

# **Academic Regulations, Curriculum and Syllabi 2021**

## **B. Tech. Computer Science and Engineering** (Duration of Study : 4 years)



**Department of Computer Science and 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**

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## **Undergraduate Programs**

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

### **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

1. To provide adaptable education in a collaborative and innovative environment in skilling the graduates to solve real world problems in the field of Computer Science and Engineering.
2. To prepare the students as critical thinking professionals with multidisciplinary research orientation and Innovation
3. To instil ethical values and nurture the graduates who will be able to contribute to society.

## Program Educational Objectives

1. Employ logical and analytical skills in solving complex real-world engineering problems in the areas of computer Science and allied fields.
2. Adaptable to emerging technologies with enhanced professional skills and ability towards continuous learning, facilitating higher studies and research
3. Demonstrate professional ethics, leadership qualities and promote inclusive and collaborative growth with human values towards societal interest

## Program Outcomes

Engineering graduate will be able to

- PO 1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. ([Engineering knowledge](#))
- PO 2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. ([Problem analysis](#))
- PO 3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. ([Design/development of solutions](#))
- PO 4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. ([Conduct investigations of complex problems](#))
- PO 5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. ([Modern tool usage](#))
- PO 6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. ([The engineer and society](#))
- PO 7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. ([Environment and sustainability](#))
- PO 8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. ([Ethics](#))
- PO 9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. ([Individual and team work](#))
- PO10: 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. ([Communication](#))

- PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. ([Project management and finance](#))
- PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. ([Life-long learning](#))
- PS01: Ability to apply the software engineering principles to meet automation of the process and service industries apart from the community utilities. ([Program Specific](#))
- PS02: Ability to design, develop and implement management systems, E-Commerce tools and Web Apps for product development. ([Program Specific](#))

**Department of Computer Science and Engineering**

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

| <b>First Semester</b>  |                     |                                                    |                          |              |          |              |              |
|------------------------|---------------------|----------------------------------------------------|--------------------------|--------------|----------|--------------|--------------|
| No                     | Course Code         | Course Name                                        | POs                      | L            | T        | P            | C            |
| 1                      | 21HSX01             | Communicative English                              | 1,9,10,11, 12            | 2            | -        | -            | 2            |
| 2                      | 21MAX01             | Engineering Mathematics I                          | 1,2,3,4,12               | 3            | -        | -            | 3            |
| 3                      | 21PYX01<br>21CYX01  | Engineering Physics /<br>Engineering Chemistry     | 1,2,12 /<br>1,2,6,7,12   | 3/3          | -        | -            | 3/3          |
| 4                      | 21BEX01<br>21BEX06  | Basics of Engineering /<br>IT Workshop             | 1,3,6,7,9,11,12/<br>1,12 | 3/-          | -        | -/ 3         | 3/1.5        |
| 5                      | 21BEX02             | Problem Solving and Programming Skills             | 1, 2,3,12                | 3            | -        | -            | 3            |
| 6                      | 21BEX03             | Problem Solving and Programming Skills Lab         | 2,3,4,12                 | -            | -        | 3            | 1.5          |
| 7                      | 21BEX04/<br>21BEX05 | Engineering Drawing /<br>Engineering Workshop      | 1,5,10,12/1,9,<br>10,12  | -            | -        | 3/3          | 1.5/1.5      |
| 8                      | 21PYX02/<br>21CYX02 | Engineering Physics Lab /Engineering Chemistry Lab | 4,9,11/1,6,7,9,1<br>2    | -            | -        | 3/3          | 1.5          |
| 9                      | 21HSX02/-           | Communicative English Lab/-                        | 1,9,10,11,12             | -            | -        | 3/-          | 1.5/-        |
|                        |                     | <b>Total</b>                                       |                          | <b>14/11</b> | <b>-</b> | <b>12/12</b> | <b>20/17</b> |
| <b>Second Semester</b> |                     |                                                    |                          |              |          |              |              |
| 1                      |                     | Language Elective                                  | 1,9,10,11,12             | 2            | -        | -            | 2            |
| 2                      | 21MAX02             | Engineering Mathematics II                         | 1,2,3,4,12               | 3            | -        | -            | 3            |
| 3                      | 21CYX01/<br>21PYX01 | Engineering Chemistry /Engineering Physics         | 1,2,6,7,12/1,2,1<br>2    | 3/3          | -        | -            | 3/3          |
| 4                      | 21BEX01/<br>21BEX06 | Basics of Engineering/<br>IT Workshop              | 1,3,6,7,9,11,12/<br>1,12 | -/3          | -        | 3/-          | 1.5/3        |
| 5                      | 21BEX07             | Python Programming                                 | 1,2,3,12                 | 3            | -        | -            | 3            |
| 6                      | 21BEX08             | Python Programming Lab                             | 2,3,4,5,12               | -            | -        | 3            | 1.5          |
| 7                      | 21BEX05/<br>21BEX04 | Engineering Workshop / Engineering Drawing         | 1,9,10/1,5,10            | -            | -        | 3/3          | 1.5/1.5      |
| 8                      | 21CYX02/<br>21PYX02 | Engineering Chemistry Lab/Engineering Physics Lab  | 1,6,7,9,12/4,9,1<br>1    | -            | -        | 3/3          | 1.5/1.5      |
| 9                      | -/21HSX02           | -/Communicative English Lab                        | -/10,12                  | -            | -        | -/3          | -/1.5        |
|                        |                     | <b>Total</b>                                       |                          | <b>11/14</b> | <b>-</b> | <b>12/12</b> | <b>17/20</b> |
| <b>Third Semester</b>  |                     |                                                    |                          |              |          |              |              |
| 1                      | 21MA304             | Probability and Statistics using Python            | 1,2,4,12                 | 3            | -        | 2            | 4            |
| 2                      | 21HSX10             | Engineering Economics and Project Management       | 1,10,11                  | 3            | -        | -            | 3            |
| 3                      | 21CS303             | Data Structures                                    | 1,2,3,12,PS02            | 3            | -        | -            | 3            |
| 4                      | 21CS304             | Digital Logic Design                               | 1,2,3,5                  | 3            | -        | 2            | 4            |
| 5                      | 21CS305             | Discrete Mathematical Structures                   | 1,2,3,12,PS01            | 3            | -        | -            | 3            |
| 6                      | 21CS306             | Object Oriented Programming with JAVA              | 1,2,3,PS02               | 3            | -        | -            | 3            |
| 7                      | 21CS307             | Data Structures Lab                                | 1,2,3,4,12               | -            | -        | 3            | 1.5          |
| 8                      | 21CS308             | JAVA Lab                                           | 3,4,12,PS02              | -            | -        | 3            | 1.5          |
| 9                      | 21ESX01             | Employability Skills I                             | 1,2,5,8,10,12            | 0            | -        | 2            | -            |
| 10                     | 21HSX11             | CC & EC Activities I                               | 6,7, 9,10                | -            | -        | 1            | -            |
|                        |                     | <b>Total</b>                                       |                          | <b>18</b>    | <b>-</b> | <b>13</b>    | <b>23</b>    |
| <b>Fourth Semester</b> |                     |                                                    |                          |              |          |              |              |
| 1                      | 21IT304             | Database Management Systems                        | 1,4,12                   | 3            | -        | -            | 3            |
| 2                      | 21IT403             | Operating Systems                                  | 1,2,12,PS02              | 3            | -        | -            | 3            |
| 3                      | 21CS403             | Computer Organization and Architecture             | 1,2,12,PS01              | 3            | -        | -            | 3            |
| 4                      | 21CS404             | Design and Analysis of Algorithms                  | 1,2,3,4,PS01             | 3            | -        | 2            | 4            |
| 5                      | 21CS405             | Web Coding and Development                         | 1,2, 3, 5, PS02          | 3            | -        | -            | 3            |

|                                            |          |                                                              |                         |           |          |           |           |
|--------------------------------------------|----------|--------------------------------------------------------------|-------------------------|-----------|----------|-----------|-----------|
| 6                                          | 21IT308  | Database Management Systems Lab                              | 3,4,12,PSO2             | -         | -        | 3         | 1.5       |
| 7                                          | 21CS407  | Web Coding and Development Lab                               | 2,3,4,5,8               | -         | -        | 3         | 1.5       |
| 8                                          | 21ESX01  | Employability Skills I                                       | 1,2,5,8,10,12           | 0         | -        | 2         | 2         |
| 9                                          | 21HSX11  | CC & EC Activities I                                         | 6,7, 9,10               | -         | -        | 1         | 1         |
|                                            |          |                                                              | <b>Total</b>            | <b>15</b> | <b>-</b> | <b>11</b> | <b>22</b> |
| <b>Fifth Semester</b>                      |          |                                                              |                         |           |          |           |           |
| 1                                          | 21EC502  | Microprocessors and Microcontroller Programming (Integrated) | 1,2,3,4,5               | 3         | -        | 2         | 4         |
| 2                                          | 21CS502  | Artificial Intelligence and Machine Learning                 | 1,2, 3,4,PSO1,PSO2      | 3         | -        | -         | 3         |
| 3                                          | 21CS503  | Computer Networks (Integrated)                               | 1,2,4,5,PSO1            | 3         | -        | 2         | 4         |
| 4                                          | 21CS504  | Theory of Computation                                        | 1, 2, 3, PSO1           | 3         | -        | -         | 3         |
| 5                                          |          | Elective I (Professional Elective)                           |                         | 3         | -        | -         | 3         |
| 6                                          |          | Elective II (Open Elective I)                                |                         | 3         | -        | -         | 3         |
| 7                                          | 21CS507  | Artificial Intelligence and Machine Learning Lab             | 1,4,5,12,PSO1,P SO2     | -         | -        | 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           | 0         | -        | 2         | -         |
| 10                                         | 21HSX12  | CC & EC Activities II                                        | 6,7, 9,10               | -         | -        | 1         | -         |
| 11                                         | 21SIX01  | Summer Internship I                                          | 1,2,8,10,12             | -         | -        | -         | 1         |
|                                            |          |                                                              | <b>Total</b>            | <b>18</b> | <b>-</b> | <b>12</b> | <b>24</b> |
| <b>Sixth Semester</b>                      |          |                                                              |                         |           |          |           |           |
| 1                                          | 21CS601  | Compiler Design                                              | 1, 2, 12, PSO1          | 3         | -        | -         | 3         |
| 2                                          | 21CS602  | Internet of Things                                           | 1, 3, 4, 7, PSO1        | 3         | -        | -         | 3         |
| 3                                          | 21CS603  | Software Engineering                                         | 1,2,3,5,11,PSO1         | 3         | -        | -         | 3         |
| 4                                          |          | Elective III (Professional Elective)                         |                         | 3         | -        | 2         | 4         |
| 5                                          |          | Elective IV (Open Elective II)                               |                         | 3         | -        | -         | 3         |
| 6                                          | 21CS606  | Case Tools Lab                                               | 3, 4, 5,11,PSO1         | -         | -        | 3         | 1.5       |
| 7                                          | 21MPX01  | Mini Project                                                 | All Pos & PSOs          | -         | -        | 3         | 1.5       |
| 8                                          | 21ESX02  | Employability Skills II                                      | 1,2,5,8,10,12           | 0         | -        | 2         | 2         |
| 9                                          | 21HSX12  | CC & EC Activities II                                        | 6,7, 9,10               | -         | -        | 1         | 1         |
| 10                                         | 21ATX01  | Environmental Studies                                        | 1,7                     | -         | -        | -         | -         |
| 11                                         | 21ATX02  | Professional Ethics and Human Values                         | ----                    | -         | -        | -         | -         |
| 12                                         | 21ATX--- | Audit Course                                                 | ----                    | -         | -        | -         | -         |
|                                            |          |                                                              | <b>Total</b>            | <b>15</b> | <b>-</b> | <b>8</b>  | <b>22</b> |
| <b>Seventh Semester</b>                    |          |                                                              |                         |           |          |           |           |
| 1                                          |          | Elective V (Professional Elective)                           |                         | 3         | -        | -         | 3         |
| 2                                          |          | Elective VI (Professional Elective)                          |                         | 3         | -        | -         | 3         |
| 3                                          |          | Elective VII (Open Elective III)                             |                         | 3         | -        | -         | 3         |
| 4                                          | 21SIX02  | Summer Internship II                                         | 1,2,5,6,10,12           | -         | -        | -         | 1         |
| 5                                          | 21PWX01  | Project                                                      | All Pos& PSOs           | -         | -        | 16        | 8         |
|                                            |          |                                                              | <b>Total</b>            | <b>9</b>  | <b>-</b> | <b>16</b> | <b>18</b> |
| <b>Eighth Semester</b>                     |          |                                                              |                         |           |          |           |           |
| 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         |
|                                            |          |                                                              | <b>Total</b>            | <b>6</b>  | <b>-</b> | <b>-</b>  | <b>14</b> |
| <b>Language Electives</b>                  |          |                                                              |                         |           |          |           |           |
| 1                                          | 21HSX03  | Advanced Communicative English                               | 10,12                   | 2         | -        | -         | 2         |
| 2                                          | 21HSX04  | Communicative German                                         | 10,12                   | 2         | -        | -         | 2         |
| 3                                          | 21HSX05  | Communicative French                                         | 10,12                   | 2         | -        | -         | 2         |
| 4                                          | 21HSX06  | Communicative Japanese                                       | 10,12                   | 2         | -        | -         | 2         |
| 5                                          | 21HSX07  | Communicative Spanish                                        | 10,12                   | 2         | -        | -         | 2         |
| 6                                          | 21HSX08  | Communicative Korean                                         | 10,12                   | 2         | -        | -         | 2         |
| 7                                          | 21HSX09  | Communicative Hindi                                          | 10,12                   | 2         | -        | -         | 2         |
| <b>Elective I :Professional Elective I</b> |          |                                                              |                         |           |          |           |           |
| <b>Career Path I, II, III</b>              |          |                                                              |                         |           |          |           |           |
| 1                                          | 21CSC11  | Exploratory Data Analytics (AI&ML)                           | 1,2,4,PSO2              | 3         | -        | -         | 3         |

|                                                                        |         |                                                               |                     |   |   |   |   |
|------------------------------------------------------------------------|---------|---------------------------------------------------------------|---------------------|---|---|---|---|
| 2                                                                      | 21CSC21 | Web Programming Languages (Full Stack Developer)              | 1,2,3,5,PS01, PS02  | 3 | - | - | 3 |
| 3                                                                      | 21ITC31 | Fundamentals of Security (Cyber Security)                     | 1,2,5,PS01, PS02    | 3 | - | - | 3 |
| <b>Non-Career Path (Core Electives)</b>                                |         |                                                               |                     |   |   |   |   |
| 4                                                                      | 21CS004 | Principles of Programming Languages                           | 1, 2, 3, 4          | 3 | - | - | 3 |
| 5                                                                      | 21CS005 | Mobile Computing                                              | 1,2,3,7             | 3 | - | - | 3 |
| 6                                                                      | 21CS006 | Distributed Operating Systems                                 | 1,2,3,12            | 3 | - | - | 3 |
| 7                                                                      |         | MOOCs/Honors                                                  |                     | 3 | - | - | 3 |
| <b>Elective III: Professional Elective II</b>                          |         |                                                               |                     |   |   |   |   |
| <b>Career Path I, II, III</b>                                          |         |                                                               |                     |   |   |   |   |
| 1                                                                      | 21CSC12 | Deep Learning (AI&ML)                                         | 1,2,4, PS01         | 3 | - | 2 | 4 |
| 2                                                                      | 21CSC22 | Web Application Developments Framework (Full Stack Developer) | 1, 3,4              | 3 | - | 2 | 4 |
| 3                                                                      | 21ITC32 | Cybernet Security (Cyber Security)                            | 1,3,4, 5, PS01      | 3 | - | 2 | 4 |
| <b>Non-Career Path (Core Electives)</b>                                |         |                                                               |                     |   |   |   |   |
| 4                                                                      | 21CS007 | Cloud Computing Essentials                                    | 2,5,6,7,8           | 3 | - | 2 | 4 |
| 5                                                                      | 21CS008 | Cryptography and Network Security                             | 3, 6,8              | 3 | - | 2 | 4 |
| <b>Elective V : Professional Elective III</b>                          |         |                                                               |                     |   |   |   |   |
| <b>Career Path I, II, III</b>                                          |         |                                                               |                     |   |   |   |   |
| 1                                                                      | 21CSC13 | Natural Language Processing (AI&ML)                           | 1,2,3,4, PO12, PS02 | 3 | - | - | 3 |
| 2                                                                      | 21CSC23 | Web Application Databases (Full Stack Developer)              | 1,3,5,PS02          | 3 | - | - | 3 |
| 3                                                                      | 21ITC33 | Cloud Security (Cyber Security)                               | 1,2,4,5             | 3 | - | - | 3 |
| <b>Non-Career Path (Core Electives)</b>                                |         |                                                               |                     |   |   |   |   |
| 4                                                                      | 21IT008 | Social Network Analysis                                       | 2, 4, 5             | 3 | - | - | 3 |
| 5                                                                      | 21CS011 | Optimization Techniques                                       | 2, 3, 5,12          | 3 | - | - | 3 |
| 6                                                                      | 21CS012 | Wireless Adhoc Networks                                       | 2, 3,10,12          | 3 | - | - | 3 |
| <b>Elective VI : Professional Elective IV</b>                          |         |                                                               |                     |   |   |   |   |
| 1                                                                      | 21CS014 | Green Computing                                               | 2,3,6,7             | 3 | - | - | 3 |
| 2                                                                      | 21CS015 | Software Project Management                                   | 1,2,3,11,12, PS02   | 3 | - | - | 3 |
| 3                                                                      | 21CS016 | Soft Computing                                                | 1,2,3,4             | 3 | - | - | 3 |
| <b>Elective VIII: Professional Elective</b>                            |         |                                                               |                     |   |   |   |   |
| 1                                                                      | 21CS017 | Fundamentals of Social Network Analysis                       | 2, 4,5              | - | - | - | 3 |
| 2                                                                      | 21CS018 | Information Retrieval Systems                                 | 1,2,3,4             | - | - | - | 3 |
| 3                                                                      | 21CS019 | Fundamentals of Devops                                        | 1,3, 5,8,10         | - | - | - | 3 |
| 4                                                                      |         | MOOCs/Honors                                                  |                     | - | - | - | 3 |
| <b>Open Elective I, II, III, and IV (Elective II, IV, VII, and IX)</b> |         |                                                               |                     |   |   |   |   |
| 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 Internet Of Things | 2,3        | 3 | - | - | 3 |
| 52                  | 21OE014 | Natural Language Processing                                    | 2,3        | 3 | - | - | 3 |
| 53                  | 21OE015 | Affective Computing                                            | 1,2,3,4    | 3 |   |   |   |
| <b>Audit Course</b> |         |                                                                |            |   |   |   |   |
| 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 (Data Engineering)**

|    |         |                                                          |         |   |   |   |   |
|----|---------|----------------------------------------------------------|---------|---|---|---|---|
| 01 | 21CSH11 | Advanced Data Structures                                 | 2,3,4   | 4 | - | - | 4 |
| 02 | 21CSH12 | Advanced Databases                                       | 2,3,4   | 4 | - | - | 4 |
| 03 | 21CSH13 | Programming, Data Structures and Algorithms Using Python | 2,3,4,5 | 4 | - | - | 4 |
| 04 | 21CSH14 | Bioinformatics                                           | 2,3     | 4 | - | - | 4 |

**Domain II (Modern Software Engineering)**

|    |         |                               |              |   |   |   |   |
|----|---------|-------------------------------|--------------|---|---|---|---|
| 01 | 21CSH21 | DevOps                        | 1,3,5,8,10   | 4 | - | - | 4 |
| 02 | 21CSH22 | Design Patterns               | 2,3          | 4 | - | - | 4 |
| 03 | 21CSH23 | Advanced Software Engineering | 1,3,4, PS01  | 4 | - | - | 4 |
| 04 | 21CSH24 | Robotic Process Automation    | 3,5, 8, PS02 | 4 | - | - | 4 |

**Domain III (Security)**

|    |         |                                    |       |   |   |   |   |
|----|---------|------------------------------------|-------|---|---|---|---|
| 01 | 21CSH31 | Computer Systems Security          | 1,2   | 4 | - | - | 4 |
| 02 | 21CSH32 | Python Programming for Security    | 2,3,4 | 4 | - | - | 4 |
| 03 | 21CSH33 | Management of Information Security | 3,6,7 | 4 | - | - | 4 |
| 04 | 21CSH34 | Computer Forensics                 | 2,3   | 4 | - | - | 4 |

**Domain IV (User Interface Design)**

|    |         |                            |         |   |   |   |   |
|----|---------|----------------------------|---------|---|---|---|---|
| 01 | 21CSH41 | Computer Graphics          | 1,2,3,4 | 4 | - | - | 4 |
| 02 | 21CSH42 | Multimedia Systems         | 3,4     | 4 | - | - | 4 |
| 03 | 21CSH43 | Human Computer Interaction | 2,3     | 4 | - | - | 4 |
| 04 | 21CSH44 | Mobile Programming         | 3,4     | 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 Learning**

|    |         |                              |      |   |   |   |   |
|----|---------|------------------------------|------|---|---|---|---|
| 01 | 21CSM11 | Fundamentals of AI & Machine | 1,12 | 4 | - | - | 4 |
|----|---------|------------------------------|------|---|---|---|---|

|                                      |         |                                                         |         |   |   |   |   |
|--------------------------------------|---------|---------------------------------------------------------|---------|---|---|---|---|
|                                      |         | Learning                                                |         |   |   |   |   |
| 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 |
| <b>Cyber Security</b>                |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Data Science &amp; Analytics</b>  |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Computer Systems Programming</b>  |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Digital IC Design</b>             |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Industrial Automation</b>         |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Communications and Networking</b> |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Avionics</b>                      |         |                                                         |         |   |   |   |   |
| 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 Systems           | 1,2     | 4 | - | - | 4 |
| <b>Geographic Information System</b> |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Electric Vehicles Technology</b>  |         |                                                         |         |   |   |   |   |
| 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 |
| <b>Smart City Management</b>         |         |                                                         |         |   |   |   |   |

|                                            |         |                                                            |               |   |   |   |   |
|--------------------------------------------|---------|------------------------------------------------------------|---------------|---|---|---|---|
| 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 |
| <b>Industrial Applications and Control</b> |         |                                                            |               |   |   |   |   |
| 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 |
| <b>Cloud Application Development</b>       |         |                                                            |               |   |   |   |   |
| 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 |
| <b>Robotics and Automation</b>             |         |                                                            |               |   |   |   |   |
| 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 |
| <b>Industrial Systems Engineering</b>      |         |                                                            |               |   |   |   |   |
| 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 |

**First Year (1<sup>st</sup> & 2<sup>nd</sup> Semesters)****21HSX01 Communicative English**  
(Common to all B Tech Programmes)**2002****Course Outcomes**

At the end of the course, students will be able to

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 | PO09 | PO10 | PO11 | PO12 |
|-----|-----|------|------|------|------|
| 1   | 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) Macmillan Educational.
3. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
4. Bailey, Stephen. *Academic writing: 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](http://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](http://learnenglish.britishcouncil.org)

##### Online Dictionaries

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

**Internal Assessment Pattern**

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

**Sample question (s)****Remember**

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

**Understand**

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

**Apply**

- Construct a dialogue between students about organizing music club activities in their college.
- Punctuate the following sentences.
  - does he speak english well
  - mount everest is the highest peak in the world
  - rama a son of dasaradha is a great king of ayodhya
- 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:
  - Identify 8 keywords from the passage below.
  - 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.
  - Introduce Jack Ma in a single sentence of not more than 12 words.
  - 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.
- 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**

At the end of the course, students will be able to

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, 42<sup>nd</sup>Ed., Khanna Publishers, New Delhi, 2012
2. E. Kreyszig, Advanced Engineering Mathematics, 9<sup>th</sup> Ed., Wiley, 2012
3. R. K. Jain, S. R. K.Iyengar, Advanced Engineering Mathematics, 4<sup>th</sup> Ed., Narosa Publishing House, New Delhi, 2014



**Reference (s)**

1. B. V. Ramana, Engineering Mathematics, 4<sup>th</sup> Ed., Tata McGraw Hill, New Delhi, 2009
2. D. S. Chandrashekharaiyah, 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, 12<sup>th</sup> 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 <sup>1</sup> (%) |
|-----------------|-----------------|-----------------|------------------------------|
| 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  $3y^4z^2\hat{i} + 4x^3z^2\hat{j} + 3x^2y^2\hat{k}$  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**

At the end of the course, students will be able to

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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>12</sub> |
|-----|-----------------|-----------------|------------------|
| 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 - Polaroids - 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, 6<sup>th</sup> 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, 2<sup>nd</sup> Edition, 2014.

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Int. Test 3 <sup>i</sup> (%) |
|-----------------|-----------------|-----------------|------------------------------|
| Remember        | 40              | 40              | -                            |
| Understand      | 40              | 40              | 25                           |
| Apply           | 20              | 20              | 75                           |
| Analyze         | -               | -               | -                            |
| Evaluate        | -               | -               | -                            |
| Create          | -               | -               | -                            |
| Total (%)       | 100             | 100             | 100                          |

**Sample question (s)****Remember**

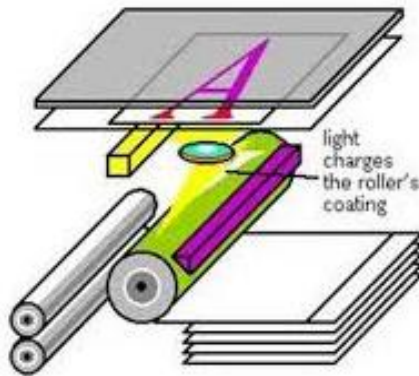
1. Define Principle of Superposition.
2. State Faraday's law of electromagnetic induction and Lenz's law.
3. Recall vector and scalar fields.

**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  $E = 2.3 \times 10^5 \text{ N/Coulomb}$ . **(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**

At the end of the course, students will be able to

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 hydroxy alkanates (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.  $\pi$ -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, 16<sup>th</sup> 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, 3<sup>rd</sup> 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 <sup>1</sup> (%) |
|-----------------|-----------------|-----------------|------------------------------|
| 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°C) is connected to another metal Y (of reduction potential = -0.140V at 25°C) 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**

At the end of the course, students will be able to

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, 3<sup>rd</sup> Ed., Tata. McGraw. Hill Publishing Co., New Delhi, 2000.
2. Ramamrutham S., Basic Civil Engineering, 3<sup>rd</sup> Ed., Dhanpat Rai Publishing Co. (P) Ltd. 2013.
3. Ganeshan.V, IC Engines, Tata McGraw-Hill Education Pvt. Ltd, 3<sup>rd</sup> Ed., 2013.



4. C.P.Arora, Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Limited, 3<sup>rd</sup> Ed., 2009.
5. P.K.Nag, Power Plant Engineering, Tata McGraw Hill Publishing Company, India, 4<sup>th</sup> Ed., 2014.
6. R.K.Rajput, Power Plant Engineering, 5<sup>th</sup> Ed., Lakshmi Publications, 2016.
7. D. P. Kothari and I. J. Nagrath, Theory and Problems of Basic Electrical Engineering, 4<sup>th</sup> Ed., PHI Learning Private limited, 2013.
8. Ramana Pilla, M. Surya Kalavathi and G.T.Chandra Sekhar, Basics of Electrical Engineering, 1<sup>st</sup> Ed., S. Chand & Company Ltd., 2018
9. D. Patranabis, Sensors and transducers, 2<sup>nd</sup> 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 <sup>1</sup> (%) |
|-----------------|-----------------|-----------------|------------------------------|
| 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. Label 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 magnetic 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. Explain 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 avoiding 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<sup>3</sup>. 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<sup>2</sup> 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**

At the end of the course, students will be able to

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 <sup>5</sup> (%) |
|-----------------|-----------------|-----------------|----------------------------------|
| 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**

At the end of the course, students will be able to

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:**

- $P > 10,000$
- $T > 0$
- $2 \leq R \leq 5$

**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:**

- $0 < L < 100$
- $0 < B < 100$

- $1 \leq H \leq 10$
- $C > 100$

**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:**

- $n \geq 2$
- 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:**

- $n > 0$
- $r \geq 0$

**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  $n$ .

`pthFactor` has the following parameter(s):

$n$ : an integer

$p$ : an integer

Constraints

- $1 \leq n \leq 1015$
- $1 \leq p \leq 109$

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  $p = 3$ rd 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  $p = 1$ st 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", "aaca"]`, 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**

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

**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  $0 \leq i < h$ ) 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`  $\in \{01\}$ .

$1 \leq |\text{binString}| \leq 50$

`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

Sample Output 1

1100

#### Explanation 1

The only magical substring of `binString` is 1100. So none of the operations can be applied on the string.

#### Sample Case 2

Sample Input For Custom Testing

1101001100

Sample Output

1101001100

#### 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**

At the end of the course, students will be able to

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 |
|-----|-----|-----|------|------|------|
| 1   | 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**

|                                                                                                  |                     |
|--------------------------------------------------------------------------------------------------|---------------------|
| <b>Module-1: Letters and Sounds of English</b>                                                   | <b>(2) sessions</b> |
| Letters and sounds, Speech Organs                                                                |                     |
| <b>Module -2: Interaction-1:</b>                                                                 | <b>(1) session</b>  |
| Greeting and taking leave, introducing oneself to others.                                        |                     |
| <b>Module -3: The Sounds of English:</b>                                                         | <b>(1) session</b>  |
| Consonants, consonant clusters and Vowels                                                        |                     |
| <b>Module -4: Pronouncing Words:</b>                                                             | <b>(1) session</b>  |
| Silent letters, Plural markers and past tense markers                                            |                     |
| <b>Module -5: Interaction-2:</b>                                                                 | <b>(1) session</b>  |
| Making request and response to them ask for and give/refuse permission,                          |                     |
| Ask for and give directions, thank and respond                                                   |                     |
| <b>Module -6: Stress and Intonation</b>                                                          | <b>(1) session</b>  |
| <b>Module -7: Interaction-3:</b>                                                                 | <b>(1) session</b>  |
| Invite, accept, and declining invitations, Make complaints and respond to them, Express sympathy |                     |
| <b>Module -8: Presentation Skills:</b>                                                           | <b>(2) sessions</b> |
| Oral and PPT Presentations                                                                       |                     |
| <b>Module -9: Interaction-4:</b>                                                                 | <b>(1) session</b>  |
| Apologize and respond, advice and suggest, Telephone Skills                                      |                     |
| <b>Module -10: Group Discussions</b>                                                             | <b>(1) Session</b>  |

**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, 1<sup>st</sup> Ed., Tata McGraHills, 2000
7. R. K. Bansal and J. B. Harrison, Spoken English, 3<sup>rd</sup> Ed., Orient Black Swan, Hyderabad, 1983

**21BEX04 Engineering Drawing**  
(Common to all B.Tech. Programmes)

0 0 3 1.5

**Course Outcomes**

At the end of the course, students will be able to

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, 54<sup>th</sup> Edition, 2014
2. D. M. Kulkarni, A.P. Rastogi, Ashoke K. Sarkar, Engineering Graphics with Auto CAD, Prentice Hall of India, 2<sup>nd</sup> Edition, 2010

#### **Reference (s)**

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

**21BEX05 Engineering Workshop**  
(Common to all B.Tech. Programmes)

0 0 3 1.5

**Course Outcomes**

At the end of the course, students will be able to

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° 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 wiring
14. Set the dim & bright lighting
15. Set the test lamping

**Reading Material (s)**

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



**21BEX06 IT Workshop**  
(Common to all B.Tech. Programmes)

0 0 3 1.5

**Course Outcomes**

At the end of the course, students will be able to

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 for living 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**

At the end of the course, students will be able to

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, GMRIIT, 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 learning, 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)

0031.5

**Course Outcomes**

At the end of the course, students will be able to:

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 -  $\epsilon$  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, 1<sup>st</sup> Ed., 2014
2. G. Svehla, Vogel's Qualitative Inorganic Analysis, 7<sup>th</sup> Ed., Pearson Education, New Delhi, 2003

**21HSX03 Advanced Communicative English**  
(Language Elective for all B Tech Programmes)

2002

**Course Outcomes**

At the end of the course, students will be able to

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 |
|-----|-----|-----|------|------|------|
| 1   | 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.

**Grammar and Vocabulary:** Formal/academic words and phrases; Phrasal prepositions; 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 to discussions.

**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/Resume and cover letter.

**Grammar and 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.

**Grammar and 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) Macmillan Educational.
3. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
4. Bailey, Stephen. *Academic writing: 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](http://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](http://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**

At the end of the course, students will be able to

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 to ordinary 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, 42<sup>nd</sup> Edition, New Delhi, 2012
2. S. R. K. Iyengar, R. K. Jain, Advanced Engineering Mathematics, Narosa Publishing House, 4<sup>th</sup> Edition, New Delhi, 2014
3. B. V. Ramana, Engineering Mathematics, Tata McGraw Hill, New Delhi, 4<sup>th</sup> Edition, 2009

**Reference book (s)**

1. T. K. V. Iyengaret.al, Engineering Mathematics, 12<sup>th</sup> Edition, Volume -II, S. Chand Publishers, 2014
2. U. M. Swamyet.al, A Text Book of Engineering Mathematics – I, Excel Books, New Delhi, 2010
3. D.S.Chandrashekharaiiah, Engineering Mathematics, Vol- 1, Prism Publishers, 2010
4. Erwin Kreyszig Advanced Engineering Mathematics, Wiley Student Edition, 9<sup>th</sup> Edition, 2012

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Int. Test 3 <sup>1</sup> (%) |
|-----------------|-----------------|-----------------|------------------------------|
| 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  $F = (x^3 - yz)I - 2x^2yJ - zK$  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  $F = (y^2 \cos x + z^3)I + (2y \sin x - 4)J + (3xz^2 + 2)K$  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**

At the end of the course, students will be able to

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**

At the end of the course, students will be able to

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)

2002

**Course Outcomes**

At the end of the course, students will be able to

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) Hobby 4) 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 oneself 4) How to talk about the weather 5) 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) Greetings 2) Etiquettes 3) Facts about Germany 4) German customs and traditions 5) 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)

2002

**Course Outcomes**

At the end of the course, students will be able to

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 | 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) Irregular verbs (Present tense) : être 8) 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) Days 4) Months 5) Colours 6) Numbers 0 to 100 (Ordinal, cardinal) 7) Parts of the face and body**15 Hours****Unit-3****Communicative skills:** 1) How to greet 2) Locating objects and places 3) How to ask and answer questions 4) How to introduce oneself 5) How to talk about the weather 6) 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) Etiquettes 3) Facts about France 4) French customs and traditions 5) 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)

2002

**Course Outcomes**

At the end of the course, students will be able to

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

## 3<sup>rd</sup> Semester

### 21MA304 - Probability and Statistics using Python

3 0 2 4

#### Course Outcomes

At the end of the course, students will be able to

1. List the basic data structures of Python and various libraries of Python.
2. Illustrate basic probability axioms and apply Bayes' theorem related to engineering problems.
3. Differentiate between various distributions of random variables on given data.
4. Examine given dataset based on descriptive statistics.
5. Compare the null or alternative hypotheses using the suitable test statistic.
6. Choose appropriate curve fitting and correlation methods for a given data

#### CO-PO Mapping

| CO | PO1 | PO2 | PO4 | PO12 |
|----|-----|-----|-----|------|
| 1  | 2   | 3   | 1   | 2    |
| 2  | 3   | 2   | 3   | 2    |
| 3  | 3   | 2   | 3   | 1    |
| 4  | 3   | 1   | 3   | 3    |
| 5  | 3   | 1   | 2   | 1    |
| 6  | 3   | 1   | 3   | 3    |

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

#### Unit I

12+8 Hours

##### Fundamental of Python Programming

Strings, Files, Lists, Dictionaries, Tuples. **Introduction to NumPy:** Creating Numpy Arrays, Numpy Data Objects, dtype, Numerical Operations. Numpy Arrays: Concatenating, Flatten, reshape, adding Dimensions, Vector Stacking, Pandas DataFrame, Accessing and Changing values of DataFrames, Pandas Pivot, groupby **Introduction to Pandas:** Reading and Writing Data in Pandas, Multi-level Indexing, Data Visualization in Pandas

*Objects and Classes*

##### Practical Components

1. Experiments on Basic experiments on fundamentals on python
2. Exploratory Data Analysis using NumPy
3. Exploratory Data Analysis using Pandas
4. Exploratory Data Analysis using Matplotlib

#### Unit II

12+6 Hours

##### Random Variables and Probability Distributions

**Introduction to Probability:** Events, Axioms of Probability and Probabilities of events; Conditional Probability, Bayes Theorem. Discrete and Continuous random variables; Expectation and Variance, Distribution of a Random Variables: **Discrete and Continuous Distributions-** Bernoulli, Binomial, Poison and Normal Distributions (without proofs); Central Limit Theorem (without proof).

*Gaussian distribution*

##### Practical Components

1. Simulation of random experiments and plot the empirical probability of each event, alongside the theoretical probability.
2. Python script to find conditional probability of a given event.
3. Simulation of various probability distributions

#### Unit III

12+10 Hours

##### Sampling Theory and Testing of Hypothesis

**Sampling:** Population and sample, parameter and statistic, standard error. Parameter estimations, Confidence Intervals, Unknown Standard Deviation. **Hypothesis Testing:** Null and alternative hypothesis, level of significance, Type I and Type II errors, one tail and two-tail tests. Hypothesis testing concerning

one mean and proportions, two means –Proportions and their differences using Z-test, Student's t-test, F-test, Chi-square test.

#### One-way ANOVA

#### Practical Components

1. Python Modules for Descriptive Statistics
2. Write a python program to perform z-test, t- test for testing the Null hypothesis for single mean
3. Write a python program to perform z-test, t- test for testing the Null hypothesis for difference of means
4. Write a python program to explore problems in F-test.
5. Write a python program to perform chi square for determine whether there is a significant association between the two variables

#### Unit IV

**12+8 Hours**

#### Curve Fitting, Correlation & Regression

**Curve Fitting:** Introduction-fitting a straight line-second degree curve-exponential curve by method of least squares. **Correlation:** Simple correlation, Karl Pearson's Correlation coefficient and Spearman's rank correlation. Simple regression, multiple regression.

#### Covariance

#### Practical Components

1. Develop a straight line curve to fit some real world observations
2. Develop a exponential curve to fit some real world observations
3. Explore problems in Correlation with sample data
4. Explore problems in Regression with sample data

**Total: 48+32 Hours**

#### Text Books:

1. Probability & Statistics by T.K.V.Iyengar&B.Krishna Gandhi & Others, S.Chand (2016) 6th edition.
2. E. Walpole, R. H. Mayers, S. L. Mayers and K. Ye, (2012), Probability and Statistics for Engineers and Scientists,9th Edition, Pearson Education, ISBN: 978-8-131-71552-9.
3. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, O'Reilly Media, Inc.

#### Reference Books:

1. Michael Baron, Probability and Statistics For Computer Scientists, 2nd Edition, CRC Press
2. Sheldon M. Ross, (2011), Introduction to Probability and Statistics for Engineers and Scientists, 4th Edition, Academic Foundation, ISBN: 978-8-190-93568-5.

#### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 10              | 10              | --                      |
| Understand      | 50              | 30              | --                      |
| Apply           | 40              | 60              | --                      |
| Analyze         | --              | --              | --                      |
| Evaluate        | --              | --              | --                      |
| Create          | --              | --              | --                      |
| Total (%)       | 100             | 100             | --                      |

#### SAMPLE QUESTION (S)

##### Remember

1. Define variable in python.
2. List any two differences between built-in and user defined functions.
3. List any two python packages used mathematics.

##### Understand

1. Explain use of probability and statistics in real world.
2. Illustrate about random variables in python.

##### Apply

1. Find different real time applications which use Markov process
2. Implement a queuing theory to handle multiple processes.



**21HSX10 Engineering Economics and Project Management****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Illustrate the basic principles of engineering economics.
2. Demonstrate Cost-Volume-Profit (CVP) analysis in business decision making.
3. Implement the simple financial statements for measuring financial performance of a firm.
4. Evaluate investment proposals through various capital budgeting methods.
5. State key issues of organization, management and administration.
6. Determine the accurate project cost estimates and plan future activities.

**COs – POs Mapping**

| COs | PO1 | PO10 | PO11 |
|-----|-----|------|------|
| 1   | 3   | 2    | 1    |
| 2   | 3   | 1    | 2    |
| 3   | 1   | 3    | 2    |
| 4   | 1   | 3    | 2    |
| 5   | 2   | 1    | 3    |
| 6   | 1   | 2    | 3    |

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

**Unit-I****11 Hours****Introduction to Engineering Economics - Demand Forecasting & Cost Analysis**

Concept of Engineering Economics – Types of efficiency – Managerial Economics Nature and Scope – Law of Demand – Types of Elasticity of demand.

Demand Forecasting & Cost Analysis: Demand Forecasting: Meaning, Factors Governing Demand Forecasting, Methods of Demand Forecasting (Survey and Statistical Methods) – Cost Analysis: Basic Cost Concepts, Break Even Analysis.

*Factors affecting the elasticity of demand – Supply and law of Supply*

**Unit-II****13 Hours****Market Structures - Financial Statements & Ratio Analysis**

Different type of Markets Structures – Features – Price Out-put determination under Perfect Competition and Monopoly

Financial Statements & Ratio Analysis: Introduction to Financial Accounting – Double entry system – Journal – Ledger – Trail Balance – Final Accounts (with simple adjustments) – Financial Analysis through Ratios: Interpretation of Liquidity Ratios (Current Ratio and quick ratio), Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio, Creditors Turnover Ratio, Capital Turnover Ratio), Solvency Ratios (Debt- Equity ratio, Interest Coverage ratio), and Profitability ratios (Gross Profit Ratio, Net Profit ratio, Operating Ratio, P/E Ratio and EPS).

*Price output determination under Monopolistic markets, Accounting concepts and conventions*

**Unit-III****12 Hours****Investment Decisions and Fundamentals of Management**

Time Value of Money – Capital Budgeting: Meaning, Need and Techniques of Capital Budgeting

Introduction to Management: Nature – Importance – Classical Theories of Management: F.W.Taylor's and Henri Fayol's Theory – Functions and Levels of Management – Decision Making Process – Inventory Control, Objectives, Functions – Analysis of Inventory – EOQ.

*Maslow & Douglas McGregor theories of Management, ABC Analysis*

**Unit-IV****12 Hours****Project Management**

Introduction – Project Life Cycle and its Phases – Project Selection Methods and Criteria – Technical Feasibility – Project Control and Scheduling through Networks – Probabilistic Models of Networks –

Time-Cost Relationship (Crashing) – Human Aspects in Project Management: Form of Project Organization – Role & Traits of Project Manager.

*Sources of Long-term and Short-term Project Finance*

**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, 2ndEd., PHI Learning Pvt. Ltd. New Delhi, 2014
3. PanneerSelvam. R, Engineering economics, 2nd Ed., Prentice Hall of India, New Delhi, 2013

### Reference (s)

1. R.B.Khanna, Project Management, PHI Learning Pvt. Ltd. New Delhi, 2011
2. R. PanneerSelvam&P.Senthil Kumar, Project Management, PHI Learning Pvt. Ltd. New Delhi, 2010
3. A. Aryasri, Management Science, 4thEd., Tata McGraw Hill, 2014
4. A. Aryasri, Managerial Economics and Financial Analysis, 4thEd., Tata McGraw Hill, 2014
5. Koontz &Weihrich, Essentials of Management, 6thEd., TMH, 2010
6. Chuck Williams and Mukherjee, Principle of Management 7thEd., Cengage Learning, 2013

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 25              | 25              | --                      |
| Understand      | 35              | 35              | --                      |
| Apply           | 40              | 40              | 50                      |
| Analyze         | --              | --              | 50                      |
| Evaluate        | --              | --              | -                       |
| Create          | --              | --              | --                      |
| Total (%)       | 100             | 100             | 100                     |

### Remember

1. Define Managerial Economics. Explain its nature and scope.
2. Define Production Function? List the various types of production functions.
3. Define the meaning of productivity? Explain how productivity can be enhanced in the Indian industries.
4. Define management and its functions.
5. List out short-term source of finance and explain briefly.
6. Why is it essential to define project life cycle and divide it into various phases?

### Understand

1. Summarize engineering economics with suitable examples.
2. Explain different elements of costs used in cost analysis.
3. Illustrate the effect of price on demand and supply with the help of a diagram.
4. Explain the features of Perfect Competition.
5. Describe the Top level Upper Middle level of management and its functions.
6. Explain Price-Output determination under Perfect Competition under Market period.

### Apply

1. Consider the following data of company for the year 2015  
 Sales = Rs.2,40,000/-  
 Fixed cost = Rs.50,000/-  
 Variable cost = Rs.75,000/-  
 Find out the followings  
 a) Profit b) BEP c) Margin of safety
2. The following trial balance of Mr. Ramesh, prepare trading, profit & loss A/c for the year ended 31.12.2018 and balance sheet as on that date.

| Particulars   | Debit (Rs.) | Credit (Rs.) |
|---------------|-------------|--------------|
| Capital       |             | 1,00,000     |
| Drawing       | 18,000      |              |
| Furniture     | 32,500      |              |
| Machinery     | 15,000      |              |
| Bills payable |             | 15,000       |
| Interest paid | 900         |              |

|                     |                 |                 |
|---------------------|-----------------|-----------------|
| Sales               |                 | 1,00,000        |
| Purchases           | 75,000          |                 |
| Opening stock       | 25,000          |                 |
| Advertisement       | 15,000          |                 |
| Wages               | 2,000           |                 |
| Insurance           | 1,000           |                 |
| Commission received |                 | 4,500           |
| Sundry debtors      | 28,100          |                 |
| Cash in hand        | 20,000          |                 |
| Sundry creditors    |                 | 10,000          |
| Interest received   |                 | 3,000           |
| <b>Total</b>        | <b>2,32,500</b> | <b>2,32,500</b> |

**Adjustments:**

Closing Stock Rs.60,000 b ) Outstanding wages Rs.500

3. From the following balances as on the date March 31<sup>st</sup>, 2014.

| Particulars        | Amount (Rs.) | Particulars   | Amount (Rs.) |
|--------------------|--------------|---------------|--------------|
| 10% Debentures     | 3,00,000     | Cash in hand  | 30,000       |
| 6% Long term Loans | 50,000       | Debtors       | 15,000       |
| Share capital      | 2,50,000     | Opening stock | 50,000       |
| Creditors          | 1,00,000     | Closing stock | 40,000       |
| Bill payable       | 45,000       | Gross Profit  | 20,000       |
| Sales              | 100000       | Building      | 700000       |

**Calculate:** Current Ratio, Debt-equity ratio, Quick ratio, Inventory turnover ratio, Debtors turnover ratio

4. A company requires 40,000 kg of raw materials. The company incurs a handling cost of Rs.360/- plus freight of Rs.390 per order. The incremental carrying cost of inventory of raw material is Rs. 15 per kg. Calculate:  
a) EOQ b) Number of orders per annum c) How frequently should orders be placed
5. The following table gives the activities in a construction project and other related information:

| Activity | Immediate Predecessors | $t_0$ | $t_m$ | $t_p$ |
|----------|------------------------|-------|-------|-------|
| A        | -                      | 1     | 9     | 11    |
| B        | -                      | 5     | 6     | 7     |
| C        | A                      | 5     | 7     | 9     |
| D        | A,B                    | 4     | 7     | 10    |
| E        | C,D                    | 1     | 4     | 7     |
| F        | C,D                    | 7     | 9     | 11    |

- a) Draw PERT diagram  
b) Calculate total project duration  
c) Mark the critical path  
d) Find out the S.D and Variance of each activity
6. ABC Ltd., a US based organization, is engaged in manufacturing television screens. It is planning to establish a subsidiary organization in India to manufacture picture tubes. Cost studies produced the following estimates for the Indian subsidiary based on the estimated annual sales of picture tube (Rs.400000/-):

| Particulars    | Total Annual Cost (Rs.) | Percent of total annual cost that is variable |
|----------------|-------------------------|-----------------------------------------------|
| Materials      | 1936000                 | 100%                                          |
| Labour         | 900000                  | 70%                                           |
| Overhead       | 800000                  | 64%                                           |
| Administration | 300000                  | 30%                                           |

The Indian production would be sold by manufacturer's representatives who would receive a commission of 8% of the sales. No portion of the parent organizations' expenses is to be allocated to the Indian subsidiary.

