hours

Textbook (s)

1. Mouftah HT, Erol-Kantarci M, Rehmani MH, editors. Transportation and power grid in smart cities: communication networks and services. John Wiley & Sons; 2018 Nov 28.

References (s)

1. JN Pelton, IB Singh, "Smart cities of today and tomorrow," Copernicus, Cham. 2019:45, Springer International Publishing AG, part of Springer Nature 2019. https://doi.org/10.1007/978-3-319-95822-4
2. H Song, R Srinivasan, T Sookoor, S Jeschke, "Smart cities: foundations, principles, and applications," John Wiley & Sons; Jul 12, 2017

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	---	---
Understand	50	25	---
Apply	25	50	50
Analyze	---	25	50
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample question (s)

Remember

1. Define smart meter
2. List three effects f charging technologies on the grid
3. Define Machine-to-Machine Communications
4. Recall smart city communication scenarios

Understand

1. Explain the operation of phasor measurement units
2. Interpret intelligent machine-to-machine communications in smart grids
3. Summarize the concept of D2D Communication
4. Outline the role of Harmonics Control in EV Wireless Chargers

Apply

1. Identify the types of wired and wireless technologies
2. Organize the architecture smart grids for smart cities
3. Identify the various?

Analyze

1. Compare modes for wireless power transfer in evs
2. Contrast Charging Methods in evs
3. Analyze the power factor control in ev wireless chargers

Stream 3: Industrial Applications and Control

Preamble:
B.Tech minors in industrial applications and control is consisting of four courses namely Modeling and Simulations of Industrial Applications, Industrial Sensors and Actuators, Programmable Logic Controllers & Control Design for Industrial Applications. At the end of the course, the learners will be able to illustrate the model and simulation of the mechanical, electrical and reactor systems. The learners will understand the role of sensors and actuators in tracking different signals, operating principles, and their coordination. The learner will be able to apply their ladder logic program skill for various applications. Also, the learners can understand the preliminaries for controller design. The learners will be able to design the PLC based controller for mechanical, electrical and reactor systems.

Prospects:
Industrial automation is on the threshold of a new revolution, moving through rapid technology changes, adoption of new systems, networking architectures, and looking toward interoperability of devices and systems. The industrial space has been impacted with incremental technology changes, rapid adoption of new systems and augmented networking architectures over the last decade. Industrial technologies such as Modeling and Simulations of Industrial Applications, Industrial Sensors and Actuators, Programmable Logic Controllers and Control Design for Industrial Applications are becoming increasingly pervasive. Given the proliferation of large-scale, continuous and parameterized industrial devices digitization has fostered, this need will turn into an obligation.

Placement Opportunities:
You will be assisting with the provision of Instrumentation and/or Electrical engineering support or Industrial Control Systems (ICS) engineering on the refinery.
As an E, C & I Engineering placement student you will get the opportunity to work on a variety of real-life projects within the Instrumentation, Electrical engineering or Industrial Control field depending upon your skills or preference.
You will get to work alongside our experts on some of the most advanced technology used within the process industry sector including measurement and control systems, analysers, safety instrumented systems, electrical devices and electrical infrastructure, distributed control systems, industrial networking and cyber security.
Eventually the course is designed to help you gain the essential skills to have a successful career in industry.

21EEM31 Modelling and Simulations of Industrial Applications

4 0 0 4

Course Outcomes

1. Illustrate the modeling and simulation of the mass, spring, damping element system
2. Develop the analytical model and simulate the bicycle, Ackerman Steering and launch vehicle system
3. Develop the mathematical model and perform simulation of BLDC motor drive.
4. Illustrate the model of the semi-batch reactor and perform dynamic simulation
5. Illustrate the need of batch reactor and nuclear reactor simulation
6. Develop the mathematical model and process the dynamic simulation of nuclear reactor.

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	3	3
3	3	3
4	2	2
5	2	2
6	3	3

3–Strongly linked | 2–Moderately linked| 1–Weakly linked

Unit-I

Modeling and Simulation of Dynamic Systems

Introduction to modeling of engineering systems, importance of modeling, dynamic models - mass, spring, damping element modeling and simulation. Off-road vehicle dynamics modeling and simulation – Basic Geometry for Ackerman Steering: Bicycle model, forces and moments on steering systems, vehicle tires, traction and slippage, modeling & simulation of launch vehicle system.

Simulation of Industrial Application of mass, spring and damping system

16 Hours

Unit-II

Electric motor modeling and simulation

Modeling and simulation of R-L-C series and parallel circuits, DC Motors and Brushless dc motor - commutation, performance characteristics, experimental model and simulation, Electrical Damping Constant, simulation and modeling of simple and cost-effective BLDC motor drives.

Linearized experimental model **15 Hours**

Unit-III

Batch Reactor modeling and simulation

Introduction, the process and the model - process description, mathematical model, application of control algorithm, dynamic simulation, mathematical model of a semi-batch reactor

Bioreactor modeling and simulation

15 Hours

Unit – IV

Nuclear Reactor modeling and simulation

Introduction, components of nuclear reactor, mathematical modeling and simulation of nuclear reactor, reactor core calculation overview, Neutron diffusion theory and nodal methods, Reactor power distribution, Simulation of a reactor core condition, Parallel processing for neutronic model.

High-performance computing in AZKIND

14 Hours

Total: 60 Hours

Textbook

1 Clarence W. de Silva, "*Modeling and Control of Engineering Systems*", 1st Edition, CRC Press, 2009.

2 Francisco Rovira Más Qin Zhang Alan C. Hansen, "*Mechatronics and Intelligent Systems for Off-road Vehicles*", Springer, 2011.

3 Amiya K. Jana, "*Chemical Process Modelling and Computer Simulation*", Second Edition, PHI Learning Pvt. Ltd., 2011.

4 Shimjith, S R, Tiwari, A P, Bandyopadhyay, B, "Modeling and Control of a Large Nuclear Reactor", Lecture Notes in Control and Information Sciences, Springer, 2013.

Reference (s)

1. Mara Tanelli, Matteo Corno, Sergio M. Savaresi, "*Modelling, Simulation and Control of Two-Wheeled Vehicles*", First Edition, John Wiley & Sons, Ltd, 2014.

2. Gh. Shokri & E. Naderi (2017), *Research on simulation and modeling of simple and cost-effective BLDC motor drives*, International Journal of Modelling and Simulation, 37:1, 15-24, DOI: 10.1080/02286203.2016.1195665

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	25	---
Understand	25	50	---
Apply	50	25	100
Analyze	--	--	---
Evaluate	--	--	---
Create	--	--	---
Total (%)	100	100	100

Sample Question (s)

Remember

1. What is modeling and simulation?
2. Write the expression of electromagnetic energy of an inductor.
3. What are the advantages and disadvantages of the batch processing over the continuous operation?
4. What is yield factor?

Understand

1. Determine an expression for the dominant time constant of an armature-controlled dc motor.
2. Describe about the feedback control of dc motors.
3. Describe the process of reactor power distribution in nuclear reactor modeling.

Apply

1. Develop a mathematical model (mass and energy balance equations) for a non-adiabatic batch reactor considering convective heat loss to the atmosphere. You may assume that Te is the temperature of the environment, he is the convective heat transfer coefficient in the environment and no insulation is provided for the cooling coil outside the reactor. Assume the required conditions of this reactor.
2. Develop the mathematical model for a batch reactor where the following reactions take place:

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

$$A \xrightarrow{k_3} D$$

All are endothermic, first-order reactions. The reacting mixture is heated by a saturated steam, which flows through a jacket around the reactor with a rate of Q (mass/time).

21EEM32 Industrial Sensors and Actuators

4 0 0 4

Course Outcomes

1. Understand how different physical variables are measured and illustrate their working principles.
2. Identify and select proper sensors for specific applications.
3. Understand issues of implementation of different sensors including calibration and error analysis.
4. Familiar with the basics of various actuators.
5. Model linear actuators and differentiate various solenoids.
6. Explain the working principle of different types of rotary actuators.

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	2	2
3	2	2
4	2	2
5	3	3
6	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Introduction to Sensors

Definition, Measurement Techniques, Classification of errors, Error analysis, Static and dynamic characteristics of transducers, Performance measures of sensors, Classification of sensors, calibration techniques.

Temperature Sensors: Thermoresistive, Resistance Temperature Detectors, Silicon Resistive, Thermistors, Semiconductor, Optical, Acoustic, Piezoelectric.

Position, Displacement and level sensors, Velocity and Acceleration Sensors.

Case study in manufacturing industries.

15 Hours

Unit II

Chemical Sensors:

Metal Oxide Chemical, ChemFET, Electrochemical, Potentiometric, Conduct metric, Amperometric, Optical Chemical, Mass Detector.