### Questions:

1. Compute the sale price per picture tube to enable management to realize an estimated 10% profit on sale proceeds in India.
2. Is it feasible for ABC Ltd., to invest in the Indian market by studying the preceding calculation? **(For Open Book Examination and not for semester end examination)**

**Analyze:**

1. From the following cases analysis the situation of price elasticity of product.

**Case 1:**

| <u>Price of product (Rs.)</u> | <u>Quantity of Demand (Units)</u> |
|-------------------------------|-----------------------------------|
| 100                           | 1000                              |
| 90                            | 1500                              |

**Case 2:**

| <u>Price of product (Rs.)</u> | <u>Quantity of Demand (Units)</u> |
|-------------------------------|-----------------------------------|
| 100                           | 1000                              |
| 70                            | 1100                              |

2. Analyze the attributes to be consider for selection project.
3. Differentiate between Perfect Competition & Monopoly Competition.
4. Compare significances and limitation of liquidity and solvency ratios.
5. You are given the following information about two companies in the year 2020.

| Particular        | Company – A   | Company – B   |
|-------------------|---------------|---------------|
| Sales             | Rs. 50,00,000 | Rs. 50,00,000 |
| Fixed Expenses    | Rs. 12,00,000 | Rs. 17,00,000 |
| Variable Expenses | Rs. 35,00,000 | Rs. 30,00,000 |

A friend seeks your advices as to which company's shares he should purchase. Assuming the capital invested is equal for the two companies, state the advice that you will give.

6. A private school is considering the purchase a school bus to transport students to school. The initial cost of the bus is Rs.600,000. The life of bus is estimated to be five years, after the life time the vehicles would have to be scrapped with no salvage value. The school's management team has derived the following estimates for annual revenues and cost for the next five years.

| year | Annual Revenue | Diver Cost | Repairs & maintenance | Other costs | Annual depreciation |
|------|----------------|------------|-----------------------|-------------|---------------------|
| 1    | 330000         | 33,000     | 8,000                 | 130000      | 120000              |
| 2    | 330000         | 35,000     | 13,000                | 135000      | 120000              |
| 3    | 350000         | 36,000     | 15,000                | 140000      | 120000              |
| 4    | 380000         | 38,000     | 16,000                | 136000      | 120000              |
| 5    | 400000         | 40,000     | 18,000                | 142000      | 120000              |

The buses would be purchased at the beginning of the project (i.e., in Year 0) and all revenues and expenditures shown in the table above would be incurred at the end of each relevant year. A business consultant has advised management that they should use a cost of capital of 10% to evaluate this project.

**Questions:**

1. Attributes to be involved to estimate the net cash flow for each year in this project.
2. Justify the steps involved in the calculation process of net present cash flows above the project investment.

**21CS303 Data Structures****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Describe the operations and implementation of List ADT
2. Comprehend the operations and implementation of Stack and Queue
3. Illustrate the applications of linear data structures
4. Describe the operations and implementation of hash table
5. Comprehend the operations and implementation of tree data structure
6. Illustrate the variations of tree data structure

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO12 | PS02 |
|----|-----|-----|-----|------|------|
| 1  | 3   | 2   | 1   | 2    | 2    |
| 2  | 3   | 2   | 1   | 2    | 2    |
| 3  | 3   | 2   | 1   | 2    | 2    |
| 4  | 3   | 2   | 1   | 1    | 2    |
| 5  | 3   | 2   | 1   | 2    | 2    |
| 6  | 3   | 2   | 1   | 2    | 2    |

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

**Unit I****12 Hours****Linear Data Structures-List**

AbstractDataTypes(ADTs)-ListADT-Array-basedimplementation-Linkedlistimplementation-Singly linked lists- Circularly linked lists- Doubly-linked lists – Applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal) - Searching - Linear Search – BinarySearch

*Doubly linked Circular list*

**Unit II****12 Hours****Linear Data Structures – Stack and Queue**

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 – Ticketcounter

*Circular Queue*

**Unit III****12 Hours****Sorting, Hashing Techniques and Trees**

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

*Extendible Hashing*

**Unit IV****12 Hours****Variations on Trees and Graphs**

Binary Search Trees: definition, basic operations of BST (Searching, Insertion and deletion) - Introduction to AVL trees: Balancing AVL tree by rotations after insertions and deletions of a data node Multi-way search trees: Introduction to m-way search trees, B-trees, B+Trees;

Heaps: Binary heaps, definition of a Max-heap, Min-heap, Creating Max-Heap, Applications: Heap sort Graphs: Terminology, Representation, Traversals: Depth First Search and Breadth First Search

*Priority queue operations: insertions and extract-max*

**Total: 48 Hours****Textbook (s)**

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education,2002

- Michael Main, Walter Savitch, Data Structures and other objects using C++, 4th Edition, Addison Wesley, 2018

#### Reference (s)

- S. Tanenbaum, Y. Langsam and M.J. Augenstein, Data Structures using C and C++, 2nd Edition, Pearson Education, 2015
- 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 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 20              | 20              | --                      |
| Understand      | 60              | 60              | --                      |
| Apply           | 20              | 20              | 80                      |
| Analyze         | --              | --              | 20                      |
| Evaluate        | --              | --              | --                      |
| Create          | --              | --              | --                      |
| Total (%)       | 100             | 100             | 100                     |

#### SAMPLE QUESTION (S)

##### Remember

- What are abstract datatypes?
- List any 2 disadvantages of array
- Define linked list
- Define data structure
- List any 2 applications of queue

##### Understand

- Compare linked list with array
- Explain Bubble Sort Process with an example
- Demonstrate with neat diagram and algorithm to insert a node before the given key
- Explain Deletion process using an example binary search tree
- Explain why the selection sort is more efficient than the bubble sort
- Explain with suitable example of LL rotation after inserting a new node into an AVL tree
- Demonstrate the application of singly linked lists for the addition of the polynomials P1 and P2

##### Apply

- Develop an algorithm to concatenate two single linked lists
- Construct a priority queue and implement all basic operations to demonstrate priority queue
- Build a recursive procedure to count the number of nodes in a binary tree

### Sample Questions for Open Book Examination

#### Apply

1. Select appropriate data structure to simulate the operations of a Music Player – Songs in the music player are linked to previous and next song. You can play songs either from starting or ending of the list.
2. A bracket is considered to be any one of the following characters: (, ), {, }, [, or ]. Two brackets are considered to be a matched pair if an opening bracket (i.e., (, [, or {) occurs to the left of a closing bracket (i.e., ), ], or }) of the exact same type. There are three types of matched pairs of brackets: [], {}, and (). A matching pair of brackets is not balanced if the set of brackets it encloses is not matched. For example, {[()]} is not balanced because the contents enclosed between { and } are not balanced. The pair of square brackets encloses a single, unbalanced opening bracket, (, and the pair of parentheses encloses a single, unbalanced closing square bracket, ]. By this logic, we say a sequence of brackets is balanced if the following conditions are met:
  3. It contains no unmatched brackets.
  4. The subset of brackets enclosed within the confines of a matched pair of brackets is also a matched pair of brackets.Given n strings of brackets, determine whether each sequence of brackets is balanced. If a string is balanced, return YES. Otherwise, return NO.
5. You are given a stack of N integers, where 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 moment, you can convert the stack into a queue. In the queue, the bottom of the original stack represents the front of the queue. However, once you convert the queue, you cannot convert it back into a stack. Your task is to remove exactly K elements in a way that maximizes the sum of the K removed elements.
6. Vikas is given a bag that consists of number blocks (integers). Vikas has to organize the numbers again in the same order as he inserted them into the bag, i.e. the first number inserted into the bag by Vikas should be picked up first, followed by the other numbers in series. Help Vikas complete this work in O(n) time complexity with the condition to use one extra bag to accomplish the task (assume that the bags are compact, in the form of a stack structure, have the same width as that of the number blocks, and are large enough to fill the bag to the top; the numbers taken from the bag are in reverse order).

**21CS304 Digital Logic Design****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to

1. Demonstrate different number systems, its conversions, and binary arithmetic.
2. Classify logic circuits using basic Logic gates and simplify logic expressions using theorems, K-map.
3. Design and implement logical devices using combinational circuits.
4. Demonstrate and compare the construction of programmable logic devices and different types of ROM.
5. Analyze Sequential circuits like latches and flip-flops.
6. Analyze and Design sequential circuits like Registers and Counters.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO5 |
|----|-----|-----|-----|-----|
| 1  | 3   | 3   | -   | -   |
| 2  | 3   | 3   | 1   | 1   |
| 3  | 3   | 1   | 1   | 2   |
| 4  | 2   | 1   | -   | 2   |
| 5  | 3   | 2   | 2   | 2   |
| 6  | 3   | 3   | 3   | 2   |

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

**Unit I****12+6 Hours****Number systems and Boolean algebra**

Review of Number Systems, Conversion of Numbers from One Radix to Another Radix, Complements, Representation of Negative Numbers, Binary Arithmetic, Binary Codes, Error detecting & correcting codes, Basic Theorems and Properties of Boolean Algebra, Digital Logic Gates, Universal Gates.

*IC specifications and pin diagram of gates*

**Practical Components**

1. Realization of Logic gates and verification of Truth tables
2. Realization of basic gates using Universal gates (NOR)
3. Realization of basic gates using Universal gates (NAND)

**Unit II****12+12Hours****Boolean Function Minimization**

Minimization of Switching Functions using K-Map up to 4-variables, Prime implicants, don't care combinations, Minimal SOP and POS forms

**Combinational Arithmetic Logic Circuits-1**

Adders, Subtractors, Binary Multiplier-*parity bit Generator*, Ripple carry adder, Multiplexer, De-Multiplexer, Encoder, Priority encoder, Decoder, MUX Realization of switching functions.

*Code Converters, Magnitude Comparator*

**Practical Components**

1. Implementation of Half Adder
2. Implementation of Full Adder
3. Implementation and verification of Encoder
4. Implementation and verification of Decoder
5. Implementation and verification of MUX
6. Implementation and verification of DE-MUX

**Unit III****12+6Hours****Programmable Logic Devices and Sequential Logic Circuits-1**

Basic PLD's-ROM-PROM-PLA-PAL - Realization of Switching functions using PLD's Classification of



Sequential Circuits (Synchronous and Asynchronous): Latches and Basic Flip-Flops-Truth Tables and Excitation Tables

*Conversion of flip-flops*

### Practical Components

1. Realization of Flip-Flops using ICs (SR Flip Flop]
2. Realization of Flip-Flops using ICs (JK Flip Flop]
3. Realization of Flip-Flops using ICs (D and T Flip Flop]

### Unit IV

**12+8 Hours**

### Sequential Logic Circuits - II

Design of Registers - Buffer Register - Control Buffer Registers - Bidirectional Shift Registers - Universal Shift Register - Design of Synchronous Counters – Ripple counter, Up-down Counters, Design of Asynchronous Counters-Variable Modulus Counters (Mod-2,4,6,10 & 16), Ring Counter, Johnson Counter, Sequence generator.

*Sequence detector*

### Practical Components

1. Verification of SISO and SIPO Shift Registers
2. Verification of PIPO and PISO Shift Registers
3. Implementation of Synchronous Counter
4. Implementation of Asynchronous Counter

**Total: 48+32 Hours**

### Textbook (s)

1. Digital Design 6th Edition by M Morris Mano, PEARSONINDIA,2018.
2. Charles H. Roth, Fundamentals of Logic Design,3<sup>rd</sup>Edition, ThomsonPublications,2014
3. John F. Wakerly, Digital Design Principles & Practices, 4<sup>th</sup>Edition, PHI/ Pearson EducationAsia,2008

### Reference (s)

1. ZviKohavi, Switching & Finite Automata theory, 2nd Edition,TMH,2008
2. R P Jain,Modern Digital Electronics, 3rd Edition,TMH,2003
3. A. Anand Kumar, Switching Theory and Logic Design, 3rd Edition,PHP,2016.

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 20              | 10              | --                      |
| Understand      | 50              | 40              | --                      |
| Apply           | 30              | 30              | --                      |
| Analyze         | --              | 20              | --                      |
| Evaluate        | --              | --              | --                      |
| Create          | --              | --              | --                      |
| Total (%)       | 100             | 100             | --                      |

### SAMPLE QUESTION (S)

#### Remember

1. Retrieve the decimal value of the fractional binary number0.1011
2. List any two postulates of Boolean algebra
3. List the four uses of Multiplexer.
4. Define Flip flop and Latch
5. Define Synchronous sequential circuit

#### Understand

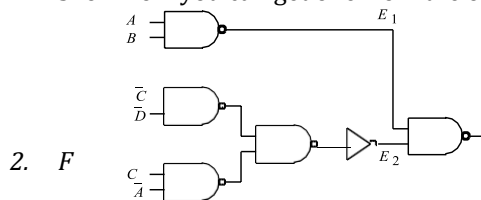
1. Explain working functionality of Programmable Logic Devices(PLD).
2. Represent the following Boolean expression to SOP and POS form:  $A+BC'+ABD'+ABCD$
3. Represent the Boolean function  $T=F(w, x, y, z) = \sum m(0,1,2,4,5,7,8,9,12,13)$  by using 8 to 1 mux.
4. Illustrate a half adder using NAND –NAND
5. Represent a T flip flop using JK flipflop.
6. Differentiate between Bi-directional and Universal Shift-Registers.

### Apply

1. Find a circuit that has no static hazards and implements the Boolean function  $F(A,B,C,D) = \sum (0,2,6,7,8,10,12)$ .
2. Construct a four input NAND gate using gates with 2 inputs. Write down the truth table. Do the same for a 4 input NOR gate.
3. Implement MOD-6 and Johnson Counter.
4. Construct a combinational circuit to convert BCD to EX-3code.
5. Implement a combinational logic circuit, which can compare two bits binary numbers.

### Analyze

1. Analyze the following in two ways to get sums of product and product of sums equations. Then show how you can get one from the other using DeMorgan's Theorem



3. Why the input variables to a PAL are buffered
4. Why the fixed format is not used and floating format is used
5. What happens when an electric signal is grounded?
6. Design a Sequence detector to detect 10111001

**21CS305 Discrete Mathematical Structures****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Construct and Verify the Correctness of Statements using Propositional and Predicate Logic.
2. Illustrate the Operations on Discrete Structures such as Relations and Functions
3. Demonstrate the Lattices and Algebraic Structures for the Modeling of Objects
4. Utilize the Counting Techniques to Solve Combinatorics Problems
5. Make use of the Binomial and multinomial Theorems to Solve Problems involving Recurrence Relations and Generating Functions
6. Demonstrate Graphs and Trees as Tools to Visualize and Simplify Situations

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PO12 | PSO1 |
|-----|-----|-----|-----|------|------|
| 1   | 3   | 3   | 3   | 1    | 1    |
| 2   | 3   | 2   | 2   | 1    | 1    |
| 3   | 3   | 1   | 1   | 1    | 1    |
| 4   | 3   | 2   | 2   | 1    | 1    |
| 5   | 3   | 2   | 2   | 1    | 1    |
| 6   | 3   | 3   | 3   | 1    | 2    |

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

**Unit I****12 Hours****Statement Logic and Predicate Logic**

Statements and Notations - Connectives - Well-formed Formulas - Truth Tables - Tautology – Equivalence Implication - Normal Forms - Rules of Inference for Statement Logic - Proof Techniques - Proof by Contradiction - Method of Induction.

Predicative Logic - Quantifiers - Universal Quantifiers - Free & Bound Variables - Rules of Inference for Predicate Logic

*Program Correctness - Design of Logic Circuits*

**Unit II****12 Hours****Binary Relations, Functions and Algebraic Structures**

Binary Relations - Properties and Operations - Relational Graphs - Relation Matrices - Equivalence Relations - Compatibility Relations - Partial Ordering Relations - HasseDiagram

Lattices - Properties and Types

Functions – Types of functions - Inverse Function - Composition of Functions

Algebraic Structures – Properties - Semi Groups – Monoids – Groups - Abelian Groups – Subgroups

*Relations in Databases – Rings - Fields*

**Unit III****12 Hours****Combinatorics, Generating Functions and Recurrence Relations**

Basics of Counting – Cardinality - Sum and Product Rules - Permutations and Combinations with Repetitions Binomial Coefficients - Binomial and Multinomial Theorems - The Principle of Inclusion and Exclusion - Pigeonhole Principle.

Generating Functions - Function of Sequences - Calculating Coefficient of Generating Functions - Recurrence Relations - Solving Recurrence Relation by Substitution.

*Algorithm Analysis - Time and Space Complexity - Combinatorics for Bioinformatics*

**Unit IV****12 Hours****Basics of Graph Theory**

Representation of Graphs - Degree of a Graph - Handshaking Property - Complete Graphs - Regular Graphs

- Bipartite Graphs - Walk – Path – Circuit – Cycle - Planar Graphs - Euler's Formula – Isomorphism - Euler

Circuit and Hamilton Cycle - Chromatic Number - Trees and its Properties - Binary Trees and its Types.  
Operations on Graphs, Four Color Problem, Applications of Graphs and Trees, Ternary Tree

**Total: 48 Hours**

**Textbook(s)**

1. Kenneth H. Rosen, Discrete Mathematics and Applications, 7<sup>th</sup> Edition, Tata McGraw Hill, 2015.
2. J.L.Mott, A.Kandel & T.P.Baker, Discrete Mathematics for Computer Scientists & Mathematicians, Prentice Hall India, 2nd Edition, 2010.

**Reference (s)**

1. Tremblay J.P. and P. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2007.
2. C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics, A Computer Oriented Approach, 3<sup>rd</sup> Edition, Tata McGraw Hill, 2008.
3. D. S. Chandrasekharaiah, Mathematical Foundation to Computer Science, Prism Books Pvt. Ltd, Hyderabad, 4<sup>th</sup> Edition, 2012.
4. Ralph P. Grimaldi, B. V. Ramana, —Discrete and Combinatorial Mathematics - An Applied Introduction||, Pearson Education, India, 5th Edition, 2011.
5. Seymour Lipschutz and Marc Lipson, Discrete Mathematics, Revised 3<sup>rd</sup> Edition, Schaum's Outline Series, Tata McGrawHill, New Delhi, 2009.

**Web References:**

1. <http://www.web.stanford.edu/class/cs103x>
2. [http://www.cs.odu.edu/~cs381/cs381content/web\\_course.html](http://www.cs.odu.edu/~cs381/cs381content/web_course.html)
3. <http://www.cse.iitd.ernet.in/~bagchi/courses/discrete-book>
4. <http://www.saylor.org/course/cs202/>
5. <http://www.nptel.ac.in/courses/106106094/>

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 30              | 30              | --                      |
| Understand      | 40              | 40              | --                      |
| Apply           | 30              | 30              | 60                      |
| Analyze         | --              | --              | 30                      |
| Evaluate        | --              | --              | 10                      |
| Create          | --              | --              | --                      |
| Total (%)       | 100             | 100             | 100                     |

**Remember**

1. Define converse, contra positive and inverse of an implication
2. List out the different Principal normal forms with example
3. State the property of first theory of digraph theory by taking a suitable example
4. Define monoid and Abelian group with a suitable example
5. Define Pigeonhole Principle and the generalization of the Pigeonhole Principle

**Understand**

1. Explain the Planarity of the Kuratowski's two planar graphs
2. Explain the General Principle of Inclusion-Exclusion for n-sets
3. Draw the Hasse diagram of the following relation R. The relation R is defined as the divisors of 60 and denoted by D<sub>60</sub>.
4. Compare between Eulerian graph and Hamiltonian graph.

**Apply**

1. Show that the identity.  $C(n, r-1) + C(n, r) = C(n+1, r)$
2. Show that the complete graphs  $K_2, K_3, K_4$  are planar
3. Let  $G$  be the set of all non-zero real numbers with a binary operation  $*$ , defined as  $a*b = a^2b^2$ . Show that  $\langle G, * \rangle$  is an abelian group.
4. Find the coefficient of  $x^9y^3$  in the expansion of  $(2x^{-3}y)^{12}$

#### Analyze

1. Differentiate between Permutation and Combination and find the relation between them.
2. Compare the Equivalence Relation, Compatible relation and Partial Order Relation.
3. Justify, whether the following argument is valid or not.

$p \Rightarrow q$   
 $r \Rightarrow sp$   
 $\forall r$   
 -----  
 $q \vee s$

4. Identify the combinations in set of electives of 7 subjects that has no repetitions for a group of 10 members having 5 students in each group.

**21CS306 Object Oriented Programming with JAVA****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Apply the object oriented programming concepts to develop modular and reusable software solutions.
2. Develop applications using different types of inheritances
3. Implement user-defined packages to promote code reusability and modular programming.
4. Analyze and recover runtime exceptions arise in the applications
5. Develop multithreaded applications with synchronization
6. Develop interactive applications for standalone and Internet

**COs-POs Mapping**

| COs | PO1 | PO2 | PO3 | PS02 |
|-----|-----|-----|-----|------|
| 1   | 3   | 2   | 1   | 1    |
| 2   | 1   | 1   | 1   | 1    |
| 3   | 1   | 1   | 1   | 1    |
| 4   | 2   | 2   | 2   | 2    |
| 5   | 3   | 2   | 2   | 2    |
| 6   | 1   | 1   | 2   | 2    |

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

**Unit I****12 Hours`****Introduction to Java**

Overview of Object Oriented Programming principles, Importance of Java to the Internet, Byte code, Methods, classes and instances, Data types, arrays, control statements, simple java program, Classes and Objects- constructors, methods, access control, this keyword, overloading methods and constructors, garbage collection, java.lang - String, StringBuffer, StringBuilder, Type wrappers - Integer, Character, Float, Double, Boolean.

*Features of object oriented programming-Java History-Computer Programming Hierarchy-Role of Java Programmer in Industry*

**Unit II****12 Hours****Inheritance, Packages & Interface**

Inheritance: Basics, Using super, Multilevel Hierarchy, Method overriding, Dynamic Method Despatch, Using Abstract classes, Using final with inheritance, Sealed Classes.

Java Collections - Arrays, ArrayList, Hashtable, StringTokenizer, Vector.

Interface: Defining an interface, differences between classes and interfaces, implementing interface, variables in interface and extending interfaces, Default Methods in Interfaces, Static Methods in Interface Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, Member access rules.

*Nested-Inner Class & Anonymous Classes-Generic Class Types*

**Unit III****11 Hours****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, daemon threads.

*Control Flow in Exceptions- JVM reaction to Exceptions- Inter Communication of Threads- Critical Factor in Thread-Deadlock*

**Unit IV****13 Hours****Applets & Event Handling**

Applets: Concepts of Applets, life cycle of an applet, types of applets, creating applets, passing parameters to applets, The AWT class hierarchy, user interface components labels, button, 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, scrollbars, check box, choices, lists panels-scroll pane, dialogs, menu bar, layout managers.

*Applet Security Policies–Anonymous Inner classes a Short-cut to Event Handling–Java Utilities (java.util Package)*

**Total: 48 Hours****Textbook (s)**

1. H. Schildt, Java: The complete reference, 7<sup>th</sup> Edition, TMH, 2006
2. T. A. Budd, An Introduction to Object-Oriented Programming, 3<sup>rd</sup> Edition, Addison Wesley Longman, 2002

**Reference (s)**

1. Dietal&Dietal, Java: How to Program, 8<sup>th</sup> Edition, PHI, 2010
2. C. S. Horstmann and G. Cornell, Core Java, Vol 1. Fundamentals, 7<sup>th</sup> Edition, Pearson Education, 2004
3. C. Horstmann, BIG JAVA Compatible with Java 5 & 6, 3<sup>rd</sup> Edition, Wiley Publishers, 2008

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1(%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|----------------|-----------------|-------------------------|
| Remember        | 25             | 15              | 10                      |
| Understand      | 30             | 15              | 30                      |
| Apply           | 25             | 40              | 30                      |
| Analyze         | 20             | 20              | 30                      |
| Evaluate        | --             | 10              | --                      |
| Create          | --             | --              | --                      |
| Total (%)       | 100            | 100             | 100                     |

**SAMPLE QUESTION (S)****Remember**

1. List all OOPs principles
2. Define class and object
3. Illustrate various data types supported by JAVA
4. State various access controls available in JAVA
5. Define inheritance
6. Define thread

**Understand**

1. Explain byte code
2. Explain the use of super, static and final keywords
3. Illustrate the use of try, catch, throw and throws
4. Java is purely object oriented programming language. Explain
5. Explain types of polymorphism with Example

**Apply**

1. Write statements that perform the following one-dimensional-array operations:
  - a. Set the 10 elements of integer array counts to zero
  - b. Add one to each of the 15 elements of integer array bonus
  - c. Display the five values of integer array best Scores in column format
2. Create two arrays that store all even no's in one array and all odd no's in another array for a given set of elements
3. Write a java program to implements final variable, Method and classes

4. Explain the reason for the following code giving compiling errors.

```
abstractclassAbstractClass
{
    abstractvoidabstractMethod()
    {
        System.out.println("First Method");
    }
}
```

5. Write a java program to implement the following techniques
1. Method Overloading
  2. Method Overriding
6. Write a Java program to implement Virtual function technique

### **Analyze**

1. Compare and Contrast an abstract class and an interface
2. Differentiate method overloading and overriding
3. Differentiate abstraction and encapsulation
4. Identify the uses of calling a synchronize method inside a synchronize method
5. Identify memory leak problems in Java objects



**21CS307 Data Structures Lab****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to

1. Implement stack and queue data structures using array and linked list
2. Demonstrate the applications of stack and queue data structures
3. Implement sorting and searching algorithms and to compare their efficiency
4. Implement binary tree, binary search tree and tree traversals
5. Solve graph problems using appropriate data structure
6. Implement hashing techniques for real world applications (telephone directory, dictionary)

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 | PO12 | PSO2 |
|----|-----|-----|-----|-----|------|------|
| 1  | 2   | 2   | 3   | 1   | 2    | 2    |
| 2  | 2   | 2   | 3   | 2   | 2    | 2    |
| 3  | 2   | 3   | 3   | 3   | 2    | 2    |
| 4  | 2   | 2   | 3   | 1   | 2    | 1    |
| 5  | 2   | 3   | 2   | 2   | 2    | 2    |
| 6  | 2   | 2   | 2   | 2   | 2    | 2    |

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

**List of Experiments****1. Arrays**

Implement list using an array and perform the following operations on it.

- **Insert(pos, element):** It should insert the given element into the list at the specified position pos. If pos is out of range (less than 0 or greater than the current list size), display an error message.
- **Delete(pos, element):** This function should delete the given element from the list at the specified position pos, if it exists. If pos is out of range or the element is not found at the given position, print an appropriate message.
- **Search(element):** This function should check if the given element is present in the list. If the element is found, return True; otherwise, return False.
- **Running Sum of 1D Array():** This function return a new array containing the running sum of input array 'num'. The running sum of an array is defined as  
Running Sum[i] = sum(nums[0]...nums[i]).
- **Display():** This function should display the current elements present in the list.

**Examples:**

Initial list: []

Insert(0, 5): [5]

Insert(1, 10): [5, 10]

Insert(5, 15): Invalid position, element not inserted

Display: [5, 10]

Initial list: [1, 2, 3, 4]

Delete(1, 2): [1, 3, 4]

Delete(0, 5): Element not found at position 0

Display: [1, 3, 4]

List: [1, 2, 3, 4]

Search(3): True

Search(5): False

Given array: [1, 2, 3, 4]

Running Sum: [1, 3, 6, 10]

Given array: [2, 4, 6, 8]

Running Sum: [2, 6, 12, 20]

## 2. Singly linked list

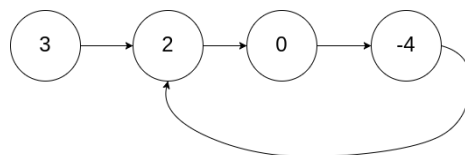
Implement a singly linked list with the following functions: insert, delete, display and detect\_cycle.

### Node Structure:

Each node should have two attributes: val to store the value of the node and next to point to the next node in the list.

- **insert(val):** This function should take an integer val as input and insert a new node with the given value at the end of the linked list.
- **delete(val):** This function should take an integer val as input and remove the first occurrence of the specified value from the linked list. If the value is not found in the list, print an appropriate message.
- **display():** This function should display all the elements present in the linked list, starting from the head to the tail.
- **detect\_cycle():** This function should detect if there is a cycle in the linked list. It should return True if a cycle is found and False otherwise. There is a cycle in a linked list if there is some node in the list that can be reached again by continuously following the next pointer.

### Example 1: detect\_cycle()

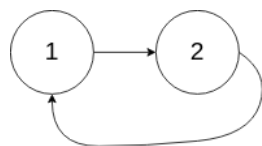


Input: head = [3,2,0,-4],

Output: true

Explanation: There is a cycle in the linked list, where the tail connects to the 1st node (0-indexed).

### Example 2: detect\_cycle()



Input: head = [1,2]

Output: true

Explanation: There is a cycle in the linked list, where the tail connects to the 0th node.

### Example 3: detect\_cycle()



Input: head = [1], pos = -1

Output: false

Explanation: There is no cycle in the linked list.

## 3. Doubly linked list

Implement a doubly linked list with the following functions: insert, delete, display, and middle\_node.

### Node Structure:

Each node should have three attributes: val to store the value of the node, prev to point to the previous node, and next to point to the next node in the list.

- **insert(val):** This function should take an integer val as input and insert a new node with the given value at the end of the doubly linked list.
- **delete(val):** This function should take an integer val as input and remove the first occurrence of the specified value from the doubly linked list. If the value is not found in the list, print an appropriate message.
- **display():** This function should display all the elements present in the doubly linked list, starting from the head to the tail.
- **middle\_node():** This function should find and return the middle node of the doubly linked list. If the list has an even number of nodes, return the first middle node.

**Example 1:** middle\_node()

Input: head = [1,2,3,4,5]

Output: [3,4,5]

Explanation: The middle node of the list is node 3.

**Example 2:** middle\_node()

Input: head = [1,2,3,4,5,6]

Output: [4,5,6]

Explanation: Since the list has two middle nodes with values 3 and 4, we return the first one.

#### 4. Linear search and Binary search

##### Linear search

You are given an m x n integer matrix with the following two properties:

- Each row is sorted in non-decreasing order.
- The first integer of each row is greater than the last integer of the previous row.
- Given an integer target, return true if target is in matrix or false otherwise.

**Example 1:**

|    |    |    |    |
|----|----|----|----|
| 1  | 3  | 5  | 7  |
| 10 | 11 | 16 | 20 |
| 23 | 30 | 34 | 60 |

Input: matrix = [[1,3,5,7],[10,11,16,20],[23,30,34,60]], target = 3

Output: true

##### Binary Search:

Given an array nums containing n distinct numbers in the range [0, n], return the only number in the range that is missing from the array.

**Example 1:**

Input: nums = [3,0,1]

Output: 2

Explanation: n = 3 since there are 3 numbers, so all numbers are in the range [0,3]. 2 is the missing number in the range since it does not appear in nums.

**Example 2:**

Input: nums = [0,1]

Output: 2

Explanation: n = 2 since there are 2 numbers, so all numbers are in the range [0,2]. 2 is the missing number in the range since it does not appear in nums.

**Example 3:**

Input: nums = [9,6,4,2,3,5,7,0,1]

Output: 8

Explanation: n = 9 since there are 9 numbers, so all numbers are in the range [0,9]. 8 is the missing number in the range since it does not appear in nums.

**Constraints:**

All the numbers of nums are unique.

**5. Stack**

**Remove All Adjacent Duplicates in String** using stack

Implement a stack Abstract Data Type (ADT) that supports the following operations:

- `push(element)`: Add the given element to the top of the stack.
- `pop()` -> element: Remove and return the top element from the stack. If the stack is empty, return None.
- `peek()` -> element: Return the top element of the stack without removing it. If the stack is empty, return None.

Implement a function that removes all adjacent duplicates in the string using a stack-based approach. A duplicate removal operation consists of selecting two adjacent and equal letters and eliminating them from the string. You should repeatedly apply these duplicate removals on the string `s` until no further duplicates can be removed.

- Input: A string `s` ( $1 \leq |s| \leq 10^5$ ) consisting of lowercase English letters.
- Output: Return a string representing the final string after all adjacent duplicates have been removed.

**Example 1:**

Input: `s = "abbaca"`

Output: `"ca"`

Explanation:

For example, in `"abbaca"` we could remove `"bb"` since the letters are adjacent and equal, and this is the only possible move. The result of this move is that the string is `"aaca"`, of which only `"aa"` is possible, so the final string is `"ca"`.

**Example 2:**

Input: `s = "azxxzy"`

Output: `"ay"`

**6. Stack applications: Infix to postfix conversion**

Implement function to convert infix expression to its postfix notation using a stack.

Infix notation is the commonly used notation to represent mathematical expressions, where operators are written between the operands. For example, `2 + 3 * 4` is an infix expression. Postfix notation (also known as Reverse Polish Notation) is a way to represent mathematical expressions where each operator follows its operands. For example, the postfix equivalent of `2 + 3 * 4` is `2 3 4 * +`.

- Input: A string `infix_expr` containing the infix expression. The expression will only contain the following characters: digits (0-9), operators (+, -, \*, /), and parentheses (, ).
- Output: A string representing the postfix expression obtained after converting the infix expression.

**Example 1:**

Input: `infix_expr = "2 + 3 * 4"`

Output: `"2 3 4 * +"`

**7. Stack applications: Evaluation of postfix expressions.**

Postfix expression as input and evaluates it to obtain the result using a stack.

- Input: A string `postfix_expr` containing the postfix expression. The expression will only contain the following characters: digits (0-9) and operators (+, -, \*, /).
- Output: An integer representing the result of the evaluated postfix expression.

**Examples:**

Input: `postfix_expr = "2 3 4 * +"`

Output: 14

Explanation: The postfix expression is evaluated as  $2 + (3 * 4) = 2 + 12 = 14$ .

**8. Queue**

Implement the queue Abstract Data Type (ADT) and use it to calculate the time needed to buy tickets.

**Problem Statement: Time Needed to Buy Tickets**

- There are  $n$  people in a line queuing to buy tickets, where the 0th person is at the front of the line and the  $(n - 1)$ th person is at the back of the line.
- You are given a 0-indexed integer array `tickets` of length  $n$  where the number of tickets that the  $i$ th person would like to buy is `tickets[i]`.
- Each person takes exactly 1 second to buy a ticket. A person can only buy 1 ticket at a time and has to go back to the end of the line (which happens instantaneously) in order to buy more tickets. If a person does not have any tickets left to buy, the person will leave the line.
- Return the time taken for the person at position  $k$  (0-indexed) to finish buying tickets.

**Example 1:**

Input: `tickets = [2,3,2]`,  $k = 2$

Output: 6

Explanation:

- In the first pass, everyone in the line buys a ticket and the line becomes `[1, 2, 1]`.

- In the second pass, everyone in the line buys a ticket and the line becomes `[0, 1, 0]`.

The person at position 2 has successfully bought 2 tickets and it took  $3 + 3 = 6$  seconds.

**Example 2:**

Input: `tickets = [5,1,1,1]`,  $k = 0$

Output: 8

Explanation:

- In the first pass, everyone in the line buys a ticket and the line becomes `[4, 0, 0, 0]`.

- In the next 4 passes, only the person in position 0 is buying tickets.

The person at position 0 has successfully bought 5 tickets and it took  $4 + 1 + 1 + 1 + 1 = 8$  seconds.

**9. Insertion sort**

Sort the array using insertion sort, and then find the **majority element** is the element that appears more than  $\lfloor n / 2 \rfloor$  times. You may assume that the majority element always exists in the array.

**Example 1:**

Input: `nums = [3,2,3]`

Output: 3

**Example 2:**

Input: `nums = [2,2,1,1,1,2,2]`

Output: 2

**10. Merge sort**

Given an array of integers `nums`, sort the array in ascending order and return it.

Solve the problem without using any built-in functions in  $O(n \log(n))$  time complexity and with the smallest space complexity possible.

**Example 1:**

Input: `nums = [5,2,3,1]`

Output: `[1,2,3,5]`

Explanation: After sorting the array, the positions of some numbers are not changed (for example, 2 and 3), while the positions of other numbers are changed (for example, 1 and 5).

**Example 2:**

Input: `nums = [5,1,1,2,0,0]`

Output: `[0,0,1,1,2,5]`

Explanation: Note that the values of `nums` are not necessarily unique.

**11. Hash Table**

Find the first non-repeating character in a string using hash table, Given a string `s`, find the first non-repeating character in it and return its index. If it does not exist, return -1.

Example 1:

Input: `s = "leetcode"`

Output: 0

Example 2:

Input: s = "loveleetcode"  
Output: 2  
Example 3:  
Input: s = "aabb"  
Output: -1

## 12. Open hashing

Implement the Open Hashing data structure that supports the following operations:

- **insert(key, value):** Insert a key-value pair into the hash table.
- **get(key)** -> value: Retrieve the value associated with a given key from the hash table.
- **remove(key):** Remove the key-value pair with the given key from the hash table.

### Constraints:

- Use an appropriate hash function to convert keys into valid indices for the hash table.
- If a collision occurs during insertion (i.e., multiple keys map to the same index), use separate chaining to handle it by creating a linked list at that index.

## 13. Tree traversal algorithms

You are given a binary tree. Your task is to implement three tree traversal algorithms: Preorder Traversal, Inorder Traversal, and Postorder Traversal.

- **Preorder Traversal:** Visit the root node first, then traverse the left subtree, and finally traverse the right subtree.
- **Inorder Traversal:** Traverse the left subtree first, then visit the root node, and finally traverse the right subtree.
- **Postorder Traversal:** Traverse the left subtree first, then traverse the right subtree, and finally visit the root node.

### Example :

Input: root = [1,2,3,4,5,null,null]

Output:

Preorder: [1, 2, 4, 5, 3]

Inorder: [4, 2, 5, 1, 3]

Postorder: [4, 5, 2, 3, 1]

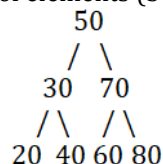
## 14. Binary Search Tree (BST)

The Binary Search Tree must maintain its BST property at all times. For every node in the BST, the keys in its left subtree are less than its key, and the keys in its right subtree are greater than its key. Implement the Binary Search Tree data structure that supports the following operations:

- **insert(key):** Insert a new key into the BST while maintaining its BST property.
- **delete(key):** Delete a key from the BST while preserving its BST property.
- **search(key)** -> bool: Check whether a given key is present in the BST.

Example:

Insertion of elements (50, 30, 20, 40, 70, 60, 80) into the BST.



Constraints:

The BST property is maintained throughout the insertions and deletions.

## 15. Balanced Binary Tree

Given a binary tree, determine if it is height-balanced. A binary tree is height-balanced if the difference in heights between its left and right subtrees is at most 1 for every node in the tree. Write a function called `is_balanced` that takes the root of the binary tree as input and returns a boolean value indicating whether the binary tree is height-balanced or not.

### Example 1:

Input: root = [3,9,20,null,null,15,7]

Output: true

**Example 2:**

Input: root = [1,2,2,3,3,null,null,4,4]

Output: false

**Example 3:**

Input: root = []

Output: true

## 16. Graph traversal algorithm

Implement the Depth First Search (DFS) algorithm to traverse the graph starting from a given source vertex. It takes the adjacency matrix representation of a graph and the source vertex as inputs and returns a list of vertices visited during the DFS traversal.

**Example**

adj\_matrix = [ [0, 1, 0, 1, 0], [1, 0, 1, 0, 1], [0, 1, 0, 1, 0], [1, 0, 1, 0, 1], [0, 1, 0, 1, 0] ]

source = 2

DFS traversal order is [2, 1, 0, 3, 4]

Source = 0

DFS traversal order is [0, 1, 2, 3, 4]

## Indicative list of applications-based experiments

1. Given an expression exp of length n consisting of some brackets, the task is to print the bracket numbers when the expression is being parsed.

**Input:**

The first line contains an integer **T**, the number of test cases. For each test case, there is a string exp containing the expression.

**Output:**

For each test case, the output is the bracket numbers of the expression.

2. Given an unsorted array **arr[]** of size **N**, rotate it by **D** elements (clockwise).

**Input:**

The first line of the input contains **T** denoting the number of test cases. First line of each test case contains two space separated elements, **N** denoting the size of the array and an integer **D** denoting the number size of the rotation. Subsequent line will be the N space separated array elements.

**Output:**

For each test case, in a new line, output the rotated array.

**Example:**

**Input:**

```
2
5 2
1 2 3 4 5
10 3
2 4 6 8 10 12 14 16 18 20
```

**Output:**

```
3 4 5 1 2
8 10 12 14 16 18 20 2 4 6
```

3. Given a singly linked list, the task is to find the length of the linked list, where the length is defined as the number of nodes in the linked list.

**Input:**

The first line of input contains the number of test cases, T. To reach each test case, the first line of the test case input contains the number of nodes, N, to be inserted into the linked list. The next line contains the data of N nodes.

**Output:**

There will be a single line of output for each test case, which contains length of the linked list.

4. Given a doubly linked list, rotate the linked list counter-clockwise by P nodes. Here, P is a given positive integer and is smaller than the count of nodes (N) in the linked list.

**Input:**

The first line of input contains an integer **T** denoting the no of test cases. For each test case, the first line of input contains two integers **N** and **P** denoting the number of nodes in Linked List and the number of nodes to be rotated respectively.

**Output:**

For each test case, output the final linked list after the P rotations in it.

5. Given a stack with **push()**, **pop()**, **empty()** operations, delete **middle** of it without using any additional data structure.

**Middle:**  $\text{ceil}(\text{size\_of\_stack}/2.0)$

**Input Format:**

The first line contains an integer T, which represents the number of test cases. For each test case, the first line contains an integer **sizeOfStack**, indicating the stack size. The next line contains space-separated integers that will be pushed into the stack.

**Output Format:**

For each test case, in a new line, print the stack elements. **If stack size is 1 then just print**

6. Given a Queue **Q** containing **N** elements. The task is to reverse the Queue. Your task is to complete the function **rev()**, that reverses the **N** elements of the queue.

**Input Format:**

The first line of input contains an integer **T** denoting the Test cases. Then **T** test cases follow. The first line contains **N** which is the number of elements which will be reversed. Second line contains **N** space separated elements.

**Output Format:**

For each test case, in a new line, print the reversed queue.

7. Given a Binary Search Tree, find the sum of all leaf nodes. A Binary Search Tree (BST) has the following property: The left subtree of a node contains only nodes with keys less than the node's key; duplicate nodes are possible. The **right sub tree** of a node contains only nodes with **keys greater than or equal** to the node's key.

**Input:**

The first line of input contains a single integer **T** denoting the number of test cases. Then T test cases follow. Each test case consists of two lines. The first line of each test case consists of integer **N**, denoting the number of elements in the BST. The second line of each test case consists of **N** space-separated integers denoting the elements in the BST.

**Output:**

For each test case, in a new line, print the sum of leaf nodes.

### Reading Material (s)

1. Data Structures Lab manual, Department of CSE, GMRIT, Rajam
2. [http://www,LeetCode.com](http://www.LeetCode.com)



**21CS308 JAVA Lab****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to

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. Design Graphical User Interface using AWT components
6. Design Graphical User Interface using Swing components

**CO-PO Mapping**

| COs | PO3 | PO4 | PO12 | PSO2 |
|-----|-----|-----|------|------|
| 1   | 1   | 1   | 2    | 1    |
| 2   | 2   | 1   | 2    | 1    |
| 3   | 2   | 2   | 2    | 1    |
| 4   | 2   | 3   | 3    | 3    |
| 5   | 3   | 2   | 2    | 3    |
| 6   | 3   | 2   | 3    | 3    |

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

**List of Experiments**

1. Case Study: Permutations and Combinations Calculator

**User Input:**

- The program should prompt the user to enter the total number of elements (n) and the number of elements to be selected (r).
- Validate the input to ensure that both n and r are positive integers, and r is less than or equal to n.

**Functional Description:**

- Create a method **calculatePermutations** that takes two integers n and r as input and returns the number of permutations.

**Formula**  $nPr = n! / (n - r)!$ , where "!" denotes factorial.

- Create a method **calculateCombinations** that takes two integers n and r as input and returns the number of combinations.

**Formula**  $nCr = n! / (r! * (n - r)!)$ .

- Implement a separate method to calculate the factorial of a given integer.

**Sample Output:**

```
Enter the total number of elements (n): 5
Enter the number of elements to be selected (r): 3
Permutations (nPr): 60
Combinations (nCr): 10
```

2. Conversion Utility that allows users to convert measurements between different units.

**User Input:**

- The program should prompt the user to enter positive integer value for conversion type.
- The program should prompt the user to enter the positive input (feet/ meters/ miles/ kilometers) based on user option.

**Functional Description:**

- utilize method overloading to handle conversions between various units, such as feet to meters, miles to kilometers, and vice versa.

**formula:** feet to meters - feet \* 0.3048

miles to kilometers - miles \* 1.60934

**Sample Output:**

```
Measurement Conversion Utility
1. Feet to Meters
2. Meters to Feet
```

3. Miles to Kilometers  
4. Kilometers to Miles  
5. Exit  
Enter your choice: 3  
Enter the distance in miles: 5  
5 miles is approximately 8.046 kilometers.

3. Case Study: **BankAccount** Class with Constructor Overloading

**Functional Description:**

- Create a **BankAccount** class to represent a bank account. The class should have private attributes such as **accountNumber** (a unique identifier for the account), **accountHolderName**, and **balance** (representing the current account balance).
- The class should have the following constructors:
  - **BankAccount(String accountNumber, String accountHolderName)**: Create an account with a zero balance.
  - **BankAccount(String accountNumber, String accountHolderName, double initialBalance)**: Create an account with the specified initial balance.
- Implement methods to:
  - **deposit(double amount)**: Add the given amount to the account balance.
  - **withdraw(double amount)**: Subtract the given amount from the account balance if sufficient funds are available.

**Sample Output:**

Welcome to the Bank Account System  
Creating a new account..  
Enter the account holder's name: John Doe  
Enter the initial balance: 500.0  
Account created successfully.  
Account Number: ACCT123456  
Account Holder: John Doe  
Balance: \$500.00  
What would you like to do?  
1. Deposit  
2. Withdraw  
3. Exit  
Enter your choice: 1  
Enter the amount to deposit: 250.0  
\$250.00 deposited successfully.  
Updated Balance: \$750.00

4. Implement inheritance concept for below case study:

*Note:* class **FictionBook** extends class **LibraryBook**, class **ClassicBook** and class **ScienceFictionBook** extends from **FictionBook**

- **LibraryBook**: Represents a general library book with attributes like title, author, and year, along with a method **displayBookInfo()** to display book details.
- **FictionBook**: Extends **LibraryBook** and adds an additional attribute genre.
- **ClassicBook**: Extends **FictionBook** and adds an additional attribute publisher.
- **ScienceFictionBook**: Extends **FictionBook** and adds an additional attribute edition

5. Case Study: Abstract Class for Finding Areas of Different Shapes

**User Input:**

- The program should prompt the user to enter positive integer value to calculate type of area.
- The program should prompt the user to enter the input based on user option.
  - **Circle**: Requires the radius as an input parameter
  - **Rectangle**: Requires the length and width as input parameters.
  - **Triangle**: Requires the base and height as input parameters.
  - **Square**: Requires the side length as an input parameter.

**Functional Description:**

- Create an abstract class **Shape** that will serve as the base class for different shapes. Include an abstract method **calculateArea()**
- Create concrete subclasses that extend the **Shape** class for different shapes like **Circle**, **Rectangle**, **Triangle** and **Square**.

**Sample Output:**

Select a shape:

1. Circle
2. Rectangle
3. Triangle
4. Square
5. Exit

Enter your choice: 1

Enter the radius of the circle: 5

The area of the selected shape is: 78.53981633974483

6. Implement Dynamic Method Dispatch in Java.
7. i. Create an **ArrayList** of integers to store a collection of numbers. Implement methods to add elements to the list, remove elements, update elements, and search for elements in the list.  
ii. Create a Java program that accepts a string input from the user. Use the **StringTokenizer** class to tokenize the input string into separate tokens based on specified delimiters (e.g., space, comma, etc.).
8. Demonstrating Mutability Differences between **String**, **StringBuilder**, and **StringBuffer** in Java
  - Explain the Concept in 100 words.
  - Perform string manipulation operation concatenation on each class
  - Print the results of each class after modification operation
9. Demonstrate multiple inheritance-like behavior achieved through interface implementation.
10. Case Study: Java Program Illustrating Multiple Catch Clauses with Finally Block

**Functional Description:**

- Implement exception handling for possible exceptions that may occur during the division, such as **ArithmeticException** and **NumberFormatException**.
- Use multiple catch clauses to handle **ArithmeticException** and **NumberFormatException** separately.
- Use a **finally** block to execute code that should be performed regardless of whether an exception occurred or not

**Sample Output:**

Enter the dividend: 10

Enter the divisor: 0

Division by zero is not allowed.

Execution completed.

11. Create your own custom exception classes to handle specific situations or errors that are not covered by the built-in exception classes.

**Functional Description:**

- Create a custom exception class that extends the **Exception** class (or any other appropriate superclass, depending on your requirements).
- Define the custom exception class to represent a specific error situation, such as **InvalidAgeException**, which is thrown when an invalid age is provided.
- Use the custom exception class in a method to throw the exception when a certain condition is met, such as when the age is less than zero or exceeds a specific limit.

**Constraints:**

The program should prompt the user to enter age integer value. Here, age<0 or age>120

**Sample Output:**

Enter age:-5

Exception: Invalid age. Age must be between 0 and 120.

12. Creates three threads by extending the **Thread** class. Each thread will display a specific message at a regular interval. The messages to be displayed are as follows:

First thread: "**Good Morning**" every 1 second

Second thread: "**Hello**" every 2 seconds

Third thread: **"Welcome"** every 3 seconds

*Note:* implement the same by using **Runnable** interface.

13. Case Study: Java Program for Producer-Consumer Problem

**User Input:**

- The program should prompt the user to enter positive integer values for **bufferSize**
- The program should prompt the user to enter positive integer values to **produceCount** and **consumeCount**

**Functional Description:**

- Buffer Implementation:
  - Create a shared buffer with a limited size (e.g., an array or an ArrayList) to hold the produced items.
- Producer & Consumer Implementation:
  - Create a Producer class & Consumer class that implements the Runnable interface.
  - The Producer class should produce items and put them into the buffer.
  - The Consumer class should consume items from the buffer.
  - Implement synchronization to avoid race conditions when accessing the buffer.

**Sample Output:**

```
Enter Buffer Size:5
Enter Procedure Count:5
Enter Consumer Count:5
Produced: 0
Consumed: 0
Produced: 1
Consumed: 1
Produced: 2
Consumed: 2
Produced: 3
Consumed: 3
Produced: 4
Consumed: 4
```

14. Case Study: Java Program for a Basic Calculator using AWT

In this case study, we'll implement a Java program to create a basic calculator using AWT. The calculator will have a simple graphical user interface (GUI) with buttons for numbers, arithmetic operations, and a display to show the result of calculations.

**AWT Implementation:**

- Create a Java AWT to implement the calculator GUI.
- The AWT should have buttons for digits (0 to 9), arithmetic operations (addition, subtraction, multiplication, division), and an equal (=) button to perform calculations.

**Display and Input:**

- Implement a display area where the user can see the entered numbers and the result of calculations.
- Provide a way for users to input numbers and arithmetic operations using the GUI buttons.

**Basic Calculations:**

- Implement methods to handle basic arithmetic calculations (addition, subtraction, multiplication, division).
- Perform calculations based on the user's input and display the result in the GUI.

**User Interface:**

- Design a user-friendly GUI with appropriate labels, buttons, and display areas.
- Use layout managers to organize the components effectively.

15. Case Study: Java Program for Temperature Converter using AWT

In this case study, we'll implement a Java AWT to create a Temperature Converter. The AWT will allow users to convert temperatures between Celsius and Fahrenheit. The user will input a temperature value in one unit, and the AWT will display the converted temperature in the other unit.

**AWT Implementation:**

- Create a Java AWTpplet to implement the temperature converter GUI.
- The AWT should have input fields for the temperature value and buttons to select the source and target temperature units (Celsius or Fahrenheit).
- Use appropriate layout managers to organize the components effectively.

**Conversion Logic:**

- Implement methods to handle temperature conversions between Celsius and Fahrenheit.
- The temperature conversion formulas are:
  - Fahrenheit to Celsius:  $C = (F - 32) * 5 / 9$
  - Celsius to Fahrenheit:  $F = (C * 9 / 5) + 32$

**User Interface:**

- Design a user-friendly GUI with appropriate labels, input fields, and buttons.
- Display the converted temperature in the GUI after the conversion is performed.

16. Case Study: Java Swing Application for Job Application Form

In this case study, we'll implement a Java Swing application with a JFrame that contains fields for name, age, email, and qualifications. The application will validate the form data when the user clicks the "Submit" button. If all fields are filled, the data will be written to a file named "application\_form.txt."

**Swing Application:**

- Create a Java Swing application with a JFrame to display the job application form.
- Design the form with labels for each field (name, age, email, qualifications) and corresponding input fields (text fields or other appropriate components).
- Add a "Submit" button to the form to allow users to submit their job application.

**Data Validation:**

- Implement validation for the form data to ensure that all fields are filled before submission.
- Display error messages for missing fields or invalid data.

**Data Writing:**

- Create a method to write the validated form data to a file named "application\_form.txt."
- The file should be created in the current working directory.
- Use appropriate file handling techniques to write the data.

**User Interaction:**

- Allow users to input their name, age, email, and qualifications using the form fields.
- Trigger the form data validation when the user clicks the "Submit" button.
- Display appropriate messages to inform the user about the success or failure of form submission.

**List of Augmented Experiments**

1. New Patient Registry Management System
2. Restaurant Billing Management System
3. Library Management System
4. ATM Management System
5. 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 Search Engine Filter
12. Electronic voting System
13. Day Planner
14. Library management System
15. Personal Finance Management System

**Reading Material (s)**

1. JAVA Lab manual, Department of CSE and IT, GMRT, Rajam

**21ESX01 Employability Skills I****0 0 2 0****Course Outcomes**

At the end of the course, students will be able to

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 | PO 8 | PO10 | PO12 |
|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |      | 3    | 2    |
| CO2 |     |     |     | 1    | 2    | 2    |
| CO3 | 2   | 1   |     | 2    |      |      |
| CO4 | 2   |     | 2   |      |      |      |
| CO5 | 2   |     | 2   |      |      |      |
| CO6 | 2   |     | 2   |      |      |      |

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

**Unit-I****Communication Skills****8 hours**

Communication Skills & Confidence: 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: 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.

**Quantitative Aptitude****8hours**

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

**Unit-II****Competitive Programming Phase – I****16 Hours****Module-1:**

**Introduction:** Importance of Competitive Programming, Conditional Statements, Loops, Nested Loops.

**Strings:** Declaration of strings, Accessing strings elements, operations

**Practice Problems:**

| Week | Topic                                   | Practice Problem Links                                                                                                                            |
|------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Introduction to Competitive Programming | <b>Codechef, Hackerrank, Codeforces, Leetcode, interviewbit...etc</b>                                                                             |
| 2    | Conditional Statements-I                | <a href="https://www.codechef.com/practice/tags/basic-programming-concepts">https://www.codechef.com/practice/tags/basic-programming-concepts</a> |
|      |                                         | <a href="https://www.codechef.com/practice/tags/conditional-statements">https://www.codechef.com/practice/tags/conditional-statements</a>         |
| 3    | Conditional Statements-II               | <a href="https://www.codechef.com/practice/tags/basic-programming-concepts">https://www.codechef.com/practice/tags/basic-programming-concepts</a> |
|      |                                         | <a href="https://www.codechef.com/practice/tags/conditional-statements">https://www.codechef.com/practice/tags/conditional-statements</a>         |

|    |                            |                                                                                                                               |
|----|----------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 4  | Loops-I                    | <a href="https://www.codechef.com/practice/tags/loops">https://www.codechef.com/practice/tags/loops</a>                       |
|    |                            | <a href="https://leetcode.com/tag/math/">https://leetcode.com/tag/math/</a>                                                   |
|    |                            | <a href="https://www.interviewbit.com/practice/#topics[]=math">https://www.interviewbit.com/practice/#topics[]=math</a>       |
|    |                            | <a href="https://www.codechef.com/practice/tags/basic-maths">https://www.codechef.com/practice/tags/basic-maths</a>           |
| 5  | Loops-II                   | <a href="https://www.codechef.com/practice/tags/loops">https://www.codechef.com/practice/tags/loops</a>                       |
|    |                            | <a href="https://leetcode.com/tag/math/">https://leetcode.com/tag/math/</a>                                                   |
|    |                            | <a href="https://www.interviewbit.com/practice/#topics[]=math">https://www.interviewbit.com/practice/#topics[]=math</a>       |
|    |                            | <a href="https://www.codechef.com/practice/tags/basic-maths">https://www.codechef.com/practice/tags/basic-maths</a>           |
| 6  | Nested Loops-I             | <a href="https://www.codechef.com/practice/topics/math">https://www.codechef.com/practice/topics/math</a>                     |
|    |                            | <a href="https://www.interviewbit.com/practice/#topics[]=math">https://www.interviewbit.com/practice/#topics[]=math</a>       |
|    |                            | <a href="https://leetcode.com/tag/math/">https://leetcode.com/tag/math/</a>                                                   |
| 7  | Nested Loops-II            | <a href="https://www.codechef.com/practice/topics/math">https://www.codechef.com/practice/topics/math</a>                     |
|    |                            | <a href="https://www.interviewbit.com/practice/#topics[]=math">https://www.interviewbit.com/practice/#topics[]=math</a>       |
|    |                            | <a href="https://leetcode.com/tag/math/">https://leetcode.com/tag/math/</a>                                                   |
| 8  | Strings-I                  | <a href="https://www.codechef.com/practice/topics/strings">https://www.codechef.com/practice/topics/strings</a>               |
|    |                            | <a href="https://leetcode.com/tag/string/">https://leetcode.com/tag/string/</a>                                               |
|    |                            | <a href="https://www.interviewbit.com/practice/#topics[]=strings">https://www.interviewbit.com/practice/#topics[]=strings</a> |
| 9  | Strings-II                 | <a href="https://www.codechef.com/practice/topics/strings">https://www.codechef.com/practice/topics/strings</a>               |
|    |                            | <a href="https://leetcode.com/tag/string/">https://leetcode.com/tag/string/</a>                                               |
|    |                            | <a href="https://www.interviewbit.com/practice/#topics[]=strings">https://www.interviewbit.com/practice/#topics[]=strings</a> |
| 10 | String Matching Algorithms | <a href="https://www.codechef.com/practice/topics/strings">https://www.codechef.com/practice/topics/strings</a>               |
|    |                            | <a href="https://leetcode.com/tag/string/">https://leetcode.com/tag/string/</a>                                               |
|    |                            | <a href="https://leetcode.com/tag/string-matching/">https://leetcode.com/tag/string-matching/</a>                             |
|    |                            | <a href="https://www.interviewbit.com/practice/#topics[]=strings">https://www.interviewbit.com/practice/#topics[]=strings</a> |

**Module-2:**

**Arrays:** Basics on Arrays: Creating elements, converting a string into array of characters, converting a number into array of character, accessing array elements **Recursion:** Definition, examples and how recursion differs from iteration.

**Practice Problems:**

| Week | Topic              | Practice Problem Links                                                                                                                                                                        |
|------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Arrays - I         | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=arrays">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=arrays</a> |
|      |                    | <a href="https://leetcode.com/tag/array/">https://leetcode.com/tag/array/</a>                                                                                                                 |
|      |                    | <a href="https://www.codechef.com/practice/topics/arrays">https://www.codechef.com/practice/topics/arrays</a>                                                                                 |
|      |                    | <a href="https://www.interviewbit.com/practice/#topics[]=arrays">https://www.interviewbit.com/practice/#topics[]=arrays</a>                                                                   |
| 12   | Arrays - II        | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=arrays">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=arrays</a> |
|      |                    | <a href="https://leetcode.com/tag/array/">https://leetcode.com/tag/array/</a>                                                                                                                 |
|      |                    | <a href="https://www.codechef.com/practice/topics/arrays">https://www.codechef.com/practice/topics/arrays</a>                                                                                 |
|      |                    | <a href="https://www.interviewbit.com/practice/#topics[]=arrays">https://www.interviewbit.com/practice/#topics[]=arrays</a>                                                                   |
| 13   | 2D Arrays & Matrix | <a href="https://www.interviewbit.com/practice/#topics[]=two-pointers">https://www.interviewbit.com/practice/#topics[]=two-pointers</a>                                                       |
|      |                    | <a href="https://leetcode.com/tag/two-pointers/">https://leetcode.com/tag/two-pointers/</a>                                                                                                   |
|      |                    | <a href="https://leetcode.com/tag/matrix/">https://leetcode.com/tag/matrix/</a>                                                                                                               |
|      |                    | <a href="https://www.codechef.com/practice/tags/matrices">https://www.codechef.com/practice/tags/matrices</a>                                                                                 |
| 14   | Recursion - I      | <a href="https://leetcode.com/tag/recursion/">https://leetcode.com/tag/recursion/</a>                                                                                                         |
|      |                    | <a href="https://www.codechef.com/practice/tags/recursion">https://www.codechef.com/practice/tags/recursion</a>                                                                               |

|    |                                   |                                                                                                                                                                                                                                             |
|----|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15 | Recursion - II & Assessment       | <a href="https://leetcode.com/tag/recursion/">https://leetcode.com/tag/recursion/</a>                                                                                                                                                       |
|    |                                   | <a href="https://www.codechef.com/practice/tags/recursion">https://www.codechef.com/practice/tags/recursion</a>                                                                                                                             |
|    |                                   | <a href="https://www.hackerearth.com/practice/basic-programming/recursion/recursion-and-backtracking/practice-problems/">https://www.hackerearth.com/practice/basic-programming/recursion/recursion-and-backtracking/practice-problems/</a> |
| 16 | Recursion - III & Assessment - II | <a href="https://leetcode.com/tag/recursion/">https://leetcode.com/tag/recursion/</a>                                                                                                                                                       |
|    |                                   | <a href="https://www.codechef.com/practice/tags/recursion">https://www.codechef.com/practice/tags/recursion</a>                                                                                                                             |

**References:**

1. <https://leetcode.com>
2. <https://www.codechef.com>
3. <https://www.hackerearth.com>
4. <https://www.interviewbit.com>
5. <https://www.hackerrank.com>



**21HSX11 CC & EC Activities I****0 0 1 0****Course Outcomes**

At the end of the course, students will be able to

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

**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 slots every week : 12
- No. of Streams (1 CC + 1 EC + 1 Community Engagement) : 3
- No. of slots allotted for each stream : 4

**Requirement for the award of 1-Credit**

- Students shall choose at least two streams of events in each semester and among which Community engagement through NSS is mandatory
- Students shall secure an overall attendance of 75% in all events put together

The credits earned through these courses will be indicated in the grade memo and will be taken into account for CGPA calculation.

**4<sup>th</sup> Semester****21IT304 Database Management Systems****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Describe the fundamental concepts of data base and data models
2. Explain the use of Relational Algebra and integrity constraints in databases
3. Use SQL's Commands to handle the Database
4. Apply Normalization for schema refinement
5. Make use of the concept of transaction management and recovery system in databases
6. Outline Indexing concepts, different types of data

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PS02 |
|-----|-----|-----|-----|------|
| 1   | 3   | 1   | 1   | 1    |
| 2   | 3   | 2   | 3   | 1    |
| 3   | 3   | 3   | 3   | 2    |
| 4   | 3   | 3   | 3   | 2    |
| 5   | 3   | 2   | 3   | 3    |
| 6   | 2   | 1   | 2   | 2    |

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

**Unit I****12 Hours****Introduction to DBMS and ERModel**

DBMS Vs. File System, instance and schema, Data abstraction, Data independence, database users and database administrator, Database system structure, Introduction to Data Models (E-R Model, Relational Model, Hierarchical Model, Network Model, Object Oriented Data Model), Database Design Process, Entities, Attributes, Entity Sets, Relationships, Relationship Sets, Additional features of ER Model.

*Applications of DBMS, Object Relational Data Model*

**Unit II****12 Hours****Introduction to Relational Model and Basic SQLQueries**

Relational Algebra Operations: Selection, Projection, Rename, Set Operators, Joins, Division, Examples of Relational Algebra Queries, Relational Calculus: Tuple Relational Calculus. Integrity Constraints over Relations, Introduction to Views. SQL Queries: Basic Structure, Set Operations, Aggregate Functions, Null values, Sub Queries, Group By And Having Clauses, OuterJoins.

*Domain Relational Calculus, Query Optimization*

**Unit III****12 Hours****Normalization and Transaction Management**

Introduction To Schema Refinement - Problems Caused By Redundancy - Decomposition - Problems Related To Decomposition - Functional Dependency - Closure of a Set of Fds - Attribute Closure - First - Second - Third Normal Forms - BCNF - Multi Valued Dependencies - Fourth Normal Form, Join Dependency, Fifth Normal Form. Transactions: Acid Properties of Transaction - Transaction States - Schedule: Serial Schedule - Concurrent Schedules - Anomalies Associated with Concurrent Schedules (RW - WR - and WW Conflicts) - Serializability - Conflict Serializability - and View Serializability.

*EF Codd Rules, Domain Dependency*

**Unit IV****12 Hours****Locking, Recovery Systems, Indexing, Different Types of Data**

Introduction to Lock Management-Lock Based Concurrency Control: 2pl-Strict 2pl-Concurrency without

Locking: Timestamp-Based Concurrency Control, Optimistic Concurrency Control. Introduction to Aries - the Log - the Write-Ahead Log Protocol-Check Pointing Indexing: Types of Single-Level Ordered Indexes, Multilevel Indexes Different Types of Data: Structured, Semi-Structured and Unstructured Data Heap File, Hash File Organizations

**Total: 48 Hours**

### Textbook (s)

1. Elmasri&Navatha, Fundamentals of Database Systems, Pearson Education, 7<sup>th</sup> Edition, 2016
2. SilberschatzKorth, Database System Concepts, McGraw hill, 7<sup>th</sup> Edition, 2020

### Reference (s)

1. SorayaSedkaoui, Data Analytics and Big Data, Wiley, 1st Edition, 2018.
2. PeterRob&CarlosCoronel, Database Systems design, Implementation and Management, 9<sup>th</sup> Edition, 2010.
3. Raghurama Krishnan & Johannes Gehrke, Database Management Systems, TATA McGraw-Hill, 3rd Edition, 2003
4. C.J.Date, An Introduction to Database Systems, Pearson Education, 8<sup>th</sup> Edition, 2006

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1(%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|----------------|-----------------|-------------------------|
| Remember        | 40             | 40              | --                      |
| Understand      | 30             | 40              | --                      |
| Apply           | 30             | 20              | 50                      |
| Analyze         | --             | --              | 50                      |
| Evaluate        | --             | --              | --                      |
| Create          | --             | --              | --                      |
| Total (%)       | 100            | 100             | 100                     |

### SAMPLE QUESTION (S)

#### Remember

1. List any four application 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 Two Phase Locking Protocol

#### 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 indexing techniques

#### Analyze

1. Compare File processing system with DBMS
2. Analyze different locking protocol for concurrency control and serializability
3. Normalization will increase the complexity of the database design. Justify

4. Compare DDL and DML of SQL
5. Compare and Contrast Serializability and Recoverability

### **Evaluate**

1. Is database redesign is necessary? explain
2. How can you evaluate the performance of two data models?
3. Evaluate the performance of query processor and list the corresponding metrics
4. How can you assess the throughput and delay for any DBMS?
5. How can you evaluate the impact of data models on the query processing?

### **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  $AB \rightarrow D$ ,  $E \rightarrow C$ ,  $AF \rightarrow B$ . From this, find out all super keys for this relation, and which of these super keys form akey.

**21IT403 Operating Systems****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Understand computer resources and operating system management.
2. Analyze various CPU Scheduling Algorithms for Process Management.
3. Examine process synchronization and coordination of operating system.
4. Analyze the Main Memory Management and allocation strategies.
5. Identify the use of Virtual Memory management policies with respect to storage management.
6. Identify the need of File-System Interface and I/O Systems.

**CO-PO Mapping**

| COs | PO1 | PO2 | PO12 | PSO2 |
|-----|-----|-----|------|------|
| 1   | 2   | 1   | 2    | 2    |
| 2   | 3   | 2   | 2    | 3    |
| 3   | 3   | 3   | 2    | 3    |
| 4   | 3   | 3   | 2    | 2    |
| 5   | 2   | 2   | 2    | 2    |
| 6   | 2   | 2   | 2    | 2    |

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

**Unit I****12 Hours****Operating-Systems Overview and Process Management**

Operating-System Overview: Computer-System Organization and Architecture, Operating-System Structure, Operating-System Operations & Services, System Calls & its types.

Threads: Multi Core Programming, Multithreading Models, Thread Scheduling algorithms.

Process Management: Process Concepts, Process Scheduling Criteria, Scheduling Algorithms and evaluation.

*Thread issues, Multilevel Queue, Multilevel feedback Queue Scheduling.*

**Unit II****12 Hours****Inter Process Communication Mechanism**

Process Synchronization: Cooperative process, the Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Synchronization problems. Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance & Detection, Recovery from Deadlock.

*Monitors, Synchronization Examples.*

**Unit III****12 Hours****Memory Management**

Main Memory: Contiguous Memory allocation, Swapping, Segmentation, Paging, Segmented paging, Multilevel paging. Virtual Memory Management: Demand Paging, Page Replacement algorithms, Allocation of Frames.

*Structure of page table, Thrashing, Memory-Mapped Files.*

**Unit IV****12 Hours****File System Interface & I/O Systems**

Mass-Storage Structure: Disk structure, Disk Scheduling, Disk management, Raid Structure.

File System: Access Methods, Directory Structures, Allocation Methods, Free-Space Management. I/O Systems: I/O hardware Application of I/O Interface, Kernel I/O Sub-System.

*File Sharing, File System Recovery, Transforming I/O Requests to Hardware Operation.*

**Total: 48 Hours**

**Textbook (s)**

1. Operating System Concepts, Abraham Silberschatz, Greg Gagne, Peter B. Galvin, 9th Edition, Wiley, 2016.
2. Operating Systems, Harvey M. Deitel, Paul J. Deitel, David R. Choffnes, 3rd Edition, Pearson Prentice Hall, 2004.

**Reference (s)**

1. Operating Systems: Internals and Design Principles, William Stallings, 7th Edition, Pearson Prentice Hall, 2013.
2. Operating systems: A Concept based Approach, D. M. Dhamdhere, 2nd Edition, TMH, 2006.
3. Operating System: A Design Approach, Crowley, 1st Edition, TMH, 2001.
4. Modern Operating Systems, Andrew S Tanenbaum, 3rd Edition, PHI, 2009.

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| 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 operating systems
2. Define operating system
3. List any four operating system services

**Understand**

1. Explain System calls
2. Explain the role memory management in operating system
3. Illustrate the working principle critical section problem

**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. Give an example of a scenario that might benefit from a file system supporting an append-only access write.

**Analyze**

1. Context switching between two threads of execution within the operating system is usually performed by a small assembly language function. In general terms, what does this small function do internally?
2. Compare CPU scheduling algorithms
3. Analyze the general strategy behind deadlock prevention, and give an example of a practical deadlock prevention method.

**Evaluate**

1. Assuming the operating system detects the system is deadlocked, what can the operating system do to recover from deadlock?
2. Describe how to implement a lock using semaphores

**Open Book Exam Questions**

1. A file to be shared among different processes, each of which has a unique number. The file can be accessed simultaneously by several processes, subject to the following constraint: the sum of all unique numbers associated with all processes currently accessing the file must be less than  $n$ . Write a monitor to co-ordinate the access to the file. You may want to write `start_access` and `end_access` monitor procedures.
2. Consider a paging system with the page table stored in memory:
  - a. If a memory reference takes 200 nanoseconds, how long does a paged memory reference take?
  - b. If we add associative registers, and 75% of all page-table references are found in the associative registers, what is the effective memory reference time?

**21CS403 Computer Organization and Architecture****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Interpret the functional architecture of computing systems.
2. Summarizethetypesofinstructionanditsmicrooperationwithaddressingmodes.
3. Identify various arithmetic operations on fixed, floating point numbers and its representation.
4. Illustrate the concepts of control unit design and I/O processor.
5. Discuss the memory hierarchy concepts.
6. Describe concept of parallelism and types of hazard.

**CO-PO Mapping**

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

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

**Unit I****13 Hours****Overview & Micro operation**

Components of a computer system – Performance measures - Classifying Instruction Set Architecture-Representing instructions -Micro operation – Logical operations – Shift operations - instruction codes - Computer Registers instruction –memory Reference instruction –Input-Output Reference instruction - Instruction cycle -Addressing and addressing modes.

*Trends in Technology-Arithmetic micro-operations*

**Unit II****11 Hours****Arithmetic Operations**

ALU - Addition and subtraction with Signed Magnitude Data - Hardware Implementation – Multiplication – Hardware Implementation for Signed Magnitude Data – Division - Hardware Implementation for Signed Magnitude Data – Divide Overflow - Floating Point operations – Parallelism and Computer Arithmetic: Sub word Parallelism.

*BCD Adder-BCD Subtraction*

**UNIT III****11 Hours****Control Unit and Memory Systems**

Basic MIPS implementation – Building data path – Control Implementation scheme – Memory hierarchy – Cache basics – Measuring and improving cache performance - Virtual memory- Input/output system-programmed I/O-DMA and Interrupts-I/O processors

*Stack organization-RISC Vs CISC Architecture*

**Unit IV****13 Hours****Parallelism**

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Multicore processors- Pipelining – Arithmetic pipeline –Instruction pipeline -Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions.

*Vector processing –single processor Vs parallel processor*

**Total: 48 Hours**



**Text Book(s):**

1. David A. Patterson and John L. Hennessey, "Computer organization and design: The hardware/software interface", Morgan Kaufman / Elsevier, Fifth edition, 2014.
2. M. Morris Mano, "Computer System Architecture", 3<sup>rd</sup> edition, Pearson/PHI, 2002.

**Reference(s):**

1. V. Carl Hamacher, Zvonko G. Varanasic and Safat G. Zaky, "Computer Organization", 6<sup>th</sup> edition, McGraw-Hill Inc, 2012.
2. William Stallings "Computer Organization and Architecture, Seventh Edition, Pearson Education, 2007.
3. Andrew S Tanenbaum "Structured Computer Organization", 5<sup>th</sup> edition, Pearson/PHI, 2007

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 40              | --              | --                      |
| Understand      | 40              | 50              | --                      |
| Apply           | 20              | 50              | 80                      |
| Analyze         | --              | --              | 20                      |
| Evaluate        | --              | --              | --                      |
| Create          | --              | --              | --                      |
| Total (%)       | 100             | 100             | 100                     |

**SAMPLE QUESTION (S)**

**Remember**

1. What is micro operation?
2. Show the Register Reference Instruction format.
3. Define PC and MAR.
4. What are the two types of data presentation?
5. Define Associative Memory

**Understand**

1. Identify the basic functional units of the system
2. Explain about logic micro operations and its applications with examples
3. Differentiate RISC and CISC architectures in terms of their instruction set and addressing modes.
4. Compare hardwired control unit is differing from micro programmed control unit designs
5. Demonstrate control memory

**Apply**

1. Starting from an initial value of R=11011101, determine the sequence of binary values in R after a logical shift-left, followed by a logical shift-right and a circular shift-right.
2. Analyze the contents of Register A that holds 8 bit binary 11011001 and Determine the B- operand and the logic micro operation to be performed in order to change the value in A to: (i) 01101101 (ii) 11111101 State the differences between register stack and memory stack.
3. Perform the arithmetic operations (+70) + (+80) and (-70) + (-80) with binary numbers in signed-2's complement representation. Use eight bits to accommodate each number together with its sign. Show that overflow occurs in both cases, that the last two carries are unequal, and that there is a sign reversal.
4. Show the hardware to be used for the addition and subtraction of two decimal numbers with negative numbers in signed-10's complement representation. Indicate how an overflow is detected. Derive the flowchart algorithm and try a few numbers to convince yourself that the algorithm produces correct results.
5. The procedure for aligning mantissas during addition or subtraction of floating-point numbers can be stated as follows: Subtract the smaller exponent from the larger and shift right the mantissa having the smaller exponent a number of places equal to the difference between the exponents. The exponent of the sum (or difference) is equal to the larger exponents. Without using a magnitude comparator, assuming biased exponents, and taking into account that only the AC can be shifted,

derive an algorithm in flowchart form for aligning the mantissas and placing the larger exponent in the AC.

### Open book Examination

#### Apply

Smith and Goodman found that for a given small size, a direct-mapped instruction cache consistently outperformed a fully associative instruction cache using LRU replacement.

- a. Explain how this would be possible (*Hint: You can't explain this with the three C's model because it "ignores" replacement policy*)
  - b. Explain where replacement policy fits into the three C's model, and explain why this means that misses caused by a replacement policy are "ignored"- or, more precisely, cannot in general be definitively classified by the three C's model.
  - c. Are there any replacement policies for the fully associative cache that would outperform the direct-mapped cache? Ignore the policy of "do what a direct-mapped cache would do".
  - d. Use a cache simulator to see if Smith and Goodman's results hold for memory reference traces that you have access to. If they do not hold, why not?
6. John takes two numbers in sign magnitude representation (the two numbers are same with different signs), The 1's complement of one number is 6. The difference between 1's complement of these two numbers is 32. Find the numbers. And also find the product of these two numbers using the result of 2's complement value of these two numbers.

#### Analyze

1. A two-word instruction is stored in memory at an address designated by the symbol W. The address field of the instruction (stored at W + 1) is designated by the symbol Y. The operand used during the execution of the instruction is stored at an address symbolized by Z. An index register contains the value X. State how Z is calculated from the other addresses if the addressing mode of the instruction is
  - a. direct
  - b. indirect
  - c. relative
  - d. indexed.
2. An 8-bit computer has a 16-bit address bus. The first 15 lines of the address are used to select a bank of 32K bytes of memory. The high-order bit of the address is used to select a register which receives the contents of the data bus. Explain how this configuration can be used to extend the memory capacity of the system to eight banks of 32K bytes each, for a total of 256K bytes of memory.

**21CS404 Design and Analysis of Algorithms****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to

1. Analyze the time and space complexity of algorithms using mathematical tools, big-O notation, and asymptotic analysis
2. Applying algorithmic paradigms using brute force approaches
3. Applying algorithmic paradigms such as Decrease and Conquer, Divide and Conquer, and Transform and Conquer approaches
4. Design efficient algorithms for a variety of problem-solving using greedy approaches
5. Develop problem-solving skills by tackling complex computational problems using dynamic programming
6. Comprehend the concept of NP-completeness, and identify NP-complete problems using backtracking and branch and bound approaches

**COs-POs Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PSO1 |
|-----|-----|-----|-----|-----|------|
| 1   | 3   | 3   | -   | 1   | 2    |
| 2   | 2   | 2   | 2   | 1   | 2    |
| 3   | 3   | 3   | 3   | 2   | 2    |
| 4   | 3   | 2   | 3   | 2   | 2    |
| 5   | 3   | 2   | 2   | 2   | 2    |
| 6   | 3   | 3   | 2   | 1   | 1    |

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

**Unit I****12 +8 hours****Introduction to Algorithms**

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

*Time complexities of basic operations on array, stack, queue*

**Practical Components**

1. Analysis of recursive algorithms
2. Analysis of Non-recursive algorithms
3. Solve the String matching problem using Brute Force approach
4. Solve the Sorting problem using Brute Force approach

**Unit II****12+8 hours****Algorithm Design Techniques - I**

Decrease and Conquer: General method, Insertion sort, Topological sorting – Divide and Conquer: General method, Merge sort, Quick sort, Fibonacci search – Transform and conquer: General method, Heapsort – Disjoint sets: Operations, Simple Union and simple find, Weighted Union, CollapseFind.

*Graph representation, graph applications*

**Practical Components**

1. Find the Topological order for the given graph using Decrease and Conquer approach
2. Solve sorting problem using divide and conquer approach
3. Solve sorting problem transform and conquer approach
4. Implement Simple Union and Find operation on disjoint-sets

**Unit III****12+10 hours****Algorithm Design Techniques - II**

Greedy method: General method, applications:-Job sequencing with deadlines, Minimum cost spanning trees (Prim's and Kruskal's Algorithms), Single source shortest path problem (Dijkstra's Algorithm), Optimal Merge Patterns (two way merge pattern) - Dynamic Programming: General method, applications:-Matrix chain multiplication, 0/1 knapsack problem, all pairs shortest path problem.

*Optimal BST, Huffman trees and codes*

### Practical Components

1. Find the minimum cost spanning tree for a given graph using greedy approach
2. Implement dijkstra's algorithm using greedy approach
3. Find the minimum record movements for optimal merge pattern using greedy approach
4. Find the optimal parenthesization solution for matrix chain multiplication problem using dynamic programming
5. Solve the 0/1 knapsack using dynamic programming

### Unit IV

**12+ 6 hours**

### Limitations of algorithm power methods to cope up

P, NP and NP-Complete Problems: - P and NP problems, NP-Complete problems. Backtracking: General method, applications:-n-queen problem, sum of subsets problem, Hamiltonian Circuit problem. Branch and Bound: General method, Applications: - Traveling sales person problem, Assignment Problem

*0/1 knapsack problem, graph coloring problem*

### Practical Components

1. Find the sum of subsets using backtracking technique
2. Find the solution for Traveling sales person problem using Branch and Bound method
3. Find the solution for Assignment Problem using branch and bound method

**Total: 48+32 hours**

### Textbook (s)

1. Introduction to The Design and Analysis of Algorithms, 3<sup>rd</sup> Edition, AnanyLevitin, Pearson Education, 2017.
2. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L. Rivest, and C.Stein, PHI Pvt. Ltd./ Pearson Education
3. Fundamentals of Computer Algorithms, Ellis Horowitz, SatrajSahni and Rajasekaran, University press.

### Reference (s)

1. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education.
2. Algorithms - Richard Johnson Baugh and Marcus Schaefer, Pearson Education.
3. [www.geeksforgeeks.org](http://www.geeksforgeeks.org)
4. [www.hackerearth.com](http://www.hackerearth.com)
5. [www.tutorialspoint.com](http://www.tutorialspoint.com)

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 15              | 10              | -                       |
| Understand      | 35              | 20              | 10                      |
| Apply           | 30              | 40              | 60                      |
| Analyze         | 20              | 30              | 30                      |
| Evaluate        | --              | -               | -                       |
| Create          | --              | -               | -                       |
| Total (%)       | 100             | 100             | 100                     |

## SAMPLE QUESTION (S)

### Remember

1. Define performance analysis of an algorithm.
2. Define recurrence relation
3. Define disjoint sets.
4. Define optimality principle

### Understand

1. Explain back tracking algorithm
2. Explain Asymptotic notations
3. Explain the LC search algorithm
4. Explain the divide and conquer strategy. Write the applications of divide and conquer strategy and write the control abstraction for divide and conquer strategy
5. Explain the 4 cases of master theorem
6. What are implicit and explicit constraints in back tracking?

### Apply

1. Solve the fractional knapsack problem with capacity  $m=20$ ,  $W=(18,15,10)$ ,  $P=(25,24,15)$  for the optimum solution.
2. Create two arrays that store all even no's in one array and all odd no's in an other array for a given set of elements
3. Find the space and time complexity of an algorithm to find the maximum element from an array.
4. Solve the recurrence relation  $T(n)=2T(n/2)+n\log n$  using master theorem.
5. Demonstrate the process of Fibonacci search with an example
6. Find the shortest tour for the TSP for the given graph using FIFOBB.

$$\begin{bmatrix} \infty & 20 & 30 & 10 & 11 \\ 15 & \infty & 16 & 4 & 2 \\ 3 & 5 & \infty & 2 & 4 \\ 19 & 6 & 18 & \infty & 3 \\ 16 & 4 & 7 & 16 & \infty \end{bmatrix}$$

### Analyze

1. Analyze the time complexity of quicksort.
2. Differentiate greedy method with dynamic approach
3. Discuss the worst case time complexity of travelling sales person problem
4. How polynomial multiplication is best with FFT
5. Compute the time complexity of fun()?

```
int fun(int n)
{ int count = 0;
  for (int i = n; i > 0; i /= 2)
    for (int j = 0; j < i; j++)
      count += 1;
  return count;
}
```

**21CS405 Web Coding and Development****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Design static web pages using HTML tags and CSS.
2. Describe the basic and advanced concepts of Java Scripts to design dynamic web pages.
3. Develop portable and dynamic web pages.
4. Demonstrate PHP server-side scripting language to develop business logic.
5. Make use of database connectivity to communicate database server from web server.
6. Develop Dynamic Web Pages using Flask.

**COs-POs Mapping**

| CO | PO1 | PO2 | PO3 | PO5 | PS02 |
|----|-----|-----|-----|-----|------|
| 1  | 3   | 2   | 2   | -   | 2    |
| 2  | 3   | 1   | 3   | 3   | 2    |
| 3  | 2   | 2   | 3   | 2   | 2    |
| 4  | 2   | 2   | 3   | 2   | 2    |
| 5  | 2   | 1   | 1   | 3   | 2    |
| 6  | -   | 2   | 3   | 2   | 2    |

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

**Unit I****12 hours**

**HTML Common tags:** Lists, Tables, images, Forms, Links and Navigation.

**CSS:** Introduction, CSS Properties, Selectors, Combinators, Controlling Fonts, Forms, Pseudo classes, Navigation Bar, Layouts, The Box Model

**Bootstrap**

Responsive Design, Layouts, Grids, Media Queries, **Components-** Forms, Drop Downs, Cards, Input Groups, Collapse, List Groups, Navbar, Popovers, Flex Box.

*Introduction to HTML5, XML, CSS3*

**Unit II****12 hours**

**Java Script:** Variables & Scope, Data types, Control Structures, Array Methods, Functions, Events, Validations, Objects, Document Object Model (DOM), Browser Object Model (BOM)

**Advanced JavaScript:** Arrow functions, Template Literals, Array Destructuring, Object Destructuring, Classes and Modules – ES6 imports and exports

*Transpilation, Iterators and Generators*

**Unit III****12 hours****PHP**

Introduction, Model View Architecture (MVC), Creating PHP script, Running PHP script, Introduction to PHP, Arrays, Functions, sending parameters in URL, working with Forms.

**Working with Database:** Running SQL Queries, connecting with Databases, Uploading Files, PHP Sessions, Redirecting, Routing, Connecting PHP with JavaScript and Authentication.

*PHP Cookies, PHP Exception Handling, Introduction to PHP laravel*

**Unit IV****12 hours****Flask**

Introduction to Flask, Virtual Environment, features of flask, url building, routing, Templates and Jinja Code, Rendering Templates, Static files, Building Forms, Sending Form data to Templates, Template Inheritance (header, footer, etc), Session Tracking, Connecting database(SQLite), Retrieving database values to templates, File uploading, Sending Mails, Deployment of website.

*wsgi file, csrf token, http methods.*

**Total: 48 Hours****Text Book(s)**

1. Programming the World Wide Web, 8<sup>th</sup> edition Robert W. Sebesta, Pearson.
2. Web Coding Development All In One for Dummies, Paul McFedries, Wiley.
3. Bootstrap: Responsive Web Development, 1<sup>st</sup> Edition, Jake Spurlock foreword by Dave Winier, 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.

**Internal Assessment Pattern:**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test/OBE (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 25              | 15              | --                      |
| Understand      | 30              | 15              | 20                      |
| Apply           | 25              | 25              | 40                      |
| Analyze         | 20              | 25              | 20                      |
| Evaluate        | --              | --              | --                      |
| Create          | --              | 20              | 20                      |
| Total (%)       | 100             | 100             | 100                     |

**Sample Question(s)**

**Remember**

1. Define and write about HTML.
2. What's the purpose of JavaScript.
3. List the ways to include CSS in Web Pages

**Understand**

1. What is the use of cascading style sheet? Explain different style sheets used in HTML.
2. Explain string object with suitable example.
3. Illustrate how work java script events.
4. Describe procedure for how to connect PHP to MYSQL.

**Apply**

1. Write an HTML program to display your class timetable.
2. Write a java script to find reverse of a given number using functions.
3. at one of the inserted record is invalid. So, write a PHP program to update the table by deleting the invalid record. [Design a responsive registration page using bootstrap].
4. Insert an image into a web page. Write a script which displays a message when the mouse is over the image. The co-ordinates of the mouse should be displayed if click is attempted on the image.
5. A person X has created the table (emp) and inserted the data in the table. After the completion of insertion, he found the Assume database table name is emp (empno, ename, dept, age).

**Analyze**

1. Analyze how URL routing works in Flask and its role in handling user requests.
2. Differentiate CSS and Bootstrap.

**21IT308 Database Management Systems Lab****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to

1. Demonstrate ER Modeling concepts to design the Database
2. Apply integrity constraints on a database
3. Make use of DDL, DML, DCL, TCL commands in creation and manipulation of Database
4. Utilize sub queries to make the complex queries more readable
5. Implementation of database queries using PL/SQL
6. Experiment with triggers to maintain the referential integrity of data

**CO-PO Mapping**

| COs | PO3 | PO4 | PO12 | PSO2 |
|-----|-----|-----|------|------|
| 1   | 3   | 3   | 3    | 3    |
| 2   | 2   | 3   | 2    | 2    |
| 3   | 2   | 3   | 3    | 3    |
| 4   | 3   | 3   | 2    | 3    |
| 5   | 2   | 3   | 2    | 3    |
| 6   | 2   | 2   | 3    | 2    |

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

**List of Experiments****Experiment 1****Application: 1**

"Established in 1977, "Roadway Travels" has been actively operating for decades, providing connectivity across various destinations in India through a fleet of several buses. Headquartered in Hyderabad, the company now aims to modernize its operations in the following key areas:

**1. Reservation System:**

Managing reservations is the responsibility of the booking office. Customers can reserve their seats up to 60 days in advance, utilizing either cash or credit payment methods. In instances where tickets are unavailable, customers receive wait-listed tickets, which can be confirmed once cancellations occur.

**2. Ticketing:**

The booking office handles ticketing processes, including sales and issuance. Both cash and credit payments are accepted for this purpose.

**3. Cancellation and Modification:**

Cancellation services are also facilitated at the booking office. Applicable cancellation charges will be levied as per company policy. Furthermore, modifications to reservations can be processed within this domain. Notably, wait-listed tickets that remain unconfirmed are eligible for full refunds."

The Following are the entities:

Bus (BusNo, Source, Destination, coachtype)

Reservation (PNRNo, Busno, NoofSeats, JourneyDt, ContactNo, Address)

Ticket (TicketNo, BusNo, JourneyDt, Source, Destination, Dept\_Time, Age, Sex)

Passenger (TicketNo, PNRNo, Name, ContactNo, Age, Sex)

Cancellation (PNRNo, JourneyDt, SeatNo, ContactNo)

**Application: 2**

**Online Learning Platform:** An online learning platform requires an ER model to handle courses, students, instructors, and enrollments. Courses have titles, descriptions, and durations. Instructors have names, expertise, and contact details. Students have profiles with names, email addresses, and student IDs. Enrollments link students to courses, including enrollment dates.

**Entities and Attributes:**



**Course** (Course\_ID (Primary Key), Title, Description, Duration (in weeks or hours)Level (Beginner, Intermediate, Advanced), Category (e.g., Programming, Mathematics, Language), Price, Language, Thumbnail Image URL,)

**Instructor** (Instructor\_ID (Primary Key), Name, Bio, ContactInfo (Email, Phone), Expertise (Areas of specialization), ProfilePictureURL)

**Student** (Student\_ID (Primary Key), FirstName, LastName, Email, DOB, Address, Contact)

**Enrollment**(Enrollment\_ID (Primary Key), Course\_ID (Foreign Key referencing Course), Student\_ID (Foreign Key referencing Student), EnrollmentDate, Status (Enrolled, Completed, Dropped, etc.))

**Lesson**(Lesson\_ID (Primary Key), Course\_ID (Foreign Key referencing Course), Title Order (Sequence within the course), Duration (in minutes or hours), Content (Text, Video URL, PDF URL, etc.))

**Quiz**(Quiz\_ID (Primary Key), Course\_ID (Foreign Key referencing Course), Title, Number of Questions, Passing Score)

**Question**(Question\_ID (Primary Key), Quiz\_ID (Foreign Key referencing Quiz), Question Text, Question Type (Multiple Choice, True/False, Short Answer, etc.))

**Answer**(Answer\_ID (Primary Key), Question\_ID (Foreign Key referencing Question), AnswerText, Correct\_Answer\_Indicator)

### Application: 3

**Music Streaming Service:** A music streaming service needs an ER model to organize its content and user interactions. The system should handle songs, albums, artists, playlists, and users. Songs have titles, durations, and release years. Albums include album names, release dates, and cover art. Artists have names, genres, and biographies. Users have profiles with names, email addresses, and subscription details. Playlists contain songs and are created by users.

### Application: 4

**Company Database:** The company is organized into departments. Each department has a unique name, a unique number, and a particular employee who manages the department. We keep track of the start date when that employee began managing the department. A department may have several locations. A department controls several projects, each of which has a unique name, a unique number, and a single location. We store each employee's name, social security number, address, salary, sex, and birthdate. An employee is assigned to one department but may work on several projects, which are not necessarily controlled by the same department. We keep track of the number of hours per week that an employee works on each project. We also keep track of the direct supervisor of each employee. We want to keep track of the dependents of each employee for insurance purposes. We keep each dependent's name, sex, birthdate, and relationship to the employee.

Entities are:

Company Database:

EMPLOYEE (SSN, EName, Address, Sex, Bdate, Salary, SuperSSN, DNo)

DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate)

DLOCATION (DNo,DLoc)

PROJECT (PNo, PName, PLocation, DNo)

WORKS\_ON (SSN, PNo, Hours)

DEPENDENT (Essn, Dependent\_name, Sex, Bdate, Relationship)

**Apply ER Model for the above applications and identify the relations present in each application represent them in ER diagram.& Convert ER model to Relational Model.**

Note: Students need to form a group minimum of 3 students and maximum of 5, and should design at least two applications into ER model by using EdrawMax software and convert them into relational model

## Experiment 2

Creating users, roles and grant privileges to users and relations.