Modern Sensors:

Film sensors, micro-scale sensors, Particle measuring systems, Vibration Sensors, SMART sensors, Machine Vision, Multi-sensor systems.

Case study in processing Industries.

15 Hours

Unit III

Electrical Actuating systems

DC motors: Principle of operation, Performance, Efficiency and characteristics, Application as Actuator. **Stepper Motors**: Principle of operation, Performance, Efficiency and characteristics, Application as Actuator. **Induction motors**: Principle of operation, Performance, Efficiency and characteristics, Application as Actuator **Linear Actuators:** Voice Coil Actuators, solenoids

Applications of Linear Actuators in industry

15 Hours

Unit IV

Pneumatic and Hydraulic actuating systems

Components of pneumatic and hydraulic systems, pumps, compressor, filter, control valves, pressure regulation, relief valves, accumulator.

Rotary Actuators: Disk Rotary Actuators, Claw Pole Rotary Actuators

Applications of Rotary Actuators in industry

15 Hours

Total: 60 Hours

Textbook (s)

1. Jacob Fraden, "Handbook of Modern Sensors, physics, design and applications", Fourth edition, Springer, 2010.
2. Patranabis D.," *Sensor and Actuators*", Prentice Hall of India (Pvt) Ltd., 2nd Edition, 2005.
3. Clarence W Silva, "*Sensors and Actuators: Control System Instrumentation*", CRC Press, 1st Edition, 2007.

Reference (s)

1. Andrzej M Pawlak, "*Sensors and Actuators in Mechatronics: Design and Applications*", CRC Press, 2006.
2. E.O. Doebelin, "*Measurement Systems: Application and Design*", McGraw Hill Higher Education, 4th Edition, 1990.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	---
Understand	40	40	---
Apply	40	40	100
Analyze	---	---	---
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Remember

1. What do you mean by an actuator?
2. What are the requirements of Magnetic Speed Sensors?

Understand

1. Compare Soft Magnetic and Hard Magnetic Materials with suitable example
2. Explain about Claw Pole Rotary Actuator with necessary sketches

Apply

1. A thickness measuring transducer system has a parallel plate capacitive sensor having pair of plates of area of 200 cm2, which are separated by a distance of 0.02cm. A mica sheet of thickness 0.01±0.001 cm is begin passed between the plates. Calculate the variation of capacitance if the electric constant of mica is 8 and permittivity of air is 8.854x10-12 F/m.
2. Identify any 3 applications of Rotary and Linear Actuators in the present scenario. Construct a mathematical model for a linear actuator.

21EEM33 Programmable Logic Controllers

4 0 0 4

Course Outcomes

1. Outline the components and operation of programmable logic controller
2. Explain the instructions associated with the PLC programming languages
3. Model the ladder logic program for various applications
4. Develop the wiring diagram for various sensor and relay
5. Identify PLC program using Timer and counter for various Industrial applications
6. Model the various Industrial applications using Program control Instructions

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	2	2
3	3	3
4	3	3
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Overview of PLC

Introduction, Parts of a PLC, Principles of Operation, PLCs versus Computers, PLC Size and Application. PLC Hardware components- I/O Section, Central Processing Unit, Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces.

Comparative study of Industrial PLCs.

15 Hours

Unit II

PLC Programming

Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation, Connecting PLC to computer - PLC Troubleshooting and Maintenance.

PLC Arithmetic Functions

15 Hours

Unit III

Developing Fundamental Plc Wiring Diagrams and Ladder Logic Programs

Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Developing Ladder Logic Program for any application.

Industrial Program Applications

15 Hours

Unit IV

Timers and Counters

Programming of Timers – Introduction - ON delay, OFF delay, Retentive Timers – PLC Timer functions – Examples of timer function in Industrial application. Programming Counters – up/down counter – Combining counter - Examples of counter function in Industrial application- PLC Program Control Instructions: Master Control Reset - Skip – Jump and Move Instruction – Case study of Tank level control system, bottle filling system and Sequential switching of motors

Data Manipulation Instructions

15 Hours

Total: 60 Hours

Textbook

1. F. D. Petruzella, "*Programmable Logic Controllers*", Tata Mc-Graw Hill, 3rd Edition, 2010.

Reference (s)

1. Hughes, T, "*Programmable Logic Controllers*", ISA Press, 2000.
2. John W. Webb, Ronald A. Reis, "*Programmable Logic Controllers Principles and Applications"*, PHI, 5th Edition, 2002.
3. Madhuchannd Mitra and Samerjit Sengupta, "*Programmable Logic Controllers Industrial Automation an Introduction*", Penram International Publishing (India) Pvt. Ltd.; 2nd Edition, 2017.

4. J. R. Hackworth and F. D. Hackworth, "*Programmable Logic Controllers Principles and Applications*", Pearson publication, 2003.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	25	20	---
Understand	50	40	---
Apply	25	40	100
Analyze	---	---	
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Remember

1. List any four tasks performed by a discrete input module
2. What is the most important characteristic of the Gray code?

Understand

1. Explain the difference between a unipolar and bipolar analog input module.
2. Draw the schematic for a conventional hardwired circuit that will perform the following circuit functions using two break-make pushbuttons:
    - Turn on light L1 when pushbutton PB1 is pressed.
    - Turn on light L2 when pushbutton PB2 is pressed.

Apply

1. Develop a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the hardwired control circuit in Figure 1

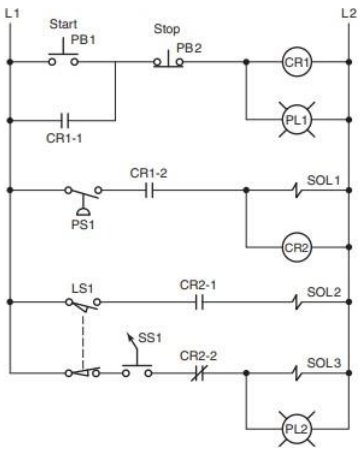


Figure 1

2. Design a PLC program and prepare a typical I/O connection diagram and ladder logic program that will correctly execute the hardwired control circuit in Figure 2 . Assume: Stop pushbutton used is an NO type. Run pushbutton used is an NO type. Jog pushbutton used has one set of NO contacts. OL contact is hardwired.

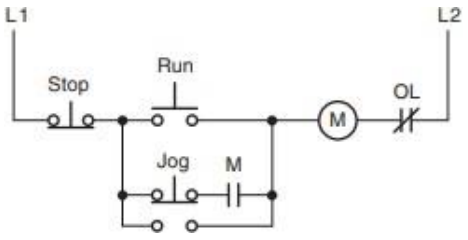


Figure 2

21EEM34 Control Design for Industrial Applications

4 0 0 4

Course Outcomes

1. Understand the preliminaries for controller design
2. Design the PLC based PID controller for DC motor
3. Design the PLC based PID controller for BLDC motor
4. Design the PID controller for mechanical systems
5. Design the PID controller for batch reactor
6. Design the PID controller for nuclear reactor

COs – POs Mapping

COs	PO_2	PO_3
1	2	2
2	3	3
3	3	3
4	3	3
5	3	3
6	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Unit I

Control systems - Preliminaries

Closed loop block diagram, stability, introduction to the time response and frequency response specifications, PID controller

Root locus method, Nyquist stability criterion

15 Hours

Unit II

Controller design for electrical systems

PLC based PID controller design for DC motor, PLC based PID controller design for BLDC motor.

Modeling of electrical systems, Preliminaries of Programmable logic controllers

15 Hours

Unit III

Controller design for mechanical systems

PID controller design for mass-spring-damper system, launch vehicle, bicycle model of a steering system

Modeling of mechanical systems

15 Hours

Unit IV

Controller design for reactor systems

PID controller for batch reactor and PID controller for nuclear reactor

Modeling of reactor systems

15 Hours

Total: 60 Hours

Textbook (s)

1. I. J. Nagrath, M. Gopal, "*Control Systems Engineering*", 5th edition, New Age International Publishers, 2010
2. Katsuhiko *Ogata*, "*Modern Control Engineering*", 5th Edition, University of Minnesota. Prentice Hall, Upper Saddle River, New Jersey, 2010.

Reference (s)

1. George Ellis, "*Control System Design Guide*", Academic Press, 3rd Edition, 2004
2. Marialena Vagia, "*PID Controller Design Approaches Theory, Tuning and Application to Frontier Areas*", University of Patras, Greece, 2012.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examination (%)
Remember	20	20	---
Understand	40	40	---
Apply	40	40	100
Analyze	---	---	
Evaluate	---	---	---
Create	---	---	---
Total (%)	100	100	100

Sample Question (s)

Remember

1. Draw the block diagram of a closed loop system
2. Enumerate the controller gains of a PID Controller

Understand

1. Explain the concept of stability in terms of time-response specifications
2. Explain the concept of stability in terms of frequency-response specifications

Apply

1. Design the PLC based PID controller for DC motor
2. Design the PLC based PID controller for BLDC motor
3. Design the PID controller for mechanical systems
4. Design the PID controller for batch reactor
5. Design the PID controller for nuclear reactor

DEPARTMENT OF INFORMATION TECHNOLOGY
B. Tech (Minors)
Cloud Application Development
(Department of Information Technology offering Minors Courses for other Departments)

Preamble

This program will equip you with all the key skills and technical know-how to kick start your career as a full-stack Cloud Native Developer. You will learn to build your own cloud-based applications and practice working with the technologies behind them. The Cloud Application Development Foundations Specialization program will teach you the tools and technologies that successful software developers use to build, deploy, test, run, and manage Cloud Native applications – putting you in an advantageous position to begin a new career in a highly in-demand areas. You do not require any prior programming experience or Cloud background to start this program. The courses in this program will help you develop skill sets in a variety of technologies including, Cloud foundations, HTML, CSS, JavaScript, GitHub, Node.js, React, Cloud Native practices, DevOps and more. After completing all the courses in the program, you will have developed and deployed several applications on a cloud platform and delivered Software as a Service (SaaS) solutions using Cloud Native methodologies.

Prospectus

The students will learn the essential characteristics, models, benefits, infrastructure, & emerging trends. Create a cloud account. Develop with front-end development languages and tools such as HTML, CSS, JavaScript and React also the student will learn program applications with back-end development languages and tools such as Node.js and NoSQL databases. *Finally the student will* Build and deploy applications using Cloud Native methodologies and tools, CI/CD tool chains, and build your portfolio using GitHub.

1. **Introduction to Cloud Computing:**

   This course introduces you to the core concepts of cloud computing. You gain the foundational knowledge required for understanding cloud computing from a business perspective as also for becoming a cloud practitioner. You understand the definition and essential characteristics of cloud computing, its history, the business case for cloud computing, and emerging technology use cases enabled by cloud. We introduce you to some of the prominent service providers of our times (e.g. AWS, Google, IBM, Microsoft, etc.) the services they offer, and look at some case studies of cloud computing across industry verticals.

   You learn about the various cloud service models (IaaS, PaaS, SaaS) and deployment models (Public, Private, Hybrid) and the key components of a cloud infrastructure (VMs, Networking, Storage - File, Block, Object, CDN). We also cover emergent cloud trends and practices including - Hybrid Multicloud, Microservices, Serverless, DevOps, Cloud Native and Application Modernization. And we go over the basics of cloud security, monitoring, and different job roles in the cloud industry.

2. **Introduction to Web Development with HTML, CSS, JavaScript**

   This course will lead you through the languages and tools you will need to develop your own Cloud Apps. Beginning with an explanation of how internet servers and clients work together to deliver applications to users, this course then takes you through the context for application development in the Cloud, introducing front-end, back-end, and full-stack development. You'll then focus on the languages you need for front-end development, working with HTML, CSS, and JavaScript. Finally, you will discover tools that help you to store your projects and keep track of changes made to project files, such as Git and GitHub.

3. **Developing Cloud Native Applications**

   In this course, you'll begin with some crucial cloud concepts. Then, you will dive into specific tools and techniques for developing cloud native apps. Learning about the Cloud Native Computing Foundation, the significance of hybrid cloud infrastructures, and how they affect cloud app developers will be covered You will then look at two key areas of cloud thinking: modernization and continuous integration/continuous delivery.

4. **Developing Cloud Apps with Node.js and React**

   In this course, you will focus on server-side JavaScript and frameworks. You will discover ways to make development faster and easier in web browsers and embedded systems.

No	Course Code	Course	POs	Contact Hours			
				L	T*	P	C
1	21ITM11	Introduction to Cloud Computing	6, 7, 12	4	-	-	4
2	21ITM12	Introduction to Web Development with HTML, CSS, JavaScript	1, 2, 3, 9, 12	4	-	-	4
3	21ITM13	Developing Cloud Native Applications	5, 8, 10	4	-	-	4
4	21ITM14	Developing Cloud Apps with Node.js and React	5, 8, 10	4	-	-	4

Placements Opportunities

In 2020, the Stack Overflow survey of developers reported that 51.4% of respondents are using Node.js, making it number one in the category of Other Frameworks, Libraries, and Tools. In the Most Loved, Dreaded, and Wanted category for Other Frameworks, Libraries, and Tools, Node.js is in the top ten at 66.8%. In the Web Frameworks category, React is number two at 35.9% in usage and 66.9% in the Most Loved, Dreaded, and Wanted category for Web Frameworks. This course is designed to help you achieve success in this fast-growing cloud computing area. You may be an IT person looking to step up in your career, a new graduate seeking to establish a solid skill set to score a job in the cloud or web development, and IT decision-maker who needs to manage more cloud-centric projects, or someone in another field who wants to be able to talk about cloud computing knowledgeably.

21ITM11 Introduction to Cloud Computing

4 0 0 4

Course Outcomes

1. Interpret the architecture and infrastructure models of cloud computing, strengths, and limitations of cloud computing.
2. Analyze the performance, scalability, and availability of the underlying cloud technologies and software
3. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
4. Apply the fundamental concepts in data centers to understand the tradeoffs in power, efficiency and cost.
5. Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
6. Analyze various cloud programming models and apply them to solve problems on the cloud.

CO – PO Mapping

COs	PO_6	PO_7	PO_{12}
1	3	3	2
2	3	3	3
3	3	2	3
4	3	2	2
5	2	3	3
6	3	3	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit-I **16 Hours**

Overview of Cloud Computing

Welcome to Introduction to Cloud Computing, Definition and Essential Characteristics of Cloud Computing, History and Evolution of Cloud Computing, History and Evolution of Cloud Computing, Key Considerations for Cloud Computing, Key Cloud Service Providers and Their Services, Cloud Adoption - No longer a choice, Cloud Adoption - Some case studies, Internet of Things in the Cloud, Artificial Intelligence on the Cloud, Blockchain and Analytics in the Cloud.

Beyond the Syllabus: Companies in the Cloud Today, Amazon Web Servies, Google services, IBM Cloud, Windows Azure, Tata Cloud, Salesforce.com

Unit-II **17 Hours**

Cloud Computing Models

Overview of Cloud Service Models, IaaS - Infrastructure as a Service, PaaS - Platform as a Service, SaaS - Software as a Service, Public Cloud, Private Cloud, Hybrid Cloud

Beyond the Syllabus: various cloud services provided by Amazon,

Unit-III **14 Hours**

Components of Cloud Computing

Overview of Cloud Infrastructure, Virtualization and Virtual Machines Explained,

Types of Virtual Machines, Bare Metal Servers, Secure Networking in Cloud, Containers, Basics of Storage on Cloud, File Storage, Block Storage, Object Storage Overview, Object Storage - Tiers and APIs, CDN - Content Delivery Networks

Beyond the Syllabus: various hypervisors like VMware, KVM, oracle VM,

Unit-IV **13 Hours**

Emergent Trends and Practices

Hybrid Multi-cloud, Microservices, Serverless Computing, Cloud Native Applications, DevOps on the Cloud, Application Modernization

Beyond the Syllabus: various Hybrid Multi Cloud Applications

Total: 60 Hours

Textbook (s)

1. George Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems- Concepts and Design”, Fourth Edition, Pearson Publication.
2. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.

3. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
4. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
5. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

Reference (s)

1. Michael Miller, Cloud Computing-Web Based Applications that change the way you work and collaborate online, 1st Edition, Pearson Education, Publishing, 2011
2. Kai Hwang, Geoffrey C Fox and Jack J.Dongarra, Distributed & Cloud Computing from Parallel Processing to the Internet of Things , 1st Edition, MK Publishing, 2010
3. David S Linthicum, Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide, 1st Edition, Addison-Wesley, 2009
4. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp2011.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	40	45	20
Understand	40	45	60
Apply	20	10	--
Analyze	--	--	20
Evaluate	--	--	--
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define Cloud Computing.
2. List characteristics of cloud computing.
3. Define private cloud.
4. What is virtualization?

Understand

1. Explain different cloud Infrastructure models.
2. Explain different levels of virtualization.
3. Explain about cloud Native applications.
4. Explain about Block Storage.
5. With neat diagram explain the public cloud.
6. Explain Internet of Things of cloud.