## Experiment 3

Create and alter tables for Company Database in SQL using Integrity Constraints.

Integrity Constraints are CHECK, NOT\_NULL, DEFAULT, UNIQUE, PRIMARY KEY, FOREIGN KEY.

Use atleast one constraint in one relation to understand the usage of constraints on database.

**Schema:**

```
CREATE TABLE employee ( Fname varchar (15) NOT NULL, Minit varchar(1), Lname varchar(15) NOT NULL, SSN varchar(9) NOT NULL, Bdate date, Address varchar(30), Sex varchar(1), Salary float, Super_ssn varchar(9), Dno int NOT NULL, PRIMARY KEY (ssn), FOREIGN KEY (Super_ssn) REFERENCES employee(ssn));
```

```
CREATE TABLE department (Dnamevarchar(15) NOT NULL, Dnumber int NOT NULL, Mgr_ssn varchar(9) NOT NULL, Mgr_start_date date, PRIMARY KEY (Dnumber), UNIQUE(Dname), FOREIGN KEY (Mgr_ssn) REFERENCES employee(ssn));
```

```
CREATE TABLE dept_locations (Dnumber int NOT NULL, Dlocationvarchar(15), PRIMARY KEY (Dnumber, Dlocation), FOREIGN KEY (Dnumber) REFERENCES department (Dnumber));
```

```
CREATE TABLE project (Pnamevarchar(15) NOT NULL, Pnumber int NOT NULL, Plocation varchar(15), Dnum int NOT NULL, PRIMARY KEY (Pnumber), UNIQUE (Pname), FOREIGN KEY (Dnum) REFERENCES department (Dnumber));
```

```
CREATE TABLE works_on (Essnvarchar(9) NOT NULL, Pno int NOT NULL, Hours float NOT NULL, PRIMARY KEY (Essn, Pno), FOREIGN KEY (Essn) REFERENCES employee(ssn), FOREIGN KEY (Pno) REFERENCES project(Pnumber));
```

```
CREATE TABLE dependent (Essnvarchar(9) NOT NULL, Dependent_name varchar(15) NOT NULL, Sex varchar(1), Bdate date, Relationship varchar(8), PRIMARY KEY (Essn, Dependent_name), FOREIGN KEY (Essn) REFERENCES employee(ssn));
```

#### Experiment 4

Execute basic SQL queries on Employee Database

To Create a database called Employee which consists of EMP, Dept, Salgrade, Project, Works\_on and Dependent tables as relations in the database use Data Definition Language command (Create, Alter).

Run sql queries on database using DML commands like Insert, Update, Delete and for retrieval of data from database use Select statement.

Employee Database:

EMP (Empno, Ename, Job, Mgr, Hiredate, sal, comm, deptno)

DEPT (Deptno, Dname, Location)

SALGRADE(Grade, Losal, Hisal)

PROJECT (Pno, Pname, Plocation, Deptno)

WORKS\_ON(Empno, Pno, Hours)

DEPENDENTS(EMPNO, DependentName, Sex, Bdate, Relation)

##### 4.1 Insertion:

Insert rows into table by using datatypes like varchar, int, date, float etc.,

Syn: INSERT INTO employee (Fname, Minit, Lname, SSN, Bdate, Address, Sex, Salary, Super\_ssn, Dno) values ('James', 'E', 'Borg', 888665555, '10-NOV-1937', '430 Stone, Houston, TX', 'M', 55000, NULL, 1);

##### 4.2 Retrieval (Set operations)

Syn: Select Name from EMP Union Select Salary from EMP;

##### 4.3 Updating

Update rows by changing the values in a row using update command syntax.

##### 4.4 Deletion

Delete an entire row or multiple rows from the table using this command

#### Experiment 5

**Implement the SQL operations on Employee Database created in Experiment 4.**

Operations are: In, Any, All, Between, Like, Exists, Group by, Order by, having.

Employee Database:

EMP (Empno, Ename, Job, Mgr, Hiredate, sal, comm, deptno)

DEPT (Deptno, Dname, Location)

SALGRADE (Grade, Losal, Hisal)

PROJECT (Pno, Pname, Plocation, Deptno)

WORKS\_ON (Empno, Pno, Hours)

DEPENDENTS (EMPNO, DependentName, Sex, Bdate, Relation)

### Experiment 6

#### Implementing the concepts of Rollback – commit, checkpoints, and Views.

Rollback – commit, checkpoints:

Create Teacher table with the following fields(Name, DeptNo, Date of joining, DeptName, Location, Salary)

1. Insert five records
2. Give Increment of 25% salary for Mathematics Department .
3. Perform Rollback command
4. Give Increment of 15% salary for Commerce Department
5. Perform commit command.

#### Views:

To create different views, use the Employee Database

1. Create a view to display Hiredate of all employees.
2. Create a view to display no of working hours of all employees with Plocation.

### Experiment 7

#### Apply different types of joins available in SQL on company database created in Experiment 4.

Types of Joins:

- Inner Join
- Outer Join
- Left Join
- Right Join

### Experiment 8

Apply subqueries and nested queries on company database (refer to experiment 4).

### Experiment 9

Implement built in functions in oracle (Numeric, Aggregate functions) on Dual table(provided by Oracle) and Employee database.

Numeric Functions: ABS, CEIL, FLOOR, SQRT etc.,

Aggregate Functions: MIN, MAX, SUM, COUNT, AVG

### Experiment 10

Implement String handling and Conversion functions on Dual table (provided by Oracle) and Employee database.

String Functions: Lowercase, Uppercase, Initcap, Rtrim, Ltrim, Lpad, Rpad etc.,

Conversion Functions: TO\_CHAR(), TO\_DATE(), TO\_NUMBER().

### Experiment 11

Sql Practice links from online platforms:

|                                            |                                                                                                                                                                   |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Employee Bonus                             | <a href="https://leetcode.com/problems/employee-bonus/">https://leetcode.com/problems/employee-bonus/</a>                                                         |
| Big Countries                              | <a href="https://leetcode.com/problems/big-countries/">https://leetcode.com/problems/big-countries/</a>                                                           |
| Employees Earning more than their managers | <a href="https://leetcode.com/problems/employees-earning-more-than-their-managers/">https://leetcode.com/problems/employees-earning-more-than-their-managers/</a> |
| Managers with at least 5 direct reports    | <a href="https://leetcode.com/problems/managers-with-at-least-5-direct-reports/">https://leetcode.com/problems/managers-with-at-least-5-direct-reports/</a>       |
| Second Highest Salary                      | <a href="https://leetcode.com/problems/second-highest-salary/">https://leetcode.com/problems/second-highest-salary/</a>                                           |
| Count Salary Categories                    | <a href="https://leetcode.com/problems/count-salary-categories/">https://leetcode.com/problems/count-salary-categories/</a>                                       |

### Experiment 12

|                                                   |                                                                                                                                                                                                               |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Triangle                                          | <a href="https://www.hackerrank.com/challenges/what-type-of-triangle/problem?isFullScreen=true">https://www.hackerrank.com/challenges/what-type-of-triangle/problem?isFullScreen=true</a>                     |
| Average Population of each country in a continent | <a href="https://www.hackerrank.com/challenges/average-population-of-continent/problem?isFullScreen=true">https://www.hackerrank.com/challenges/average-population-of-continent/problem?isFullScreen=true</a> |
| TopEarnings                                       | <a href="https://www.hackerrank.com/challenges/earnings-">https://www.hackerrank.com/challenges/earnings-</a>                                                                                                 |

|                        |                                                                                                                                                                                                                                                                                                         |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <a href="https://www.hackerrank.com/challenges/occupations/problem?isFullScreen=true">ofemployees/problem?isFullScreen=true</a>                                                                                                                                                                         |
| Occupations            | <a href="https://www.hackerrank.com/challenges/occupations/problem?isF">https://www.hackerrank.com/challenges/occupations/problem?isF</a>                                                                                                                                                               |
| New Company            | <a href="https://www.hackerrank.com/challenges/the-company/problem?isFullScreen=true">https://www.hackerrank.com/challenges/the-</a><br><a href="https://www.hackerrank.com/challenges/the-company/problem?isFullScreen=true">ompany/problem?isFullScreen=true</a>                                      |
| 15Days of Learning SQL | <a href="https://www.hackerrank.com/challenges/15-days-of-learning-sql/problem?isFullScreen=true">https://www.hackerrank.com/challenges/15-days-of-learning-</a><br><a href="https://www.hackerrank.com/challenges/15-days-of-learning-sql/problem?isFullScreen=true">sql/problem?isFullScreen=true</a> |

### **Experiment 13**

Implement PL/SQL operations on Employee Database to retrieve one row as output.

### **Experiment 14**

Implementing functions, stored procedures on company database using PL/SQL

### **Experiment 15**

Implement cursors on Employee database using PL/SQL to retrieve multiple rows as output.

### **Experiment 16**

Creating triggers using PL/SQL

## **E-RESOURCES AND OTHER DIGITAL MATERIAL**

1. Prof Arnab Bhattacharya IIT Kanpur, SQL Introduction <https://nptel.ac.in/courses/106104135/10>
2. Prof Arnab Bhattacharya IIT Kanpur SQL: Updates, Joins, Views, and Triggers
3. <https://nptel.ac.in/courses/106104135/11>

### **List of Augmented Experiments**

1. Inventory control management System
2. College Management System
3. Hospital management System
4. Library management System
5. Payroll management System
6. Health care organization Management System
7. Restaurant Management System
8. Blood Donation Management System
9. Art Gallery Management System
10. Hotel Management System
11. School Management System
12. Salary Management System
13. Wholesale Management System
14. Time Table Management System
15. Website Management

### **Reading Material (s)**

1. Database Management Systems Lab Manual, Department of CSE, GMRIT,Rajam

**21CS407 Web Coding and Development Lab****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to

1. Design static web pages using HTML and CSS.
2. Design responsive web pages using Bootstrap for visually appealing web pages.
3. Create JavaScript functions for user authentication, form validation, dynamic content generation, and data visualization.
4. Develop business logic using PHP scripts.
5. Build database connectivity to facilitate communication between the Web Server and the Database Server.
6. Develop Web Applications using Flask framework.

**CO-PO Mapping**

| COs | PO2 | PO3 | PO4 | PO5 | PO8 |
|-----|-----|-----|-----|-----|-----|
| 1   | 3   | 3   | 1   | 2   | 1   |
| 2   | 3   | 3   | 3   | 2   | 3   |
| 3   | 2   | 2   | 3   | 2   | 1   |
| 4   | 2   | 3   | 3   | 2   | 3   |
| 5   | 2   | 3   | 3   | 3   | 2   |
| 6   | 2   | 2   | 3   | 2   | 2   |

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

**List of Experiments**

1. Design the following static web pages required for Online Examination System web site.
  - a. Home Page
  - b. Login Page: a. Student Login Page b. Admin Login Page
  - c. Registration page
  - d. Test Page
  - e. Results Page.
2. Apply different font styles, font families, font colors, animations, and other formatting styles to the above static web pages.
3. Apply CSS Box model to design above static web pages
4. Make the static pages Responsive and attractive using Bootstrap components (\*\*Mobile View)
5. Write a JavaScript function that validates the student's login credentials. If the username and password are correct, redirect them to the test page; otherwise, show an error message.
6. Implement a form validation function for the registration page. Ensure that the password and confirm password fields match and that the email is in a valid format.
7. Write a JavaScript program that dynamically generates a set of multiple-choice questions and their answer choices from an array of question objects. Allow the user to select an answer and submit the test
8. a. Create a JavaScript function that calculates the user's test score based on their answers and displays it on the results page.  
b. Implement a chart or graph using a JavaScript library (e.g., Chart.js) to visualize the user's performance on the test, showing the number of correct and incorrect answers.
9. Create a PHP script that takes user registration data (e.g., username, email, password) from the registration form and inserts it into a database table for storing user information.

10. Develop a PHP script that validates the entered login credentials (username and password) against the database records. If valid, allow the user to log in.
11. Write a PHP script that receives the user's test answers from the test page and stores them in a database table along with the user's ID and timestamp.
12. Create a PHP script that retrieves the user's test results from the database and displays them on the results page. Include the user's score and a list of questions answered correctly and incorrectly.
13. Write a Flask application that establishes a connection to a SQLite database. Define a User model with fields like username, email, and password.
14. a. Create a Flask route for user registration. When a user submits the registration form, insert their information into the database.  
b. Implement Flask routes for student and admin login pages. Validate the entered login credentials against the database records.
15. Write a Flask route that retrieves a set of test questions from the database and displays them on the test page.
16. a. Develop a Flask route that receives the user's test answers and stores them in the database along with the user's ID and timestamp.  
b. Create a Flask route that retrieves the user's test results from the database and displays them on the results page.

#### **List of Augmented Projects**

1. WebCrawlers
2. Online Hospital Management
3. Online Shopping Project
4. Web based Appointment Systems
5. Scrapbook
6. Online Job Recruitment System
7. Attendance management system
8. Online Banking system
9. Online Exam
10. Railway Reservation system
11. Leave Application Management System
12. Address Book
13. Movie Rental Systems
14. Online Auction System
15. Student Information system

#### **Reading Material (s)**

1. Web Technologies Lab manual–Department of CSE & IT-GMRIT Rajam

**21ESX01 Employability Skills I****0 0 2 2****Course Outcomes**

At the end of the course, students will be able to

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 | PO 8 | PO10 | PO12 |
|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |      | 3    | 2    |
| CO2 |     |     |     | 1    | 2    | 2    |
| CO3 | 2   | 1   |     | 2    |      |      |
| CO4 | 2   |     | 2   |      |      |      |
| CO5 | 2   |     | 2   |      |      |      |
| CO6 | 2   |     | 2   |      |      |      |

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

**Unit-I****Communication Skills****8 hours**

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)

**Quantitative Aptitude****8 hours**

Percentages, Profit and loss, Mixtures and Allegations, Simple Interest, Compound Interest

**Unit-II****Competitive Programming Phase – II****16 Hours****Module-1:**

Fundamental mathematical concepts: Basic Mathematics, Number Theory, Geometry - Bit manipulation - Two-pointer technique.

**Practice Problems:**

| Week | Topic         | Practice Problem Links                                                                                                                                                                                          |
|------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Math-I        | <a href="https://www.codechef.com/practice-old/topics/math">https://www.codechef.com/practice-old/topics/math</a>                                                                                               |
|      |               | <a href="https://leetcode.com/tag/math/">https://leetcode.com/tag/math/</a>                                                                                                                                     |
|      |               | <a href="https://www.codechef.com/practice-old/tags/mathematics">https://www.codechef.com/practice-old/tags/mathematics</a>                                                                                     |
|      |               | <a href="https://www.interviewbit.com/courses/programming/math">https://www.interviewbit.com/courses/programming/math</a>                                                                                       |
| 2    | Math-II       | <a href="https://www.hackerrank.com/domains/mathematics">https://www.hackerrank.com/domains/mathematics</a>                                                                                                     |
|      |               | <a href="https://www.codechef.com/practice-old/tags/mathematics">https://www.codechef.com/practice-old/tags/mathematics</a>                                                                                     |
|      |               | <a href="https://www.hackerearth.com/practice/math/number-theory/basic-number-theory-1/practice-problems/">https://www.hackerearth.com/practice/math/number-theory/basic-number-theory-1/practice-problems/</a> |
| 3    | Number Theory | <a href="https://www.codechef.com/practice-old/tags/number-theory">https://www.codechef.com/practice-old/tags/number-theory</a>                                                                                 |
|      |               | <a href="https://leetcode.com/tag/number-theory/">https://leetcode.com/tag/number-theory/</a>                                                                                                                   |

|   |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                     | <a href="https://www.hackerrank.com/domains/mathematics?filters%5Bsubdomains%5D%5B%5D=number-theory">https://www.hackerrank.com/domains/mathematics?filters%5Bsubdomains%5D%5B%5D=number-theory</a>                                                                                                                                                                                                                                                                 |
| 4 | Geometry            | <a href="https://www.codechef.com/practice-old/tags/geometry">https://www.codechef.com/practice-old/tags/geometry</a><br><a href="https://www.hackerrank.com/domains/mathematics?filters%5Bsubdomains%5D%5B%5D=geometry">https://www.hackerrank.com/domains/mathematics?filters%5Bsubdomains%5D%5B%5D=geometry</a><br><a href="https://leetcode.com/tag/geometry/">https://leetcode.com/tag/geometry/</a>                                                           |
| 5 | Bit Manipulation-I  | <a href="https://www.codechef.com/practice-old/tags/bit-manipulation">https://www.codechef.com/practice-old/tags/bit-manipulation</a><br><a href="https://www.hackerearth.com/practice/basic-programming/bit-manipulation/basics-of-bit-manipulation/practice-problems/">https://www.hackerearth.com/practice/basic-programming/bit-manipulation/basics-of-bit-manipulation/practice-problems/</a>                                                                  |
| 6 | Bit Manipulation-II | <a href="https://leetcode.com/tag/bit-manipulation/">https://leetcode.com/tag/bit-manipulation/</a><br><a href="https://www.interviewbit.com/courses/programming/bit-manipulation">https://www.interviewbit.com/courses/programming/bit-manipulation</a><br><a href="https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=bit-manipulation">https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=bit-manipulation</a> |
| 7 | Two Pointer         | <a href="https://www.interviewbit.com/practice/#topics[]=two-pointers">https://www.interviewbit.com/practice/#topics[]=two-pointers</a><br><a href="https://leetcode.com/tag/two-pointers/">https://leetcode.com/tag/two-pointers/</a><br><a href="https://www.codechef.com/practice-old/tags/two-pointers">https://www.codechef.com/practice-old/tags/two-pointers</a>                                                                                             |

**Module-2:**

**Data Structures:** Searching - Linked List - Stack – Queue – Graph Traversal Methods - Hashing Techniques.

|    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8  | Searching - I  | <a href="https://www.codechef.com/practice/topics/binary-search">https://www.codechef.com/practice/topics/binary-search</a><br><a href="https://leetcode.com/tag/binary-search/">https://leetcode.com/tag/binary-search/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=binary-search">https://www.interviewbit.com/practice/#topics[]=binary-search</a><br><a href="https://www.codechef.com/practice/tags/searching">https://www.codechef.com/practice/tags/searching</a> |
| 9  | Searching - II | <a href="https://www.codechef.com/practice/topics/binary-search">https://www.codechef.com/practice/topics/binary-search</a><br><a href="https://leetcode.com/tag/binary-search/">https://leetcode.com/tag/binary-search/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=binary-search">https://www.interviewbit.com/practice/#topics[]=binary-search</a><br><a href="https://www.codechef.com/practice/tags/searching">https://www.codechef.com/practice/tags/searching</a> |
| 10 | Stacks         | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=stacks">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=stacks</a><br><a href="https://leetcode.com/tag/stack/">https://leetcode.com/tag/stack/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=stacks-and-queues">https://www.interviewbit.com/practice/#topics[]=stacks-and-queues</a>                                                          |
| 11 | Queues         | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=queues">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=queues</a><br><a href="https://leetcode.com/tag/queue/">https://leetcode.com/tag/queue/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=stacks-and-queues">https://www.interviewbit.com/practice/#topics[]=stacks-and-queues</a>                                                          |
| 12 | Linked List-I  | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=linked-lists">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=linked-lists</a><br><a href="https://leetcode.com/tag/linked-list/">https://leetcode.com/tag/linked-list/</a>                                                                                                                                                                                       |
| 13 | Linked List-II | <a href="https://www.interviewbit.com/practice/#topics[]=linked-lists">https://www.interviewbit.com/practice/#topics[]=linked-lists</a><br><a href="https://leetcode.com/tag/doubly-linked-list/">https://leetcode.com/tag/doubly-linked-list/</a>                                                                                                                                                                                                                                           |
| 14 | BFS            | <a href="https://www.codechef.com/practice-old/tags/bfs&amp;two-pointers">https://www.codechef.com/practice-old/tags/bfs&amp;two-pointers</a><br><a href="https://leetcode.com/tag/breadth-first-search/">https://leetcode.com/tag/breadth-first-search/</a><br><a href="https://www.hackerearth.com/practice/algorithms/graphs/breadth-first-search/practice-problems/">https://www.hackerearth.com/practice/algorithms/graphs/breadth-first-search/practice-problems/</a>                  |
| 15 | DFS            | <a href="https://leetcode.com/tag/depth-first-search/">https://leetcode.com/tag/depth-first-search/</a>                                                                                                                                                                                                                                                                                                                                                                                      |



|    |         |                                                                                                                                                                                                         |
|----|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |         | <a href="https://www.hackerearth.com/practice/algorithms/graphs/depth-first-search/practice-problems/">https://www.hackerearth.com/practice/algorithms/graphs/depth-first-search/practice-problems/</a> |
| 16 | Hashing | <a href="https://www.codechef.com/practice-old/tags/hashing">https://www.codechef.com/practice-old/tags/hashing</a>                                                                                     |
|    |         | <a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=hash-function">https://leetcode.com/problemset/?page=1&amp;topicSlugs=hash-function</a>                                                 |

**References:**

1. <https://leetcode.com>
2. <https://www.codechef.com>
3. <https://www.hackerearth.com>
4. <https://www.interviewbit.com>
5. <https://www.hackerrank.com>

**21HSX11 CC & EC Activities I****0 0 1 1****Course Outcomes**

At the end of the course, students will be able to

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 spirit 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

**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 slots every week : 12
- No. of Streams (1 CC + 1 EC + 1 Community Engagement) : 3
- No. of slots allotted for each stream : 4

**Requirement for the award of 1-Credit**

- Students shall choose at least two streams of events in each semester and among which Community engagement through NSS is mandatory
- Students shall secure an overall attendance of 75% in all events put together

The credits earned through these courses will be indicated in the grade memo and will be taken into account for CGPA calculation.

## 5<sup>th</sup> Semester

### 21ECE02 Microprocessors and Microcontroller Programming

3 0 2 4

#### Course Outcomes

At the end of the course, students will be able to

1. Summarize the architecture of 8086 microprocessor
2. Execute assembly language programs of 8086 microprocessor is a
3. Demonstrate the memory interfacing with 8086 microprocessor
4. Explain the architecture of 8051 microcontroller
5. Implement assembly language programs of 8051 microcontroller
6. Demonstrate the interfacing of peripherals with 8051 microcontroller

#### COs – POs Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
|-----|-----|-----|-----|-----|-----|
| 1   | 2   | 1   | 1   | -   | -   |
| 2   | 2   | 2   | 2   | 2   | 3   |
| 3   | 2   | 2   | 2   | 2   | 2   |
| 4   | 2   | 1   | 1   | -   | -   |
| 5   | 2   | 2   | 2   | 2   | 3   |
| 6   | 3   | 3   | 3   | 3   | 3   |

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

#### Unit I

14+8 Hours

##### 8086 Microprocessors and Assembly Language Programming

Introduction and evolution of processors, Architecture of 8086 microprocessor, Register organization of 8086, Memory segmentation, Addressing Modes. Instruction set of 8086 microprocessor: Data transfer instructions, Arithmetic instructions, Logical Instructions, String instructions, Stack related instructions, Branching instructions, Assembler directives.

*Data transfer instructions of 8085 microprocessor, Architecture of 8085 microprocessor*

#### Practical Components

1. Data transfer program using different addressing modes in assembly language programming.
2. Perform arithmetic operations on 8 bit and 16 bit numbers in assembly language programming.
3. Data transfer program using string instruction in assembly language programming.
4. Program for data conversion in assembly language programming.

#### Unit II

10+8 Hours

##### 8086 Operational Modes and Peripheral Interfacing

Procedures and macros, Stack Structure of 8086, Minimum and Maximum mode operations of 8086 with timing diagrams, Memory interfacing, 8255 Programmable Peripheral Interfacing.

*Dynamic RAM, Direct memory access concept*

#### Practical Components

1. Write assembly language program using procedure.
2. Program to arrange three bytes in ascending and descending order in assembly language.
3. Program to reject negative numbers from a series of bytes.
4. Program to reject odd numbers from a series of bytes.

#### Unit III

12+8 Hours

##### 8051 Microcontroller and Assembly Language Programming

Comparison between microprocessor and microcontroller, 8051 family microcontroller, RAM architecture of 8051, Integrated Development Environment (IDE), Pin description of 8051 microcontroller, Machine cycle. Addressing Modes, Instruction set of 8051: Data transfer instructions, Arithmetic instructions, Logical Instructions, Stack related instructions, Branching instructions. Programming and Applications of Timers, Interrupts, Universal Asynchronous Receiver Transmitter (UART).

*External memory interfacing with 8051 microcontroller, various constituents of hex file*

### Practical Components

1. Program to perform arithmetic operations.
2. Program to toggle the LED in assembly language.
3. Programming and interfacing of traffic light logic in assembly language.
4. Program to generate square wave using interrupts.

### Unit IV

12+8 Hours

#### Interfacing with 8051 microcontrollers with External Peripherals

Interfacing with 8051 microcontrollers with: Keypad matrix, LCD, Seven segment displays, Stepper motor, Analog to Digital Converter (804), Digital to Analog Converter (808).

*Interfacing of temperature sensor (LM 35) with 8051, interfacing of relay with 8051*

### Practical Components

1. Programming and interfacing of the key pad matrix.
2. Programming and interfacing of 7-segment display to display numbers from 0 to 9
3. Programming and interfacing of 7-segment display to display possible characters/symbols
4. Programming and interfacing of the LCD.

**Total: 48+32 Hours**

### Textbook (s)

1. A.K. Ray & K. M Bhurchandi, Advanced Microprocessors & peripherals, Tata McGraw-Hill, 3<sup>rd</sup> Edition, 2012
2. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, The 8051 Micro controller and Embedded systems: using assembles and C, Pearson, 2<sup>nd</sup> Edition,2007

### Reference (s)

1. D.V.Hall, Microprocessor and Interfacing, Tata McGraw Hill Publishing Company, 2<sup>nd</sup> Edition 2006
2. N. Sentil Kumar, M Sarvanan, S Jeevananthan, Microprocessors and Microcontrollers, Oxford University Press, 1<sup>st</sup> Edition, 2010
3. Kenneth J Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Thomson Publishers, 3<sup>rd</sup> Edition, 2004

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Lab Examination (%) |
|-----------------|-----------------|-----------------|---------------------|
| Remember        | 25              | 25              | --                  |
| Understand      | 35              | 35              | --                  |
| Apply           | 40              | 40              | 100                 |
| Analyze         | --              | --              | --                  |
| Evaluate        | --              | --              | --                  |
| Create          | --              | --              | --                  |
| Total (%)       | 100             | 100             | 100                 |

### Sample Question (S)

#### Remember

1. List out any four sixteen-bit registers of 8086 microprocessor which can't split into two eight bit registers.
2. State the advantages of memory segmentation.
3. State the significance of Reset pin of 8051 microcontroller.
4. List four differences between 8051 family of microcontroller.

#### Understand

1. Calculate the physical address generated by the 8086 microprocessor to fetch the code if CS = 2A40H & IP = AAAAH.
2. Explain the function of BIU and EU of 8086 microprocessor.
3. Explain the consequences of execution of MOV IP, #14H instruction of 8051 microcontroller.

4. Explain the structure of internal RAM of 8051 microcontroller.
5. 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 to add five eight bit numbers.
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 1<sup>st</sup> row of LCD.

**21CS502 Artificial Intelligence and Machine Learning****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

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. Model the concepts of classification and regression
5. Summarize and learn various unsupervised learning algorithms
6. Demonstrate and resolve complex clusters using dimensionality reduction

**CO-PO Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PS01 | PS02 |
|-----|-----|-----|-----|-----|------|------|
| 1   | 2   | 2   | 2   | 2   | 2    | 3    |
| 2   | 3   | 3   | 3   | 3   | 3    | 2    |
| 3   | 2   | 2   | 2   | 2   | 2    | 1    |
| 4   | 3   | 3   | 3   | 3   | 3    | 2    |
| 5   | 2   | 2   | 2   | 2   | 2    | 1    |
| 6   | 3   | 3   | 3   | 3   | 3    | 3    |

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

**Unit -I****12 Hours**

**Artificial Intelligence** Foundation to AI, Problem Solving- State Space Search, Constraint Satisfaction Problems, AI Problems, AI Types and Agents, AI Tasks, AI Techniques, Heuristic Search Techniques- Best First Search Techniques, 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, AI Bots, Applications of AI, Applied AI***Unit -II****12 Hours**

**Machine Learning** Foundation for Machine Learning – Types of Machine Learning, Machine Learning Process, Preliminaries- Over fitting, Training, Testing and Validating Sets, Splitting and Feature Scaling, Data Pre-processing- Importing Libraries, Importing Datasets, Missing Data and Dependent Variables, Machine Learning Applications.

*Rules of Probability, Bayes Theorem, Bias, Variance and Co-variance.***Unit -III****12 Hours**

**Supervised Learning** Classification- Naïve Bayes, Support Vector Machines, Extension to SVM, K-Nearest Neighbours, Decision Tree, Classify Vs Predict, Regression – Linear Regression, Gradient Descent and Logistic Regression, Regularization, LASSO & Ridge Regression Algorithms, Performance metrics.

*Margins and Vectors, Continuous and Discrete variables***Unit -IV:****12 Hours**

**Unsupervised Learning** Clustering- Iterative Distance based Clustering, Association Rule Learning, K-Means Clustering and Hierarchical Clustering, Measure of Quality Clustering. Dimensionality Reduction – Feature Selection, Principal Component Analysis, Independent Component Analysis and Linear Discriminant Analysis.

*Similarity and Distance Measures, Gaussian and Normal Deviation***Total: 48 Hours****Text Book (s)**

1. Russel and Norvig, Artificial Intelligence A modern Approach, 4th Edition, Pearson Education 2021
2. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3rd Edition, Packt Publishing, 2020

- Stephen Marsland- Machine Learning – An Algorithmic Perspective – Second Edition – Chap Man & Hall CRC Press, 2015

### Reference (s)

- E. Rich K. Knight and B.Nair – Artificial Intelligence– Third Edition – Tata McGraw Hill, 2017
- 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(%) |
|-----------------|-----------------|-----------------|-------------------|
| Remember        | 25              | 20              | -                 |
| Understand      | 35              | 40              | 30                |
| Apply           | 40              | 40              | 40                |
| Analyze         | -               | -               | 30                |
| Evaluate        | -               | -               | -                 |
| Create          | -               | -               | -                 |
| Total (%)       | 100             | 100             | 100               |

### Sample question (s)

#### Remember

- Define entropy.
- What is pruning?
- Define hypothesis

#### Understand

- What is Machine Learning?
- How KNN is different from K- means Clustering?
- Explain confusion matrix with an example

#### Apply

- 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.
- Apply *k*-Nearest Neighbour algorithm to classify the iris data set and print both correct and wrong predictions in it.
- Write a program to demonstrate the working of the decision tree based ID3 algorithm.
- Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.

#### Analyze

- Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw the relevant graphs
- 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)

- 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 2090s in science fiction literature and film. With each subsequent year, the technology of artificial intelligence is developed and improved.
  - Justify the detailed steps involved for getting the above scenario w.r.t. human brain and computer vision.
  - 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?
- 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.



**21CS503 Computer Networks****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to:

1. Illustrate the knowledge of the basic Data Communication System and Computer Network Systems.
2. Classify various wired and wireless transmission media for data communication networks
3. Demonstrate different techniques of error detection and correction to detect and solve error bit during data transmission
4. Illustrate the subnetting, routing mechanisms and congestion issues in network design.
5. Experiment with different network tools.
6. Summarize the internal functionalities of main protocols such as HTTP, SNMP, TCP, UDP, IP

**CO-PO Mapping**

| COs | PO1 | PO2 | PO4 | PO5 | PSO1 |
|-----|-----|-----|-----|-----|------|
| 1   | 3   | 1   | 1   | 1   | 1    |
| 2   | 3   | 2   | 2   | 1   | 2    |
| 3   | 1   | 3   | 2   | 2   | 1    |
| 4   | 2   | 3   | 2   | 3   | 1    |
| 5   | 1   | 3   | 2   | 3   | 2    |
| 6   | 3   | 1   | 2   | 2   | 2    |

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

**UNIT – I****12 + 8 hours**

**Introduction to Data Communications:** Components, Data Representation, Data flow

Network hardware, Network software, OSI, TCP/IP Reference models, Example Networks: ARPANET, Internet..

**Physical Layer:** Transmission media: Guided media- twisted pairs, coaxial cable, fiberoptics, unguided media-Wireless transmission, Switching Techniques: Circuit Switching-Packet Switching-Message Switching.

*Taxonomy of networking devices*

**Practical Components:**

1. Familiarization with Networking Components and devices: LAN Adapters - Hubs – Switches - Routers etc.
2. Familiarization with Transmission media and Tools: Co-axial cable - UTP Cable - Crimping Tool - Connectors etc.
3. Preparing the UTP cable for cross and direct connections using crimping tool.
4. a) To configure the IP address for a computer connected to LAN and to configure network parameters of a web browser for the same computer.  
b) Configuration of TCP/IP Protocols in Windows

**UNIT – II****12 + 6 hours**

**Design Issues:** Framing-error detection and correction-CRC

**Elementary Data link Protocols:** Stop and wait-Sliding, Window protocols: Go-back-n-Selective Repeat, **Medium Access sub layer:** Channel allocation methods, Multiple Access protocols: ALOHA-CSMA-IEEE Standard 802.3 and Ethernet

*Data Link Control Protocols: HDLC-SLIP-PPP*

**Practical Components:**

1. Implement the data link layer framing methods:
  - a) Character stuffing method
  - b) Bit Stuffing method
2. Implement on a data set of characters the two CRC polynomials: CRC 12 - CRC 16
3. Develop a simple data link layer that performs the flow control using

- a) The sliding window protocol,
- b) Go-Back-N Protocol.

**UNIT – III**

**12 + 8 hours**

**Network Layer:** Design issues, Routing algorithms: shortest path routing, distance vector routing, Flooding, Hierarchical routing, Broadcast, Multicast, Congestion Control Algorithms - Approaches to Congestion Control, Quality of Service-leaky bucket algorithm, token bucket algorithm, The Network layer in the internet-IPv4 Protocol, IP Addresses, Subnetting.

*Internet control protocols*

**Practical Components:**

1. Implement Dijkstra's algorithm to compute the Shortest path through a graph.
2. Take an example subnet graph with weights indicating delay between nodes. Now Obtain Routing table at each node using distance vector routing algorithm.
3. Take an example subnet of hosts. Obtain broadcast tree for it
4. Write a program for congestion control using Leaky bucket algorithm.

**UNIT – IV**

**12 + 10 hours**

**Transport Layer:** Transport Services, Elements of Transport protocols, Connection management, TCP and UDP protocols. Application Layer – Domain name system, SNMP, Electronic Mail, World Wide Web, HTTP

*Proxy Servers, Data compression*

**Practical Components:**

1.
  - a) Installing of internal modem and connecting to Internet.
  - b) To configure WiFi for your PC.
2. Wireshark
  - a) Packet Capture Using Wire shark
  - b) Starting Wire shark
  - c) Viewing Captured Traffic
  - d) Analysis and Statistics & Filters.
3. Do the following using NS3 Simulator
  - a) NS3 Simulator-Introduction and installation
  - b) Simulate to Find the Number of Packets Dropped
  - c) Simulate to Find the Number of Packets Dropped by TCP/UDP
  - d) Simulate to Find the Number of Packets Dropped due to Congestion
  - e) Simulate to Compare Data Rate & Throughput.
  - f) Simulate to Plot Congestion for Different Source/Destination
  - g) Simulate to Determine the Performance with respect to Transmission of Packets
4. Write a program for how to connect and transfer data between two nodes with each other.
5. Study and build a sample network topology to configure it for dynamic routing protocol using NS3

**Total: 48+32 hours**

**Textbook (s)**

1. Andrew S Tanenbaum, Computer Networks, 5th Edition, Pearson Education /PHI, 2013
2. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, Tata McGraw Hill Higher Education, 2013
3. Reference (s)
4. William Stallings, Data and Computer Communications, 8th Edition, Pearson Prentice Hall, 2007
5. W.A. Shay, Thomson, Understanding communications and Networks, 3rd Edition, Cengage Learning, 2005

### Internal Assessment Pattern

| Cognitive Level | Internal Test 1 (%) | Internal Test 2 (%) |
|-----------------|---------------------|---------------------|
| Remember        | 25                  | 20                  |
| Understand      | 40                  | 40                  |
| Apply           | 35                  | 40                  |
| Analyze         | -                   | -                   |
| Evaluate        | -                   | -                   |
| Create          | --                  | --                  |
| Total (%)       | 100                 | 100                 |

### Sample Questions

#### Remember

1. List the applications of Computer Networks
2. Write two differences between OSI and TCP/IP models.
3. State 5 key assumptions in Dynamic channel allocation?
4. State the purpose of DNS.
5. Define congestion.

#### Understand

1. Illustrate OSI Reference model.
2. Explain various design issues of data link layer
3. What are the responsibilities of Data Link layer and explain Pure Aloha and Slotted Aloha protocols.
4. Describe Distance Vector routing algorithm with example and explain count to infinity problem 5. Represent the Manchester encoding for the bit stream: 0001110101.

#### Apply

1. What is the check summed frame transmitted if the message is 1101011011 and the generator polynomial is  $x^4 + x + 1$  using CRC
2. Can you think of any circumstances under which an open-loop protocol, (e.g., a Hamming code) might be preferable to the feedback-type protocols?
3. Assuming that all routers and hosts are working properly and that all software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination?
4. The following data fragment occurs in the middle of a data stream for which the byte-stuffing algorithm described in the text is used: A B ESC C ESC FLAG FLAG D. What is the output after stuffing?
5. The following character encoding is used in a data link protocol: A: 01000111; B: 11100011; FLAG: 01111110; ESC: 11100000 Show the bit sequence transmitted (in binary) for the four-character frame: A B ESC FLAG when each of the following framing methods are used:
  - (a) Character count.
  - (b) Flag bytes with byte stuffing. (
  - c) Starting and ending flag bytes, with bit stuffing.

**21CS504 Theory of Computation****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Define State machines, languages and computations
2. Design a state machine with and without outputs
3. Compare regular grammars and regular languages
4. Relate Context free languages and Context free grammars
5. Design Pushdown automata for Context free languages
6. Illustrate decidable and un-decidable problems

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PSO1 |
|-----|-----|-----|-----|------|
| 1   | 3   | 3   | 2   | 2    |
| 2   | 2   | 2   | 2   | 2    |
| 3   | 3   | 2   | 3   | 2    |
| 4   | 2   | 3   | 2   | 2    |
| 5   | 2   | 2   | 3   | 1    |
| 6   | 2   | 3   | 2   | 1    |

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

**Unit I****13 Hours**

**Finite Automata:** Introduction to formal languages- language operations- Finite automata model- Deterministic Finite Automata – Nondeterministic Finite automata - Recognition of a language by an Automaton - Equivalence of DFA and NFA - Finite Automata with Null-Closure - Minimization of Finite Automata - Equivalence of FAs - Mealy and Moore Machine, Equivalence of Mealy and Moore machines.

*Mathematical induction, strong principle, Complementation of Finite automata, Compound Automata*

**Unit II****11 Hours**

**Regular Languages:** Regular Sets-Regular expressions- Equivalence of Finite automata and regular expressions –Pumping Lemma for Regular Languages - Closure Properties of Regular sets. Regular Grammars: Right linear grammar- Left linear grammar- Equivalence of RLG and finite automata- Equivalence of LLG and finite automata.

*Myhill-Nerode theorem –applications of regular expressions*

**Unit III****13 Hours**

**Context free language-** Closure Properties of Context free languages, pumping lemma for context free languages- Context-free grammar-simplification of Context free Grammar-Normal forms: Chomsky Normal form and Greibach Normal form.

**Pushdown Automata:** PDA Model-Design-Acceptance by empty stack and final state- Non-deterministic PDA. Context free grammar to Pushdown automata conversion.

*Context Sensitive Languages, Linear bounded automata*

**Unit IV****11 Hours**

**Turing Machine:** Chomsky classification of languages- Turing Machine Model - Design of TM- Turing Machines variants–Undecidable languages - properties of Recursive and Recursively Enumerable Languages -Post Correspondence Problem - Halting Problem - Polynomial Reducibility, P – NP, NP – Complete and NP – Hard problems

*Computable Functions - Constant Functions, Recursive Functions*

**Total 48 Hours****Text Books:**

1. J. E. Hopcroft and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson/Addison Wesley, 2007

- Mishra & Chandra Sekharan, Theory of Computer Science & Automata Language and Computation, 3rd Edition, Prentice Hall of India, 2007

**Reference books:**

- P. Linz, Introduction to Formal Language and Computation, 2nd Edition, Narosa, 2006.
- H. R. Lewis & C. H. Papadimitriou, Elements of the Theory of Computation, Prentice Hall of India, 2nd Edition - 2006.

**Internal Assessment Pattern**

| Cognitive Level | Internal Test 1 (%) | Internal Test 2 (%) | Open Book Exam (%) |
|-----------------|---------------------|---------------------|--------------------|
| Remember        | 20                  | 20                  | --                 |
| Understand      | 30                  | 20                  | --                 |
| Apply           | 30                  | 40                  | 60                 |
| Analyze         | 20                  | 20                  | 40                 |
| Evaluate        | --                  | --                  | --                 |
| Create          | --                  | --                  | --                 |
| Total (%)       | 100                 | 100                 | 100                |

**SAMPLE QUESTION (S)**

**Remember**

- Write the analytical representation of NFA.
- Define context free grammar.
- State Rice's theorem

**Understand**

- Compare Mealy and Moore machine
- Explain the closure properties of regular languages
- Illustrate the Chomsky classification of languages.

**Apply**

- Design pushdown automata for  $L = \{a^n b^n / n \geq 1\}$ .
- Construct Turing machine for palindrome strings over  $\Sigma = \{a, b\}$

**Analyse**

- How does a Mealy machine different from Moore machine?
- Does PCP with 2 lists  $X = \{10, 110, 11\}$   $Y = \{1, 01, 0\}$  has a solution? Justify your answer.

**Open Book Exam Questions**

- Suppose  $r_1$  and  $r_2$  are regular expressions over the same alphabet  $\Sigma$ . We say  $r_1 = r_2$  to denote equality of the languages represented by  $r_1$  and  $r_2$ . In other words, every string in the language represented by  $r_1$  is also included in the language represented by  $r_2$  and vice versa. For each of the following pairs of regular expressions over  $\Sigma = \{0, 1\}$ , either prove that they represent the same language, or give a string that is present in the language of one but not in the language of the other. In the latter case, you must also describe why your solution string is in the language of one regular expression, but not in that of the other.
  - $r_1 = 1 * (1 + 0) * 0 *$  and  $r_2 = (0 * 1 *) *$
  - $r_1 = ((0 + 1) * 0) * 0$  and  $r_2 = (0 + 1) * 0 * 0$
  - $r_1 = (0 + 1) * 01(0 + 1) *$  and  $r_2 = 1 * (0 + 1) * 0(0 + 1) * 1$
- When we say that a TM  $M$  accepts a language  $L$  by halting, we mean that if  $M$  is started with a word  $w$  on its tape, it halts if and only if  $w \in L$ . In class, we have seen how every binary string can be thought of as encoding a deterministic Turing machine (DTM) that accepts by halting. Recall also that with the encoding studied in class, every DTM can be encoded as a binary string with no two consecutive 0's. Similarly, every binary string can be thought of as an input string on a given (possibly different) alphabet. We will use  $[[w]]_{TM}$  to denote the Turing machine encoded by  $w \in (0 + 1)^*$ . Similarly, we will use  $[[w]]_{\Sigma}$  to denote the input string encoded by  $w \in (0 + 1)^*$ . Let  $L_1$  and  $L_2$  be as defined below:
  - $L_1 = \{w \mid w \in (0 + 1)^+ \text{ and there is at least one input string on which } [[w]]_{TM} \text{ doesn't halt}\}.$
  - $L_2 = \{w100w2 \mid w1, w2 \in (0 + 1)^*, w1 \text{ has no two consecutive zeros, and } [[w1]]_{TM} \text{ does not halt on } [[w2]]_{\Sigma}\}.$

Which of the following statements are true? Justify your answer.

- If  $L_1$  is recursively enumerable, then  $L_2$  is recursive.

(b)  $L_1$  is co-recursively enumerable

(c) The language  $L_2 = \{ww^R \mid w \in L_1\}$  is recursive. Here,  $w^R$  means the reverse of the word  $w$ .

**21CS004 Principles of Programming Languages****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Explain the concepts of programming languages.
2. Describe syntax and semantics of programming languages.
3. Explain data types, and basic statements of programming languages.
4. Illustrate the concept of subprogram.
5. Demonstrate the concepts of ADT and OOP.
6. Summarize the concept of exception handling and event handling.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO4 |
|----|-----|-----|-----|-----|
| 1  | 3   | 1   | 2   | 2   |
| 2  | 3   | 2   | 1   | 2   |
| 3  | 3   | 1   | 3   | 1   |
| 4  | 3   | 2   | 2   | 2   |
| 5  | 3   | 2   | 2   | 3   |
| 6  | 3   | 2   | 2   | 3   |

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

**Unit I****Preliminary Concepts****12 Hours**

Reasons for studying concepts of programming languages, programming domains, language evaluation criteria, influences on language design, language categories, language design trade-offs, implementation methods, programming environments, Evolution of Major Programming Languages.

**Syntax and Semantics:** General problem of describing syntax, formal methods of describing syntax, attribute grammars, describing the meanings of programs.

**Unit II****Data types, Expressions and Statements, Control Structure****12 Hours**

**Names, Bindings, and Scopes:** Introduction, names, variables, concept of binding, scope, scope and lifetime, referencing environments, named constants

**Data types:** Introduction, primitive, character, string types, user defined ordinal types, array, associative arrays, record, tuple types, list types, union types, pointer and reference types, type checking, strong typing, type equivalence

**Expressions and Statements:** Arithmetic expressions, overloaded operators, type conversions, relational and Boolean expressions, short-circuit evaluation, assignment statements, mixed-mode assignment

**Control Structures:** introduction, selection statements, iterative statements, unconditional branching, guarded commands.

**Unit III****Subprograms****12 Hours**

**Subprograms:** Fundamentals of subprograms, design issues for subprograms, local referencing environments, parameter passing methods, parameters that are subprograms, calling subprograms indirectly, overloaded subprograms, generic subprograms, design issues for functions, user defined overloaded operators, closures, co routines

**Implementing subprograms:** General semantics of calls and returns, implementing simple subprograms, implementing subprograms with stack-dynamic local variables, nested subprograms, blocks, implementing dynamic scoping.

**Unit IV****ADT, OOP, Exception and Event Handling****12 Hours**

**Abstract Data types:** The concept of abstraction, introductions to data abstraction, design issues, language examples, parameterized ADT, encapsulation constructs, naming encapsulations

**Object Oriented Programming:** Design issues for OOP, OOP in Smalltalk, C++, Java, Ada 95, C#, Implementation of Object-Oriented constructs.

**Exception Handling and Event Handling:** Introduction, exception handling in Ada, C++, Java, introduction to event handling, event handling with Java and C#.