Analyze

1. Compare cloud center and service infrastructure.
2. Analyze different cloud services provided.

OBE Sample Question

1. A company has peak customer demand for its IT services in the month of April. It has enough IT resources to handle off peak demand but not peak load. What is the best approach to handle this situation?
2. Elaborate on "the advantages of Simple data backup as well as more comprehensive disaster recovery and business continuity planning as an essential part of business and personal life on cloud computing."

21ITM12 Introduction to Web Development with HTML, CSS, JavaScript

4 0 0 4

Course Outcomes

1. Understand client-side scripting tools to create and modify web pages.
2. Infer the knowledge of web programming to develop and maintain web pages.
3. Develop portable and dynamic web pages.
4. Apply the knowledge of java script for validating the web pages.
5. Identify the usage of repository to deploy the web projects.
6. Explore the knowledge of deploying projects in a repository.

CO – PO Mapping

COs	PO_1	PO_2	PO_3	PO_9	PO_{12}
1	3	2	1	3	2
2	3	2	1	3	1
3	3	2	1	3	2
4	3	2	1	3	2
5	3	2	1	3	1
6	3	2	1	3	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I **16 Hours**

Introduction to Programming for the Cloud

Welcome to Introduction to Cloud Development HTML, CSS, and JavaScript, Overview of Web and Cloud Development, Learning Front-End Development, Introducing, Application Development Tools, More Application Development Tools,

The Importance of Back-End Development

Unit II **15 Hours**

HTML5 and CSS Overview

Introduction to HTML, HTML Features, HTML Management and Support, HTML Scripting, HTML5 Browser Support,

CSS: Styling HTML

HTML5 Elements

HTML5 Tags and Structural Elements, HTML5 Input Element: Attributes for the Input Tag

Web CORS, Web RTC

.

Unit III **15 Hours**

JavaScript Programming for Web Applications

JavaScript Language: Overview and Syntax, JavaScript: Variables and Control Statements, JavaScript: Functions and Prototypes, Client-Side JavaScript: with HTML

Client-Side JavaScript: with DOM, JavaScript DOM Objects

JavaScript APIs

Unit IV **14 Hours**

GitHub

Overview of Git/GitHub, Introduction to GitHub, GitHub Repositories, GitHub Branches

Cloning and Forking GitHub Projects,

Managing GitHub Projects

Total: 60 Hours

Textbook (s)

1. Programming the World Wide Web, 8th edition Robert W. Sebesta, pearson.
2. HTML & CSS: The Complete Reference, Fifth Edition, Thomas Powell, Mc Graw Hill

Reference (s)

1. Web programming with HTML, XHTML and CSS, 2e, Jon Duckett, Wiley India.
2. Web programming Bai, Michael Ekedahl, CENAGE Learning, India edition.
3. An Introduction to Web Design + Programming, Paul S.Wang, India Edition.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	30	10	--

Apply	30	30	40
Analyze	10	20	30
Evaluate	10	20	30
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Define HTML
2. Mention types of lists available in HTML
3. List the ways to add CSS to an HTML document

Understand

1. Explain about Document Object Model
2. Explain about Browser Object Model
3. Explain about the functions in Javascript

Apply

1. Design a static web page that contains following navigation links.
   Home Page
   About Us
   Contact Us
2. Apply different font styles, font families, font colors, animations and other formatting styles to the above static web pages.

Analyze

1. Compare between HTML4 and HTML5
2. Compare between CSS and CSS3.

Evaluate

1. Validate the registration form using Javascript.
2. Validate the login form using Javascript.

Open Book Exam

Question 1:

Here are a couple of useful things you can do with JavaScript just to get you started:

1. Check if all input's in signup form are valid before submitting and display error's if not
2. Have a search box bring up suggestions as you type
3. Makes changes or reload parts of the page's DOM without having to reload the page using AJAX
4. Add smooth scrolling to part of the page on single page website designs when a link on the navbar is clicked
5. Create a page loading animation
6. Make a parallax
7. Make a slider
8. Create cool animations

Question 2:

I use them for parts of my apps that need extra high performance. Otherwise, I avoid them. Other than extreme circumstances where you are willing to sacrifice lots of dev time to squeeze every bit of performance out of JavaScript, the complexity that prototypes add will make your app worse off.

Generally, I think that prototypes are often used out of habit rather than need, because people come from strongly typed languages where you have to use a class for everything. In most cases, you are well off using simple object literals and functions that create them (sometimes referred to a factory functions). It is simpler and flexible.

I use prototypes when I need very, very high performance. An example of this might be if you're doing a virtual scroll component, where you need to create hundreds or thousands of objects in 1/60th of a second to achieve 60FPS. It won't help a lot, object literals are created extremely fast too (my iPhone can create hundreds of millions per second), so you won't gain a lot.

Sidenote 1: If you make use of bind, like most people do when using prototypes, you lose much of performance benefits of the prototype. This is not commonly known.

Sidenote 2: Keep in mind that the new keyword and the ES6 class keyword are just leaky abstractions on top of the prototype, that in my opinion complicates prototypes even further - they are tricky enough without convoluted abstractions on top of them. Not a fan.

21ITM13 Developing Cloud Native Applications

4 0 0 4

Course Outcomes

At the end of the course, students will be able to

1. Understand cloud native applications.
2. Analyze various cloud modernization concepts.
3. Examine cloud resources and services .
4. Analyze the Cloud Continuous Delivery Tool chains.
5. Identify RESTful Web Services.
6. Identify the REST APIs with Watson AI Services.

CO – PO Mapping

COs	PO_5	PO_8	PO_{10}
1	3	3	2
2	3	3	2
3	3	2	2
4	2	3	3
5	3	3	1
6	3	2	2

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I **16 Hours**

Introduction to Cloud Native

Introduction to Developing Cloud Native Applications, Cloud Computing Overview ,Cloud Native Applications, CNCF, Hybrid Cloud, Preparation for Modernization, Continuous Integration/Continuous Delivery – SRE

TDD

Unit II **15 Hours**

Getting Started with IBM Cloud

IBM Cloud Overview: IaaS, PaaS, and Runtimes, IBM Cloud Overview: Services, Regions and Cloud Foundry, Building in the IBM Cloud, Getting Started with IBM Cloud Catalog Resources, Creating and Managing an IBM Cloud Application, Creating an IBM Cloud Service and Web App, Managing Access to IBM Cloud Resources

Unit III **15 Hours**

IBM Cloud CLI

Introduction to Node.js, Preparing to use CLIs, Using CLIs

DevOps on IBM Cloud

Introduction to a DevOps Approach, IBM Cloud Continuous Delivery Overview, Creating IBM Cloud Continuous Delivery Toolchains, Web IDE Features, Source Code Management (Git Repo) and Issue Tracker,

Build and Deploy Automated Delivery Pipeline

Unit IV **14 Hours**

REST Architecture and Watson API

Introduction to Representational State Transfer (REST) , REST Characteristics and RESTful Web Services, JavaScript Object Notation (JSON), Using REST APIs with Watson AI Services.

Introduction to Data Services in IBM Cloud

Overview of Database Services in IBM Cloud, Overview of IBM Cloudant , Getting Started with IBM Cloudant

Introduction to Postman

Total: 60 Hours

Textbook (s)

1. Developing Cloud Native Applications, Ahmed AzraqHala A. AzizUzma Siddiqui, 3rd Edition, 2017.
2. Developing Open Cloud Native Microservices, Graham Charters, Sebastian Daschner, O'Reilly, a, 1st Edition, 2019.

Reference (s)

1. Developing Cloud Native Applications In Azure Using.Net Core, Rekha Kodali Gopala Behara Sankara Govindarajulu, BPB Publications, 1st Edition, 2020.
2. Cloud Native: Using Containers, Functions, and Data to Build Next-Generation Applications, Boris Scholl , Trent Swanson , Peter jausovec, O'Reilly 1st Edition, 2019.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	30	10	--
Apply	30	30	40
Analyze	10	20	30
Evaluate	10	20	30
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. List any four cloud applications.
2. Define Integration
3. List four cloud services

Understand

1. Explain cloud foundry
2. Explain RESTful Web Services
3. Illustrate Representational State Transfer

Apply

1. Give an example of Creating and Managing an IBM Cloud Application
2. How to build IBM cloud.

Analyze

1. Compare SRE and TDD
2. Analyze Source Code Management (Git Repo) and Issue Tracker

Evaluate

1. Describe CNCF.
2. Summarise the REST APIs with Watson AI Services

Open Book Exam Questions

1. How to move from monolithic app development to cloud-native app development?
2. Protecting your company data is mission critical. Confidential Computing provides encrypted enclaves that break down data siloes, not only within your organization, but with external entities—all without ever exposing the data to any of the parties give solutions for encrypting the data.