**Total: 48 Hours**

**Textbook (s)**

1. Robert W. Sebesta, "Concepts of Programming Languages", Tenth Edition, Addison Wesley, 2012.
2. Programming Languages, Principles & Paradigms, 2ed, Allen B Tucker, Robert E Noonan, TMH

**Reference (s)**

1. R. Kent Dybvig, "The Scheme programming language", Fourth Edition, MIT Press, 2009.
2. Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Prentice Hall, 2008.
3. Richard A. O'Keefe, "The craft of Prolog", MIT Press, 2009.
4. W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam (%) |
|-----------------|-----------------|-----------------|--------------------|
| Remember        | 50              | 40              | --                 |
| Understand      | 50              | 50              | --                 |
| Apply           | --              | 10              | 50                 |
| Analyze         | --              | --              | 50                 |
| Evaluate        | --              | --              | --                 |
| Create          | --              | --              | --                 |
| Total (%)       | 100             | 100             | 100                |

**SAMPLE QUESTION (S)**

**Remember**

1. Define programming language?
2. Define named constants?
3. Define subprogram?

**Understand**

1. Explain numeric types?
2. Summarize grammars for simple assignment statements.
3. Discuss language evaluation criteria and the characteristics that affect them.

**Apply**

1. Identity the exceptions occurred in C++ and Ada.
2. Construct BNF notation for following:
  - i. For loop
  - ii. If-else condition
  - iii. Structure definition
3. Solve the given grammar is ambiguous or not.
 

```

<assign> -><id>=<expr>
<id>->A|B|C
<expr>-><expr>+<expr>
|<expr>*<expr>
|(<expr>)
|<id>
```



**21CS005 Mobile Computing****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Explain the basic concepts and fundamentals of mobile computing and telecommunication systems along with various standards.
2. Illustrate the techniques, protocols related to GSM and GPRS architecture to perform requirements analysis.
3. Explain major components of Mobile IP to improve the service qualities of a network
4. Compare various ad hoc routing protocols to examine the performance of network
5. Explain the architecture of Wireless Sensor Network and WLAN design issues and limitations.
6. Outline the basic knowledge in developing smart phone applications using various platforms, toolkits, APIs and third party libraries

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PO7 |
|-----|-----|-----|-----|-----|
| 1   | 2   | 2   | 3   | 2   |
| 2   | 2   | 2   | 2   | 2   |
| 3   | 2   | 2   | 1   | 2   |
| 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****Introduction to Mobile Communications****12 Hours**

Overview: Mobile Communication and Mobile Computing – Architecture; Generations of Telecommunications – 1G, 2G, 3G, 4G and 5G; Wireless Technologies – WPAN, WLAN, WMAN; Wireless Medium Access Control (MAC) – Overview, SDMA, TDMA, FDMA, CDMA;  
2G Technologies: GSM – Services, Architecture, Radio Interface, Protocol Stack, Localization, Call Handling, Handover, Security; 2.5G – GPRS and 3G – EDGE.

*Networking: Communication Modes, Basic Network Designs, Cellular Infrastructures*

**Unit II****Mobile Network Layer and Transport Layer****12 Hours**

Mobile Network Layer: Mobile IP Overview, IP Packet delivery, Agent discovery and advertisement, Registration, Tunneling and Encapsulation, Optimizations, Security, and Dynamic Host Configuration Protocol (DHCP).

Mobile Transport Layer – Motivation, Traditional TCP, Classical TCP Approaches: Indirect TCP, Snooping TCP, Mobile TCP, Transaction-oriented TCP; Optimizations, TCP for 2.5G/3G.

*Multi Task gadget: wide area mobile data - air link standards for data - wireless application environment*

**Unit III****Mobile Ad-hoc Network (MANET)****12 Hours**

Introduction to Mobile ad-hoc networks, Characteristics and features, Applications, Limitations; Routing protocols – Design Issues, Routing algorithms: Proactive (DSDV & OLSR) and Reactive (DSR & AODV), Security in ad hoc networks; Wireless LAN – IEEE 802.11 – System Architecture, Protocol Layers.

Wireless Sensor Network (WSN): Introduction, Architecture, Applications, Properties and Security.

*Satellite systems: history - applications - basics - broadcast systems*

#### Unit IV

#### Mobile Platforms and Applications

**12 Hours**

Mobile OS: Overview on Mobile Device Operation Systems (Android, iOS, Black Berry) – Architecture, App development Kit; Introduction to Network Simulators: Characteristics, Applications, Limitations, Types of Simulators: Wireless Application Protocol (WAP): Introduction, Architecture, Applications.  
*Application layer Protocols – FTP, SMTP, HTTP, DNS; Windows 10.*

**Total: 48 Hours**

#### Textbook (s)

1. Raj Kamal, Mobile Computing, Oxford press, Third Edition, 2018
2. Jochen Schiller, Mobile Communications, Pearson Education, Second Edition, 2020

#### Reference (s)

1. Asoke K Talukder, Hasan Ahmad and RoopaYavagal, Mobile Computing, Second Edition, McGraw Hill, 2010
2. Prasant Kumar Pattnail and Rajib Mall, Fundamentals of Mobile Computing, Second Edition, PHI Learning Pvt. Ltd., 2015
3. Frank Adelstein, et al., Fundamentals of Mobile and Pervasive Computing, McGraw Hill, 2005
4. [http://www.isi.edu/nsnam/ns/doc/ns\\_doc.pdf](http://www.isi.edu/nsnam/ns/doc/ns_doc.pdf) (NS2 manual)

#### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam (%) |
|-----------------|-----------------|-----------------|--------------------|
| Remember        | 30              | 25              | 10                 |
| Understand      | 25              | 15              | 20                 |
| Apply           | 25              | 20              | 30                 |
| Analyze         | 20              | 20              | 30                 |
| Evaluate        | --              | 10              | 10                 |
| Create          | --              | 10              | --                 |
| Total (%)       | 100             | 100             | 100                |

#### SAMPLE QUESTION (S)

##### Remember

1. Define Mobile Computing
2. List the applications of mobile computing
3. List the limitations of mobile computing
4. Define Mobile Adhoc Network
5. List the MANET routing issues

##### Understand

1. Explain mobile computing with architecture
2. Explain TDMA and FDMA with neat diagrams
3. Illustrate the different services provided by the GSM, Explain with system architecture
4. Explain IP Packet delivery with diagram
5. Describe DSSM (Direct Sequence Spread Spectrum)

##### Apply

1. Illustrate Registration process achieved in mobile network layer
2. Discuss the feature of tunneling and encapsulation
3. Illustrate the function of Dynamic Host Configuration Protocol (DHCP)
4. Discuss about security in Ad-hoc network
5. Illustrate the properties of MANETS

##### Analyze

1. Compare Snooping TCP and Indirect TCP
2. Analyze the performance of Dynamic Source Routing protocol

3. Compare about iOS and Blackberry Operating Systems
4. Compare NS2 and NS3 simulators
5. Explain about Android Operating System with architecture

#### **Evaluate**

1. Evaluate the performance of Wireless Datagram protocol
2. Evaluate the performance of DSDV
3. Evaluate the performance of DSR
4. How Traditional TCP is different from I-TCP
5. How localization and Call handling is performed

#### **Open Book Exam Questions**

**Q1.** Describe the functions of the MS and SIM. Why does GSM separate the MS and SIM? How and where is user-related data represented/stored in the GSM system? How is user data protected from unauthorized access, especially over the air interface? How could the position of an MS (not only the current BTS) be localized? Think of the MS reports regarding signal quality.

**Q2.** Describe the Concept of GPRS. Using the best delay class in GPRS and a data rate of 115.2 kbit/s – how many bytes are in transit before a first acknowledgement from the receiver could reach the sender (neglect further delays in the fixed network and receiver system)? Now think of typical web transfer with 10 Kbyte average transmission size – how would a standard TCP behave on top of GPRS (see chapters 9 and 10)? Think of congestion avoidance and its relation to the round-trip time. What changes are needed?

**21CS006 Distributed Operating Systems****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Summarize the fundamental concepts of Distributed Operating Systems.
2. Illustrate the Concepts of Message passing system and Remote Procedure Calls.
3. Design and Implementation of Distributed Shared Memory and Structures.
4. Utilize the Synchronization and Distributed File Systems.
5. Make use of Resource Management and Process Management Concepts.
6. Outline the concept of Naming and Security in Distributed Operating Systems.

**CO-PO Mapping**

| CO | PO1 | PO2 | PO3 | PO12 |
|----|-----|-----|-----|------|
| 1  | 3   | 2   | 2   | 1    |
| 2  | 3   | 2   | 2   | 1    |
| 3  | 3   | 2   | 2   | 1    |
| 4  | 2   | 2   | 2   | 1    |
| 5  | 3   | 2   | 2   | 1    |
| 6  | 3   | 1   | 2   | 1    |

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

**Unit I****Introduction and Communication in Distributed System****12 Hours**

Introduction: Design Issues - Distributed Computing Environment - Message Passing - Features of Good Message Passing System-Issues in IPC by Message Passing-Synchronization- Buffering  
Remote Procedure Calls: The RPC Model - Transparency of RPC- Implementing RPC Mechanism - Stub Generation - RPC Messages - Marshaling Arguments and Results - Server Management - Parameter-Passing Semantics- Call Semantics

*Communication Protocols for RPCs - Complicated RPCs - Client-Server Binding-Case Study: Sun RPC*

**Unit II****Distributed Shared Memory and Synchronization****12 Hours**

Distributed Shared Memory: General Architecture of DSM Systems- Design and Implementation Issues of DSM – Granularity - Structure of Shared Memory Space  
Synchronization: Clock Synchronization - Event Ordering - Mutual Exclusion –Deadlocks- Election Algorithms

*Consistency Models-Replacement Strategy - Thrashing*

**Unit III****Resource Management and Distributed FileSystems****12 Hours**

Resource Management: Features of a Good Global Scheduling Algorithm - Task Assignment Approach – Load Balancing Approach – Load Sharing Approach  
Distributed File Systems: Introduction -Desirable Features of a Good Distributed File System - File Models – File Accessing Models – File Sharing Semantics – File Caching Schemes - File Replication

*Process Management - Process Migration- Threads- Case Study: DCE Distributed File Service*

**Unit IV****Naming and Security****12 Hours**

Naming: Desirable Features of a Good Naming System - Fundamental Terminologies and Concepts - System-Oriented Names - Object-Locating Mechanisms - Human-Oriented Names - Name Caches  
Security: Potential Attacks to Computer Systems - Cryptography – Authentication

*Access Control - Digital Signatures - Design Principles- Case Study: DCE Directory Service*

**Total: 48Hours****Textbook (s)**

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2009
2. Andrew S Tannebaum, "Distributed Operating Systems", Pearson Education, 2007

**Reference (s)**

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012
2. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007
3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
4. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003

**Internal Assessment Pattern**

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

**SAMPLE QUESTION (S)****Remember**

1. List any four advantages of Distributed operating systems
2. Define distributed operating systems.
3. List any five reasons why to build distributed operating System.
4. What are the features of good distributed file systems?
5. List the features of a Good Naming System

**Understand**

1. Explain the design issues of distributed operating systems.
2. Explain the role of Naming in distributed operating systems
3. Summarize the internal and external synchronization of Physical clocks
4. Differentiate Resource Management and Process Management
5. Explain in detail about security and authentication.

**Apply**

1. Construct the different protocols of RPC.
2. Identify the File shearing Semantics and file caching Schemes.
3. Develop the Bully and Ring Algorithm
4. Develop the scenario how might the clocks in two computers that are linked by a local network be synchronized without reference to an external time source
5. Utilize the various deadlock prevention techniques with suitable example?

**Analyze**

1. Analyze the Concept of exception handling in RPC.
2. Examine the Concept of Thread.
3. Compare Fault tolerance and Thrashing.
4. Classify the deadlock avoidance techniques.
5. Simplify an algorithm using multicast and logical clocks for mutual exclusion.

**Open Book Exam Questions****Question 1:**

A distributed system has DSM facility. The process-scheduling mechanism of this system selects another process to run when a fault occurs for the currently running process, and the CPU is utilized while the block is being fetched. Two system engineers arguing about how to better utilize the CPUs of this system have the following opinions:

- (a) The first one says that if a large number of processes are scheduled for execution at a node, the available memory space of the node can be distributed among these processes that almost always there will be a ready process to run when a page fault occurs. Thus, CPU utilization can be kept high.
- (b) The second one says that if only a few processes are scheduled for execution at a node, the available memory space of the node can be allocated to each of the few processes, and each process will produce fewer page faults. Thus, CPU utilization can be kept high. Whose argument is correct? Give reasons for your answer.

**Question 2:**

The password mechanism is used in a distributed system to authenticate users at login time. State the most suitable locations (according to you) for storing the login program and the password file in the following cases:

- (a) The distributed system is based on the workstation-server model with each workstation having a small hard disk of about 20 megabytes capacity.
- (b) The distributed system is based on the workstation-server model. Some of the workstations are diskless and others have a small hard disk of about 20 megabytes capacity.
- (c) The distributed system is based on the processor-pool model.

**21CS507 Artificial Intelligence and Machine Learning Lab****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to:

1. Construct rule-based systems for solving real-world problems.
2. Demonstrate the function of data repositories and pre-processing tools.
3. Apply and evaluate classification techniques for solving classification problems.
4. Build regression models to accurately predict outcomes.
5. Apply clustering techniques to group data and analyze the outcomes.
6. Simplify complex data using dimensionality reduction.

**CO-PO Mapping**

| CO | PO1 | PO4 | PO5 | PO12 | PS01 | PS02 |
|----|-----|-----|-----|------|------|------|
| 1  | 3   | 3   | 2   | 3    | 3    | 3    |
| 2  | 2   | 2   | 3   | 2    | 3    | 3    |
| 3  | 3   | 3   | 3   | 2    | 3    | 3    |
| 4  | 2   | 2   | 3   | 2    | 2    | 2    |
| 5  | 3   | 3   | 2   | 2    | 2    | 2    |
| 6  | 3   | 3   | 3   | 2    | 2    | 2    |

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

**List of Experiments:**

## Expert System

1. Develop a Rule Based system (Consider any Problem from the Annexure any Real Time)

## Data Pre-Processing and Data Pre-Processing Tools

2. Importing Datasets, Missing Data, Feature Encoding, Handling Outliers
3. Splitting Datasets to Training Dataset and Test Dataset, Feature Scaling, Data Sampling

## Classification

4. K-Nearest Neighbor(K-NN) Classifier
5. Support Vector Machine Classification
6. Naïve Bayes Classifier
7. Decision Tree Classification

## Regression

8. Simple Linear Regression
9. Multiple Linear Regressions
10. Polynomial Regression
11. Logistic Regression

## Clustering

12. Association Rule Learning
13. K Means Clustering
14. Hierarchical Clustering

## Dimensionality Reduction

15. Principal Component Analysis
16. Linear Discriminate Analysis

**Text Book (s)**

1. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3rd Edition, Packt Publishing., 2020
2. Stephen Marsland- Machine Learning – An Algorithmic Perspective – Second Edition – Chap Man & Hall CRC Press, 2015

**Reference (s)**

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Machine Learning A-Z: Hands-On Python, Udemy.

**Annexure:**

1. Banking System
2. Weather System
3. Medical System
4. Gaming System
5. Dressing System
6. Disease Diagnose or Prediction System

**Augmented Experiments:**

1. Rule Based Expert System: Design, Suiting and Shirting for an event/ occasion
2. Gaming: Chess, Water Jug Problem, 8 Queens Problem
3. Real Time: Traffic Lights
4. Real Time: Banking Transactions ( Only Debit and Credit )
5. Mathematical Approach for Theorem Proving
6. Financial Approach for Loans via Cash / Vehicle / Gold
7. Medical Expert Systems
8. Disease Classification Strategies
9. Disease Prediction Strategies
10. Work on a Real Dataset.



**21TPX01 Term Paper****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to

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

**Term Paper:** The Term Paper is a self-study report and shall be carried out either during 5th or 6th semester in choice with Mini Project. Every student will take up this term paper individually 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 as nominated by HoD with the approval of CoE

**21ESX02 Employability Skills II****0 0 2 0****Course Outcomes**

At the end of the course, students will be able to

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 | PO 8 | PO10 | PO12 |
|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |      | 3    | 2    |
| CO2 |     |     |     | 1    | 2    | 2    |
| CO3 | 2   | 1   |     | 2    |      |      |
| CO4 | 2   |     | 2   |      |      |      |
| CO5 | 2   |     | 2   |      |      |      |
| CO6 | 2   |     | 2   |      |      |      |

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

**Soft Skills:**

| Sl No.               | 5th Semester (Topic & Content)                                                                                                                                                                 | No. of Periods |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1.                   | <b>Introduction to Campus Placements:</b> Stages of Campus Placement, Skills assessed in Campus Placements & How to get ready?                                                                 | 01             |
| 2.                   | <b>Motivational Talk on Positive Thinking:</b> Beliefs, Thoughts, Actions, Habits & Results (Success)                                                                                          | 01             |
| 3.                   | <b>Resume Preparation:</b> Resume? Templates? Mistakes to be avoided in a Resume, Steps to be followed in preparing it.(with examples)                                                         | 02             |
| 4.                   | <b>Group Discussions (Recap):</b> GD? Stages of a GD, Skills assessed in a GD, Blunders to be avoided, How to excel in a GD? (through Practice Sessions)                                       | 02             |
| 5.                   | <b>Psychometric Tests:</b> Definition, Types of Psychometric Tests: Numerical Computation, Data Interpretation, Verbal Comprehension, Verbal Critical Reasoning and Personality Questionnaires | 01             |
| 6.                   | <b>Exercises related to Communication:</b> Story Writing, TAT etc                                                                                                                              | 01             |
| <b>Total Periods</b> |                                                                                                                                                                                                | <b>08</b>      |

**Quantitative Aptitude:**

| Sl No.               | Semester-V (Topic)  | No. of Periods |
|----------------------|---------------------|----------------|
| 1.                   | Square & Cube roots | 01             |
| 2.                   | Partnership         | 01             |
| 3.                   | Partnership         | 01             |
| 4.                   | Logarithms          | 01             |
| 5.                   | Progressions        | 01             |
| 6.                   | Mensuration         | 01             |
| 7.                   | Mensuration         | 01             |
| 8.                   | Data Sufficiency    | 01             |
| <b>Total Periods</b> |                     | <b>08</b>      |

**Domain Specific: (Data Structures and Algorithms (DSA)-Phase-1)****16 Hours****Module-1:**

**Introduction:** Importance of Competitive Programming, Conditional Statements, Loops, Nested Loops. Strings, Arrays, Recursion and pointers

**Practice Problems:**

| Week | Topic                  | Practice Problem Links                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Introduction to CP     | Creating accounts on Globla Coding Platforms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 2    | Conditional Statements | <a href="https://www.codechef.com/practice/tags/conditional-statements">https://www.codechef.com/practice/tags/conditional-statements</a>                                                                                                                                                                                                                                                                                                                                                                                      |
| 3    | Loops                  | <a href="https://www.codechef.com/practice/tags/loops">https://www.codechef.com/practice/tags/loops</a><br><a href="https://leetcode.com/tag/math/">https://leetcode.com/tag/math/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=math">https://www.interviewbit.com/practice/#topics[]=math</a>                                                                                                                                                                                                              |
| 4    | Nested Loops           | <a href="https://www.codechef.com/practice/topics/math">https://www.codechef.com/practice/topics/math</a><br><a href="https://www.interviewbit.com/practice/#topics[]=math">https://www.interviewbit.com/practice/#topics[]=math</a>                                                                                                                                                                                                                                                                                           |
| 5    | Strings                | <a href="https://www.codechef.com/practice/topics/strings">https://www.codechef.com/practice/topics/strings</a><br><a href="https://leetcode.com/tag/string/">https://leetcode.com/tag/string/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=strings">https://www.interviewbit.com/practice/#topics[]=strings</a>                                                                                                                                                                                            |
| 6    | Arrays                 | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=arrays">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=arrays</a><br><a href="https://leetcode.com/tag/array/">https://leetcode.com/tag/array/</a><br><a href="https://www.codechef.com/practice/topics/arrays">https://www.codechef.com/practice/topics/arrays</a><br><a href="https://www.interviewbit.com/practice/#topics[]=arrays">https://www.interviewbit.com/practice/#topics[]=arrays</a> |
| 7    | Two Pointer            | <a href="https://www.interviewbit.com/practice/#topics[]=two-pointers">https://www.interviewbit.com/practice/#topics[]=two-pointers</a><br><a href="https://leetcode.com/tag/two-pointers/">https://leetcode.com/tag/two-pointers/</a>                                                                                                                                                                                                                                                                                         |
| 8    | Recursion              | <a href="https://leetcode.com/tag/recursion/">https://leetcode.com/tag/recursion/</a><br><a href="https://www.codechef.com/practice/tags/recursion">https://www.codechef.com/practice/tags/recursion</a>                                                                                                                                                                                                                                                                                                                       |

**Module-2:**

Searching, Sorting, Linked List, Linked List: Double Linked List, Circular Linked List, Stack, Queue, hashing

**Practice Problems:**

| Week | Topic                                                    | Practice Problem Links                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Searching-I                                              | <a href="https://www.codechef.com/practice/topics/binary-search">https://www.codechef.com/practice/topics/binary-search</a><br><a href="https://leetcode.com/tag/binary-search/">https://leetcode.com/tag/binary-search/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=binary-search">https://www.interviewbit.com/practice/#topics[]=binary-search</a><br><a href="https://www.codechef.com/practice/tags/searching">https://www.codechef.com/practice/tags/searching</a> |
| 10   | Searching-II                                             | <a href="https://www.codechef.com/practice/topics/binary-search">https://www.codechef.com/practice/topics/binary-search</a><br><a href="https://leetcode.com/tag/binary-search/">https://leetcode.com/tag/binary-search/</a><br><a href="https://www.interviewbit.com/practice/#topics[]=binary-search">https://www.interviewbit.com/practice/#topics[]=binary-search</a><br><a href="https://www.codechef.com/practice/tags/searching">https://www.codechef.com/practice/tags/searching</a> |
| 11   | Sorting-I                                                | <a href="https://www.codechef.com/practice/topics/sorting">https://www.codechef.com/practice/topics/sorting</a><br><a href="https://leetcode.com/tag/sorting/">https://leetcode.com/tag/sorting/</a><br><a href="https://leetcode.com/tag/merge-sort/">https://leetcode.com/tag/merge-sort/</a>                                                                                                                                                                                              |
| 12   | Sorting-II                                               | <a href="https://www.codechef.com/practice/topics/sorting">https://www.codechef.com/practice/topics/sorting</a><br><a href="https://leetcode.com/tag/sorting/">https://leetcode.com/tag/sorting/</a>                                                                                                                                                                                                                                                                                         |
| 13   | LinkedList: Double<br>LinkedList,<br>Circular LinkedList | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=linked-lists">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=linked-lists</a><br><a href="https://leetcode.com/tag/linked-list/">https://leetcode.com/tag/linked-list/</a>                                                                                                                                                                                       |

|    |         |                                                                                                                                                                                               |
|----|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |         | <a href="https://www.interviewbit.com/practice/#topics[]=linked-lists">https://www.interviewbit.com/practice/#topics[]=linked-lists</a>                                                       |
|    |         | <a href="https://leetcode.com/tag/doubly-linked-list/">https://leetcode.com/tag/doubly-linked-list/</a>                                                                                       |
| 14 | Stack   | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=stacks">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=stacks</a> |
|    |         | <a href="https://leetcode.com/tag/stack/">https://leetcode.com/tag/stack/</a>                                                                                                                 |
|    |         | <a href="https://www.interviewbit.com/practice/#topics[]=stacks-and-queues">https://www.interviewbit.com/practice/#topics[]=stacks-and-queues</a>                                             |
| 15 | Queue   | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=queues">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=queues</a> |
|    |         | <a href="https://leetcode.com/tag/queue/">https://leetcode.com/tag/queue/</a>                                                                                                                 |
|    |         | <a href="https://www.interviewbit.com/practice/#topics[]=stacks-and-queues">https://www.interviewbit.com/practice/#topics[]=stacks-and-queues</a>                                             |
| 16 | Hashing | <a href="https://www.interviewbit.com/practice/#topics[]=hashing">https://www.interviewbit.com/practice/#topics[]=hashing</a>                                                                 |

#### References:

1. <https://leetcode.com>
2. <https://www.codechef.com>
3. <https://www.hackerearth.com>
4. <https://www.interviewbit.com>
5. <https://www.hackerrank.com>

**21HSX12 CC & EC Activities II****0 0 1 0****Course Outcomes**

At the end of the course, students will be able to

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 spirit 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 |
|----------|-----|-----|-----|------|
| <b>1</b> | -   | -   | -   | 3    |
| <b>2</b> | 3   | 2   | -   | -    |
| <b>3</b> | 3   | -   | -   | -    |
| <b>4</b> | -   | -   | 3   | -    |
| <b>5</b> | 3   | -   | -   | -    |
| <b>6</b> | 3   | -   | -   | -    |

**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 @ 2 slots every week : 24
- No. of Stream (2-CC + 1-EC) : 3
- No. of slots allotted for each stream : 8

**Requirement for the award of 1- Credit**

- Students shall choose at least two streams of events in each semester
- Students shall secure 75% attendance in each stream of events to obtain a certificate
- Students shall obtain 2 certificates of Participation in each semester.

The credits earned through these courses will be indicated in the grade sheet and will not be taken into account for CGPA calculation.

**21SIX01 Summer Internship I****0 0 0 1****Course Outcomes**

At the end of the course, students will be able to

1. Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job function/s
2. Solve real life challenges in the workplace by analyzing work environment and conditions, and selecting appropriate skill sets acquired from the course
3. Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement
4. Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means
5. Demonstrate the ability to harness resources by examining challenges and considering opportunities
6. Demonstrate appreciation and respect for diverse groups of professionals by engaging harmoniously with different company stakeholders

**COs – POs Mapping**

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

**Summer Internship:** As a part of curriculum in all branches of Engineering, it is mandatory for all students to undergo summer internship Programme at industries (core or allied) / R & D organization to get practical insight of their subject domain during summer break after the 4th semester. This summer internship Programme shall be availed to a maximum duration of 4 weeks and the assessment shall be carried out with both internal and external experts leading to “Satisfactory” and “Non-Satisfactory Performance”, and it will not be accounted for the calculation of CGPA.

**Audit Course****0 0 0 0****Course Outcomes**

At the end of the course, students will be able to

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

**Audit Courses:** Audit courses are among the compulsory courses and do not carry any credits. All the students shall register for one Audit courses in the beginning of 3<sup>rd</sup> semester. List of the courses will be notified at the beginning of the third semester for all students and the student has to choose one audit course under self-study mode at the beginning of third semester. All the students (regular and lateral entry students) shall complete the audit course similar to other regular courses and the results will be indicated with “Satisfactory” or “Not Satisfactory” performance.

## 6th Semester

### 21CS601 Compiler Design

3 0 0 3

#### Course Outcomes

At the end of the course, students will be able to

1. Explain different translators and acquire knowledge of compiler & its Phases.
2. Identify formal grammars for specifying the syntax and Semantics of programming languages.
3. Construct parse table for a given grammar.
4. Examine the intermediate code for a given program.
5. Illustrate the symbol table management and storage organization.
6. Develop code optimization techniques to improve the performance of a program.

#### CO-PO Mapping

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

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

#### Unit I

12 Hours

Overview of Language Processing-Compiler-Assembler-Interpreters-Linkers & Loaders-Phases of a Compiler-Lexical Analysis-Role of Lexical Analysis-Token-Patterns and Lexemes-Lexical Errors-Regular definitions for the Language constructs- Transition diagrams for recognition of Tokens-Reserved Words and Identifiers.

*Input buffering, LEX tool*

#### Unit II

12Hours

Syntax Analysis-Top-down Parsing-First and Follow-Recursive predictive parsing- Non-Recursive Predictive Parsing-LL(1) Grammar-Bottom-up parsing-ShiftReduce Parsing-Model of an LR Parser-Construction of SLR(1) Tables-Construction of CLR(1)-LALR(1)-Parsing tables

*Handling Ambiguous grammars- Dangling ELSE ambiguity*

#### Unit III

12 Hours

Semantic Analysis - SDT: Synthesized and Inherited Attributes-Intermediate Code-Three Address Code-Quadruples-Triples-Indirect Triples-Abstract Syntax Trees-DAG for Expressions-Symbol Table management-Runtime Environment:Storage Organization-Storage Allocation strategies

*Data structures used in symbol table, Three address code for control statements*

#### Unit IV

12 Hours

Machine Independent Code Optimization-Common Sub-expression Elimination-Constant Folding-Copy Propagation-Dead Code Elimination-Strength Reduction-Loop Optimization-Basic Blocks-Flow Graph-DAG for basic blocks-Machine Dependent Code Optimization:Peephole Optimization-Register Allocation-Instruction Scheduling

*Code generation algorithm – optimization among basic blocks*

**Total: 48 Hours**



**Text Books:-**

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers, Principles, Techniques and Tools, 2nd Edition, Pearson, 2007.
2. V. Raghavan, Principles of Compiler Design, 2nd Edition, TMH, 2011.

**Reference Books:-**

1. Nandini Prasad, Principles of Compiler Design, 2nd Edition, Elsevier, 2012.
2. Yunlin Su Song Y. Yan, Principles of Compilers, A New approach to Compilers including the Algebraic Methods, Springer, 2011.

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam (%) |
|-----------------|-----------------|-----------------|--------------------|
| Remember        | 20              | 20              | --                 |
| Understand      | 40              | 40              | --                 |
| Apply           | 30              | 20              | 60                 |
| Analyze         | 10              | 20              | 40                 |
| Evaluate        | --              | --              | --                 |
| Create          | --              | --              | --                 |
| Total (%)       | 100             | 100             | 100                |

**SAMPLE QUESTION (S)**

**Remember**

1. Define Lexeme.
2. What is Bottom-up parsing?
3. What is inherited attribute?
4. What is constant folding?

**Understand**

1. Explain the phases of compiler.
2. Explain about various intermediate code representations.
3. Illustrate the machine independent code optimization techniques with an example for each.

**Apply**

1. Calculate the first and follow functions for the given grammar-  
 $S \rightarrow (L) / a$   
 $L \rightarrow SL'$   
 $L' \rightarrow ,SL' / \epsilon$
2. Construct CLR(1) parsing table for the following grammar  
 $S' \rightarrow S$   
 $S \rightarrow C C$   
 $C \rightarrow cC$   
 $C \rightarrow d$

**Analyse**

1. Compare and contrast different storage organization strategies.
2. How does machine dependent code optimization is different from machine independent code optimization?

**Open book Questions**

1. Construct the basic block and flow graph for the following C fragments  

```

a=3;
    b=4;
    for(i=0;i<n;i++)
    {
        a=a*b+5;
        a=a-4;
    }
    c=a+b*3;

```
2. Write the recursive C function to generate Fibonacci sequence. Represent the activation record for each recursive call in case of Fibonacci (8).

**21CS602 Internet of Things****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to:

1. Illustrate IoT framework, architecture and design principles of M2M Communication
2. Outline the design principles of Web and Internet Connectivity and its protocols
3. Summarize MAC and IP addressing in IoT, 6LowPAN and LoRaWAN protocols
4. Identify the suitable sensor technology for data collection and how to store and use it for Computing
5. Develop business models in IoT by identifying vulnerabilities and attacks involving in IoT
6. Inspect an application using IoT technology

**CO-PO Mapping**

| COs | PO1 | PO3 | PO4 | PO7 | PSO1 |
|-----|-----|-----|-----|-----|------|
| 1   | 2   | 2   | 3   | 3   | 1    |
| 2   | 2   | 2   | 2   | 2   | 2    |
| 3   | 2   | 1   | 1   | 2   | 2    |
| 4   | 2   | 3   | 2   | 2   | 3    |
| 5   | 2   | 2   | 2   | 3   | 2    |
| 6   | 2   | 3   | 3   | 3   | 3    |

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

**UNIT I****12Hours**

**Overview of IoT:** Overview of Wireless Sensor Networks, Overview of Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication.

**Design Principles:** IoT/M2M Systems Layers and Design Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway

*Examples of IoT, Ease of Designing and Affordability*

**UNIT II****12 Hours**

**Design Principles for Web Connectivity:** Introduction, Web Communication Protocols: Constrained Applications Protocol (CoAP), Lightweight Machine-to-Machine Communication; Message Communication Protocols: Message Queue Telemetry Transport (MQTT);

**Internet Connectivity Principles:** Introduction, Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Introduction to 6LowPAN and LoRaWAN

**Application Layer Protocols:** HTTP, HTTPS, FTP and Telnet

**UNIT III****12 Hours**

**Sensor Technology:** Sensing the Real World using Analog and Digital Sensors, Industrial IoT, Automotive IoT, Actuator, RFID Technology – Principles, Architecture, Applications & Components, Web of Things of RFIDs. **Data Collection, Storage and Computing:** Introduction, Cloud computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud Service Models for IoT

**Sensor Data Communication Protocol:** Serial Bus – USB, CAN

**UNIT IV****12 Hours**

**Business Models and Processes using IoT:** Introduction, Business Models, Business Scenarios in IoT.

**IoT Privacy, Security and Vulnerabilities Solutions:** Security and Privacy Requirements, Threat Analysis, IoT Layered Attacker Model, Access Control and Secure Message Communication, Security Models

**Case Studies:** Smart Home, Smart City, Precision Agriculture

**IoT Hardware: Raspberry pi, Arduino**

**Total: 48 Hours**

**Textbook:**

1. Raj Kamal, "Internet of Things: Architecture and Design Principles". TMH Publications, 2017.
2. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1<sup>st</sup> Edition, VPT, 2014

**Reference:**

1. Ovidiu Vermesan & Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communications, 2017.

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Assignment Test (%) |
|-----------------|-----------------|-----------------|---------------------|
| Remember        | 25              | 25              | -                   |
| Understand      | 30              | 30              | 40                  |
| Apply           | 20              | 20              | 30                  |
| Analyze         | 25              | 20              | 30                  |
| Evaluate        | --              | --              | --                  |
| Create          | --              | --              | --                  |
| Total (%)       | 100             | 100             | 100                 |

**Remember**

1. Write the major significance of Internet of Things.
2. State the crucial requirement of 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.
7. Identify the on-demand processing and storage capabilities that is used to analyze the data generated by IoT objects in batch or stream format.

**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.
7. Report the standard requirement of real time analytics to fulfill the demand of real-time stream processing engine.

**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.

#### **Analyze**

1. Comparative analysis on real-time analytics in Cloud-IoT and fog computing.
2. Compare the communication efficiencies for the following protocols such as AMPQ, CoAP, DDS, MQTT, UPnP and XMPP in terms of Transport Layer Protocols.
3. Differentiate the major significances of nesC, keil C and Dynamic C.
4. Relate a set of minimal features to be fulfilled by the programming frameworks for IoT.
5. Comparative analysis on IoT programming approaches

#### **Evaluate**

1. Select an example that utilizes the device-collaboration framework for the proactive suggestion application
2. Appraise a semantic QA cache that implement the device/cloud collaboration framework to compute the probability of the on-device semantic QA cache to answer a given query correctly. Select a suitable example that use automatically tagging recognized images to display the additional information such as social sentiment in order to achieve similar performance improvement for speech-recognition application with DL through device/cloud collaboration framework
3. Critique on fog-computing assisted distributed analytics system that uses a set of fall-detection algorithms, including algorithms based on acceleration measurements and time-series analysis methods, as well as filtering techniques to facilitate the fall-detection process.
4. Defend the augmented reality applications in terms of Game based on Fog Computing and Linked Data

#### **OBE Questions:**

1. Whenever a person wants to find a parking space on the campus, he has to login to the application using his user id and password, a request message will then be sent to the server. The server will send back a response with the available parking details, real-time mapped directions and real-time parking space to allocate parking according to the size of the vehicle. The application would be smart enough to identify whether the car is heading towards the same parking space or not. If not, the application would re-route the same car to another nearest available parking space. The above mentioned will be applicable to those vehicles that have logged in to the system and used the navigating system. But we also need to consider those vehicles which have not logged in and are manually finding parking space and heading towards the same parking slot. Can you solve this problem? Develop a smart efficient application system to solve the problem related to real-time parking space.
2. From the underground storage tank, water is pumped using motors to overhead water tanks, which are placed at the highest elevated floor of the building for optimum pressure. The system should also continuously monitor the soil moisture along with rain predictions to water the landscapes in the campus. . How can the system work? The system should check water quality whether it is drinkable or brackish i.e. it should check PH-level, oxygen level, etc. It should check water level of over-head as well as lower-head tanks and control the pumping of water as per the required limit of the over-head tank. The system should also give real time water volume of both the tanks, through the android application. Watering system mobile app should display type of soil, which is being taken, how much water is needed, and its moisture level. It should check weather forecast online and act accordingly,

verifying if the forecast was appropriate or not. Develop a smart efficient application system to solve the problem related to “Water Management System”

**21CS603 Software Engineering****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Explain the need of Software Life Cycle Models
2. Build end-user requirements into system and software requirements,
3. Summarize the system models of software engineering
4. Identify and apply appropriate software architectures and patterns to carry out high level design
5. Choose various testing techniques during software development
6. Categorize Risk management and Software quality for software products

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PO5 | PO11 | PSO1 |
|-----|-----|-----|-----|-----|------|------|
| 1   | 3   | 2   | 2   | 2   | 2    | 3    |
| 2   | 3   | 2   | 3   | 2   | 3    | 3    |
| 3   | 3   | 2   | 3   | 3   | 3    | 3    |
| 4   | 3   | 2   | 3   | 2   | 3    | 3    |
| 5   | 3   | 2   | 3   | 2   | 3    | 3    |
| 6   | 3   | 2   | 2   | 2   | 3    | 3    |

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

**UNIT – I****12 Hours**

Introduction to Software Engineering and SDLC, Software Myths, CMMI, Process models: Linear Sequential model, Prototyping model, Evolutionary models: Spiral model, Agile developmental methodologies-Scrum & XP

*Incremental model, software development: Product based and application based*

**Unit II****12 Hours**

Software Requirements: Functional and non-functional requirements, user requirements, system requirements, interface specification.

Software Requirements Engineering Process, Feasibility studies, Requirements elicitation and analysis, requirements validation.

System models: Context models, behavioral models, data models, object models.

*Structure of Software Requirements Document, Structured analysis methods*

**Unit III****12 Hours**

Design concepts, data design, software architecture, Architectural styles and patterns, User interface design - Golden rules, User interface analysis and design and steps. Conceptual model of UML, basic structural modeling, Static and Dynamic UML diagrams: class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, etc.,

*Data Acquisition System - Monitoring and Control System*

**Unit IV****12 Hours**

**Testing strategies and Risk Management:** Testing levels: Unit testing, integration testing, system testing – alpha and beta testing, Testing Types: black box and white box testing techniques, Cyclomatic Complexity, debugging, Risk management - Risk types, strategies, estimation and Planning. Software Quality - Quality assurance and its techniques

*Software measurement, metrics for software quality*

**Total: 48 Hours****Textbook (s)**

1. Roger S. Pressman, Software Engineering, A practitioner's Approach, 8<sup>th</sup> Edition, McGraw-Hill International Edition, 2015
2. I. Sommerville, Software Engineering, 7<sup>th</sup> Edition, Pearson education, 2004.
3. Rajib Mal, Fundamentals of software Engineering, 4<sup>th</sup> Edition, Eastern Economy Edition, 2014.

### Reference(s)

1. K. K. Aggarwal and Yogesh Singh, Software engineering, 3<sup>rd</sup> Edition, New Age International Publication, 2008

### 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. Define software engineering.
2. List different types software myths.

#### Understand

1. Describe software architecture styles and patterns .
2. Illustrate golden rules for user interface design.

#### Apply

1. Applying the process of requirement analysis, discuss how the requirements can be collected for a project.
2. Applying debugging strategy find an error from a code?

#### Analyze

1. Compare and Contrast software life cycle models.
2. Analyze risk types in the risk management.

### Open Book Exam Questions

Assume that 10 errors have been introduced in the requirements model and that each error will be amplified by a factor of 2:1 into design and an addition 20 design errors are introduced and then amplified 1.5:1 into code where an additional 30 errors are introduced. Assume further that all unit testing will find 30 percent of all errors, integration will find 30 percent of the remaining errors, and validation tests will find 50 percent of the remaining errors. No reviews are conducted. How many errors will be released to the field.

**21CS007 Cloud Computing Essentials****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to

1. Interpret the architecture and infrastructure models of cloud computing, strengths, and limitations of cloud computing.
2. Explain the virtualization concepts of machines and data centers.
3. Infer the design concepts of cloud ready applications
4. Compare different cloud centre's implementation
5. Discuss the concepts of cloud scaling and disaster recovery
6. Analyze the performance, scalability, and availability of the underlying cloud technologies and software

**CO-PO Mapping**

| CO | PO2 | PO5 | PO6 | PO7 | PO8 |
|----|-----|-----|-----|-----|-----|
| 1  | 3   | 3   | 2   | 3   | 1   |
| 2  | 3   | 1   | 1   | 2   | 3   |
| 3  | 2   | 2   | 3   | 1   | 2   |
| 4  | 2   | 1   | 3   | 3   | 1   |
| 5  | 2   | 1   | 3   | 1   | 2   |
| 6  | 2   | 3   | 3   | 3   | 3   |

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

**Unit I****12+6 Hours**

**Characterization of Distributed Systems:** Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges. System Models: Introduction, Architectural Models- Software Layers, System Architecture, Variations, Interface and Objects, Design Requirements for Distributed Architectures, Fundamental Models- Interaction Model, Failure Model, Security Model.  
*Communication between Distributed Objects- Object Model, Distributed Object Model.*

**Practical Components:**

1. Study of Cloud Computing & Architecture.
2. Install KVM/VMware Workstation for creating a virtual environment on windows platform. Concept: Virtualization
3. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.

**Unit II****12+8 Hours****Introduction to Cloud Computing**

Overview of Computing Paradigm: Recent Trends in Computing, Evolution of Cloud Computing. Introduction to Cloud Computing: Cloud Computing (NIST Model), Properties, Characteristics & Disadvantages, Role of Open Standards. Cloud Computing Architecture: Cloud Computing Stack, Service Models (XaaS), Deployment Models. Infrastructure as a Service (IaaS): Introduction to IaaS, Resource Virtualization. Platform as a Service (PaaS): Introduction to PaaS, Cloud Platform and Management. Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS.  
*Companies in the Cloud Today, Amazon Web Services, Google services, IBM Cloud, Windows Azure, Tata Cloud, Salesforce.com*

**Practical Components:**

1. Install Google App Engine. Create hello world app and other simple web applications using python/java.
2. Use GAE launcher to launch the web applications.
3. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
4. Signup an AWS Free Tier Account and Explore Management Console and configure AWS CLI



### Unit III

**12+10 Hours**

#### **Virtualization & Design**

Virtualization, Virtual machine, Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Data centre, Virtualization for Data-Centre Automation. Service Levels for Cloud Applications Ready for the cloud: Web Application Design, Machine Image Design, Privacy Design, Database Management.

*various hypervisors like VMware, KVM, Oracle VM, HTTPS, Electronic Payment*

#### **Practical Components:**

1. Working on to transfer the files from one virtual machine to another virtual machine.
2. Working on to launch virtual machine using Trystack (Online OpenStack Demo Version)
3. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves). Hadoop file management: Adding files and directories, Retrieving files, Deleting files
4. Run Wordcount application using Hadoop single node cluster.
5. Move files between regular Linux file-system and HDFS using put and get commands

### Unit IV

#### **Cloud Service Providers**

**12 + 8 Hours**

EMC, EMC IT, Captiva Cloud Toolkit, Google, Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue, service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud.

*Service Cloud: Knowledge as a Service, Rack space, VMware, Manjra soft, Aneka Platform*

#### **Practical Components:**

1. Working and installation of Microsoft Azure
2. Working with Mangrasoft Aneka Software
3. Installation and Configuration of Justcloud
4. Working with AWS services in AWS CloudShell

**Total: 48+32 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, Wiley, 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, 1<sup>st</sup> 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, 1<sup>st</sup> Edition, MK Publishing, 2010
3. David S. Linthicum, Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide, 1<sup>st</sup> 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, 2011.

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) |
|-----------------|-----------------|-----------------|
| Remember        | 30              | 30              |
| Understand      | 40              | 40              |
| Apply           | 30              | 30              |
| Analyze         | --              | --              |
| Evaluate        | --              | --              |
| Create          | --              | --              |
| Total (%)       | 100             | 100             |

### SAMPLE QUESTION (S)

#### Remember

1. Define Cloud Computing.
2. List types of virtualizations.
3. Define proactivescaling.
4. What is CIATriad?

#### 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.
5. With neat diagram explain the functioning of Xen Architecture.
6. List and explain various cloud service providers risks.

#### Analyze

1. Compare cloud center and service infrastructure.
2. Analyze different cloud services provided by Amazon

**21CS008 Cryptography and Network Security****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to

1. Explain the fundamentals of Cryptography, encryption and decryption algorithms
2. Make use of the symmetric and public key cryptographic algorithms
3. Choose the various authentication applications for security
4. Interpret the functionalities of IP and web security.
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+10 Hours**

**Introduction:** Security Attacks, Security Goals, Computer criminals, Methods of Defence, Security Services, Security Mechanisms. **Basics of Cryptography:** Symmetric Cipher Model, Substitution Techniques, Transportation, Techniques, Other Cipher Properties- Confusion, Diffusion, Block and Stream Ciphers. Block Cipher Design Principles and Modes of Operations, **Symmetric Key Cryptosystems:** Principles of Private Key System, Data Encryption Standard (DES), Strength of DES, Triple DES, International Data Encryption algorithm(IDEA), Advanced Encryption Standard (AES) *Blowfish, CAST-128.*

**Practical Components:**

1. Write a program that contains a string (char pointer) with a value "Hello world". The program should XOR each character in this string with 0 and displays the result.
2. Write a program that contains a string (char pointer) with a value "Hello world". The program should AND or and XOR each character in this string with 127 and display the result.
3. Write a program to perform encryption and decryption using the following algorithms
  - a. Ceaser cipher
  - b. Substitution cipher
4. Write a program to perform encryption and decryption using the following algorithms
  - a. Mono-alphabetic cipher
  - b. Hill Cipher
5. Write a program to perform encryption using the following algorithms
  - a. Railfence Technique
  - b. Transposition Technique

**Unit II****12+8 Hours**

**Public Key Cryptography:** Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange. Cryptographic Hash Functions: Principles of Cryptographic Hash functions, Applications of Cryptographic Hash Functions, Secure Hash Algorithm (SHA), Message Authentication Codes – Message Authentication Requirements and Functions, HMAC, Digital Signatures, Elgamal Digital Signature Schemes *Digital Signature Standards*

**Practical Components:**

1. Write a program to implement the Play-fair Cipher algorithm.
2. Write a program to implement the DES algorithm logic.
3. Write a program to implement the Blowfish algorithm logic.

### Unit III

**12+8 Hours**

**Authentication Applications:** Kerberos, Key Management and Distribution, X.509 Directory Authentication service, Public Key Infrastructure, Electronic Mail Security: Pretty Good Privacy, S/MIME.  
**IP Security:** Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining security Associations, Internet Key Exchange,

**Web Security:** Web Security Considerations, Secure Sockets Layer and Transport Layer Security, HTTPS, Electronic Payment

#### Practical Components:

1. Write a Java program to implement RSA algorithm.
2. Calculate the message digest of a text using the SHA-1 algorithm.
3. Write a program to implement the Triple-DES algorithm logic.
4. Write a program to implement the AES algorithm logic.

### Unit IV

#### Locking, Recovery Systems, Indexing, Different Types of Data

**12 + 6 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.

Format String Attacks, SQL Injection Cybercrime and Computer Crime, Intellectual Property.