21ITM14 Developing Cloud Apps with Node.js and React

4 0 0 4

Course Outcomes

1. Understand Server side programming with java script.
2. Create server-side applications with Node.js Java script framework.
3. Build applications using REACT & ES6.
4. Practice DevOps and utilize continuous delivery pipelines with Git.
5. Deploy web applications to different Cloud platforms.
6. Extend Node.js application with third-party packages.

CO – PO Mapping

Cos	PO_5	PO_8	PO_{10}
1	3	2	3
2	3	2	2
3	3	3	3
4	3	3	2
5	3	3	2
6	3	2	3

3–Strongly linked | 2–Moderately linked | 1–Weakly linked

Syllabus

Unit I **15 Hours**

Introduction to Server-Side JavaScript

Welcome to Developing Cloud Applications with Node.js and React, Introduction to Node.js (optional), Introduction to Server-Side JavaScript, Creating a Web Server with Node.js.

Working with Node.js Modules

Unit II **15 Hours**

Asynchronous I/O with Callback Programming

Asynchronous I/O with Callback Programming, Creating Callback Functions.

Working with JSON

Unit III **13 Hours**

Express Web Application Framework

Extending Node.js, Express Web Application Framework, Your First Express Web Application, Routing, Middleware.

Templating

Unit IV **17 Hours**

Building a Rich Front-End Application using REACT & ES6

Introduction to ES6, Introduction to Front End Frameworks and React.JS, Working with React Components, Passing Data and States between Components, Connecting React to External Services, Testing Cloud Applications, Introduction to Logging,

IBM Cloud Monitoring with LogDNA and Sysdig

Total: 60 Hours

Textbook (s)

1. Fullstack React, The complete guide to ReactJS and Friends, Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Guttman, Tyler McGinnis, 1st Edition, Newline publications, 2021.
2. The Road to React, Robin Wieruch, 2021 Edition.
3. React Explained, Zac Gordon, 2020 Edition, OS Training.

Reference (s)

1. Learning React: Modern Patterns for Developing React Apps, Alex Banks, Eve Porcello, 2nd Edition, O'Reilly Publications.
2. Beginning React, Greg Lim, 2nd Edition, 2020
3. React.js Essentials, Artemij Fedosejev, 1st Edition, 2015, Peckt Publishing Ltd.

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Exam (%)
Remember	20	20	--
Understand	30	30	--
Apply	20	20	30
Analyze	20	10	20
Evaluate	10	30	50
Create	--	--	--
Total (%)	100	100	100

Sample Question (S)

Remember

1. Name a few techniques to optimize React app performance.
2. List the lifecycle methods of React?

Understand

1. Explain Strict Mode in React.
2. Explain React state and props

Apply

1. What are the differences between functional and class components?
2. What is the difference between Shadow DOM and Virtual DOM?

Analyze

1. Is it good to use setState() in componentWillMount() method?
2. Why should we not update the state directly?
3. Do Hooks replace render props and higher order components?

Evaluate

1. Can you force a component to re-render without calling setState?Describe how to implement a lock using semaphores.
2. Describe how to combine multiple inline style objects?
3. Describe how to re-render the view when the browser is resized?

Open Book Exam Questions

1. Real-time chat is any online communication tool that enables the live transmission of text, video, or audio messages from a sender to a receiver. Real-time chats can take the form of one-to-one or one-to-many group chats built on instant messaging (IM) or Internet Relay Chat (IRC) technologies. Using Node.js implement basic functionalities for building real-time chats of any complexity with a skeleton structure.

DEPARTMENT OF MECHANICAL ENGINEERING

AR20 MINOR COURSES

Minors for other Departments offered by Mechanical Engineering

B.Tech. (Minor)							
Title I-Robotics and Automation							
S.No.	**Course Code**	**Course Name**	**POs**	**L**	**T**	**P**	**C**
1	21MEM11	Introduction to Robotics	1,2,3	4	-	-	4
2	21MEM12	Drives and Sensors	1,2,3,4	4	-	-	4
3	21MEM13	Control Systems for Robotics	1,2,3,4	4	-	-	4
4	21MEM14	Machine Learning for Robotics	2,5	4	-	-	4
Title II- Industrial Systems Engineering							
1	21MEM21	Industrial Engineering	1,10,11,12	4	-	-	4
2	21MEM22	Fundamentals of Operations Research	1,2,3,5	4	-	-	4
3	21MEM23	Enterprise Resource Planning	1,2,3,5,11,12	4	-	-	4
4	21MEM24	Production Planning and Control	1,2,3,5,11,12	4	-	-	4

Robotics and Automation:

Robotics is a field of engineering that deal with design and application of robots. Robots are used in industries for speeding up the manufacturing process. They are also used in the field of nuclear science, sea-exploration, servicing of transmission electric signals, designing of bio-medical equipment's etc.

Robotics engineering is one of the recognized professional careers in India. There are ample opportunities in this field for robotics engineers both in India as well as in abroad countries. A specialization in robotics engineering may lead to potential career opportunities in manufacturing, research and engineering, agriculture, mining, nuclear, power plant maintenances and a variety of other areas. Besides, there is great scope for qualified experts and researchers to associate themselves with different segments of R & D in robotics.

Industrial Systems Engineering:

The industrial & systems engineering specialization curriculum prepares the engineers to create the excellence in operations management, industrial engineering, and decision sciences such as information systems & analytics by adopting world class real practices and further helps them to become an expert in management consulting to solve the industrial as well as business management problems. It is a branch of engineering that uses mathematical, statistical, and scientific techniques to design, analyze, implement, and improve systems of people, information, and materials. Such systems often involve complex interactions between humans and machines. ISEs strive to ensure that these systems work safely and efficiently.

A specialization in Industrial systems engineering may lead to potential career opportunities as Ergonomist Engineer, Operations Analyst, Quality Control Engineer, Sales Engineer, Project Manager etc.,

21MEM11 Introduction to Robotics

4 0 0 4

Course Outcomes:

1. Explain fundamentals of the robotics, history, evolution, applications, and anatomy
2. Infer basic configurations and components of robotic systems
3. Apply the basic transformations to robotic systems
4. Model the robot motion through forward kinematics and inverse kinematics
5. Develop mathematical models for dynamic motions and trajectory planning
6. Explain Robotic programming with application

COs – POs Mapping

COs	PO_1	PO_2	PO_3
1	3	1	1
2	2	1	1
3	3	2	1
4	1	3	2
5	1	3	2
6	1	3	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I - Introduction to Robotics

Overview of Robotics: Present and future applications. Classification based on coordinate system and control system. Definition of mechanisms and manipulators

Anatomy of Robots: Components of robots, common types of arms, Function line diagram representation of robot arms, and Degrees of Freedom

15 Hours

Unit II - Robot Manipulator Kinematics

Kinematic Modeling: Position and orientation of a rigid body, Coordinate Transformation and Homogeneous transformations

Kinematics: DH parameters, Forward kinematics, Jacobian, Singularity and Statics. Inverse kinematics

15 Hours

Unit III - Robot Dynamics and Trajectory Planning

Dynamics: Introduction to Dynamics of Robotics and Jacobian for velocity analysis. Robot Dynamics equation: Lagrange - Euler and Newton - Euler formations formulations.

Trajectory and Path planning: Point to point and continuous path trajectories. General considerations in path planning. Trajectory planning by straight line motion, Skew motion, joint integrated motion and avoidance of obstacles

15 Hours

Unit IV - Robotics Programming and Application

Introduction to Robotic Programming, On-line and off-line programming, programming examples.

Robot applications - Material handling, Machine loading and unloading, assembly, Inspection, Welding and Spray painting

15 Hours

Total: 60 Hours

Textbook(s):

1. Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill
2. Robotics and Control: R K Mittal and Nagrath, McGraw Hill

Reference(s):

1. Philippe Coiffet, Michael Chirouze, An Introduction to Robot Technology, Springer Science & Business Media, Illustrated Edition, 2011
2. K S Fu, Ralph Gonzalez, C S G Lee, Robotics: Control Sensing. Vision, and Intelligence, Tata McGraw-Hill Education, 2nd Edition, 2008
3. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic Engineering: An Integrated approach, Prentice Hall, 1st Edition, 1989
4. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson/Prentice Hall, 3rd Edition, 2005
5. S K Saha, Introduction to Robotics, Tata McGraw-Hill Education, 2nd Edition, 2014

Sample Questions:

1. Determine the equations of motion for 2DOF RR- planar manipulator arm using Lagrange-Euler Formulation.
2. Explain the different ways of accomplishing lead through method of robot programming.
3. Explain in detail the DH algorithm for frame assignment with supporting sketches.

21MEM12 Drives and Sensors

4 0 0 4

Course Outcomes:

1. Apply theoretical knowledge: understanding selection of suitable sensors and actuators; designing electro-mechanical systems
2. Use concepts in common methods for converting a physical parameter into an electrical quantity
3. Understand different types of drive systems
4. Work with mechanical systems that include digital and analogue electronics as a data acquisition model
5. Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters
6. Evaluate performance characteristics of different types of sensors

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_4
1	3	3	2	2
2	2	3	3	2
3	3	2	2	1
4	3	2	2	1
5	2	3	1	1
6	2	3	1	1

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I - Introduction to Robot Drives and Actuators

Introduction, drives and actuators, classification of actuator systems, open loop control, closed loop control with feedback, functions and classification of drive systems, chain and linkages, lead screw, ball screws, belt drives, gear drives, precision gear boxes, harmonic drives, speed reducers, classification of grippers

15 Hours

Unit II – Electric Drives and Servo systems

Introduction, classification, Electric Drives - AC motors, DC motors, stepper motors, types of stepper motors, half step mode operation, micro step mode, linear actuators, direct drive actuators.
Pneumatic and Hydraulic actuators – Advantages and Disadvantages

15 Hours

Unit III - Fundamentals of Sensors and Transducers Performance

Terminology, static and dynamic characteristics of transducers, classification of sensors and transducers, signal processing and signal conditioning. Operational amplifiers, filters, protection devices, analog to digital converter, digital to analog converter

15 Hours

Unit IV - Sensors and their applications

Inductive, capacitive, magnetic, various types of photo sensors, detection methods, through beam detection, reflex detection & proximity detection, ultrasonic and microwave sensors. Applications and understanding of the above sensors

15 Hours

Total: 60 Hours

Textbook(s):

1. Knapczyk, J. (2014). Basics of Robotics: Theory and Components of Manipulators and Robots. Austria: Springer Vienna.
2. De Silva, C. W. (2015). Sensors and Actuators: Engineering System Instrumentation, 2nd Edition. United States: CRC Press.
3. D.V.S. Murthy, "Transducers and Instrumentation", PHI 20032. B.C. Nakra and K.K. Chaudhary, “Instrumentation, Measurement and Analysis”: Tata McGraw Hill.

Reference(s):

1. Pawlak, A. M. (2017). Sensors and Actuators in Mechatronics: Design and Applications. CRC Press.
2. Prof. R. C., and Bishop, R. H., Modern Control Systems, Addison Wesley, 7th Edition, 1995.

Sample Questions:

1. What are the different types of actuators used for robots? Explain the working of a hydraulic actuator system.
2. What are the basic characteristics that a sensor should possess?
3. Discuss the advantages and disadvantages of different types of actuators. Explain the working of pneumatic actuator system.

21MEM13 Control Systems for Robotics

4 0 0 4

Course Outcomes:

1. Elucidate the need and implementation of related Instrumentation & control in robotics
2. Illustrate the movement of robotic joints with computers/microcontrollers
3. Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form
4. Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis
5. Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions
6. Formulate different types of analysis in frequency domain to explain the nature of stability of the system

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_4
1	3	2	-	-
2	2	3	-	-
3	-	2	3	-
4	-	-	2	3
5	-	3	3	-
6	-	-	3	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I - Introduction to Control Systems

Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs

15 Hours

Unit II - Time Response of feedback control systems

Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers

15 Hours

Unit III - Stability analysis

Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion, Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci

15 Hours

Unit IV - Frequency domain analysis and stability

Frequency domain analysis and stability: Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion

15 Hours

Total: 60 Hours

Textbook(s):

1. Nagrath I. J. and M. Gopal, Control Systems Engineering, New Age International (P) Ltd, 5th Ed, 2007.

Reference(s):

1. Kuo, B. C., and Golnaraghi, F., Automatic Control Systems, John Wiley & Sons, 8th Ed, 2003.
2. Prof, R. C., and Bishop, R. H., Modern Control Systems, Addison Wesley, 7th Ed, 1995.

Sample Questions:

1. Distinguish between open loop system and close loop system.
2. Explain the effect of time constant on the speed of time response of a control system.
3. Obtain the transfer function of an armature-controlled DC motor.

21MEM14 Machine Learning for Robotics

4 0 0 4

Course Outcomes:

1. Discuss about the concepts of machine learning
2. Describe the types of trees and bias
3. Outline the supervised learning methods with various case studies
4. Compare the learning methodologies and dimensionality concepts
5. Summarize the applications of neural networks in robotic applications
6. Illustrate the applications of machine learning using case studies

COs – POs Mapping

COs	PO_2	PO_5
1	1	2
2	3	2
3	3	1
4	3	2
5	3	2
6	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I Introduction

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

Solving problems by searching -Informed search and exploration–Constraint satisfaction problems- Adversarial search, knowledge, and reasoning–knowledge representation – first order logic.

15 Hours

Unit II Problem Solving and Planning

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

15 Hours

Unit III Reasoning and Learning

Uncertainty - Probabilistic reasoning - Filtering and prediction - Hidden Markov models - Kalman filters - Dynamic Bayesian Networks, Speech recognition, making decisions.

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing and perception.

15 Hours

Unit IV AI in Robotics

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

15 Hours

Total: 60 Hours

Textbook(s):

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approach”, Pearson Education, India, 2016
2. Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”, Harlow: Addison Wesley, 2002

Reference(s):

1. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992
2. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, “Introduction to AI Robotics”, MIT Press, 2000
3. Francis.X.Govers, “Artificial Intelligence for Robotics”, Packt Publishing, 2018
4. Huimin Lu, Xing Lu, “Artificial Intelligence and Robotics”, Springer, 2017

Sample Questions:

1. What do you understand by AI bias? Discuss in detail with some examples.
2. What is data mining? Explain with example.
3. What is Computer Vision? Give an example of it.

21MEM21 Industrial Management

4 0 0 4

Course Outcomes

1. Design organization structure and implement management principles in real time business environment
2. Establish layouts for different types of industries, manufacturing, process and service sectors
3. Elaborate productivity and profitability by implementing work study and SQC
4. Select and maintain skilled and sufficient manpower for various business proposals
5. Find total production time and cost by using networking techniques
6. Enunciate a best method of making a product in the production process

COs – POs Mapping

COs	PO_1	PO_{10}	PO_{11}	PO_{12}
1	3	1	2	2
2	3	2	2	1
3	3	1	1	2
4	3	1	2	2
5	2	2	1	1
6	3	1	1	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Evolution of Management Thought-Organizational Structures

Douglas McGregor's Theory X and Theory Y, Maslow's Hierarchy of Human Needs, Systems Approach to Management. Designing. Basic concepts related to Organization, Depart mentation and Decentralization, Types of mechanistic and organic structures of organization (Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization) and their merits, demerits, and suitability.

Cellular Organization and team structure

15 Hours

Unit II

Facilities location- Work study

Plant location, definition, factors affecting the plant location, comparison of rural and urban sites methods for selection of plant, Matrix approach, Plant Layout; definition, objectives, types of production, types of plant layout, various data analyzing forms, travel chart. Definition, objectives, method study; definition, objectives, steps involved, various types of associated charts. Work measurement- definition, time study, steps involved, equipment, different methods of performance rating, allowances, standard time calculation. Work Sampling, definition, steps involved.

Standard time calculations and differences with time study

15 Hours

Unit III

Materials Management-Quality Control

Objectives, Inventory, functions, types, associated costs, inventory classification techniques, EOQ, ABC and VED analysis. Inspection and quality control, types of inspections, Statistical Quality Control; techniques, variables and attributes, assignable and non-assignable causes, variable control charts, and R charts, attributes control charts, p charts and c charts. sampling plans.

Introduction to TQM, Quality Circles, ISO 9000 series procedures

15 Hours

Unit IV

Introduction to PERT / CPM-Introduction to Human Resource Management

Project management, network modeling: PERT/CPM Time and cost estimations. Functions of HRM, Job Evaluation, different types of evaluation methods, Job description, Merit Rating, difference with job evaluation.

Different methods of merit ratings, wage incentives.