#### Practical Components:

1. Implement the Diffie-Hellman Key Exchange mechanism.
2. Write a program that can encrypt and decrypt using a general substitution block cipher.
3. Write a program that can encrypt and decrypt in 4-bit in cipher clock chaining mode using DES.

**Total: 48+32Hours**

#### Textbook (s)

1. William Stallings, "Cryptography And Network Security – Principles and Practices", 7<sup>th</sup> edition, Pearson Education Limited 2017.
2. AtulKahate, "Cryptography and Network Security", 2<sup>nd</sup> edition Tata McGraw-Hill, 2003.
3. Behourz A Forouzan, Cryptography and Network Security, 2<sup>nd</sup> edition, Tata McGraw-Hill 2011

#### Reference (s)

1. Matt Bishop, "Computer Security art and science ", Second Edition, Pearson Education, 2002
2. Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with Coding Theory" Second Edition, Pearson Education, 2007
3. Jonathan Katz, and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press, 2007
4. Douglas R. Stinson, "Cryptography Theory and Practice", Third Edition, Chapman & Hall/CRC, 2006
5. Wenbo Mao, "Modern Cryptography – Theory and Practice", Pearson Education, First Edition, 2006.
6. OWASP top ten security vulnerabilities: <http://xml.coverpages.org/OWASPTopTen.pdf>

#### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) |
|-----------------|-----------------|-----------------|
| Remember        | 30              | 30              |
| Understand      | 40              | 40              |
| Apply           | 30              | 30              |
| Analyze         | --              | --              |
| Evaluate        | --              | --              |
| Create          | --              | --              |
| Total (%)       | 100             | 100             |

#### SAMPLE QUESTION (S)

##### Remember

1. Mention any two security attacks
2. List any two goals of security
3. Define Hash function

### **Understand**

1. Differentiate between asymmetric and symmetric key cryptography
2. How do we achieve authentication?
3. Differentiate between the two applications of hash function.

### **Apply**

1. How do we apply PGP to the Email Security?
2. Implement firewall using iptables command.
3. Can message encryption itself provide measure of authentication?

### **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 favourite place central park tomorrow after your class". Help Jones to convert the message to unreadable format using the key of their favourite 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.

**21CS606 Case Tools Lab****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to

1. Apply basics of Unified Modeling Language (UML) to illustrate its importance in software engineering and system design
2. Design various use cases to showcase the functional requirements of the system.
3. Construct UML diagrams for static and dynamic views of the system
4. Inference various case studies and design the model
5. Construct the code from the model for the given application
6. Demonstrate and deploy the solutions for various real time problems.

**COs-POs Mapping**

| COs | PO3 | PO4 | PO5 | PO11 | PS01 |
|-----|-----|-----|-----|------|------|
| 1   | 2   | 3   | 1   | 2    | 2    |
| 2   | 2   | 3   | 2   | 2    | 2    |
| 3   | 3   | 3   | 3   | 2    | 2    |
| 4   | 3   | 3   | 3   | 2    | 3    |
| 5   | 2   | 2   | 3   | 2    | 3    |
| 6   | 2   | 1   | 2   | 2    | 3    |

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

**List of Experiments:**

Case studies given below should be Modeled using Rational Rose tool in different views i.e. Use case diagram, Class diagram, Sequence Diagram, Collaboration Diagram, State Diagram, Activity Diagram, Component Diagram, Deployment Diagram and Forward and Reverse Engineering.

**CASE STUDY 1:****LIBRARY MANAGEMENT SYSTEM:**

This case study on the library management system gives us the complete information about the library and the daily transactions done in a Library. We need to maintain the record of new s and retrieve the details of books available in the library which mainly focuses on basic operations in a library like adding new member, new books, and up new information, searching books and members and facility to borrow and return books.

**CASE STUDY 2:****A HOSPITAL MANAGEMENT SYSTEM:**

Entry in the hospital management system is done through system users. Master form for users is used to create user profile. Whole system is display in user's selected language. For example if user knows Germany then whole hospital management system is display in German language after login. Above all modules are related to patient. So when patient is admit then patient information is enter from patient entry form like patient name, patient initial, patient sex, patient birth date, blood group, patient ID.

**CASE STUDY 3:****AUTOMATED TELLER MACHINE (ATM)**

Software is designed for supporting a computerized ATM banking network. All the process involved in the bank is computerized these days. All the accounts maintained in the bank and also the transactions effected, including ATM transactions are to be processed by the computers in the bank. An ATM accepts a relevant cash card, interacts with user, communicates with the central system to carry out the transaction, dispenses cash, and prints receipts. The system to be designed and implemented must include appropriate record keeping and security provisions. The system must handle concurrent access to the same account.

**CASE STUDY 4:****DESIGN A STUDENT REGISTRATION SYSTEM :**

Each student has access to his or her course and grade information only and must be authenticated prior to viewing or updating the information. A course instructor will use the system to view the list of courses he or she is assigned for a given semester or has taught previously, view the list of students registered for the course(s) he or she is teaching and record final grades for each student in the course(s). TA assignments will also be viewable through this system. Instructors must also be authenticated prior to viewing or updating any information.

#### **CASE STUDY 5:**

##### **MULTITHREADED AIRPORT SIMULATION:**

Everyday number of airplanes lands and takes off from airport. It is the responsibility of the Air Traffic Control (ATC) to regulate these planes. The aim of this simulation is to reconstruct the events occurring during landing or take off. Whenever plane enters the RADAR space, RADAR signals the ATC about the plane. Then the pilot sends the plane details. ATC checks the runway and decides priority. ATC signals the pilot whose plane is having highest priority to land/take off. Then the pilot performs the corresponding command.

#### **CASE STUDY 6:**

##### **POINT OF SALE:**

Shops are the integral part of any civilization. They are present in every culture since ages. This application emphasizes on the transaction going on between the customer and shop keeper during sale of product. The customer approaches the shop keeper/ sales boy and places his order. The shop keeper forwards the order to sales boy who fetches the required goods from inventory. Then the shop keeper calculates bill and issues to the customer. The customer on paying the bill takes goods from the shop keeper. In turn, shop keeper fetches goods from supplier.

#### **List of Augmented Experiments**

1. Create a UML model for Passport automation system.
2. Create a UML model for Book bank
3. Create a UML model for Exam Registration
4. Create a UML model for Stock maintenance system.
5. Create a UML model for Online course reservation system
6. Create a UML model for E-ticketing
7. Create a UML model for Credit card processing
8. Create a UML model for e-book management system
9. Create a UML model for Recruitment system
10. Create a UML model for Quiz system

#### **Reading Material (s)**

1. Case tools Lab manual, Department of CSE, GMRIT, Rajam

**21MPX01 Mini Project****0 0 3 1.5****Course Outcomes**

At the end of the course, students will be able to

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 | PS01 | PS02 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 1   | 3   | 2   | -   | -   | -   | 3   | 2   | -   | -   | -    | -    | -    | 2    | 2    |
| 2   | 3   | 3   | -   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    |
| 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -   | -   | -    | 2    | -    | 2    | 2    |
| 4   | -   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    | 2    | -    | -    |
| 5   | -   | -   | -   | -   | -   | -   | -   | 3   | -   | -    | -    | -    | -    | -    |
| 6   | -   | -   | -   | -   | -   | -   | -   | -   | 3   | -    | -    | -    | 2    | 2    |

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

**Mini Project:** The curriculum offers Mini Projects in two different forms viz: (i) Mini Project as a mandatory component in all lab courses (ii) 2 credit Mini Project during 5th or 6th semester. With respect to second one (ii) student will take mini project batch wise and the batches will be divided as similar to lab courses. The report will be evaluated by a committee as nominated by CoE constituted with internal & external panels



**21ESX02 Employability Skills II****0 0 2 2****Course Outcomes**

At the end of the course, students will be able to

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 | PO 8 | PO10 | PO12 |
|-----|-----|-----|-----|------|------|------|
| CO1 |     |     |     |      | 3    | 2    |
| CO2 |     |     |     | 1    | 2    | 2    |
| CO3 | 2   | 1   |     | 2    |      |      |
| CO4 | 2   |     | 2   |      |      |      |
| CO5 | 2   |     | 2   |      |      |      |
| CO6 | 2   |     | 2   |      |      |      |

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

**Soft Skills:**

| Sl No.               | Topic & Content                                                                                                                                                                                                               | No. of Periods |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1.                   | <b>Resume (Recap):</b> Resume? Templates? Mistakes to be avoided in a Resume and Steps to be followed in preparing it.                                                                                                        | <b>01</b>      |
| 2.                   | <b>Group Discussions (Recap) &amp; Practice:</b> 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)                 | <b>01</b>      |
| 3.                   | <b>Interview Skills:</b> Interview? Types of Interviews, 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) | <b>03</b>      |
| 4.                   | <b>Mock Interviews:</b> Practice sessions with Feedback.                                                                                                                                                                      | <b>02</b>      |
| 5.                   | <b>Exercises related to Communication:</b> Email Writing, Voice Versant., etc.                                                                                                                                                | <b>01</b>      |
| <b>Total Periods</b> |                                                                                                                                                                                                                               | <b>08</b>      |

**Quantitative Aptitude:**

| Sl. No.              | Topic                 | No. of Periods |
|----------------------|-----------------------|----------------|
| 1.                   | Time and Distance     | 01             |
| 2.                   | Time and Distance     | 01             |
| 3.                   | Problems on Trains    | 01             |
| 4.                   | Problems on Trains    | 01             |
| 5.                   | Blood relations       | 01             |
| 6.                   | Ratio and Proportions | 01             |
| 7.                   | Calendars             | 01             |
| 8.                   | Clocks                | 01             |
| <b>Total Periods</b> |                       | <b>08</b>      |

**Domain Specific: (Advanced Competitive Programming)**

**16 Hours**

**Module-1:**

**Non-Linear Data Structures:** Heaps - Maps- Trees- Graphs - Tries.

**Practice Problems:**

| Week | Topic        | Practice Problem Links                                                                                                                                                                                                |
|------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Searching    | <a href="https://www.hackerearth.com/practice/algorithms/searching/linear-search/practice-problems/">https://www.hackerearth.com/practice/algorithms/searching/linear-search/practice-problems/</a>                   |
|      |              | <a href="https://www.codechef.com/practice/topics/binary-search">https://www.codechef.com/practice/topics/binary-search</a>                                                                                           |
|      |              | <a href="https://leetcode.com/tag/binary-search/">https://leetcode.com/tag/binary-search/</a>                                                                                                                         |
|      |              | <a href="https://www.interviewbit.com/practice/#topics[]=binary-search">https://www.interviewbit.com/practice/#topics[]=binary-search</a>                                                                             |
| 2    | Sorting      | <a href="https://www.codechef.com/practice/topics/sorting">https://www.codechef.com/practice/topics/sorting</a>                                                                                                       |
|      |              | <a href="https://leetcode.com/tag/sorting/">https://leetcode.com/tag/sorting/</a>                                                                                                                                     |
|      |              | <a href="https://leetcode.com/tag/merge-sort/">https://leetcode.com/tag/merge-sort/</a>                                                                                                                               |
|      |              | <a href="https://www.codechef.com/practice/topics/sorting">https://www.codechef.com/practice/topics/sorting</a>                                                                                                       |
| 3    | Heaps & Maps | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=heap">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=heap</a>                             |
|      |              | <a href="https://www.interviewbit.com/courses/programming/heaps-and-maps">https://www.interviewbit.com/courses/programming/heaps-and-maps</a>                                                                         |
|      |              | <a href="https://workat.tech/problem-solving/topics/bst-heaps-and-map/practice">https://workat.tech/problem-solving/topics/bst-heaps-and-map/practice</a>                                                             |
| 4    | Trees - I    | <a href="https://www.codechef.com/practice-old/tags/trees">https://www.codechef.com/practice-old/tags/trees</a>                                                                                                       |
|      |              | <a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=binary-tree">https://leetcode.com/problemset/?page=1&amp;topicSlugs=binary-tree</a>                                                                   |
|      |              | <a href="https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/">https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/</a> |
|      |              | <a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=trees">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=trees</a>                           |
| 5    | Trees - II   | <a href="https://www.codechef.com/practice-old/tags/tree-data-structure">https://www.codechef.com/practice-old/tags/tree-data-structure</a>                                                                           |
|      |              | <a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=binary-search-tree">https://leetcode.com/problemset/?page=1&amp;topicSlugs=binary-search-tree</a>                                                     |
| 6    | Trees - III  | <a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=segment-tree">https://leetcode.com/problemset/?page=1&amp;topicSlugs=segment-tree</a>                                                                 |
|      |              | <a href="https://www.interviewbit.com/courses/programming/tree-data-structure">https://www.interviewbit.com/courses/programming/tree-data-structure</a>                                                               |
| 7    | Graphs - I   | <a href="https://www.codechef.com/practice-old/tags/graphs">https://www.codechef.com/practice-old/tags/graphs</a>                                                                                                     |
|      |              | <a href="https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=graph-theory">https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=graph-theory</a>                       |
| 8    | Graphs - II  | <a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=graph">https://leetcode.com/problemset/?page=1&amp;topicSlugs=graph</a>                                                                               |
|      |              | <a href="https://www.interviewbit.com/courses/programming/graph-data-structure-algorithms">https://www.interviewbit.com/courses/programming/graph-data-structure-algorithms</a>                                       |

**Module-2:****Algorithm design Techniques:** Backtracking – Dynamic Programming – Greedy Approach.

|    |                          |                                                                                                                                                                                                                                                                         |
|----|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9  | Backtracking - I         | <a href="https://www.codechef.com/practice-old/tags/backtracking">https://www.codechef.com/practice-old/tags/backtracking</a>                                                                                                                                           |
|    |                          | <a href="https://leetcode.com/tag/backtracking/">https://leetcode.com/tag/backtracking/</a>                                                                                                                                                                             |
| 10 | Backtracking - II        | <a href="https://www.interviewbit.com/courses/programming/backtracking#problems">https://www.interviewbit.com/courses/programming/backtracking#problems</a>                                                                                                             |
|    |                          | <a href="https://workat.tech/problem-solving/topics/backtracking/practice">https://workat.tech/problem-solving/topics/backtracking/practice</a>                                                                                                                         |
| 11 | Dynamic Programming - I  | <a href="https://www.codechef.com/practice-old/tags/dynamic-programming">https://www.codechef.com/practice-old/tags/dynamic-programming</a>                                                                                                                             |
|    |                          | <a href="https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=dynamic-programming">https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=dynamic-programming</a>                                                           |
|    |                          | <a href="https://www.hackerearth.com/practice/algorithms/dynamic-programming/introduction-to-dynamic-programming-1/practice-problems/">https://www.hackerearth.com/practice/algorithms/dynamic-programming/introduction-to-dynamic-programming-1/practice-problems/</a> |
| 12 | Dynamic Programming - II | <a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=dynamic-programming">https://leetcode.com/problemset/?page=1&amp;topicSlugs=dynamic-programming</a>                                                                                                     |
|    |                          | <a href="https://www.interviewbit.com/courses/programming/dynamic-programming">https://www.interviewbit.com/courses/programming/dynamic-programming</a>                                                                                                                 |

|    |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                        | programming#problems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 13 | Greedy Algorithms - I  | <a href="https://www.codechef.com/practice-old/tags/greedy">https://www.codechef.com/practice-old/tags/greedy</a><br><a href="https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=greedy">https://www.hackerrank.com/domains/algorithms?filters%5Bsubdomains%5D%5B%5D=greedy</a><br><a href="https://www.hackerearth.com/practice/algorithms/greedy/basics-of-greedy-algorithms/practice-problems/">https://www.hackerearth.com/practice/algorithms/greedy/basics-of-greedy-algorithms/practice-problems/</a>                               |
| 14 | Greedy Algorithms - II | <a href="https://www.interviewbit.com/courses/programming/greedy-algorithm#problems">https://www.interviewbit.com/courses/programming/greedy-algorithm#problems</a><br><a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=greedy">https://leetcode.com/problemset/?page=1&amp;topicSlugs=greedy</a>                                                                                                                                                                                                                                                    |
| 15 | Tries - I              | <a href="https://www.codechef.com/practice-old/tags/tries">https://www.codechef.com/practice-old/tags/tries</a><br><a href="https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=trie">https://www.hackerrank.com/domains/data-structures?filters%5Bsubdomains%5D%5B%5D=trie</a><br><a href="https://www.hackerearth.com/practice/data-structures/advanced-data-structures/trie-keyword-tree/practice-problems/">https://www.hackerearth.com/practice/data-structures/advanced-data-structures/trie-keyword-tree/practice-problems/</a> |
| 16 | Tries - II             | <a href="https://leetcode.com/problemset/?page=1&amp;topicSlugs=trie">https://leetcode.com/problemset/?page=1&amp;topicSlugs=trie</a><br><a href="https://workat.tech/problem-solving/topics/string-and-tries/practice">https://workat.tech/problem-solving/topics/string-and-tries/practice</a>                                                                                                                                                                                                                                                                    |

**References:**

1. <https://leetcode.com>
2. <https://www.codechef.com>
3. <https://www.hackerearth.com>
4. <https://www.interviewbit.com>
5. <https://www.hackerrank.com>

**21HSX12 CC & EC Activities II****0 0 1 1****Course Outcomes**

At the end of the course, students will be able to

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 spirit 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   |     | -   | -    |

**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 @ 2 slots every week : 24
- No. of Stream (2-CC + 1-EC) : 3
- No. of slots allotted for each stream : 8

**Requirement for the award of 1- Credit**

- Students shall choose at least two streams of events in each semester
- Students shall secure 75% attendance in each stream of events to obtain a certificate
- Students shall obtain 2 certificates of Participation in each semester.

The credits earned through these courses will be indicated in the grade sheet and will not be taken into account for CGPA calculation.

## 21ATX-- AUDIT COURSE

### Course Outcomes

At the end of the course, students will be able to

At the end of the Audit Course the students will be able to

1. Interpret the meaning of values and select their goals by self- Investigation based on personal values.
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    |

**Career Path I (Artificial Intelligence & Machine Learning)****21CSC11 Exploratory Data Analytics****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Explain the Data Analysis Fundamentals
2. Illustrate various data Visual aids
3. Categorize 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**

| COs | PO1 | PO2 | PO4 | PSO2 |
|-----|-----|-----|-----|------|
| 1   | 3   | 1   | 2   | 3    |
| 2   | 3   | 3   | 3   | 2    |
| 3   | 3   | 1   | 2   | 1    |
| 4   | 2   | 3   | 3   | 2    |
| 5   | 3   | 3   | 3   | 1    |
| 6   | 3   | 3   | 2   | 1    |

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

**Unit I****Exploratory Data Analysis Fundamentals****12Hours**

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, Measurement 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.

*Objectives of Exploratory data Analysis, The applications of EDA.*

**Unit II****12Hours****Visual aids for EDA**

Line chart, Bar charts, Boxplot, 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 tendency, measure of dispersion (standard deviation, variance, skewness, kurtosis, percentiles, quartiles)

*Violin Plots, Inter Quartile Range, Discretization & binning, heatmaps*

**Unit III****12 Hours****Correlation and Inferences from statistical tests:**

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.

*Correlation vs causation, ANOVA*

#### Unit IV

**12 Hours**

**Multivariate Analysis:** overview, Factor Analysis, Cluster Analysis, Discriminant analysis, EDA Case Study

*Multidimensional Scaling, MANOVA vs ANOVA*

**Total: 48Hours**

#### 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. RadhikaDatar, Harish Garg : Hands-On Exploratory Data Analysis with R , Packt,2020
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 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 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. Investigation of missing values
  - i. What's missing? To what extent?
  - ii. Visualizing missing values in a dataframe



**21CSC12 Deep Learning****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to

1. Explain the fundamental of Artificial Neural Networks
2. Identify different data representations for Neural Networks
3. Make use of different CNN models.
4. Compare different character encoding techniques.
5. Exemplify different Deep unsupervised models
6. Examine different deep learning applications.

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 |
|-----|-----|-----|-----|-----|-----|------|
| 1   | 3   | 3   | 2   | 1   | 2   | 3    |
| 2   | 3   | 2   | -   | 1   | 2   | 1    |
| 3   | 3   | 2   | 2   | 2   | 3   | 3    |
| 4   | 2   | 3   | -   | 1   | 2   | 1    |
| 5   | 2   | 3   | 2   | 2   | 2   | 3    |
| 6   | 3   | 3   | 3   | 3   | 3   | 3    |

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

**Unit I****12+8 Hours****Introduction to Neural Networks**

Artificial Neural Networks: Introduction, Neuron Model, Neural Network Architecture, Learning Rules, Single Layer Perceptron, Multilayer Perceptron, adaptive resonance theory (ART), Back propagation Networks : Kohonen's self-organizing networks, Hopfield network, Applications of NN, Data representations for neural networks : 0D tensors, 1D tensors, 2D tensors, tensor attributes, data tensors (Vector data, Time series data, images, video), tensor operations.

*Model Parameters vs Hyperparameters, Types of activation functions, Gradient descent, delta rule*

**Practical Component:**

1. Build a Neural Network with back propagation algorithm and test the same using appropriate dataset.
2. The implementation of tensors and various operations on tensors.
3. Implementation of single layer perceptron and multi-layer perceptron model
4. Build a model using time series data with suitable observation

**Unit II****12+10 Hours**

**convolution networks:** Building blocks of CNNs, Architectures, Filters and Feature Maps, pooling layers, Convolutions over volumes, Softmax regression, Deep Learning frameworks, Training and testing on different distributions, Bias and Variance with mismatched data distributions, Transfer learning, Multi-task learning, end-to-end deep learning.

CNN models: AlexNet, VGG -16, Residual Networks, YOLO

*Keras, tensorflow, data augmentation, Batch Normalization, Dropout*

**Practical Component:**

1. Digit and Character recognizer using CNN
2. Explore AlexNet with suitable dataset
3. Explore VGG16 with suitable dataset
4. Explore ResNet with suitable dataset
5. Explore YOLO with suitable dataset

### Unit III

11+8 Hours

#### Recurrent Networks

One-hot encoding of words and characters, using word embeddings, Recurrent Neural Network Model, Vanishing gradients with RNNs, Gated Recurrent Unit (GRU), LSTM (long short term memory), Encoder Decoder sequence to sequence architectures, Deep Unsupervised Learning: Autoencoders, variational Autoencoders, Generative adversarial network, Deep Boltzmann Machines

*n-grams, bag-of-words, Bi directional RNN, Exploding gradient*

#### Practical Component:

1. One-hot encoding of words and characters using word embeddings.
2. Study the construction and working of Recurrent Neural Network
3. Explore LSTM to predict stock prices based on historic data.
4. Explore GRU to predict stock prices based on historic data.

### Unit IV

12 + 6 Hours

#### Applications of Deep Learning

Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models. Attention models for computer vision tasks

*Batch Gradient Descent vs Stochastic Gradient Descent, limitations of deep learning*

#### Practical Component:

1. Explore applications like Image segmentation and object detection.
2. Explore attention models for computer vision tasks with suitable example
3. Automatic image captioning and video to text models.

**Total: 48+32 Hours**

#### Textbook (s)

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep Learning." An MIT Press book in preparation. (2015).
2. Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms by Nicholas Locascio and Nikhil Buduma O'Reilly Media; 1 edition (June 29, 2017)
3. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition
4. B. Yegnanarayana, "Artificial Neural Networks", PHI.

#### Reference (s)

1. Francois Chollet, Deep Learning with Python
2. Deep Learning: A Practitioner's Approach by Adam Gibson and Josh Patterson Shroff/O'Reilly; First edition (2017)
3. Python Deep Learning by Daniel Slater and Gianmario Spacagna, Packt Publishing; 2/e (January 16, 2020)
4. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006
5. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective

#### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | OBE (%) |
|-----------------|-----------------|-----------------|---------|
| Remember        | 40              | 40              | -       |
| Understand      | 30              | 40              | -       |
| Apply           | 30              | 20              | 50      |
| Analyze         | --              | --              | 50      |
| Evaluate        | --              | --              | -       |

|           |     |     |     |
|-----------|-----|-----|-----|
| Create    | --  | --  | -   |
| Total (%) | 100 | 100 | 100 |

### SAMPLE QUESTION (S)

#### Remember

1. What is neuron?
2. List any two learning rules.
3. Define Convolution neural network
4. Define one-hot encoding technique
5. Define LSTM

#### Understand

1. Explain Multilayer perceptron
2. Explain data representation through tensors
3. Outline different character encoding techniques
4. Illustrate usage of auto encoders
5. Construct Gated Recurrent Unit (GRU)

#### Apply

1. Apply 2D tensors to represent image data
2. Develop CNN model to classify digits.
3. Build a CNN model to recognize images
4. Apply LSTM to extract text from a video
5. Build an appropriate DL model for image segmentation

#### Analyze

1. Examine differences between ANN and CNN.
2. Compare ML with DL
3. Compare and contract different activation functions.

#### Evaluate

1. Evaluate performance of DL and ML for an image classification problem.

### Open Book Exam Questions

#### Question 1:

List out any four datasets available in keras API and explain the features of each dataset and take an handwritten “mnist” numeric numbers dataset from keras API to classify handwritten digits.

#### Question 2:

Take a dataset which consists student photos and apply appropriate CNN models to display name of each student or object which appears on image. Note: Each image in a dataset consists group of mixed objects.

**Career Path II (Full Stack Developer)**  
**21CSC21 Web Programming Languages**

3 0 0 3

**Course Outcomes**

At the end of the course, students will be able to

1. Describe the fundamental concepts and characteristics of web applications.
2. Analyze the templates and common scenarios of web development.
3. Examine various web programming languages and their usages.
4. Analyze the flow of data through various layers of web.
5. Identify the use of data management and compatibility of web browsers.
6. Identify the need of security and performance for a web application.

**CO - PO Mapping**

| COs | PO1 | PO2 | PO3 | PO5 | PS01 | PS02 |
|-----|-----|-----|-----|-----|------|------|
| 1   | 3   | 2   | 2   | 1   | 3    | 2    |
| 2   | 2   | 3   | 3   | 2   | 3    | 1    |
| 3   | 3   | 2   | 3   | 3   | 1    | 3    |
| 4   | 2   | 3   | 2   | 2   | 1    | 3    |
| 5   | 2   | 2   | 2   | 3   | 2    | 2    |
| 6   | 1   | 2   | 3   | 1   | 1    | 1    |

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

**Syllabus****Unit I****12 Hours****Overview of the web**

Web application Overview: Basic concepts of web, Hyper Text Mark-up Language (HTML) and Cascading stylesheets (CSS), Web programming languages

Web server: Introduction, Anatomy of HTTP transaction, Request and response structures, REST APIs.

Data management: Browser storage - Local storage & Session storage, Database storage.

*HTML, CSS, HTTP, Status codes*

**Unit II****12 Hours****Web programming in JavaScript**

Introduction: Basic concepts – Arrays, objects, functions, classes and interfaces, ES6 JavaScript standard.

Node JS: Introduction, Node packages, HTTP web server – Creating a HTTP server that supports Create, Read, Update and Delete operations via various HTTP methods, Adding common request parser

Express: Creating a web server with express and body parser packages

*NodeJS, ES6, Node packages.*

**Unit III****12 Hours****Web programming in Java**

Introduction: Basic concepts – Arrays, objects, methods, classes and interfaces, Extensible Markup Language (XML).

Web programming techniques – Servlets, Java Server Pages (JSP)

Servlets: Introduction, creating a HTTP servlet for Create, Read, Update and Delete operations

Java Server Pages (JSP): Introduction, creating a JSP for Create, Read, Update and Delete operations

*Servlet, XML, JSP*

**Unit IV****12 Hours****Web programming in Python**

Introduction: Basic concepts – Arrays, objects, methods, classes and interfaces, Python's HTTP package

HTTP server: Introduction, creating a server that supports Create, Read, Update and Delete operations

*HTTP server, Python packages*

**Total: 48 Hours**

### Textbook (s)

1. Learn Web Development with Python, Fabrizio Romano, Gaston C. Hillar, ArunRavindran, 1st Edition, 2018.
2. Learn Java for Web Development, Vishal Layka, 1st Edition, 2014.
3. Node.js, John Bach, Alexander Aronowitz, 3rd Edition, 2021

### Reference (s)

1. HTML 5 in simple steps, Kogent Learning Solutions Inc, Dreamtech Press.
2. Beginning HTML, XHTML, CSS, and JavaScript, John Duckett, Wiley India.
3. Beginning CSS: Cascading Style Sheets for Web Design, Ian Pouncey, Richard York, Wiley India.
4. Web Designing & Architecture-Educational Technology Centre, University of Buffalo.

### 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 HTML tags and CSS properties
2. Define web server
3. List four browser storage methods

#### Understand

1. What HTTP method should be used for updating data in a server?
2. Explain the of CSS in web development
3. Illustrate the working of a HTTP server

#### Apply

1. When user opens a website, the underlying web application wants to store browser specific data. What is a good approach for saving the data?
2. Give an example of a scenario that might benefit from browser storage instead of backend storage.

#### Analyze

1. There is a common body parsing workflow that every request to a server must obey. What is a good way to implement it?
2. Compare Servlet and Java Server Page
3. Analyze the general strategy behind cookies and session management.

#### Evaluate

1. Assuming the server received a permission error from the database, what is the best way to propagate it to the user?
2. Describe how to implement user authentication in a web server.

### Open Book Exam Questions

1. A file is to be stored in the web server. However, the access to this file is to be limited to specific set of users. How can one achieve this using a web server?
2. Consider a request that yields data of high cardinality. How can one send the data without affecting the performance of the website?

**21CSC22 Web Application Developments Framework****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to

1. Describe the fundamentals of web frameworks and their role in web development.
2. Classify model, view and controller layers of a web application.
3. Design a web application using a framework.
4. Know the concept of Java web framework.
5. Analyze how modern-day web applications are different from web sites.
6. Learn the technologies of Python web framework.

**CO-PO Mapping**

| COs | PO1 | PO3 | PO5 | PSO2 |
|-----|-----|-----|-----|------|
| 1   | 3   | 3   | 1   | 1    |
| 2   | 3   | 2   | 2   | 2    |
| 3   | 3   | 3   | 3   | 3    |
| 4   | 3   | 3   | 2   | 3    |
| 5   | 3   | 2   | 2   | 3    |
| 6   | 2   | 3   | 3   | 2    |

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

**UNIT- I****10+4 Hours****Fundamentals of Web Framework**

Web framework-History, Types of framework architectures, Model-view-controller (MVC), Three-tier organization

Introduction to frameworks-Framework applications, General-purpose website frameworks-Server-side, Client-side features

*MVC, Three-tier organisation, Framework***Practical Components**

1. Realization of separation of data, data fetch and representation logics
2. Realization of markup- language and it's styling

**UNIT- II****14+10 Hours****Angular – JavaScript web framework**

Introduction – Angular MVC, Model, View, Controller, Ajax, Data binding

Angular concepts - Directives, Scopes, Controllers, Modules, Expressions

Developing a simple To-Do application using AngularJS (Developing a single page application)

*MVC, Ajax, Data binding***Practical Components**

1. Implementation of angular directives
2. Implementation of angular components
3. Implementation of custom/user-defined directive
4. Create a TODO Application using Angular JS
5. Implement routing and navigation in Angular JS

**Unit III****13+12 Hours****React framework**

Introduction to React: What is Full-Stack Web Development?, Node.js and NPM, Front-end JavaScript Frameworks and Libraries Overview, Introduction to React, React App Overview, Introduction to JSX, React Components, React Components: State and Props, React Components: Lifecycle Methods Part 1

React Router and Single Page Applications: Presentational and Container Components, React Components: Lifecycle Methods Part 2, Functional Components, React Virtual DOM, React Router, Single Page Applications, React Router: Parameters

React Forms, Flow Architecture and Introduction to Redux: Controlled Forms, Uncontrolled Components, The Model-View-Controller Framework, The Flux Architecture, Introduction to Redux, React Redux Forms

### Practical Components

1. React Components
2. React Router and Single page applications
3. Controlled Form Validation, Uncontrolled Forms
4. Create a TODO Application using React JS
5. Creating a movie list Application in React JS
6. Creating a Progressive web application with Reusable React Components

### Unit IV

**11+6 Hours**

#### Django – Python web framework

Introduction to Django- History-Django Components-Alternate Components-MVC Architecture in Django  
MVC creation in Django – Configuring Django, Creating model, view and controller in Django, REST in Django and templates  
*MVC, Django, REST*

### Practical Components

1. Creating models for database queries
2. Writing Django template for rendering data
3. Implementation of REST API using Django

**Total: 48+32 Hours**

### Textbook (s)

1. Angular: Up and Running, ShyamSeshadri, 1st Edition, O'Reilly, 2018
2. Struts the Complete Reference, James Holmes, 2nd Edition, Mc. Graw Hill Professional, 2006.
3. Programming with Django, Wiley Publishing

### Reference (s)

1. Angular 6 for Enterprise-Ready Web Applications, DoguhanUluca, 1st edition, 2018
2. The Definitive Guide to Django, Adrian Holovaty, Jacob Kaplan-Moss, Apress, 2009.
3. Struts 2 In Action, Donald Brown, Chad Michael Davis, Scott Stanlick, Dreamtech press, 2008.

### Internal Assessment Pattern

| Cognitive Level   | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam (%) |
|-------------------|-----------------|-----------------|--------------------|
| <b>Remember</b>   | 20              | 10              | --                 |
| <b>Understand</b> | 50              | 40              | --                 |
| <b>Apply</b>      | 30              | 30              | --                 |
| <b>Analyze</b>    | --              | 20              | --                 |
| <b>Evaluate</b>   | --              | --              | --                 |
| <b>Create</b>     | --              | --              | --                 |
| Total (%)         | 100             | 100             | --                 |

### Sample Question (S)

#### Remember

1. Explain model, view and controller
2. List any 4 directives in Angular
3. List the Struts Tag Libraries.
4. Define a scope in Angular
5. Define a template in Django

#### Understand

1. Write a template in Django that conditionally renders data.
2. Write an example custom tag in Struts
3. Illustrate form validation in Struts.
4. Illustrate the use of ng-filter directive in AngularJS
5. Write an example snippet for ng-if directive in AngularJS
6. Differentiate between plain-validator and field-validator in Struts.

7. For a single Struts application, can we have multiple struts-config.xml files?

### Apply

1. Write a snippet that uses ng-for, ng-if and compare it with usage of ng-filter directives in AngularJS
2. Write a sample code for creating a User model in Django that has the following properties:
  - a. Name (string)
  - b. Age (number)
  - c. Email (email)
  - d. Phone number (number)
3. Write a sample Django template that renders the User data whose age is > 15.
4. Create an actionForm bean in Struts.
5. Illustrate the steps required for setting up validator framework in Struts.

### Analyse

1. What does the following code snippet in struts-config.xml do?

```
<exception
  key="stockdataBase.error.invalidCurrencyType"
  path="/AvailbleCurrency.jsp"
  type="Stock.account.illegalCurrencyTypeException">
</exception>
```
2. When can global scope be used over local scope in AngularJS?
3. Why is ng-filter more preferable than ng-if in AngularJS?
4. What happens to existing data in the database when models are edited in Django?
5. Write User and Group models with relevant attributes, where a User can be part of multiple groups. Ensure that when a User is queried, the groups he belongs too are also part of the response.



**Career Path III (Cyber Security)**  
**21ITC31 Fundamentals of Security**

**3 0 0 3**

**Course Outcomes**

At the end of the course, students will be able to

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 | PO5 | PSO1 | PSO2 |
|----|-----|-----|-----|------|------|
| 1  | 3   | 1   | 1   | 3    | 3    |
| 2  | 3   | 3   | 2   | 3    | 2    |
| 3  | 1   | 2   | 3   | 2    | 2    |
| 4  | 2   | 3   | 1   | 3    | 3    |
| 5  | 3   | 2   | 3   | 2    | 3    |
| 6  | 3   | 2   | 2   | 3    | 3    |

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

**Unit I**

**12 Hours**

**Security concepts**

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.

*protocols suite, hacking, network sniffing, social engineering*

**Unit II**

**12 Hours**

**Cryptography**

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

*Applications of Cryptography, cipher types, steganography*

**Unit III**

**12 Hours**

**Security Threats and Vulnerabilities**

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.

*Types of firewalls, advanced persistent threat*

**Unit IV**

**12 Hours**

**Network Security**

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.

*TCP Vulnerabilities, SSH vs SSL,*

**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, 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, 3<sup>rd</sup> 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. Buila 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?

**21ITC32 Cybernet Security****3 0 2 4****Course Outcomes**

At the end of the course, students will be able to

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 cyber-crimes, IT laws and acts.

**CO-PO Mapping**

| COs | PO1 | PO3 | PO4 | PO5 | PO12 | PSO1 | PSO2 |
|-----|-----|-----|-----|-----|------|------|------|
| 1   | 3   | 3   | 1   | 1   | 2    | 1    | 2    |
| 2   | 3   | 3   | 1   | 3   | 3    | 1    | 1    |
| 3   | 1   | 2   | 3   | 3   | 3    | 2    | 2    |
| 4   | 3   | 1   | 1   | 3   | 3    | 3    | 2    |
| 5   | 1   | 3   | 3   | 3   | 3    | 3    | 3    |
| 6   | 1   | 3   | 2   | 1   | 1    | 1    | 1    |

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

**Unit I****Introduction to Cyber Security****12+8 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 cyber crimes, Reasons for Cyber Crimes, Cyber Security Tools : Nmap, Metasploit, Wireshark, tcpdump, snort.

*Cyber security awareness, social engineering, cyber stalking*

**Practical Components**

1. Lab Activity: Study the use of network reconnaissance tools like WHOIS, dig, ping, hping, traceroute, nslookup to gather information about networks and domain registrars.
2. Lab Activity: Study of packet sniffing tools like tcpdump, Wireshark, etc.
3. Lab Activity: Perform Network Scanning using NMAP in Windows and ZENMAP in Kali Linux.
4. Lab Activity: Study of Intrusion detection tool SNORT.

**Unit II****Web security****12+8 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)

*Cross-Site Request Forgery (XSRF/CSRF), spear phishing.*

**Practical Components**

1. Lab Activity: Perform port scanning using Nmap.
2. Lab Activity: Penetration Testing and Exploiting with Metasploit, Armitage, and msfconsole.
3. Lab Activity: Simulate DoS and DDoS attacks using various tools.
4. Lab Activity: Study of SQLMap to explore SQL Injection attacks.

### Unit III

#### Intrusion Detection System

**12+8 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

*firewall vs IDS, Physical IDS, honeynet*

#### Practical Components

1. Lab Activity: Use iptables in Linux to create firewalls.
2. Lab Activity: Use Snort as a packet sniffer and write your own IDS rules.
3. Lab Activity: Setup honeypot.
4. Lab Activity: Demonstrate Intrusion Detection System (IDS) using any tool (SNORT or any other software).

### Unit IV

#### Cyber Laws and Digital Forensics

**12 + 8 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.

*Cybercrime and Punishment*

#### Practical Components

1. Lab Activity: Write a security policy for password protection.
2. Lab Activity: Install Rootkits to study a variety of options.
3. Lab Activity: Implement a Digital Signature Scheme.
4. Lab Activity: Case Study on Indian IT Act 2000.

**Total: 48+32 Hours**

#### Textbook (s)

1. Wenliang Du, Computer & Internet Security: A Hands-on Approach, (2020)
2. William Stallings, Lawrie Brown, Computer Security Principle sand Practice Third Edition, 2015
3. SunitBelapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, Wiley India Pvt. Ltd, 2011.
4. Nelson Phillips and EnfingerSteuart, "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. DafyddStuttard 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 (%) | OBE (%) |
|-----------------|-----------------|-----------------|---------|
| Remember        | 50              | 40              | -       |
| Understand      | 30              | 40              | -       |
| Apply           | 20              | 20              | 50      |
| Analyze         | --              | --              | 50      |

|           |     |     |   |
|-----------|-----|-----|---|
| 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 cyber crime.
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 intruder.
2. Apply snort rules to detect intrusion
3. Identify open ports in a network using nmap.
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         | 202.168.1.0  | > 1023    | Allow  |
| 2 | 202.168.1.1    | Any         | Any          | Any       | Deny   |
| 3 | Any            | Any         | 202.168.1.1  | Any       | Deny   |
| 4 | 202.168.1.0    | Any         | Any          | Any       | Allow  |
| 5 | Any            | Any         | 202.168.1.2  | SMTP      | Allow  |
| 6 | Any            | Any         | 202.168.1.3  | 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 202.168.1.0 to 202.168.1.254. 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.
- d) Nmap to reveal open services and ports by IP address as well as by domain name(Note: IP number is of your choice).
- e) Nmapcommand to scan multiple hosts at once.
- f) Nmapcommand to find OS information of a host(host IP address is of your choice).
- g) Nmapcommand to check firewall settings of a host(host IP address is of your choice).

## 7<sup>th</sup> Semester

### Career Path I (Artificial Intelligence & Machine Learning)

#### 21CSC13 Natural Language Processing

3 0 0 3

#### Course Outcomes

At the end of the course, students will be able to

1. Describe the fundamentals and building blocks of Natural Language Processing (NLP).
2. Explain different text representation techniques and labeling methods in NLP.
3. Apply different Natural Language models and named entities
4. Explain the fundamentals of RNN and their applications in NLP.
5. Make use of GRUs and LSTM models for translation
6. Describe various applications of NLP across different domains.

#### CO-PO Mapping:

| CO | PO1 | PO2 | PO3 | PO4 | PO12 | PS02 |
|----|-----|-----|-----|-----|------|------|
| 1  | 3   | 2   | 1   | 1   | 2    | 2    |
| 2  | 3   | 2   | 2   | 2   | 2    | 3    |
| 3  | 3   | 3   | 2   | 1   | 3    | 3    |
| 4  | 3   | 3   | 2   | 3   | 3    | 3    |
| 5  | 3   | 3   | 2   | 3   | 3    | 3    |
| 6  | 3   | 3   | 2   | 3   | 3    | 3    |

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

#### Unit I

12 Hours

##### Introduction to NLP:

History, NLP in the real world, Building blocks of language, Approaches to NLP, NLP Pipeline, NLP Challenges, Deep learning in NLP, Morphology fundamentals;

*Objectives of NLP, The applications of NLP.*

#### Unit II

12 Hours

##### Text Representation and Sequence Labelling

Basic Vectorization approaches- One-Hot Encoding, Bag of Words, Bag of N-Gram, TF-IDF; Distributed universal text and handcrafted feature Representations, Neural language models, N-gram language model Sequence labeling for POS and Named Entities: POS tagging, Named Entities tagging, hidden markov models, conditional Random Fields Visualizing Embeddings, Viterbi algorithm.

*Evaluation of Named Entity Recognition, Markov chains.*

#### Unit III

12 Hours

##### Deep learning architectures for NLP:

RNN for language model, Sequence Labeling and Sequence Classification, Encoder-Decoder with RNNs and Transformers, GRUs and LSTMs for machine translation, Convolutional neural networks for sentence classification.

*Transformers as Autoregressive Language Models, Potential Harms from Language Models.*

#### Unit IV

12 Hours

##### Case Study on NLP:

sentiment analysis, machine translation, automated speech recognition systems, question-answering based systems, topic modelling, Text Generation and Summarization.

*Semantic Role Labeling Lexicons for Sentiment, Affect, and Connotation.*

**Total: 48 Hours**

**Textbook (s)**

1. Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft)
2. Yoav Goldberg. Neural Network Methods for Natural Language Processing
3. Vajjala, Sowmya, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana. Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems. O'Reilly Media, 2020.

**Reference (s)**

1. Rajesh Arumugam, Rajalingappaa Shanmugamani : Hands-On Natural Language Processing with Python
2. Manning C., Schütze H., Foundations of Statistical Natural Language Processing--(MIT Press)
3. Jacob Eisenstein. Natural Language Processing.

**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 Natural language processing.
2. Define purpose of different building blocks of NLP
3. List any two challenges in NLP.

**Understand**

1. Explain different Basic Vectorization approaches
2. Explain the role of various Named Entities
3. Explain purpose of Viterbi algorithm

**Apply**

1. Apply various Deep learning models for NLP
2. Make use of RNN for text translation

**Analyze**

1. Compare and contrast GRUs and LSTMs for machine translation.
2. Distinguish various methods to Convolutional neural networks for sentence classification.

**Evaluate**

1. Evaluate the statistics of a sentiment analysis
2. Design an automated speech recognition systems

**Open book Question:**

1. Design a model to analyse a given sentence is negative, positive or neutral for a given dataset.
2. Design and develop a model to translate a text to speech for a given set of statements.



## Career Path II (Full Stack Developer)

### 21CSC23 Web Application Databases

3 0 0 3

#### Course Outcomes

At the end of the course, students will be able to

1. Describe the working principles of web-based client-server applications.
2. Analyze architecture of various web-based applications.
3. Examine the requirements of structured and un-structured data.
4. Identify the structure of modern-day web applications.
5. Identify the use advanced querying techniques to enable faster data transfer.
6. Analyze the security issues in data transfer via the web.

#### CO – PO Mapping

| COs | PO1 | PO3 | PO5 | PS02 |
|-----|-----|-----|-----|------|
| 1   | 3   | 3   | 1   | 1    |
| 2   | 3   | 2   | 2   | 2    |
| 3   | 3   | 3   | 3   | 3    |
| 4   | 3   | 3   | 2   | 3    |
| 5   | 3   | 2   | 2   | 3    |
| 6   | 2   | 3   | 3   | 2    |

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

#### Syllabus

##### Unit I

12 Hours

##### Overview of Web databases

Web application Overview: Basic concepts of web, Web database architectures, Web database gateways, Web-database programming: Client-side and server-side web database programming  
*Database gateways, CGI, Browser extensions*

##### Unit II

12 Hours

##### Structured and unstructured Web databases

Structured databases: Structured data, Data models, Relational database management systems, MySQL – Introduction, querying, updating and deleting data, Challenges of structured data.  
Unstructured databases: Unstructured data and its usages, NoSQL databases, MongoDB- Introduction, querying, updating and deleting data, Challenges of unstructured data- Cassandra, GraphQL  
*Structured data, unstructured data, Relational database, Document-based database*

##### Unit III

12 Hours

##### Database connections & data operations

Connecting to database: Native database APIs, Database-independent APIs, Template-driven database access packages, Third-party class libraries.  
CRUD operations: Querying web database, User driven querying, writing to web databases – create, delete and update.  
*JDBC, ODBC, template parsing.*

##### Unit IV

12 Hours

##### Authentication, Authorization and Communication in web services

Web requests: Structure of web requests, JavaScript Object Notation (JSON), Request methods – GET, POST, PUT, DELETE, response status codes  
State management: Session management, cookies, request and response headers.  
Security: User authentication, User authorisation, Proxy servers, Digital signatures, Digital certificates, SSL and HTTPS.  
Kafka, RabbitMQ  
*JSON, User authentication and authorisation*

**Total: 48 Hours****Textbook (s)**

1. Web Database Applications with PHP and MySQL, Hugh E. Williams, David Lane, 2nd Edition, O'Reilly, 2004.
2. NoSQL Distilled, PramodSadalage, Martin Fowler, 1st Edition, 2012

**Reference (s)**

1. Getting Started with NoSQL, GauravVaish, Paperback, Packt, 2013.
2. Fundamentals of Database Systems, ElmasriNavathe Pearson Education.
3. An Introduction to Database systems, C.J. Date, A.Kannan, S.SwamiNadhan, Pearson, 8th Edition.
4. Web Application Security, Andrew Hoffman, O'Reilly, 2020.

**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 various database architecture layers
2. Define structured and unstructured data
3. List various database connections

**Understand**

1. Explain Data models
2. Explain the difference between structured and unstructured data
3. Illustrate how state management is achieved for web database requests

**Apply**

1. When the incoming data varies from request to request, storing and querying it appropriately is a critical problem. Apply the concept of databases to solve this problem.
2. Give an example of a scenario that might benefit from a database that supports authorisation.

**Analyze**

1. Data needs to be secured from various users using authentication. How can this be achieved?
2. Compare various database connection techniques.
3. Analyze the general strategy behind state management and its importance.

**Evaluate**

1. Assuming the database has recognised an unusual activity, what can it do to protect the data?
2. Describe how to implement authorisation using SSL.

**Open Book Exam Questions**

1. Data is to be shared among various people of an organization with various roles. Data can be viewed by anyone with proper authentication whereas only people with certain designation can update or delete data. Write an authorization technique that can help achieve this.
2. Consider a messaging application that is built using a NoSQL database:
  - Suggest a good type of NoSQL storage technique that can help improve performance
  - If we use key-value based approach, what are the pitfalls of it?

### Career Path III (Cyber Security)

#### 21ITC33 Cloud Security

3 0 0 3

#### Course Outcomes

At the end of the course, students will be able to

1. Understand core concepts of the cloud computing paradigm
2. Learn about characteristics, advantages and challenges brought by the various models and services in cloud computing.
3. Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based services.
4. Understand security challenges, threats and risks involved in the cloud application
5. Analyze the Security Requirements for the Architecture in cloud services
6. Understand Data Security and best practices involved in securing the cloud.

#### CO-PO Mapping

| CO | PO1 | PO2 | PO4 | PO5 |
|----|-----|-----|-----|-----|
| 1  | 3   | 1   | 1   | 2   |
| 2  | 2   | 2   | 2   | 3   |
| 3  | 2   | 1   | 2   | 2   |
| 4  | 3   | 2   | 2   | 3   |
| 5  | 2   | 3   | 3   | 2   |
| 6  | 3   | 2   | 2   | 2   |

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

#### Unit I

11 Hours

Cloud Computing Fundamentals and Architecture- Understanding and Roots of Cloud Computing, Essential Characteristics, Cloud Reference Architecture, Cloud Service Models: SaaS, PaaS, IaaS, Cloud Deployment Models, Expected Benefits, Forming Clouds with example.

#### Unit II

13 Hours

Cloud Computing Software Security Fundamentals- Cloud Information Security Objectives, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Security Concerns, Risk Tolerance, Legal and Regulatory Issues

#### Unit III

12 Hours

Cloud Computing Risk Issues and Security Challenges:

The CIA Triad, Privacy and Compliance Risks, Threats to Infrastructure, Data, and Access Control, Cloud Service Provider Risks

Security Challenges- Security Policy Implementation, Virtualization Security Management, VM Security Recommendations, VM-Specific Security Techniques.

#### Unit IV

12 Hours

Securing the cloud: Architecture and Data Security

Security Requirements for the Architecture, Security Patterns and Architectural Elements, Cloud Security Architecture, Planning Key Strategies for Secure Operation .

Overview of Data Security in Cloud Computing, Data Encryption: Applications and Limits, Cloud Data Security: Sensitive Data Categorization, Cloud Data Storage, Cloud Lock-in, Key strategies to secure the cloud, Best practices for cloud computing, security monitoring

**Total: 48 Hours**

#### Textbook (s)

1. Russell Dean Vines and Ronald L. Krutz, Cloud Security: A Comprehensive Guide To Secure Cloud Computing, Wiley India Pvt Ltd, 2010
2. Vic Winkler (J.R.), Securing The Cloud: Cloud Computing Security Techniques and Tactics, Syngress/Elsevier, 2011

### Reference (s)

1. Thomas Erl, Cloud Computing Design Patterns, Prentice Hall, 2015
2. Barrie Sosinsky, Cloud Computing Bible, Wiley India, 2011
3. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011

### Internal Assessment Pattern

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

### Remember

1. Define Cloud Computing.
2. List Cloud Service Models
3. List Cloud Information Security Objectives
4. What is cloud foundry?

### Understand

1. Identify Cloud Computing Risk Issues and Security Challenges
2. Explain the Data Security
3. Explain all session management techniques
4. Explain different cloud service models

### Apply

1. Demonstrate the process for war file deployment in the cloud.
2. How does Sensitive Data Categorization happens in Cloud?

### Analyze

1. Justify your answer which technique is used for Session management.
2. Deploy Security Challenges

**21IT010 Social Network Analysis (Elective V)****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Acquire Knowledge to analyze Social Networks
2. Model, Aggregate and Represent Knowledge for Semantic Web
3. Use Extraction and Mining tools for Social Networks
4. Apply Reality Mining to Predict Human Behaviors for Social Communities
5. Apply various Algorithms for Evolution and Opinion Mining in Social Networks
6. Write algorithms and systems for expert location in social networks

**CO – PO Mapping**

| COs | PO2 | PO4 | PO5 |
|-----|-----|-----|-----|
| 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

**Syllabus****Unit I****11 Hours****Introduction**

Introduction to Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Statistical Properties of Social Networks, Network analysis, Development of Social Network Analysis-Key concepts and measures in network analysis, Discussion networks-Blogs and online communities-Web-based networks

*Case Studies of Social Network sites like Facebook-Twitter-Linkedin etc.*

**Unit II****13 Hours****Evolution**

Evolution in Social Networks– Framework, Tracing Smoothly Evolving Communities, Models and Algorithms for Social Influence Analysis, Influence Related Statistics, Social Similarity and Influence, Influence Maximization in Viral Marketing, Link Prediction in Social Networks, Feature based Link Prediction

*Neurons & Social Actor-Advanced techniques in Link Prediction*

**Unit III****12 Hours****Mining Communities and Opinion Mining**

Applications of Community Mining Algorithms, Node Classification in Social Networks  
Opinion Extraction–Sentiment Classification and Clustering, Temporal Sentiment Analysis-Irony Detection in Opinion Mining-Wish Analysis–Product Review Mining–Review Classification  
*Tracking Sentiments towards Topics over Time*

**Unit IV****12 Hours****Modelling and Visualization**

Visualizing Online Social Networks, A Taxonomy of Visualizations, Graph Representation-Centrality-Clustering-Node-Edge Diagrams-Visualizing Social Networks with Matrix-Based Representations-Node-Link Diagrams, Hybrid Representations, Modelling and Aggregating Social Network Data, Random Walks and their Applications, Ontological representation of Social Individuals and Relationships.

*Use of Hadoop and MapReduce-Gephi*

**Total: 48 Hours****Textbook (s)**

1. Charu C. Aggarwal, Social Network Data Analytics, Springer, 2011

- Peter Mika, Social Networks and the Semantic Web, Springer, 1st Edition, 2007.

### Reference (s)

- BorkoFurht, Handbook of Social Network Technologies and Applications, Springer, 1st Edition, 2010.
- GuandongXu,Yanchun Zhang and Lin Li, Web Mining and Social Networking, Techniques and applications, Springer, 1st Edition, 2011.
- Giles, Mark Smith, John Yen, Advances in Social Network Mining and Analysis, Springer,2010.
- Ajith Abraham, Aboul Ella Hassanien, VáclavSnášel, Computational Social NetworkAnalysis: Trends, Tools and Research Advances, Springer, 2009.

### SAMPLE QUESTION (S)

#### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Comprehensive Test1 (%) |
|-----------------|-----------------|-----------------|-------------------------|
| Remember        | 35              | 20              | -                       |
| Understand      | 35              | 30              | -                       |
| Apply           | 20              | 40              | 70                      |
| Analyze         | 10              | 10              | 20                      |
| Evaluate        | --              | -               | 10                      |
| Create          | --              | -               | -                       |
| Total (%)       | 100             | 100             | 100                     |

### Sample Question (S)

#### Remember

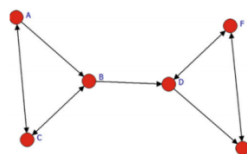
- What are the limitations of current web?
- List the statistical properties of social networks
- Define social similarity.
- What are the two different measures in influence related statistics

#### Understand

- Explain about development of semantic web in research.
- Demonstrate web based networks.
- Illustrate the ways of visualizing social networks with matrix based representation and node – link diagram.
- Explain core methods of community detection and mining.
- Explain algorithms and systems for expert location in social networks.
- Outline the models and algorithms for social influence analysis.

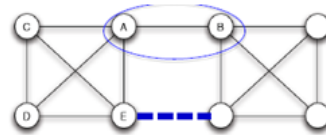
#### Apply

- Make use of the following graph to solve Degree Centrality, Between-ness Centrality and Cliques.



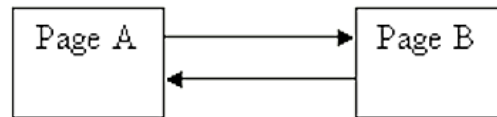
- Solve Path, Length and Distance between nodes (i.e., Density measures) using SNA Data Processing Tools.
- Make use of the above graph to solve network density and cut points.
- Develop random graphs using ErdosReini Model
- Solve Weak Ties, Traidic closure for the following graph.

<sup>1</sup>Comprehensive test should contain only questions related to Higher Order Thinking (HOT) Skills Pertaining to this course

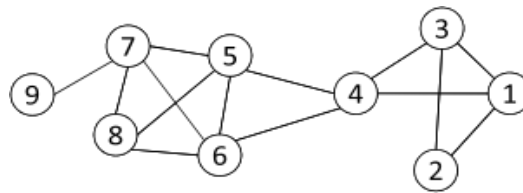


### Analyse

6. Compute PageRank for the following figure.



7. Discover Spectral Clustering steps for the following graph.



8. Examine the ways to visualize community's hubs and node centrality measures using sna package.
9. Analyze positive, moderate and negative feeds using sentiment analysis on twitter data.

### Open Book Exam Questions

1. Visualization of team data in Gephi-What should be my considerations?
2. How do we calculate data processing time using cloud analyst?

**21CS011 Optimization Techniques (Elective V)****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Explain the need of optimization of engineering systems.
2. Formulate and solve linear programming problems.
3. Solve the problems on network models such as transportation and assignment.
4. Analyze the complexity of solutions to an optimization problem.
5. Apply unconstrained optimization and constrained non-linear programming
6. Illustrate about dynamic programming and modern optimization techniques.

**CO-PO Mapping**

| CO | PO2 | PO3 | PO5 | PO12 |
|----|-----|-----|-----|------|
| 1  | 2   | 2   | 2   | 2    |
| 2  | 2   | 1   | 1   | 2    |
| 3  | 3   | 2   | 2   | 2    |
| 4  | 2   | 1   | 1   | 2    |
| 5  | 1   | 3   | 3   | 2    |
| 6  | 3   | 2   | 2   | 2    |

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

**Unit I****12 Hours****Introduction to Optimization & Classical Optimization Techniques:**

Engineering Applications of Optimization, Statement of Optimization Problem.

Classical Optimization Techniques: Single variable optimization, multivariable optimization with no constraints, multivariable optimization with equality constraints, multivariable optimization with inequality constraints, convex programming problem.

*Optimization techniques, Engineering Optimization Literature.***Unit II****12 Hours****Linear Programming & Transportation Problems:**

Applications of Linear Programming, 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 – simplex algorithm.

Introduction to Transportation problems, various methods of Transportation problem, Variations in Transportation problem,

*Two phases of simplex method***Unit III****12 Hours****Assignment Problems & Unconstrained Nonlinear Programming:**

Introduction to Assignment problems, variations in Assignment problems. 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.

Introduction, Random Search Methods, Grid Search method, Univariate method, Powell's Method, Simplex Method, Gradient of a Function, Steepest descent method. Newton's Method.

*Marquardt Method, Quasi-Newton Methods***Unit IV****12 Hours****Dynamic Programming & Modern methods of Optimization:**

Multistage decision process, Concept of suboptimization and principle of optimality, computational procedure in dynamic programming, Examples of calculus and tabular method of solutions.

Modern methods of optimization: Genetic Algorithms, particle swarm optimization and Ant colony optimization.

*Simulated Annealing, neural network-based optimization***Total: 48 Hours**



### Textbook (s)

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice, Wiley, 4th edition, 2009.

### Reference (s)

1. Deb K. - Optimization for Engineering Design Algorithms and Examples, PHI - 2000
2. George Bernard Dantzig, MukundNarainThapa, Linear programming, Springer series in operations research 3rd edition, 2003.
3. H.A. Taha, Operations Research: An Introduction, 8th Edition, Pearson/Prentice Hall, 2007.
4. Kalyanmoy Deb, Optimization for Engineering Design-Algorithms and Examples, PHI Learning Pvt. Ltd., New Delhi, 2005.
5. Arora J, Introduction to Optimization Design, Elsevier Academic Press, New Delhi, 2004
6. Saravanan R, Manufacturing Optimization through Intelligent Techniques, Taylor & Francis (CRC Press), 2006
7. Hardley G., Linear Programming, Narosa Book Distributors Private Ltd., 2002

### Internal Assessment Pattern

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

### Understand

1. Explain about soft computing?
2. Classify supervised learning and unsupervised learning?
3. Summarise the difference between conventional control system and Fuzzy control

### Apply

1. Demonstrate the application of Fuzzy logic in Industrial manufacturing?
2. Show the differences between Traditional Algorithms and Genetic Algorithm
3. A genetic algorithm is to be used to evolve a binary string of length n containing only 1s. The initial population is a randomly generated set of binary strings of length n. Give a suitable fitness function for this problem.

### Analyze

1. If the population size in a genetic algorithm is restricted to 1, what search algorithm does it correspond to? Justify your answer.
2. Consider two fuzzy sets X and Y with the following membership functions:  $X = \{(x_1/0.4, (x_2/0.7), (x_3/0.8), (x_4/1)\}$   $Y = \{(x_1/0.3), (x_2/0.6), (x_3/0.5), (x_4/0.9)\}$  Resolve:  $X \cup Y, X \cap Y, X - Y, X + Y, X * Y$

### Open Book Examination Question

#### Evaluate

1. Suppose a genetic algorithm uses chromosomes of the form  $x = abcdefgh$  with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as:  $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$  and let the initial population consist of four individuals with the following chromosomes:  $x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$   $x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$   $x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$   $x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$ . Evaluate the fitness of each individual, showing all your workings, and arrange the min order with the fittest first and the least fit last.
2. Suggest a suitable evolutionary computing technique for finding optimized Economic Load Dispatch. Support your answer by providing detailed analysis

3. Consider four travel packages offered by Thomas Cook, Club Mahindra, World around, and Himalaya Travels. We want to choose one. Their costs are INR 100,000, INR 200,000, INR150,000 and INR 175,000. Their travel time in hours are 1150, 200, 100, and 125 respectively. They are viewed as interesting with degrees 0.4, 0.3, 0.6, 0.5. Define your own fuzzy set of acceptable travel times. Then determine the fuzzy set of interesting travel packages whose cost and travel times are acceptable and use this set to choose one of your own packages

**21CS012 Wireless Adhoc Network (Elective-V)****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Discuss the various challenging issues of wireless Adhoc networks.
2. Apply the MAC protocols using reservation and scheduling mechanisms.
3. Apply the routing protocols and transport layer protocol using various TCS mechanisms in wireless Adhoc networks.
4. Discuss the issues of MAC and network layer solution to provide quality of service.
5. Describe the significances of various battery management schemes for wireless Adhoc networks.
6. Analyze the security requirements and secure routing in wireless Adhoc networks.

**COs-POs Mapping**

| COs | PO2 | PO3 | PO10 | PO12 |
|-----|-----|-----|------|------|
| 1   | 2   | 3   | 2    | 1    |
| 2   | 3   | 2   | 2    | 2    |
| 3   | 3   | 3   | 2    | 2    |
| 4   | 2   | 3   | 2    | 1    |
| 5   | 1   | 3   | 2    | 1    |
| 6   | 2   | 3   | 2    | 2    |

3-Stronglylinked|2-Moderatelylinked|1-Weaklylinked

**UNIT I****12 Hours**

**Wireless AdHoc Networks:** Introduction, Properties, applications, limitations, Issues in AdHoc Wireless Networks, Ad Hoc Wireless Internet. **MAC Protocols:** Introduction, Issues in Designing a MAC protocol for AdHoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MACProtocols, Contention-Based Protocols, Contention-Based Protocols with reservation Mechanisms.

*Contention-Based MAC Protocols with Scheduling Mechanisms*

**UNIT II****12 Hours**

**RoutingProtocols:**Introduction,IssuesinDesigningaRoutingProtocolforAdHocWirelessNetworks,Classifi cation of Routing Protocols, Proactive/ Table-Driven Routing Protocols, Reactive/ On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols, Power – Aware Routing Protocols. **TransportLayer:** Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCPOverAdHoc Wireless Networks.

*OtherTransportLayerProtocolforAd HocWirelessNetworks.*

**UNIT III****12 Hours**

**QualityofService:**Introduction,IssuesandChallengesinProvidingQoSInAdHocWirelessNetworks,Classific ation of QoS Solutions, MAC Layer Solutions, Network Layer Solutions, QoS Frameworks for Ad HocWirelessNetworks.**EnergyManagement:**Introduction,NeedforEnergyManagementinAdHocWireless Networks,ClassificationofAdHocWirelessNetworks,BatteryManagementSchemes,TransmissionPowerMa nagementSchemes.

*System Power Management Schemes.*

**UNIT IV****12 Hours**

**Security Protocols: Network Security Requirements, Issues and Challenges in Security**

**Provisioning,**Network Security Attacks, Key Management, Secure Routingin AdHoc Wireless Networks.

**WirelessSensorNetworks:** Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, Location Discovery.

*Quality of a Sensor Network, Evolving Standards, Other Issues*

**Total: 48 Hours**

### Textbook(s)

1. AdHoc Wireless Networks: Architectures and Protocols-C.Siva Ram Murthy and B.S.Manoj,2004,PHI.
2. WirelessAd-hocandSensorNetworks:Protocols,PerformanceandControl-JagannathanSarangapani,CRCPress

### Reference(s)

1. WirelessSensorNetworks-C.S.Raghavendra,KrishnaM.Sivalingam,2004,Springer.
2. Ad-HocMobileWirelessNetworks:Protocols&Systems,C.K.Toh,Firsted.PearsonEducation

### SAMPLEQUESTION(S)

#### Internal Assessment Pattern

| Cognitive Level | Int.Test1 (%) | Int.Test2 (%) | OBE(%) |
|-----------------|---------------|---------------|--------|
| Remember        | 40            | 50            | 20     |
| Understand      | 35            | 30            | 20     |
| Apply           | 25            | 20            | 60     |
| Analyze         | --            | --            | --     |
| Evaluate        | --            | --            | --     |
| Create          | --            | --            | --     |
| Total(%)        | 100           | 100           | 100    |

#### Remember

1. Find out the major significance of cellular wireless networks and Adhoc wireless networks.
2. List few latest application systems of Adhoc wireless networks.
3. Identify the challenging issues in Adhoc network configuration and maintenance.
4. Show the proactive steps to solve the hidden terminal problem.
5. List the transmission impediments of wireless channel.
6. List the issues that affect the design, deployment, and performance of adhoc wireless system.
7. List the benefits when deployment of a commercial adhoc wireless network compared to wired network.
8. Write the advantages of hybrid wireless networks.
9. Define Scalability.
10. Write the design goals of MAC protocol for ad-hoc networks.
11. Describe the issues of MAC protocol for adhoc networks in brief.
12. Show the classifications of MAC protocol.
13. Identify the effects of exposed terminal problem in wireless networks.
14. Relate the advantages of directional antennas of MMAC over MACAW.
15. Name the mechanisms used in MAC layer.

#### Understand

1. Summarize the issues that affect the deployment and performance of adhoc wireless system.
2. Outline the benefits when deployment of a commercial adhoc wireless networks compared to wired network.
3. Compare Ad-hoc Networks and Wireless LAN.
4. Compare the efficiency of the packet queuing mechanism adopted in MACA and MACAW.
5. Relate contention-based protocols with reservation mechanisms and contention-based protocols with scheduling mechanisms by means of packet delivery, reception, and acknowledgment ratio.
6. Describe the design strategies of MACAW protocol.
7. Illustrate various steps involved in five-phase reservation protocol with its frame format.
8. Compare the differences of Adhoc on-demand Distance vector routing protocol (AODV) and dynamic sequence routing protocol (DSRP).
9. Identify any four reasons that lead to the quick power drain of nodes in mobile adhoc network.

10. Explain the sensor network architecture with a suitable illustration.

### Apply

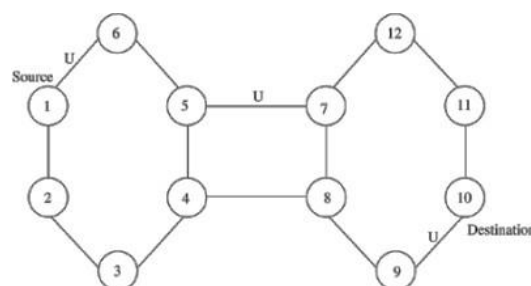
1. Calculate the maximum achievable data rate over a 9 KHz channel whose signal-to-noise ratio is 20 dB.
2. Think of four scenarios where wireless networks can replace wired networks in order to improve the efficiency of people at their workplace. Briefly describe how in each case a wireless network will fit the role better than a wired network.
3. Determine the transfer time of a 22 KB file with a mobile data network: (a) with a transmission rate of 10 Kbps and (b) repeat the same for 802.11 WLAN operating at 2 Mbps. (c) What is the length of the file that WLAN can carry in the time that mobile data service carried a 20 KB file? (d) What do you infer from the answers to the above questions?
4. Assume that in one slot in Bluetooth, 256 bits of payload could be transmitted. How many slots are needed if the payload size is (a) 512 bits, (b) 728 bits, and (c) 1,024 bits. Assume that the non-payload portions do not change.
5. With reference to the discussion on scatternets, illustrate the trade-off of synchronization and bandwidth using a timing diagram. (Hint: Consider the case when a Bluetooth device acts as a master in one piconet and as a slave in another.)

### Analyze

1. Discuss the deployment scenarios for various HIPERLAN standards in the ETSI BRAN system.
2. Compare the EY-NPMA and the CSMA/CA mechanisms.
3. In serial communications, the baud rate of transmission is specified. Legacy applications on Bluetooth devices specify the baud rate. In the case of old serial communications, the data rate is the specified baud rate, but in the case of Bluetooth serial communications, it is not so. Why?
4. Identify and elaborate some of the important issues in pricing for multi-hop wireless communication.
5. Channel quality estimation can be done both at the sender and the receiver. Which is more advantageous? Why?
6. Compare an adhoc network and a cellular network with respect to bandwidth usage and cost-effectiveness.
7. Compare the pros and cons of using scheduling-based MAC protocols over reservation-based MAC protocols.

### Evaluate

1. Consider the topology given in below to simulate DSR, SSA, and ABR protocols for path establishment from node 1 to node 10, find the paths found and the ratio of the number of Route Request packets sent in the network. (Links labeled "U" refer to unstable ones.)



2. Justify whether the LCC algorithm (when run consistently with node degrees or node IDs) gives a deterministic result? If so, prove the above fact. Otherwise, give a counter-example.
3. Critique on how content-based multicasting (CBM) could be advantageous or disadvantageous as far as the bandwidth utilization of the network is concerned.
4. Discuss how network security requirements vary in the following application scenarios of ad hoc wireless networks:
  - A. Home Network

- B. Classroom Network
  - C. Military Network
  - D. Emergency Search and Rescue Network
5. Discuss how security provisioning in ad hoc wireless networks differs from that in infrastructure-based networks.?

**21CS014 Green Computing (Elective VI)****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Describe green IT with its different dimensions and strategies.
2. Analyze green devices and hardware along with its green software methodologies.
3. Examine the green IT standards for enhancing environmental sustainability.
4. Analyze the various green enterprise activities, functions and their role with IT.
5. Identify the various laws, standards and protocols for regulating green IT.
6. Identify the various key sustainability and green IT trends.

**CO – PO Mapping**

| COs | PO2 | PO3 | PO6 | PO7 |
|-----|-----|-----|-----|-----|
| 1   | 2   | 2   | 3   | 3   |
| 2   | 3   | 3   | 3   | 3   |
| 3   | 3   | 3   | 3   | 3   |
| 4   | 3   | 3   | 3   | 3   |
| 5   | 2   | 2   | 3   | 3   |
| 6   | 2   | 2   | 3   | 2   |

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

**Syllabus****Unit I****12 Hours****Fundamentals**

Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green IT, Holistic Approach to Greening IT, Greening IT, Applying IT for enhancing Environmental Sustainability, Green IT Standards and Eco-Labeling of IT.

*Enterprise Green IT strategy, Green IT: Burden or Opportunity?*

**Unit II****12 Hours****Green Devices and Hardware with Green Software**

Green Devices and Hardware: Introduction, Life Cycle of a device or hardware, Reuse, Recycle and Dispose. Green Software: Introduction, Energy-saving software techniques, Evaluating and measuring software Impact to platform power.

*Research the sustainability of paper use in an organization.*

**Unit III****12 Hours****Green Enterprises and the Role of IT**

Introduction, Organization and Enterprise Greening, Information systems in Greening Enterprises, Greening Enterprise: IT Usage and Hardware, Inter-Organizational Enterprise activities and Green Issues, Enablers and making the case for IT and Green Enterprise.

*Analyze an organization's IT sustainability.*

**Unit IV****12 Hours****Managing and Regulating Green IT**

Introduction, Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social media.

**Laws, Standards and Protocols** :Introduction, The regulatory environment and IT manufacturers, Non regulatory government initiatives, Industry associations and standards bodies.

*Green building standards, Green data centers, Social movements and Greenpeace.*

**Total: 48 Hours****Textbook (s)**

1. Harnessing Green IT Principles and Practices, San Murugesan, G.R. Gangadharan, Wiley Publication, ISBN:9788126539680,2012.

### Reference (s)

5. Foundation of Green IT, Marty Poniatowski, Prentice Hall Publication, ISBN:9780137043750,2009.

### Internal Assessment Pattern

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

### Sample Question (S)

#### Remember

1. Define Green IT
2. Define Green Software

#### Understand

1. Explain the Life Cycle of a Green device or hardware.
2. Illustrate the concept of process re-engineering in a simple way from a green perspective.

#### Apply

1. Identify the several key standards for process and product of Green IT.
2. Apply ERP system with modules and relationships in any recent trend.

#### Analyze

1. Analyze and give recommendations on how green strategies can be implemented in Homes to make a greener world. Explain about the same in your perspective.
2. Classify the major categories of information systems within an organization? Provide examples of greening enterprise activities at each level.

#### Evaluate

1. Recommend with a case study to depict the ways in which a green enterprise transformation (GET) can be applied for a service organization. For the selected service organization, briefly explain the following:
  - i) the practical aspects of a preliminary green IT audit.
  - ii) the green business objectives.
  - iii) a high-level SWOT analysis from a GET perspective.
2. Choose the UML diagrams to present the following models of green information systems:
  - i) use case diagram for "emissions benchmark maintenance".
  - ii) state machine diagram for "class-emission report".

#### Open Book Exam Questions

1. What is the meaning of Green Computing, gather statistics, or develop a list of ways to practice green computing; now expand the discussion to determine if Green Computing is possible, if it can make a difference, or if it is a marketing term used by large organizations in today's environmentally friendly society.
2. "Green computing or green IT is the study and practice of environmentally sustainable computing or IT"
  - i. In your own words, explain the term Green IT.
  - ii. Summarise the challenges in making Green IT a reality. Consider environmental factors such as political, economic, social, technological, legal and ecological in your answer.
  - iii. Cite 2 examples of success stories on Green IT. Evaluate if the same effort is achievable in your origin country.



**21CS015 SOFTWARE PROJECT MANAGEMENT (Elective VI)****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Explain the concepts and issues of Software Project Management
2. Illustrate various Software Architectures
3. Classify Software Risks and Risk Management Strategies
4. Design effective software development model to meet organizational needs
5. Experiment with appropriate methodologies to develop a project schedule
6. Experiment with appropriate techniques to assess ongoing project performance

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PO11 | PO12 | PS02 |
|-----|-----|-----|-----|------|------|------|
| 1   | 3   | 2   | 2   | 2    | 2    | 2    |
| 2   | 3   | 2   | 2   | 2    | 2    | 3    |
| 3   | 3   | 2   | 2   | 2    | 2    | 3    |
| 4   | 3   | 2   | 3   | 2    | 2    | 3    |
| 5   | 3   | 2   | 3   | 3    | 2    | 3    |
| 6   | 3   | 2   | 3   | 3    | 2    | 3    |

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

**Unit I****12 Hours**

**Conventional Software Management:** The Waterfall Model, Conventional Software Management Performance. **Transition:** The principles of conventional software Engineering, Principles of Modern software management, transitioning to an iterative process.

**Evolution of Software Economics:** Software Economics, Software Cost Estimation. **Improving Software Economics:** Reducing Software Product Size, Improving Software Processes, Improving Team Effectiveness, Improving Automation, Achieving Required Quality, Peer Inspections.  
*Software Development Phases, Procedural vs Object Oriented Paradigm.*

**Unit II****12 Hours**

**Life Cycle Phases:** Engineering and Production Stages, Inception, Elaboration, Construction, Transition Phases.

**Artifacts of Software Process:** The Artifact Sets, Types of Artifacts.

**Software Architectures:** A Management Perspective and Technical Perspective,

**Workflows of the process:** Software Process Workflows, Iteration Workflows.

*Off-the-Shelf Components, Requirement Specification Document, Methods of Specification.*

**Unit III****12 Hours**

**Checkpoints of the Process:** Major Milestones, Minor Milestones, Periodic Status Assessments.

**Iterative Process Planning:** Work breakdown Structures, Planning Guidelines, Cost and Schedule Estimating process, Iteration Planning Process.

**Project Organizations and Responsibilities:** Line-of-Business Organizations, Project Organizations, Evolution of Organizations.

**Process Automation:** Automation Building Blocks, The Project Environment.

*CASE Tools for Requirements Specification, Planning and Estimation, Pragmatic Planning.*

**Unit IV****12 Hours**

**Project control and Process Instrumentation:** The Seven Core Metrics, Management Indicators, Quality Indicators, Life Cycle Expectations, Pragmatic Software Metrics, Metrics Automation, Tailoring the Process.

**Future Software Project Management:** Modern Project Profiles, Next Generation Software Economics, The COCOMO Cost Estimation Model: Basic COCOMO

*Bugs of testing, Bug tracking tools*

**Total: 48 Hours**

**Textbook (s)**

1. Walker Royce, "Software Project Management – A UnifiedFramework", 1stEdition, Pearson Education, 2005.
2. PankajJalote, "Software Project Management in Practice", 1stEdition, Pearson Education, 2002.

**Reference (s)**

1. Bob Hughes, "Mike Cotterell, Rajib Mall, Software ProjectManagement", 5thEdition, McGraw-Hill Higher Education, 2011.
2. Joel Henry, "Software Project Management", 1st Edition, Pearson Education, 2004.
3. Norman E. Fenton, Shari Lawrence Pfleeger, "Software Metrics: A Rigorous and Practical Approach", 1st Edition, PWS Publishing Company, 1997.

**Internal Assessment Pattern**

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

**SAMPLE QUESTION (S)**

**Remember**

1. Define Software Process
2. List the phases of Software Development.
3. What is an Artifact?
4. What is Process Automation?

**Understand**

1. Explain various formal methods of specification.
2. Explain COCOMO II Model.
3. Explain Critical Path Methods to schedule a software project.

**Apply**

1. Identify the amount of Information need to present in a page.
2. Organize the different Software tool specification methods.
3. Assume that the size of an organic type software product has been estimated to be 32,000 lines of source code. Assume that the average salary of software engineers be Rest. 15,000/- per month. Determine the effort required to develop the software product and the nominal development time.

**Open Book Questions**

1. Calculate the effort and development time for the model related to your mini-project which was developed in previous semester using COCOMO basic cost estimation model. (Take your mini-project size in KLOC)[Apply]
2. Analyze your mini-project with respect to changes using Type 0, Type 1, Type 2, Type 3 & Type 4 categories. [ Apply ]

**21CS016 Soft Computing (Elective VI)****3 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Identify an appropriate soft computing technique to build an Intelligent Machine
2. Apply supervised learning methods for neural network models for pattern classification and regression problems
3. Demonstrate the use of various Associative Memory Networks
4. Apply unsupervised learning methods of neural network models for storing and pattern classification
5. Determine the solutions of modeled networks using soft computing approaches for a given problem
6. Explain fuzzy logic and Genetic Algorithm to handle uncertainty

**COs – POs Mapping**

| COs | PO1 | PO2 | PO3 | PO4 |
|-----|-----|-----|-----|-----|
| 1   | 3   | 3   | 2   | 2   |
| 2   | 2   | 3   | 2   | 2   |
| 3   | 2   | 2   | 3   | 3   |
| 4   | 3   | 3   | 2   | 2   |
| 5   | 3   | 3   | 2   | 2   |
| 6   | 3   | 2   | 3   | 3   |

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

**Unit I****12 Hours**

**Basic elements of Soft Computing:** Difference between Hard Computing & Soft Computing - Introduction to Neural Networks - Fuzzy Logic - Genetic Algorithms - Hybrid Systems.

**Artificial Neural Networks:** Introduction to Artificial Neural Networks - Evolution of Neural Networks - Basic Models of Neural Networks - McCulloch-Pitts Neuron - Hebb Network.

*Basics of Artificial Intelligence and Computational Intelligence.*

**Unit II****12 Hours**

**Supervised Learning Network:** Artificial Neural Networks: Introduction - Perceptron Networks - Back Propagation Network. Radial Basis Function Network.

**Associative Memory Networks:** Auto-associative Memory Network - Hetero auto-associative Memory Network - Bidirectional Associative Memory (BAM) - Hopfield Networks.

*Functional Link Neural Network.*

**Unit III****12 Hours**

**Unsupervised Learning Network:** Introduction - Fixed Weight Competitive Nets -Kohonen Self-Organizing Feature Maps - Learning Vector Quantization - Counter Propagation Networks – Basic Concepts on Adaptive Resonance Theory Networks (ART-1 & ART-2).

*Support Vector Machines and their applications for Classification.*

**Unit IV****12 Hours**

**Introduction to Fuzzy Sets:** Difference between Classical Sets & Fuzzy Sets – Properties.

Classical Relations and Fuzzy Relations: Cartesian product of Relations - Classical Relations - Fuzzy Relations

Membership Functions: Features of Membership Functions -Fuzzification - and Defuzzification

**Genetic Algorithm:** Basic Concepts on Genetic Operators.

*Concepts on Fuzzy Controller and its applications - a Simple Application of Genetic Algorithm for function Optimization.*

**Total: 48 Hours****Textbook (s)**

1. S. N. Sivanandam, S N Deepa, Principles of Soft Computing, 2<sup>nd</sup> Edition, Wiley India, 2007
2. V. Kecman, Learning and Soft Computing, Pearson Education, India, 2006

### Reference(s)

1. J-S R Jung, C-T Sun and E. Mizutani, Neuro Fuzzy and Soft Computing, Pearson Education, India, 2015
2. G. J. Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic, Prentice Hall, USA, 1995
3. D. E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y, 1989
4. S. Haykins, Neural networks: a comprehensive foundation Pearson Education, India, 2002
5. A. P. Engelbrecht, Computational Intelligence: An Introduction, John Wiley & Sons, 2007.
6. X. Yu and M. Gen, Introduction to Evolutionary Algorithms, Springer Verlag, 2010.

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | OBE# (%) |
|-----------------|-----------------|-----------------|----------|
| Remember        | 25              | 15              | --       |
| Understand      | 35              | 15              | --       |
| Apply           | 20              | 20              | 40       |
| Analyze         | 20              | 30              | 40       |
| Evaluate        | --              | 20              | 20       |
| Create          | --              | --              | --       |
| Total (%)       | 100             | 100             | 100      |

### SAMPLE QUESTION (S)

#### Remember

1. Define Chromosome
2. List two methods in which the information flows in a nervous system
3. List five unsupervised learning algorithms
4. List the difference between classical logic and fuzzy logic
5. List the computational units of ART

#### Understand

1. Explain the components of Soft Computing
2. Explain the role of activation function in exhibiting the output from a neuron
3. Construct the 5 node pattern {0,1,1,0,1} by Hopfield network and explain the procedure for recalling and storing
4. Explain Adaptive Resonance Theory and its type
5. Explain CPN and illustrate the steps involved in training algorithm of full CPN

#### Apply

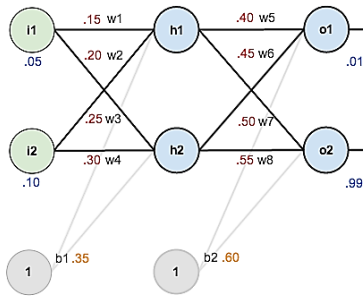
1. Construct a ANN circuit which makes the flow of data using multilayered and multilevel networks
2. Apply clusters of various datasets maintained by learning approach considering live example
3. Draw the neat architecture of hamming network and trace the inhibitory and excitatory neurons by considering an inconsistent vector
4. Find the Max-min and Max Product composition of the fuzzy relation matrices  $R=\{0.6,0.3,0.2,0.9\}_{(2 \times 2)}$   $S=\{1,0.5,0.3,0.8,0.4,0.7\}_{(2 \times 3)}$
5. Find the cardinality for the matrices  $R=\{1,4,6,7\}_{(2 \times 2)}$   $S=\{5,2,3,7\}_{(2 \times 2)}$

#### Analyze

1. Differentiate between learning and training algorithms considering multilayer perceptron network and trace the different types of networks obtained.
2. Differentiate between Counter Propagation Network and Adaptive Resonance Theory

#### Evaluate

1. Evaluate using Back Propagation algorithm for the below map considering weights , inputs and outputs



2. Evaluate the instance, that the 2 dimensional input vector  $X$  is presented to the three-neuron Kohonen network,  $x = [0.52 \ 0.12]$ . The initial weight vectors,  $W_j$  are given by

$$W_1 = [0.27, 0.81]$$

$$W_2 = [0.42, 0.70]$$

$$W_3 = [0.43, 0.21]$$

in a form of  $2 \times 1$  matrix. Find the winning neuron using the Euclidean distance and apply kernel self-organization map. State the differences between register machines and stack machine?

**21SIX02 Summer Internship II****0 0 0 1.5****Course Outcomes**

At the end of the course, students will be able to

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

**CO-PO Mapping**

| <b>COs</b> | <b>PO1</b> | <b>PO2</b> | <b>PO5</b> | <b>PO6</b> | <b>PO10</b> | <b>PO12</b> |
|------------|------------|------------|------------|------------|-------------|-------------|
| <b>1</b>   | -          | -          | -          | -          | 3           | -           |
| <b>2</b>   | 3          | 1          | -          | -          | -           | -           |
| <b>3</b>   | 3          | -          | 3          | -          | -           | 2           |
| <b>4</b>   | 3          | 1          | -          | -          | -           | -           |
| <b>5</b>   | 3          | 1          | 3          | 3          | -           | 1           |
| <b>6</b>   | 3          | 1          | 3          | -          | -           | 1           |

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

**21PWX01Project Work****0 0 16 8****Course Outcomes**

At the end of the course, students will be able to

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.

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| 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

## 8<sup>th</sup> Semester

### 21CS017 Fundamentals of Social Networks Analysis (Elective VIII)

0 0 0 3

#### Course Outcomes

At the end of the course, students will be able to

1. Explain the fundamental principles of social networking
2. Identify the architectures and challenges in building social networks
3. Interpret the capabilities and limitations of the existing network analysis methods
4. Model the knowledge to analyze real-world networks
5. Demonstrates the knowledge of basic mathematical models used in the analysis of social networks
6. Demonstrate human behaviour in social web and related communities.

#### CO-PO Mapping

| CO | PO2 | PO4 | PO5 |
|----|-----|-----|-----|
| 1  | 3   | 1   | 2   |
| 2  | 3   | 1   | 1   |
| 3  | 1   | 3   | 3   |
| 4  | 3   | 1   | 1   |
| 5  | 1   | 3   | 3   |
| 6  | 1   | 2   | 2   |

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

#### Unit I

**11 Hours**

Introduction to social network analysis and Descriptive network analysis: Introduction to new science of networks. Networks examples. Graph theory basics. Statistical network properties. Degree distribution, clustering coefficient.

Frequent patterns. Network motifs. Cliques and k-cores.

#### Unit II

**13 Hours**

Network structure, Node centralities and ranking on network: Nodes and edges, network diameter and average path length.

Node centrality metrics: degree, closeness and betweenness centrality. Eigenvector centrality and PageRank. Algorithm HITS.

#### Unit III

**12 Hours**

Network communities and Affiliation networks: Networks communities. Graph partitioning and cut metrics. Edge betweenness. Modularity clustering.

Affiliation network and bipartite graphs. 1-mode projections. Recommendation systems

#### Unit IV

**12 Hours**

Predicting human behaviour and privacy issues: Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

Applications of SNA: covert networks, community welfare, collaborative networks, co-citation networks

**Total: 48 Hours**

#### Textbook (s)

1. David Easley and John Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press 2010.
2. Stanley Wasserman and Katherine Faust, Social Network Analysis. Methods and Applications, Cambridge University Press, 1994



### Reference (s)

1. Matthew O. Jackson, Social and Economic Networks, Princeton University Press, 2010.
2. Eric Kolaczyk, Gabor Csardi, Statistical Analysis of Network Data with R, Springer, 2014.
3. Mark Newman, Networks: An Introduction, Oxford University Press, 2010.

### Internal Assessment Pattern

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

### Remember

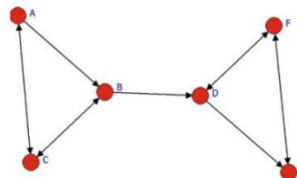
1. What are the limitations of current web?
2. List the statistical properties of social networks
3. Define social similarity.
4. What are the two different measures in influence related statistics

### Understand

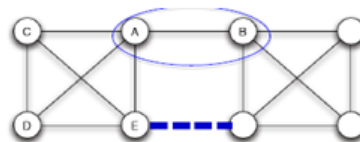
1. Explain about development of semantic web in research.
2. Demonstrate web based networks.
3. Illustrate the ways of visualizing social networks with matrix based representation and node – link diagram.
4. Explain core methods of community detection and mining.
5. Explain algorithms and systems for expert location in social networks.
6. Outline the models and algorithms for social influence analysis.

### Apply

1. Make use of the following graph to solve Degree Centrality, Between-ness Centrality and Cliques.



2. Solve Path, Length and Distance between nodes (i.e., Density measures) using SNA Data Processing Tools.
3. Make use of the above graph to solve network density and cut points.
4. Develop random graphs using ErdosReini Model
5. Solve Weak Ties, Traidic closure for the following graph.

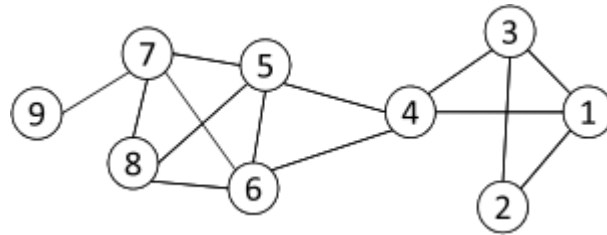


### Analyze

1. Compute PageRank for the following figure.



2. Discover Spectral Clustering steps for the following graph.



4. Examine the ways to visualize community's hubs and node centrality measures using sna package.
4. Analyze positive, moderate and negative feeds using sentiment analysis on twitter data.