15 Hours

Total: 60 Hours

Textbook (s)

1. O.P. Khanna, Industrial Engineering and Management, S Chand & Co Publications, 3rd Edition, 2013
2. Teslang Martand, Industrial Engineering and Production Management, S Chand & Co Publications, 1stEdition, 2002
3. Phillip E Hicks, Industrial Engineering and Management; a new perspective, TMH publications, 2nd Edition, 1994
4. H.T. Amrine, J. A. Ritchey and O.S. Hulley, Manufacturing Organization and Management, , Prentice-Hall, 2nd Edition, 1966
5. P.C. Tripathi and P.N. Reddy, Principles of Management, TMH Publications, 4th Edition, 2012

Reference (s)

1. H. Koontz & H. Weihrich, Essentials of Management, Tata McGraw Hill, 8th Edition, 2010
2. Paneer Selvam, Production and Operations Management, PHI, 3rd Edition, 2012

Sample Question (s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examinations (%)
Remember	35	35	-
Understand	45	35	-
Apply	20	30	-
Analyze	-	-	50
Evaluate	-	-	30
Create	-	-	20
Total (%)	**100**	**100**	**100**

Remember

1. List the five objectives of work study
2. List any four merits and demerits of committee organization
3. Define Mc-Gregor's theory X and theory Y
4. List the three types of plant layout
5. List any four functions of HRM
6. List the three functions of material management?

Understand

1. Explain the factors effecting plant locations
2. Explain about purchase management
3. Write about Statistical Quality Control-techniques
4. Compare the Mc-Gregor's Theory X and Theory Y

Apply

1. Explain the attribute charts
2. Compare the PERT and CPM
3. Explain about stores management and stores records
4. What are the different types of evaluation methods and explain them?
5. Identify duties of purchase manager

Analyse

1. Compare the rural and urban sites methods for selection of plant
2. Classify of various types of associated charts
3. Explain about the suitability of line and staff organization

Evaluate

1. Explain the jobs of a network along with their time estimates. Draw the project network, evaluate the completion time of the project, and identify the critical paths for any case study

Create

1. Create a plant layout and establish optimum resources for an organization
2. Create a new problem-solving technique for network analysis

21MEM22 Fundamentals of Operations Research

4 0 0 4

Course Outcomes

1. Formulate a real time situation into a mathematical model.
2. Assign a right job to a right person using job sequencing.
3. Make right decisions in operations management using game theory, queuing theory and replacement analysis.
4. Solve nonlinear problems using nonlinear programming techniques.
5. Perform optimum problem solving using dynamic programming and simulation techniques.
6. Distinguish the process of waiting lines and its applications.

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_5
1	3	2	2	1
2	1	2	3	2
3	1	3	3	2
4	3	2	2	3
5	2	1	3	2
6	3	2	1	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Linear Programming – Characteristics and Methods, Development, definition, characteristics and phases, types of models, operation research models, applications, Allocation

Linear programming problem formulation, graphical solution, simplex method, two phase methods, big m method, duality principle

Nonlinear Programming

One Dimensional Minimization: Unimodal function, Elimination methods, unrestricted search, Exhaustive Search, Dichotomous search

Evaluation of a nonlinear problem using advanced search methods

15 Hours

Unit II

Transportation Problem- Solution methodology with examples

Formulation, optimal solution, unbalanced transportation problem, degeneracy, assignment problem formulation, optimal solution, variants of assignment problem travelling salesman problem

Solving a given transportation problem using soft computing techniques

15 Hours

Unit III

Sequencing- Solution methodology

Introduction, flow, shop sequencing, n jobs through two machines, n jobs through three machines, job shop sequencing, and two jobs through "m" machines

Replacement

Introduction, replacement of items that deteriorate with time, when money value is not counted and counted, replacement of items that fail completely, group replacement.

Development of a replacement policy of the components for an enterprise

15 Hours

Unit IV

Theory of Games-Various types of games

Introduction, mini. Max (max. mini) criterion and optimal strategy, solution of games with saddle points, Rectangular games without saddle points, 2 x 2 games, dominance principle, m x 2 & 2 x n games, graphical method.

Waiting Lines

Introduction, single channel, poison arrivals, exponential service times, with infinite population and finite population models, multichannel, poison arrivals, exponential service times with infinite population single channel poison arrivals.

Implementing the principles of waiting lines for a given case study.

15 Hours
Total: 60 Hours

Textbook (s)

1. S.D Sharma, Operations Research: Theory method and Applications, Kedarnath, Ram Nath & Co, Meerut Publications, 16th Edition, 2012
2. FredErick S Hiller & Gerald J Liberman, Introduction to Operations Research, TMH Publications, 7th Edition, 2002

Reference (s)

1. Handy A Taha, Operations Research: An Introduction, Prentice Hall of India Publications, 6th Edition, 1997
2. R. Pannerselvam, Operation Research, PHI Publications, 1st Edition, 2002
3. J. K Sharma, Operation Research: Problems and Solutions, McMillan, 1st Edition, 2002

Sample Question (s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examinations (%)
Remember	35	30	-
Understand	35	40	-
Apply	30	30	
Analyze	-	-	60
Evaluate	-	-	20
Create	-	-	20
Total (%)	**100**	**100**	**100**

Remember

1. Define Operations research for engineers
2. State the factors to be consider in Simplex procedure
3. List any three assumptions in Game theory strategies

Understand

1. Explain about the procedural steps involved in two phase methods?
2. Classify different types of queuing systems?
3. Explain the role of computers in Operations research?

Apply

1. Seven jobs are to be processed on two machines A and B in the order A→B. Each machine can process only one job at a time. The processing times (in Hours) are as follows. Find the optimum sequence

Job	1	2	3	4	5	6	7
Machine A	10	12	13	7	14	5	16
Machine B	15	11	8	9	6	7	16

2. Determine the initial basic feasible solution of the following transportation problem?

To →		I	II	III	Supply
From	A	50	30	200	1
	B	90	45	170	3
	C	250	200	50	4
Demand		4	2	2	

Analyze

1. ABC Company is engaged in manufacturing 5 brands of packed snacks. It is having five manufacturing setups, each capable of manufacturing any of its brands, one at a time. The cost to make a brand on these setups varies according to the following table. Analyse the optimum assignment of products on these setups resulting in the minimum cost?

Brands↓ & Setups→	S1	S2	S3	S4	S5
B1	4	6	7	5	11
B2	7	3	6	9	5
B3	8	5	4	6	9
B4	9	12	7	11	10
B5	7	5	9	8	11

2. Analyze the game whose payoff matrix to the player A is given in the following table?

		B		
		I	II	III
A	I	1	8	4
	II	6	4	5
	III	0	1	2

Evaluate

1. Fleet cars have increased their costs as they continue in service due to increased direct operating cost and increased maintenance. The initial cost is Rs. 3,500 and the trade in value drops as time passes until it reaches a constant value of Rs.500. Given the cost of operating, maintaining and the trade in value, evaluate the proper length of service before cars should be replaced?

Year of service	1	2	3	4	5
Year-end trade in value	1900	1050	600	500	500
Annual operating cost	1500	1800	2100	2400	2700
Annual maintaining cost	300	400	600	800	1000

2. Use Simplex method to evaluate the following problem:

   $Maximize\ Z = 3x_1+5x_2+4X_3$

   $Subjected\ to 2\ x_1+3x_2 \leq 8;\ 2x_2+5X_3 \leq 10;3\ x_1+2x_2+4X_3 \leq 15;\ x_1, x_2, X_3 \geq 0$

3. A TV repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs sets in the order in which they come in, and if the arrival of sets is approximately Poisson with an average rate of 10 per 8-hour day, what is repairman's expected idle time each day?

Create

1. Create a suitable OR model by taking a medium scale industry
2. Create an assignment model for a large-scale enterprise

21MEM23 Enterprise Resource Planning

4 0 0 4

Course Outcomes

1. Describe the concept of ERP and develop ERP model for various projects
2. Describe the advantages, strategic value, and organizational impact of utilizing an ERP system for the management of information across the functional areas of a business
3. Develop model for E-commerce architecture for any application
4. Demonstrate a working knowledge of how data and transactions are integrated in an ERP system
5. Design the ERP implementation strategies by evaluating organizational opportunities and challenges
6. Create reengineered business processes for successful ERP implementation

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_5	PO_{11}	PO_{12}
1	3	2	2	3	2	2
2	3	2	2	3	2	2
3	2	2	2	3	2	2
4	2	2	2	2	2	2
5	2	1	3	2	2	2
6	2	1	3	2	2	2

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Basics of ERP

Business Modelling: Business process concept and business functions
ERP: Introduction, benefits, origin, evolution, and structure. Conceptual model of ERP, the evolution of ERP and the structure of ERP
Business intelligence

15 Hours

Unit II

Business modules in ERP

Companies and business Processes, Finance, Manufacturing, Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution
Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing (OLAP), Product Life Cycle Management (PLM), Supply Chain Management (SCM)
Business Analytics

15 Hours

Unit III

Enterprise information architectures

Enterprise architecture, planning, ERP usage in real world, Integration of ERP, Supply chain and Customer Relationship Applications, an overview of Integrated Management Information, ERP and E–Commerce , ERP and Internet
Data Migration

15 Hours

Unit IV

ERP Implementation

ERP & E-Commerce, Future Directives in ERP, ERP and Internet, Critical success and failure factors, Integrating ERP into organizational culture. Change management techniques. Using ERP tool: SAP/ORACLE- case study Implementation life cycle of ERP, ERP Implementation best Practices, Future of ERP applications
Selection of ERP software

15 Hours

Total: 60 Hours

Textbook (s)

1. Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning Concepts and Practice", PHI, 2003
2. Joseph A Brady, Ellen F Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Thompson Course Technology, USA, 2006
3. Alexis Leon, Enterprise Resource Planning, Tata McGraw Hill, 2nd Edition, 2000

Reference (s)

1. Rahul V. Altekar "Enterprise Resource Planning", Tata McGraw Hill, 2011
2. Mary Summer, "Enterprise Resource Planning"- Pearson Education, 2005

3. Jyotindra Zaveri, Enterprise Resource Planning, Himalaya Publishing House, 2012

Sample Question (s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examinations (%)
Remember	30	30	-
Understand	40	40	-
Apply	30	30	60
Analyze	-	-	30
Evaluate	-	-	10
Create	-	-	-
Total (%)	**100**	**100**	**100**

Remember

1. List the implementation methodologies of ERP software
2. List any four tangible and intangible benefits of ERP system
3. What is inventory management system?
4. What is CRM?
5. List out the various ERP system packages available in market

Understand

1. Explain in detail about ERP implementation methodology
2. Describe about the following ERP functional modules:
    a. Human capital Management
    b. Financial management
    c. Supply chain planning
    d. Sales and service
3. Explain about the following terms in ERP:
    a. Product lifecycle Management
    b. Customer Relationship Management
    c. Enterprise Asset management
    d. Quality Management.
4. Explain in detail about application of ERP in service industries.
5. Explain the various criteria to be met and possessed by an ERP system, when proposed for the small and medium enterprises.
6. Explain the following with suitable examples wherever necessary:
   (i) ERP system architecture
   (ii) Future trends in web-enabled ERP.
7. Differentiate between ERP and E-Commerce.

Apply

1. Write detailed reports on i) ERP and E-Business ii) Emerging trends in ERP for healthcare industry.
2. How BPR relates to ERP. Explain in the context of an IT industry.
3. Discuss key activities of ERP solution to petroleum, gas and oil Industry. ***(For Open Book Examination and not for semester end examination)***
4. Using a flow diagram, explain the various 'Phases' involved in the ERP implementation life cycle of an IT industry.
5. Explain 7 requirements from educational institutes in terms of ERP.

Analyze

1. List various steps in Procurement Cycle of an Electronics part manufacturing industry and explain what support ERP provides in each step to make the process more efficient. ***(For Open Book Examination and not for semester end examination)***
2. You have recently joined as Technology Consultant in a leading Mumbai based automobile firm that manufactures various models of passenger Cars and three wheelers right from 2007. This profit-making firm plans to streamline its main business process, i.e., its manufacturing process through ERP adoption. Now, your GM instructs you to prepare and present a 'Manufacturing Process cum Data Model' for your firm, which will be treated as a Blueprint for streamlining your firm. Your 'Process cum Data Model' should provide the following :
    i) Representative list of various core processes and their brief description in an ideal automobile manufacturing company like your firm and
    ii) Representative list of various Entities and their brief description, for forming a 'Data Model' that is suitable for a manufacturing company like your firm. Justify your report with charts providing valid information on processes and relevant Data. ***(For Open Book Examination and not for semester end examination)***

Evaluate

1. Glomove is a Singapore based premier MNC, involved in the design, manufacturing, global marketing and selling of its high demand products such as Footwear, Sports shoes, apparels, equipment etc. right from 2009. This profit-making firm decided to adopt ERP in 2015 and fully implemented the ERP system by 2018 in its many modules say CRM, Manufacturing, HR. SCM, FICO etc. by renowned ERP Vendors. Initially ERP was seen as a success, but of late especially after July 2020, the firm's customer attrition, operating cost etc are increasing whereas the sales volume has come down. Having invested huge capital in ERP implementation and maintenance the firm is now puzzled and want to identify the probable failure factors responsible for this ERP debacle. The firm has approached you and in your assumed role as a ERP Management Consultant prepare and present the firm with a 'Generic Report' incorporating the most probable factors, possible avenues (both Internal and external) along with any other solid reasons for the ERP failure, as identified by you. You may assume relevant data for this case, but the same needs mention in the report. Justify your report with valid points as well as your valuable suggestions for the Firm to overcome the debacle. ***(For Open Book Examination and not for semester end examination)***
2. Ganong Brothers LTD is the oldest candy company in Canada, but it's only through continuous innovation and keeping up with technology trends that a company like this can remain successful. That's why Ganong Brothers decided to implement a new ERP system in 2002 to obtain real-time financial data, improve order processing and support a mixed-mode manufacturing workflow. By implementing ERP software, Ganong Brothers obtained the ability to estimate demand several months in advance to help determine material requirements. The company is also able to readily access information about product and customer profitability. Evaluate the possibilities and challenges of integrating estimation tools of GBL with AI, which are a new feature that is becoming more and more common in ERP solutions***. (For Open Book Examination and not for semester end examination)***

21MEM24 Production Planning and Control

4 0 0 4

Course Outcomes

1. Explain the features of the operations and production planning functions in an organization
2. Develop extrapolative forecasting models for demand
3. Explain productivity and quality and how it contributes to the competitiveness of firms
4. Compare different production aspects such as production control, quality control, manufacturing costs control, marketing management and waste reduction
5. Develop an aggregate and disaggregate production plan schedule into assembly quantities for end items
6. Explain the strategies of dispatching

COs – POs Mapping

COs	PO_1	PO_2	PO_3	PO_5	PO_{11}	PO_{12}
1	2	2	1	-	3	1
2	3	3	2	-	2	1
3	2	1	3	-	1	2
4	3	2	1	-	3	2
5	3	1	2	-	3	2
6	3	1	2	3	2	3

3 – Strongly linked | 2 – Moderately linked | 1 – Weakly linked

Unit I

Introduction-Forecasting

Definition - Objectives of production Planning and Control - Functions of production planning and control Elements of production control - Types of production - Organization of production planning and control department - Internal organization of department. Importance of forecasting -Types of forecasting, their uses - General principles of forecasting - Forecasting techniques.

Qualitative and Quantitative methods

15 Hours

Unit II

Inventory management

Functions of inventories - relevant inventory costs - ABC analysis –VED analysis -EOQ model – Inventory control systems - P-Systems and Q-Systems -Introduction MRPI, MRP II & ERP, LOB (Line of Balance)

JIT inventory, and Japanese concepts

15 Hours

Unit III

Routing

Definition - Routing procedure -Route sheets - Bill of material – Factors affecting routing procedure.

Schedule

Definition - Difference with loading. Scheduling Policies - Techniques, Standard scheduling methods, Line Balancing, Aggregate planning, Master production schedule, Chase planning, Information Technology in Production Planning and Scheduling

Expediting, controlling aspects

15 Hours

Unit IV

Dispatching

Activities of dispatcher - Dispatching procedure – functions of dispatcher-follow-up - Reason for existence of functions –Role of computers in dispatching

Role of Information technology tools in Dispatching

15 Hours

Total: 60 Hours

Textbook (s)

1. S Eilon, Elements of Production Planning and Control, Navaneet Prakasan Ltd, Revised Edition 2014
2. P Rama Murthy, Production and Operations management, New Age International, Revised Edition, 2005

Reference (s)

1. S.N. Chary, Operations Management, Tata McGraw-Hill Education, 4th Edition, 2009
2. M K. Starr and David W. Miller, Inventory Control Theory and Practice, Prentice-Hall, 1962
3. J E. Biegel, Production Control A Quantitative Approach, Prentice-Hall, 1971
4. Joseph Monks, Operations Management, McGraw Hill Series, 1996

Sample Question (s)

Internal Assessment Pattern

Cognitive Level	Int. Test 1 (%)	Int. Test 2 (%)	Open Book Examinations (%)
Remember	35	30	-
Understand	35	50	-
Apply	30	20	25
Analyze	-	-	50
Evaluate	-	-	25
Create	-	-	-
Total (%)	**100**	**100**	**100**

Remember

1. State the objectives of production planning and control.

Understand

1. What is production planning and control?
2. What is the need for production planning and control?
3. What are the principles of forecasting?

Apply

1. Develop production scheduling method by using heuristic approach.

Analyze

1. Compare the scheduling techniques for time, material and cost.

Evaluate

1. Compare the scheduling techniques for the optimal criteria