**21CS018 Information Retrieval Systems (Elective VIII)****0 0 0 3****Course Outcomes**

At the end of the course, students will be able to

1. Explain the Objectives of Information Retrieval Systems and its relation to Digital Libraries and Data warehouse
2. Illustrate various System Search Browse and Miscellaneous Capabilities
3. Explain Automatic Indexing, Information Extraction methods
4. Demonstrate Inverted file structures, N-gram data structure, and PAT data structure
5. Interpret Classical techniques of Information Retrieval, and additional techniques employed by Web search engines
6. develop information retrieval system by using user search techniques and text search Algorithms

**CO-PO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 |
|-----|-----|-----|-----|-----|
| 1   | 3   | 2   | 2   | 2   |
| 2   | 3   | 2   | 2   | 2   |
| 3   | 2   | 3   | 1   | 1   |
| 4   | 2   | 3   | 1   | 1   |
| 5   | 2   | 3   | 1   | 1   |
| 6   | 3   | 3   | 2   | 2   |

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

**Unit I****11 Hours****Introduction:** Definition, Objectives, Functional Overview, Relationship to DBMS, Digital libraries and Data Warehouses.**Information Retrieval System Capabilities:** Search, Browse, Miscellaneous.*Miscellaneous capabilities.***Unit II****13 Hours****Cataloging and Indexing:** Objectives, Indexing Process, Automatic Indexing, Information Extraction.**Data Structures:** Introduction, Stemming Algorithms, Inverted file structures, N-gram data structure, PAT data structure, Signature file structure, Hypertext data structure.*Signature file structure, Hypertext data structure.***Unit III****12 Hours****Automatic Indexing:** Classes of automatic indexing, Statistical indexing, Natural language, Concept indexing, Hypertext linkages**Document and Term Clustering:** Introduction, Thesaurus generation, Item clustering, Hierarchy of clusters.*Measurement Example-TREC Results.***Unit IV****12 Hours****User Search Techniques:** Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, Searching the Internet and hypertext, Information Visualization**Text Search Algorithms:** Introduction, Software text search algorithms, Hardware text search systems.*Hardware text search systems***Total: 48 Hours****Textbook (s)**

1. Kowalski, Gerald, Mark T Maybury: Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press, 1997.
2. <http://nlp.stanford.edu/IR-book/html/htmledition/evaluation-in-information-retrieval-1.html>

### Reference (s)

1. Frakes, W.B. and RicardoBaeza Yates, Information Retrieval Data Structures and Algorithms, 1st Edition Prentice Hall, 1992.
2. Robert Korfhage, Information Storage & Retrieval, 1st Edition, John Wiley & Sons, 2005

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam (%) |
|-----------------|-----------------|-----------------|--------------------|
| Remember        | 30              | 30              | --                 |
| Understand      | 40              | 40              | --                 |
| Apply           | 10              | 20              | 80                 |
| Analyze         | 20              | 10              | 20                 |
| Evaluate        | --              | --              | --                 |
| Create          | --              | --              | --                 |
| Total (%)       | 100             | 100             | 100                |

### SAMPLE QUESTION (S)

#### Remember

1. Define measures for IRS
2. Define PAT
3. State Browse capabilities
4. List automatic indexing
5. Recall term clustering algorithms

#### Understand

1. Explain Functional Overview
2. Explain Stemming algorithms
3. Summarize Brute force algorithms
4. Illustrate S/w text search Algorithms
5. Interpret standard test collection
6. Classify S/w & H/w text search system

#### Apply

1. Demonstrate Precision
2. Design a hybrid Indexing Data Structure
3. Use stemming Algorithms for IRS

#### Analyze

1. Analyze s/w and h/w indexing methods
2. Analyze search and Browse capabilities
3. Compare Pat and Stemming algorithms
4. Analyze Term clustering Algorithms

#### Evaluate

1. Determine Which of the indexing algorithm is efficient
2. Check all automatic indexing methods for its efficiency
3. Compare S/w text search and H/w text search algorithms

**21CS019 Fundamentals of DevOps(Elective VIII)****0 0 0 3****Course Outcomes**

At the end of the course, students will be able to:

1. Illustrate the need of Improvement and value of DevOps
2. Outline the Value Stream using DevOps
3. Describe the Organizational Change and transformation
4. Illustrate the Concept and Goal of Accelerate Flow
5. Outline Feedback Loops and its usage
6. Demonstrate the Concept and Goal of Learning

**CO-PO Mapping:**

| COs | PO1 | PO3 | PO5 | PO8 | PO10 |
|-----|-----|-----|-----|-----|------|
| 1   | 3   | 3   | 3   | 3   | 3    |
| 2   | 2   | 2   | 2   | 2   | 2    |
| 3   | 1   | 2   | 1   | 1   | 2    |
| 4   | 3   | 2   | 2   | 1   | 2    |
| 5   | 3   | 3   | 3   | 3   | 2    |
| 6   | 2   | 3   | 2   | 1   | 2    |

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

**UNIT I****12 Hours**

**Introduction to DevOps:** Understanding Improvement, The Convergence, History, and Value of DevOps;  
**Understanding the Value Stream using DevOps:** Analyzing the technology Value Stream; The ways of DevOps: Flow, Feedback Loops, Culture of Continual Experimentation and Learning;

**UNIT II****12 Hours**

**Value Stream in DevOps:** Concept and Goals of Streams, Picking a Value Stream, Understanding Organizational Change, Enabling Transformation;

**UNIT III****13 Hours**

**Accelerate Flow:** Concept and Goal of Accelerate Flow, Continuous Delivery Patterns and Practices, the Deployment Pipeline, Creating Consistency in the Pipeline, Automated Testing, Deployment Strategies;  
**Amplifying the Feedback Loops:** Concept and Goals of Feedback Loops, Creating a Service Reliability Culture, Fast Feedback, Understanding Monitoring, Understanding Complexity

**UNIT IV****11 Hours**

**Learning Acceleration with DevOps:** Concept and Goal of Learning, Learning Organizations, Communication, Blameless Culture;

**Total: 48 Hours****Text Books:**

1. Kim, G., Behr, K., and Spafford, G. (2013). The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win. IT Revolution Press
2. Kim, G., Humble, J., Debois, P., and Willis, J. (2016). The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations. IT Revolution Press

**Reference Books:**

1. JulianFish, The Practical Guide to Enterprise DevOps and Continuous Delivery

**Internal Marks Assessment:**

| <b>CognitiveLevel</b> | <b>Int. Test 1(%)</b> | <b>Int. Test 2(%)</b> | <b>OBE Test (%)</b> |
|-----------------------|-----------------------|-----------------------|---------------------|
| Remember              | 25                    | 25                    |                     |
| Understand            | 40                    | 30                    | 40                  |
| Apply                 | 20                    | 20                    | 30                  |
| Analyze               | 15                    | 20                    | 30                  |
| Evaluate              | --                    | --                    | --                  |
| Create                | --                    | --                    | --                  |
| Total (%)             | 100                   | 100                   | 100                 |

**Sample Questions**

**Remember**

- 1) What is DevOps
- 2) Define Value Stream
- 3) What is **Accelerate Flow**

**Understand**

- 1) Explain about Ways of DevOps
- 2) Explain Picking Value Stream min DevOps
- 3) Describe Feedback Loops

**Apply**

- 1) Give Some Real Time Applications of DevOps

**21FIX01 Full Semester Internship (FSI)****0009****Course Outcomes**

At the end of the course, students will be able to

- 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 | PS01 | PS02 |
|-----|-----|-----|-----|-----|-----|------|------|------|
| 1   | 3   | -   | -   | -   | -   | -    | 3    | 3    |
| 2   | -   | 3   | -   | -   | -   | -    | 3    | 3    |
| 3   | -   | -   | 3   | -   | -   | -    | 3    | 3    |
| 4   | -   | -   | -   | 3   | -   | -    | -    | -    |
| 5   | -   | -   | -   | -   | 3   | -    | -    | -    |
| 6   | -   | -   | -   | -   | -   | 3    | -    | -    |

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

## B. Tech. (Honors)

### Domain I (Data Engineering)

#### 21CSH11 Advanced Data Structures

4 0 0 4

#### Course Outcomes

At the end of the course, students will be able to

1. Recognize the variations in implementation of fundamental linear data structures
2. Describe and implement different types of search and balanced trees
3. Demonstrate the concepts and implementations of heaps and its types
4. Identify heap data structure for appropriate use cases
5. Outline the applications of hash table data structure
6. Illustrate the use of data structure for strings

#### CO-PO Mapping

| CO | PO2 | PO3 | PO4 |
|----|-----|-----|-----|
| 1  | 2   | 3   | 2   |
| 2  | 3   | 3   | 3   |
| 3  | 3   | 3   | 3   |
| 4  | 3   | 3   | 3   |
| 5  | 3   | 3   | 3   |
| 6  | 2   | 3   | 2   |

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

#### Unit I

##### Elementary Data Structures: Review

11Hours

List – Stack – Queue – Double Ended Queue – Dynamic Allocation of nodes – Shadow copies of Array based structures – Generic List

#### Unit II

##### Search Trees and Balanced Trees

13Hours

Two models of search trees – General properties and Transformations – Height of search tree – Basic insert, delete operations – Dealing with non-unique keys – Building Optimal search trees – Converting trees into lists – Height balanced trees – Weight balanced trees – Red-Black trees – Splay trees – Skip lists – Interval trees – Segment trees

#### Unit III

##### Heaps

12 Hours

Balanced search trees as heaps – Array based heaps – Heaps as trees – Leftlist heaps – Skew heaps – Binomial heaps – Changing keys in heaps – Fibonacci heaps – Heaps of optimal complexity – Double ended heap structures

#### Unit IV

##### Hash Tables and Data Structures for Strings

12 Hours

Hash Tables

Basic hash tables and collision resolution – Universal families of hash functions – perfect hash functions – hash trees – Extendible hashing – Bloom filters

Tries and Compressed tries – Dictionaries – Suffix trees – Suffix arrays

**Total: 48 Hours**

#### Textbook (s)

1. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, “Introduction to Algorithms”, MIT Press, Cambridge, 2009



## Reference (s)

1. Alfred L Aho, John E Hopcroft, Jeffery D Ullman, "Data Structures and Algorithms, Pearson Publications, 2016
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++, 4<sup>th</sup> Edition, Addison Wesley, 2018

## Internal Assessment Pattern

| Cognitive Level  | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Test (%) |
|------------------|-----------------|-----------------|--------------------|
| Remember         | 20              | 20              | --                 |
| Understand       | 35              | 35              | --                 |
| Apply            | 25              | 25              | 40                 |
| Analyze          | 20              | 20              | 40                 |
| Evaluate         | --              | --              | 20                 |
| Create           | --              | --              | --                 |
| <b>Total (%)</b> | <b>100</b>      | <b>100</b>      | <b>100</b>         |

## SAMPLE QUESTION (S)

### Remember

1. List out linear data structures
2. Name the basic operations of stack data structure
3. Define balance factor of AVL tree
4. Define complete binary tree
5. What is self-referential structure?
6. Name two basic operations on stack data structure supports
7. Define a double linked list structure
8. What are advantages and disadvantages of circular linked list?

### Understand

1. Explain Bubble Sort Process with an example
2. Demonstrate with neat diagram and algorithm to insert a node before the given key
3. Explain Deletion process using an example binary search tree
4. Explain why the selection sort is more efficient than the bubble sort
5. Explain with suitable example of LL rotation after inserting a new node into an AVL tree
6. Demonstrate the application of singly linked lists for the addition of the polynomials P1 and P2

### Apply

1. Construct a symbol parse tree for the key words of following program

```
void main()
{
    longint n, num, d;
    char prime;
    clrscr();
    printf("Enter the range for prime no");
    scanf("%ld", &n);
    for(num=2; num<=n; num++)
    {
        prime='t';
        for(d=2; d<=sqrt(num); d++)
            if (num%d==0)
            {
                prime='f';
                break;
            }
        if(prime=='t')
            printf("%10ld", num);
    }
}
```

```
}  
getch();  
}
```

2. Develop an algorithm to concatenate two single linked lists
3. Construct a priority queue and implement all basic operations to demonstrate priority queue
4. Build a recursive procedure to count the number of nodes in a binary tree
5. Develop a queue using single linked list data structure

### Analyze

1. Analyze the efficiency of insertion sort for the following inputs to sort  
 $A = \{12, 23, 3, 11, 56, 6, 78, 7\}$   $B = \{12, 14, 23, 45, 56, 67, 78, 81\}$
2. Analyze the efficiency of BST deletion to delete a node with two children
3. Compare BST deletion and AVL deletion methods according to time efficiency.
4. Choose a suitable data structure to implement a linked stack
5. Analyze the efficiency of BFS graph traversal method

### Evaluate

1. Justify that the height of the AVL tree is  $O(\log n)$  where  $n$  is the no of nodes in the tree
2. Prove that the height of a complete, balanced binary tree of ' $n$ ' nodes is " $\log(n+1)$ "
3. The worst time complexity of binary search is  $O(\log n)$ , Justify
4. Choose a suitable data structure to implement double ended queue
5. Compare the height by successive insertion of following numbers if inserted into a BST and AVL tree  
 $\{12, 14, 23, 45, 56, 67, 78, 81\}$

**21CSH12 Advanced Databases****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to

1. Interpret Distributed Databases and its architectures
2. Utilize various fragmentation techniques given a database
3. Illustrate query optimization and Transaction Management in DDBMS
4. Compare various approaches to concurrency control in Distributed database
5. Choose various algorithms and techniques for deadlock and recovery in Distributed database
6. Explain about data on external storage and indexing

**COs – POs Mapping**

| COs | PO2 | PO3 | PO4 |
|-----|-----|-----|-----|
| 1   | 3   | 2   | 1   |
| 2   | 3   | 3   | 2   |
| 3   | 3   | 2   | 1   |
| 4   | 2   | 2   | 2   |
| 5   | 3   | 2   | 1   |
| 6   | 3   | 3   | 2   |

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

**Unit I****12 Hours**

Introduction to DDBMS: Distributed data processing; what is a DDBS; Features of Distributed versus Centralized Databases, Advantages and disadvantages of DDBS; Principles of Distributed Databases, Levels of Distribution Transparency, Distributed DBMS Architecture.

Distributed Database Design: Top-Down Design Process, Distribution design issues, fragmentation, allocation, Data Directory.

**UNIT – II****12 Hours**

Optimization of Access Strategies, A Framework for Query Optimization, Join Queries, General Queries. The Management of Distributed Transactions, A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions.

**UNIT-III****12 Hours**

Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, and Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control. Basic Concepts of reliability, Non-blocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration.

**UNIT-IV****12 Hours**

Data on External Storage: File Organization and Indexing, Clustered Indexing, Primary and Secondary Indexes, Index Data Structures, Hash-Based Indexing, Hash Tables, Tree-Based Indexing, B-Tress, Comparison of File Organization.

**Total: 48 Hours****Textbook (s)**

6. Principles of Distributed Database Systems, M. Tamer Özsu, and Patrick Valduriez Prentice-Hall, 4th Edition, 2020.
7. Distributed Databases Principles & Systems, Stefano Ceri, Giuseppe Pelagatti, Tata Mcgraw-Hill, 2017.
8. Database System Concepts, SilberschatzKorth, McGraw hill, 7th Edition, 2020

### Reference (s)

1. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley.
2. Distributed Database Management Systems: A Practical Approach, Saeed K. Rahimi, Frank S. Haug, Wiley, 2015.
3. Principles of Transaction Processing, Philip A. Bernstein, Eric Newcomer, 2nd Edition, Elsevier, 2009.
4. Distributed Database Systems, Chhanda Ray, Pearson Education
5. Distributed Database Systems, D. David Arthur Bell, Jane B. Grimson, Addison-Wesley

### Internal Assessment Pattern

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

### SAMPLE QUESTION (S)

#### Remember

1. List any two types of fragmentation
2. Define data directory
3. Define clustered indexing
4. List the 4 properties of Transaction

#### Understand

1. Explain advantages and disadvantages of Distributed Databases
2. Explain the levels of distributed transparency
3. Illustrate about join queries
4. Explain about B+ trees

#### Apply

1. Apply fragmentation on any example data and show the results.
2. Illustrate the Commit and Rollback operations of Distributed Transactions
3. Compare various File organizations.

### Open Book Exam Questions

Question 1:

Consider a database consisting of a single relation R:

| A | B  |
|---|----|
| 1 | 10 |
| 2 | 0  |

(a) The following two transactions run concurrently on this database:

| Line | T1                               | T2                    |
|------|----------------------------------|-----------------------|
| 1    | begin transaction;               | begin transaction;    |
| 2    | update R set B = B-10 where A=1; | select sum(B) from R; |
| 3    | update R set B = B+10 where A=2; | commit;               |
| 4    | commit;                          |                       |

Is it ever possible for T2 to see a value of zero in its output? Explain why or why not.

(b) The following two transactions run concurrently on this database:

| Line | T1 | T2 |
|------|----|----|
|------|----|----|

|   |                              |                       |
|---|------------------------------|-----------------------|
| 1 | begin transaction;           | begin transaction;    |
| 2 | insert into R values (3,150) | select sum(B) from R; |
| 3 | commit                       | select sum(B) from R; |
| 4 |                              | commit;               |

Is it ever possible for T2 to see a different value as the output of the select sum(B) from R statements?

**Question 2:**

1. SELECT DISTINCT name, address FROM Repayment WHERE borrower\_id= ?;
2. SELECT \* FROM Repayment WHERE borrower\_id= ? AND repayment\_date> ?;
3. SELECT borrower\_id, loanamount FROM Repayment WHERE loanamountBETWEEN ?AND ?;
4. INSERT INTO Request VALUES (?, ?, ?, ?, ?, ?);

Suggest one or more indexes, taking into account of the above. State the indexed attributes for each index, along with the index type (primary or secondary). Argue shortly for your choices. Emphasis is on the suggested indexes supports the SQL commands as effectively as possible.

**21CSH13 Programming, Data Structures and Algorithms Using Python****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to

1. Recall the fundamental Concepts of Python Programming
2. Identify the various data structures in Python
3. Illustrate sorting techniques by using python language
4. Recall the basic algorithmic notations and complexity analysis
5. Differentiate algorithmic approaches for problem solving
6. Experiment exception handling mechanism using Object Oriented paradigm

**CO-PO Mapping**

| COs | PO2 | PO3 | PO4 | PO5 |
|-----|-----|-----|-----|-----|
| 1   | 2   | 2   | 2   | 2   |
| 2   | 2   | 2   | 2   | 2   |
| 3   | 3   | 3   | 3   | 3   |
| 4   | 3   | 3   | 3   | 3   |
| 5   | 3   | 3   | 3   | 3   |
| 6   | 2   | 2   | 2   | 2   |

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

**Unit-1****12 Hours****Basic Python Fundamentals:**

Introduction to programming, algorithms and data structures; Python: variables, operations, control flow - assignments, conditionals, loops, functions Python: types, expressions, strings, lists, and tuples. Python memory model: names, mutable and immutable values; Inductive function definitions: numerical and structural induction.

**Python functions:** optional arguments, default values Passing functions as arguments Higher order functions on lists: map, filter, and list comprehension.

*local, global, nonlocal names Nested functions.*

**Unit-2****12 hours**

**Data structures:** lists, Dictionaries, Tuples, Sets, stack, queue, heaps

**Linked lists:** find, insert, delete; Binary search trees: find, insert, delete; Height-balanced binary search trees

**Sorting Techniques:**

Elementary inductive sorting: selection, Insertion sort In-place sorting, Merge sort, Quicksort, Stable sorting

*Disjoint Sets, heaps*

**Unit-3****12 hours**

**Basic algorithmic analysis:** input size, asymptotic Notation and complexity;

**Algorithmic Approaches:** Backtracking: N Queens, recording all solutions; Brute Force: Maximum element; Divide and Conquer: Maximum Subarray Sum; Greedy Approach: Huffman Coding Dynamic programming: Longest Common Subsequence, Coin Change Problem;

*Back tracking, Branch and Bound*

**Unit-4****12 hours**

**Exception Handling:** Exception handling, Basic input/output, Handling files, String processing

**Object Oriented Programming:** Abstract data types, Classes and Python Object; Inheritance in Python Class, Encapsulation, Polymorphism, Data abstraction

*Operator Overloading, Regular Expression*

**Total: 48 Hours**

**Internal Assessment Pattern**

| Cognitive Level  | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Test (%) |
|------------------|-----------------|-----------------|--------------------|
| Remember         | 30              | 30              | --                 |
| Understand       | 35              | 35              | --                 |
| Apply            | 35              | 35              | 50                 |
| Analyze          | --              | --              | 50                 |
| Evaluate         | --              | --              | --                 |
| Create           | --              | --              | --                 |
| <b>Total (%)</b> | <b>100</b>      | <b>100</b>      | <b>100</b>         |

**Text Books:**

1. Martin C. Brown, 1st Python: The Complete Reference, Edition, Publisher: Osborne/McGraw-Hill , 2018
2. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L. Rivest, and C.Stein, PHI Pvt. Ltd./ Pearson Education
3. Fundamentals of Computer Algorithms, Ellis Horowitz, SatrajSahni and Rajasekaran, University press.

**References:**

1. Introduction to The Design and Analysis of Algorithms, 3rd Edition, AnanyLevitin, Pearson Education, 2017.
2. R. Nageswara Rao, "Core Python Programming", 2nd Edition: DreamTech Press, 2020

**Weblink:**

[Programming, Data Structures and Algorithms Using Python - Course \(nptel.ac.in\)](https://nptel.ac.in/courses/2019Fall/112102001/)

**21CSH14 Bioinformatics****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to:

1. Explain different types of bioinformatics data (gene, protein, disease, etc.), including their biological characteristics and relationships
2. Discuss the differences between genomics and proteomics
3. Analyse processed data with the support of analytical and visualization tools
4. Apply advisement, including systems biology, structural bioinformatics and proteomics
5. Analyse how to solve the biological problems using computational approach
6. Analyse internet packages of bioinformatics.

**CO-PO Mapping**

| COs | PO2 | PO3 |
|-----|-----|-----|
| 1   | 3   | 3   |
| 2   | 2   | 2   |
| 3   | 2   | 1   |
| 4   | 2   | 3   |
| 5   | 3   | 3   |
| 6   | 3   | 2   |

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

**UNIT –I****12 Hours**

**Introduction:** Definitions, Sequencing, Biological sequence/structure, Genome Projects, Pattern recognition and prediction, Folding problem, Sequence Analysis, Homology and Analogy.

**Protein Information Resources:**

Biological databases, Primary sequence databases, Protein Sequence databases, Secondary databases, Protein pattern databases, and Structure classification databases.

DNA sequence databases, specialized genomic resources

**Unit-II****12 Hours****Genome Information Resources: DNA Sequence Analysis:**

Importance of DNA analysis, Gene structure and DNA sequences, Features of DNA sequence analysis, EST (Expressed Sequence Tag) searches, Gene hunting, Profile of a cell, EST analysis, Effects of EST data on DNA databases

**Unit-III****12 Hours****Pairwise Alignment Techniques:**

Database searching, Alphabets and complexity, Algorithm and programs, Comparing two sequences, subsequence's, Identity and similarity, The Dot plot, Local and global similarity, different alignment techniques, Dynamic Programming, Pair wise database searching.

**Multiple Sequence Alignment:**

Definition and Goal, the consensus, computational complexity, Manual methods, Simultaneous methods, Progressive methods, Databases of Multiple alignments and searching

**Unit-IV****12 Hours****Secondary Database Searching:**

Importance and need of secondary database searches, secondary database structure and building a sequence search protocol

**Analysis Packages:**

Analysis package structure, commercial databases, commercial software, comprehensive packages, packages specializing in DNA analysis, Intranet Packages, Internet Packages.

**Total: 48 Hours**



**Text Books:**

1. Introduction to Bioinformatics, by T K Attwood & D J Parry-Smith Addison Wesley Longman, 1999.  
ISBN: 0-582-32788-1
2. Bioinformatics a Beginner's Guide Paperback, by Jean Michael Claverie, CerdicNotredame, Wiley India Private Limited, 2003 ISBN-13: 978-8126503803

**Reference Books:**

1. Introduction to Bioinformatics by Arthur M. Lesk, Third Edition, Oxford University Press, 2009

**Internal Assessment Pattern**

| Cognitive Level  | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Examination (%) |
|------------------|-----------------|-----------------|---------------------------|
| Remember         | 30              | 30              | --                        |
| Understand       | 35              | 35              | --                        |
| Apply            | 35              | 35              | 50                        |
| Analyze          | --              | --              | 50                        |
| Evaluate         | --              | --              | --                        |
| Create           | --              | --              | --                        |
| <b>Total (%)</b> | <b>100</b>      | <b>100</b>      | <b>100</b>                |

**Sample question (s)**

**Remember**

1. Which of the tools are used for the identification of motifs?
2. Define Bioinformatics.
3. List the gene in Bioinformatics.

**Understand**

1. Explain the DNA sequence
2. Differentiate Primary sequence databases and Secondary databases.
3. Explain the Importance and need of secondary database searches.

**Apply**

1. Make use of Dynamic Programming to Pair wise database searching.
2. Model an Algorithm to Comparing two sequences

**Analyze**

1. Analysis the various package structures used in DNA structure.

## Domain II (Modern Software Engineering)

### 21CSH21DevOps

4 0 0 4

#### Course Outcomes

At the end of the course, students will be able to:

1. Illustrate the need of Improvement and value of DevOps
2. Outline the Value Stream using DevOps
3. Describe the Organizational Change and transformation
4. Illustrate the Concept and Goal of Accelerate Flow
5. Outline Feedback Loops and its usage
6. Demonstrate the Concept and Goal of Learning

#### CO-PO Mapping:

| COs | PO1 | PO3 | PO5 | PO8 | PO10 |
|-----|-----|-----|-----|-----|------|
| 1   | 3   | 3   | 3   | 3   | 3    |
| 2   | 2   | 2   | 2   | 2   | 2    |
| 3   | 1   | 2   | 1   | 1   | 2    |
| 4   | 3   | 2   | 2   | 1   | 2    |
| 5   | 3   | 3   | 3   | 3   | 2    |
| 6   | 2   | 3   | 2   | 1   | 2    |

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

#### UNIT I

12 Hours

**Introduction to DevOps:** Understanding Improvement, The Convergence, History, and Value of DevOps;  
**Understanding the Value Stream using DevOps:** Analyzing the technology Value Stream; The ways of DevOps: Flow, Feedback Loops, Culture of Continual Experimentation and Learning.

#### UNIT II

12 Hours

**Value Stream in DevOps:** Concept and Goals of Streams, Picking a Value Stream, Understanding Organizational Change, Enabling Transformation;

#### UNIT III

12 Hours

**Accelerate Flow:** Concept and Goal of Accelerate Flow, Continuous Delivery Patterns and Practices, the Deployment Pipeline, Creating Consistency in the Pipeline, Automated Testing, Deployment Strategies;  
**Amplifying the Feedback Loops:** Concept and Goals of Feedback Loops, Creating a Service Reliability Culture, Fast Feedback, Understanding Monitoring, Understanding Complexity

#### UNIT IV

12 Hours

**Learning Acceleration with DevOps:** Concept and Goal of Learning, Learning Organizations, Communication, Blameless Culture.

**Total: 48 Hours**

#### Text Books:

1. Kim, G., Behr, K., and Spafford, G. (2013). The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win. IT Revolution Press
2. Kim, G., Humble, J., Debois, P., and Willis, J. (2016). The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations. IT Revolution Press

#### Reference Books:

1. JulianFish, ThePracticalGuide toEnterpriseDevOps andContinuousDelivery

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | OBE Test (%) |
|-----------------|-----------------|-----------------|--------------|
| Remember        | 25              | 25              |              |
| Understand      | 40              | 30              | 40           |
| Apply           | 20              | 20              | 30           |
| Analyze         | 15              | 20              | 30           |
| Evaluate        | --              | --              | --           |
| Create          | --              | --              | --           |
| Total (%)       | 100             | 100             | 100          |

### Sample Questions

#### Remember

- 1) What is DevOps
- 2) Define Value Stream
- 3) What is **Accelerate Flow**

#### Understand

- 1) Explain about Ways of DevOps
- 2) Explain Picking Value Stream min DevOps
- 3) Describe Feedback Loops

#### Apply

- 1) Give Some Real Time Applications of DevOps

**21CSH22 Design Patterns****4 0 0 4****Course Outcome:**

At the end of the course students are able to:

1. Explain the catalogue of design patterns
2. Exemplify the appropriate pattern to solve object-oriented design problems using design patterns
3. Identify design solution using creational patterns
4. Identify structural patterns to solve design problems.
5. Design solutions by using behavioural patterns.
6. Choose a design pattern from the Pattern Community

**COs-POs Mapping:**

| COs | PO2 | PO3 |
|-----|-----|-----|
| 1   | 3   | 3   |
| 2   | 2   | 2   |
| 3   | 3   | 3   |
| 4   | 2   | 2   |
| 5   | 3   | 2   |
| 6   | 3   | 3   |

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

**UNIT – I****12 Hours**

Introduction: What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

**UNIT – II****12 Hours**

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns. Structural Pattern Part-I: Adapter, Bridge, Composite.

**UNIT-III****12 Hours**

Structural Pattern Part-II: Decorator, Façade, Flyweight, Proxy. Behavioral Patterns Part-I: Chain of Responsibility, Command, Interpreter, Iterator

**UNIT-IV****12 Hours**

Behavioral Patterns Part-II: Mediator, Memento, Observer, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns. What to Expect from Design Patterns: A Brief History, the Pattern Community an Invitation, A Parting Thought.

**Total: 48 Hours****Internal Assessment Pattern**

| Cognitive Level  | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Test (%) |
|------------------|-----------------|-----------------|--------------------|
| Remember         | 20              | 20              | --                 |
| Understand       | 35              | 35              | --                 |
| Apply            | 25              | 25              | 50                 |
| Analyze          | 20              | 20              | 50                 |
| Evaluate         | --              | --              | --                 |
| Create           | --              | --              | --                 |
| <b>Total (%)</b> | <b>100</b>      | <b>100</b>      | <b>100</b>         |

**TEXT BOOK:**

1. Erich Gamma, Design Patterns, Pearson Education, 2015

**REFERENCE BOOKS:**

1. Mark Grand, Pattern's in JAVA Vol-I, Wiley Dream Tech, 2098
2. Mark Grand, JAVA Enterprise Design Patterns Vol-III, Wiley Dream Tech.2001
3. Eric Freeman, Head First Design Patterns, Oreilly-SPD, 2004

4. Alan Shalloway, Design Patterns Explained, Pearson Education, 2004

**Remember**

1. Define Prototype
2. Define Decorator pattern

**Understand**

1. List the Related patterns of Observer
2. Define Intent of State Pattern
3. Explain about motivation, Structure, Participants and consequences of Observer pattern
4. Explain about motivation, Structure, Participants and consequences of Mediator pattern

**Apply**

1. Identify all the Participants for Proxy Pattern.
2. Develop the Motivation, Structure, Collaborations and Implementation of Prototype and Singleton Pattern
3. Develop the Intent, Applicability, Sample code, and Known uses of the Factory Method

**Analyze**

1. Formulate the benefits of design Patterns to the Young Designers
2. Formulate Pattern community features
3. Analyze the Flyweight pattern in detail

**21CSH23 Advanced Software Engineering****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to:

1. Explain various system models, their prototyping and specifications
2. Demonstrate the different phases involved in Agile models
3. Outline and understand Various types of System Architectures
4. Outline Object-Oriented Design Process required for software development
5. Utilise the Verification and Validation techniques to software project
6. Interpret various Agile testing Methods

**CO-PO Mapping:**

| CO | PO1 | PO3 | PO4 | PSO1 |
|----|-----|-----|-----|------|
| 1  | 3   | 2   | 2   | 2    |
| 2  | 3   | 2   | 2   | 2    |
| 3  | 3   | 2   | 2   | 2    |
| 4  | 2   | 2   | 2   | 3    |
| 5  | 2   | 2   | 2   | 3    |
| 6  | 2   | 2   | 2   | 2    |

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

**Unit-1****12 Hours**

**System Models and Software Prototyping and Specifications:** System Models, Software Prototyping and Specifications System models: Context, Behavioural, Data, and Object models, CASE Workbenches; Software Prototyping: Prototyping in the Software Process, Rapid Prototyping Techniques, User Interface Prototyping; Specifications: Formal Specification in the Software Process, Interface Specification, Behavioural Specification, , Agile models, Phases of agile models, When to use the Agile Model?, Advantages and Disadvantages of Agile Method.

**Unit-2****12 Hours**

**Architectural Design:** Introduction: System Structuring; Control Models; Modular Decomposition; Domain- Specific Architectures; Distributed Systems Architectures: Multiprocessor Architectures; Client-Server Architectures, Distributed Object Architectures; CORBA (Common Object Request Broker Architecture)

**Unit-3****12 Hours**

**Software Design:** Object Oriented Design: Objects and Object Classes, Object-Oriented Design Process, Design Evolution; Real Time Software Design: Systems Design, Real-Time Executives, Monitoring and Control Systems, Data Acquisition Systems; Design with Reuse: Component-Based Development, Application Families

**Unit-4****12 Hours**

**Verification, Validation and Testing:** Verification and Validation (V & V): Static and Dynamic V & V, V & V Goals, V & V vs. Debugging, Software Inspections / Reviews, Clean-Room Software Development; Software Testing: Defect Testing, Integration Testing, Interface Testing, Object-Oriented Testing, Testing Workbenches, Agile testing Methods.

**Total: 48 Hours****Text Books:**

1. J.F.Peters and W. Pedrycz, Software Engineering: An Engineering Approach, 1st edition, John Wiley and Sons, 2000
2. Roger Pressman and Bruce R. Maxim, Software Engineering: A Practitioner's Approach, 8<sup>th</sup> Edition, McGraw-Hill, 2020
3. Rajesh R V, Becoming an Agile Software Architect: Strategies,

### 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

1. Define software engineering.
2. List different types software myths.

#### Understand

1. Describe software architecture styles and patterns .
2. Illustrate golden rules for user interface design.

#### Apply

1. Applying the process of requirement analysis, discuss how the requirements can be collected for a project.
2. Applying debugging strategy find an error from a code?

#### Analyze

1. Compare and Contrast software life cycle models.
2. Analyze risk types in the risk management.

### Open Book Exam Questions

Assume that 10 errors have been introduced in the requirements model and that each error will be amplified by a factor of 2:1 into design and an addition 20 design errors are introduced and then amplified 1.5:1 into code where an additional 30 errors are introduced. Assume further that all unit testing will find 30 percent of all errors, integration will find 30 percent of the remaining errors, and validation tests will find 50 percent of the remaining errors. No reviews are conducted. How many errors will be released to the field.

**21CSH24 Robotic Process Automation****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to

1. Outline the Robotic Process Automation technology
2. Illustrate the usage of Recording and advance UI Interaction
3. Identify UiPath programming techniques to deploy robot configurations
4. Summarize various data extraction techniques and perform integrations with various popular applications
5. Develop a programmed robot that includes logging and exception handling
6. Inspect Deploy and control Bots with UiPath Orchestrator

**CO-PO Mapping**

| COs | PO3 | PO5 | PO8 | PSO2 |
|-----|-----|-----|-----|------|
| 1   | 3   | 1   | 3   | 1    |
| 2   | 2   | 1   | 2   | 1    |
| 3   | 1   | 2   | 2   | 2    |
| 4   | 3   | 2   | 2   | 2    |
| 5   | 3   | 3   | 3   | 2    |
| 6   | 2   | 3   | 3   | 1    |

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

**Unit I****12 Hours****Introduction to Robotic Process Automation (RPA)**

Introduction: What is Robotic Process Automation (RPA), Scope & techniques of Automation, Benefits of RPA, Components of RPA, UiPath Studio, Installation of UiPath Studio, Learning UiPath Studio, **Sequence, Flowchart & Control Flow**: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations

*Applications of RPA, RPA platforms*

**Unit II****12 Hours**

**Controls**: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events  
**Recording and advanced UI Interaction** Basic recording, Desktop recording, Web recording, Citrix, Screen Scraping, When to use OCR, How to use OCR Avoiding typical failure points, **Plugins and Extensions**: Terminal plugin, Java plugin, Java plugin with UiPath Studio, Citrix automation, Citrix environment, Mail plugin, , Web integration, Excel and Word plugins, Credential management Extensions  
*Types of OCR available, PDF plugin*

**Unit III****12 Hours**

**Handling User Events and Assistant Bots**: What are assistant bots, Monitoring system event triggers: Hotkey trigger, Mouse trigger, Monitoring image and element triggers, Launching an assistant bot on a keyboard event,

**Exception Handling, Debugging, and Logging**: Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots Debugging techniques, Setting breakpoints, Slow step, Highlighting, Break, Collecting crash dumps: Enabling crash dumps, Disabling crash dumps, Error reporting: Enterprise Edition customers, Community Edition users.

*Exception Handling, System trigger*

**Unit IV****12 Hours**

**Managing and Maintaining the Code**: Project organization, Picking an appropriate layout for each workflow, Breaking the process into smaller parts, Using exception handling, Making your workflow readable, Keeping it clean, Nesting workflows, Reusability of workflows, Templates, Commenting techniques, State Machine, When to use Flowcharts State Machines or Sequences.

**Deploying and Maintaining the Bot**: Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots, Activating and uploading a license to Orchestrator, Publishing and managing updates, Packages, Managing packages  
*Reusability of workflows, License management*



**Total: 48 Hours****Textbook (s)**

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: O'Reilly Publishing, 2018, ISBN: 9781788470940.
2. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018

**Reference (s)**

1. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
2. SrikanthMerianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation, 1st Edition, Consulting Opportunity Holdings LLC, 2018
3. <https://www.uipath.com/rpa/robotic-process-automation>
4. <https://www.udemy.com/robotic-process-automation>

**Internal Assessment Pattern**

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

**SAMPLE QUESTION (S)****Remember**

1. List any four application of RPA
2. Define Control flow
3. List RPA platforms

**Understand**

1. Explain Data manipulation with suitable example
2. Explain the Control flow for Decision making
3. Illustrate the techniques of Automation

**Apply**

1. How to use OCR Avoiding typical failure points
2. Give some real-world applications of Recording and Advance UI
3. Create how to Launching an assistant bot on a keyboard event,

**Domain III (Security)**  
**21CSH31 Computer Systems Security**

**4 0 0 4**

**Course Outcomes**

At the end of the course, students will be able to

1. Explain the fundamental concepts of computer security
2. Illustrate hacking and defense
3. Choose appropriate confidentiality policies
4. Identify different Secure architecture principles
5. Identify various Web security methods
6. Choose appropriate internet security methods

**CO-PO Mapping**

| COs | 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**

**Computer System Security Introduction:**

**12 Hours**

Introduction, What is computer security and what to I earn? Sample Attacks, The Marketplace for vulnerabilities, Error 404 Hacking digital India part 1 chase.

**Hijacking & Defense:** Control Hijacking, More Control Hijacking attacks integer overflow, More Control Hijacking attacks format string vulnerabilities, Defense against Control Hijacking -Platform Defenses, Defense against Control Hijacking - Run-time Defenses, Advanced Control Hijacking attacks.

**Unit II**

**12 Hours**

**Confidentiality Policies:**

Confinement Principle, Detour Unix user IDs process IDs and privileges, More on confinement techniques, System call interposition, Error 404 digital Hacking in India part 2 chase, VM based isolation Confinement principle, Software fault isolation, Rootkits, Intrusion Detection Systems.

**Unit III**

**Secure architecture principles isolation and leas:**

**12 Hours**

Access Control Concepts, Unix and windows access control summary, other issues in access control, Introduction to browser isolation.

**Web security landscape:** Web security definitions goals and threat models, HTTP content rendering. Browser isolation, Security interface, Cookies frames and frame busting, Major web server threats, Cross site request forgery, Cross site scripting, Defenses and protections against XSS, Finding vulnerabilities, Secure development.

**Unit IV**

**Internet Infrastructure:**

**12 Hours**

Basic security problems, Routing security, DNSrevisited, Summary of weaknesses of internet security, Link layer connectivity and TCP IP connectivity, Packet filtering firewall, Intrusion detection.

**Total: 48 Hours**

### Textbook (s)

1. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.
2. Michael T. Goodrich and Roberto Tamassia, Introduction to Computer Security, Addison Wesley, 2011.

### Reference (s)

1. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.
2. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2001.

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam (%) |
|-----------------|-----------------|-----------------|--------------------|
| Remember        | 50              | 40              | --                 |
| Understand      | 40              | 40              | --                 |
| Apply           | 10              | 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

**21CSH32 Python Programming for Security****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to:

1. Explain the basic data structures and multithreading in python
2. Outline about Socket Programming
3. Experiment with Client server approach using TCP and UDP.
4. Analyze Network Traffic using python
5. Identify proper Authentication and Authorization.
6. Choose appropriate Password management approach.

**COs-POs Mapping**

| COs             | PO2 | PO3 | PO4 |
|-----------------|-----|-----|-----|
| CO <sub>1</sub> | 3   | 2   | 1   |
| CO <sub>2</sub> | 3   | 2   | 2   |
| CO <sub>3</sub> | 1   | 1   | 3   |
| CO <sub>4</sub> | 3   | 1   | 2   |
| CO <sub>5</sub> | 3   | 1   | 2   |
| CO <sub>6</sub> | 2   | 1   | 3   |

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

**Unit -1:****12 Hours**

Python Introduction: python data structures, functions, classes, inheritance, Managing exceptions, modules and packages, managing dependencies and virtual environment, working with file system, managing threads: multi-threading and concurrency, working with socket.

**Unit -2:****12 Hours**

Socket Programming: Network Sockets in python, TCP/IP Suite, Implementing a simple TCP client and TCP server, implementing a simple UDP client and UDP server.

**Unit-3:****12 Hours**

Network Traffic Analysis with Python: Scapy: Capturing and injecting packets, Port-scanning and traceroute, reading, writing and sniffing a pcap files; network monitoring: PySNMP for SNMP, data visualization pygal, matplotlib, graphviz for network monitoring.

**Unit-4:****12 Hours**

Authentication and Authorization:HTTP session management:HTTP session,HTTP cookies, Session-state persistence; User authentication: User registration, authentication and testing; User password management: Password-change workflow,Password storage,configuring password hashing,Password-reset workflow;Authorization:Application-level authorization, enforcing authorization.

**Total: 48 Hours****Text Books:**

1. José Manuel Ortega (2018). Mastering Python for Networking and Security. Packt Publishing Ltd
2. Dennis Byrne (2021) Full Stack Python Security by Manning Publications Co
3. Chou, E. (2017). Mastering Python Networking. Packt Publishing Ltd.

**References:**

1. O'Connor, T. J. (2012). Violent Python: A Cookbook for Hackers, Forensic Analysts, Penetration Testers and Security Engineers, Syngress (Elsevier)
2. Sarker, M. F., & Washington, S. (2015). Learning Python Network Programming. Packt Publishing Ltd.

### 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                |

### Remember

1. What are the benefits of Python?
2. What is an Interpreted language?
3. List any four string handling functions

### Understand

1. Explain lists and tuples?
2. Differentiate 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

**21CSH33 Management of Information Security****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to:

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****12 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****12 Hours**

**Planning for contingencies:** Introduction, Fundamentals and Components of contingency planning.

**Information Security Policy:** Introduction, Why policy?, EISP; ISSP, SSSP, Guidelines for effective policy.

**UNIT-3****12 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****12 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: 48 Hours**

**Text Book:**

1. Michael E. Whitman and Herbert J. Mattord, Management of Information Security, 6th Edition, Cengage Learning, 2018

**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                |

**Remember**

1. List the various security metrics
2. List advantages of security audit
3. Define Vulnerability.

**Understand**

1. Explain need of configurations
2. Explain Identification of Digital Evidence,
3. Write about NIST sample metrics
4. Discuss about vulnerability scanning.

**Apply**

1. Apply any auditing tool to perform security audit.
2. Apply different network scanning tools to collect vulnerable information.

**Analyze**

1. Analyze log files of IDS&IPS tools to find level of risk



**21CSH34 Computer Forensics****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to

1. Understand the real time computer forensic issue.
2. Understand data recovery, forensics lab certification and physical requirements.
3. Identify different storage formats for data acquisition.
4. Analyze various data acquisition tools for collecting digital evidence.
5. Apply various strategies to secure digital evidences.
6. Identify and apply various computer forensics tools to solve the computer forensic cases.

**CO-PO Mapping:**

| COs | PO2 | PO3 |
|-----|-----|-----|
| 1   | 1   | 1   |
| 2   | 2   | 1   |
| 3   | 2   | 1   |
| 4   | 2   | 2   |
| 5   | 2   | 2   |
| 6   | 2   | 2   |

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

**UNIT I****12 Hours****Computer Forensics and Investigations & Investor's Office and Laboratory**

Understanding Computer Forensics, Preparing for Computer Investigations, Taking A Systematic Approach, Procedure for Corporate High-Tech Investigations, Understanding Data Recovery Workstations and Software, Understanding Forensics Lab Certification Requirements, Determining the Physical Requirements for a Computer Forensics Lab, Selecting a Basic Forensic Workstation.

*Nature and scope of cybercrime-categories of cybercrime, social engineering*

**UNIT II****12 Hours****Data Acquisition& Processing Crime and Incident Scenes**

Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisition, Performing RAID Data Acquisition, Using Remote Network Acquisition Tools, Using Other Forensics Acquisition Tools.

*Open source data acquisition tools*

**UNIT III****12 Hours****Digital Evidence**

Identifying Digital Evidence, Collecting the Evidence in Private-Sector Incident Scenes, Processing law, Enforcement Crime Scenes, Preparing for a Search, Securing a Computer Incident or Crime Scene, Sizing Digital evidence at the Scene, Storing Digital evidence, obtaining a Digital Hash.

*Selecting a basic forensic work station, methodologies to store digital evidence*

**UNIT IV****12 Hours****Current Computer Forensics Tools**

Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software.; Computer Forensics Analysis and Validation: Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisition.

*Digital evidence handling procedures, Linux system forensics, windows system forensics*

**Total: 48 Hours**

### Textbook (s)

1. Nelson, Phillips Eninger, Stuart, Computer Forensics and Investigations, Cengage Learning, 4th Edition, 2009
2. Man Young Rhee, Internet Security: Cryptographic Principles, Algorithms and Protocols, Wiley Publications, 2003

### Reference (s)

1. John R.Vacca, Computer Forensics, Cengage Learning, 2005
2. MarjieT.Britz, Computer Forensics and Cyber Crime: An Introduction, 3rdEd, Prentice Hall, 2013

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1(%) | Int. Test 2(%) | Assignment Test4 (%) |
|-----------------|----------------|----------------|----------------------|
| Remember        | 30             | 20             | -                    |
| Understand      | 35             | 30             | -                    |
| Apply           | 30             | 30             | -                    |
| Analyze         | 15             | 20             | 50                   |
| Evaluate        | --             | --             | 50                   |
| Create          | --             | --             | -                    |
| Total (%)       | 100            | 100            | 100                  |

### SAMPLE QUESTION (S)

#### Remember

1. List the various disk storage formats
2. List some digital evidences
3. List some tools used for digital evidences
4. List different type of compression methods.

#### Understand

1. Explain RAID Data Acquisition
2. Explain Identification of Digital Evidence,
3. Write about Locating and Recovering Graphics
4. Discuss about Mobile Device Forensics

#### Apply

1. Apply any different digital forensics tool to create OS image.
2. Apply different networking tools to collect evidences.

#### Analyze

1. Compare different digital forensic open-source tools to select a suitable tool which identifies hidden data.

#### Evaluate

1. Evaluate the performance of dd and dfcldd LINUX commands
2. Evaluate the performance of Widows based tools when compared with LINUX

#### Create

1. Use any open-source tool to create ISO image of a disk

**Domain IV (User Interface Design)****21CSH41 Computer Graphics****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to

1. Demonstrate fundamental concepts of computer graphics and interpret mathematical foundation of computer graphics
2. Examine Filled area primitives, two-dimensional transformations and Viewing pipeline
3. Identify the usage of various clipping algorithms
4. Recall Three-dimensional object representation and Projection
5. Differentiate between 2-D and 3-D transformations and Viewing pipeline
6. Illustrate the Animation Design techniques and hidden surface elimination methods

**COs-POs Mapping**

| COs | PO1 | PO2 | PO3 | PO4 |
|-----|-----|-----|-----|-----|
| 1   | 3   | 2   | 1   | 1   |
| 2   | 2   | 3   | 2   | 2   |
| 3   | 3   | 2   | 2   | 2   |
| 4   | 3   | 3   | 2   | 2   |
| 5   | 3   | 2   | 2   | 2   |
| 6   | 2   | 3   | 3   | 3   |

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

**UNIT I:****12 Hours****Introduction:** Application of Computer Graphics, raster scan systems, random scan systems, raster scan display processors.**Output primitives :** Points and lines, line drawing algorithms( Bresenham's and DDA Line derivations and algorithms), mid-point circle and ellipse algorithms.**Filled area primitives:** Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms, inside and outside tests.**UNIT II:****12 Hours****2-D geometrical transforms:** Basic transformations (translation, scaling, rotation, reflection and shear), matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.**2-D viewing:** The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland-Hodgeman polygon clipping algorithm.**UNIT III:****12 Hours****3-D object representation:** Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces.**3-D Geometric transformations and Viewing:** Translation, rotation, scaling, reflection and shear transformations, composite transformations. 3D Viewing pipeline, clipping, projections (Parallel and Perspective).**UNIT IV:****12 Hours****Visible surface detection methods:** Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSPtree methods, area sub-division and octree methods.**Computer animation:** Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications.**Total: 48 Hours**

### TEXT BOOKS:

1. Donald Hearn and Pauline Baker M, –Computer Graphics”, Prentice Hall, New Delhi, 2007
2. Newman W.M. and Sproull R.F., Principles of Interactive Computer Graphics, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2007

### REFERENCE BOOKS:

1. S. Harrington, Computer Graphics, A Programming Approach, MGH Publication, New Delhi, 2004
2. J.D. Foley et. Al, A Fundamental of Computer Graphics, Addition Wesley, London, 2003

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Test (%) |
|-----------------|-----------------|-----------------|--------------------|
| Remember        | 20              | 20              | --                 |
| Understand      | 35              | 35              | --                 |
| Apply           | 25              | 25              | 40                 |
| Analyze         | 20              | 20              | 40                 |
| Evaluate        | --              | --              | 20                 |
| Create          | --              | --              | --                 |
| Total (%)       | 100             | 100             | 100                |

### SAMPLE QUESTION (S)

#### Remember

1. List the applications of computer graphics
2. Write 2D transformation matrix for translation, rotation and scaling
3. Define parallel projection
4. List the steps to design computer animation

#### Understand

1. Explain Bresenham’s Line drawing algorithm
2. Explain Sutherland-Hodgeman polygon clipping algorithm
3. Write about Depth sorting visible surface detection method

#### Apply

1. Draw a circle with center (5,8) and radius 7 units using Midpoint circle generation algorithm
2. Obtain the reflection of a point A(10, 10) with respect to the line  $y=x+2$
3. Use Cohen Sutherland clipping algorithm to clip two lines p1p2 and p3p4 with p1(40,15) p2(75,45) p3(70,20) p4(100,10) against window a(50,10) b(80,10) c(80,40) d(50,40).
4. Clip the polygon v1-v6 against the window ABCD. Assume any convenient numerical values for the vertices preserving the information containing the figure. Employ Sutherland-Hodgeman algorithm.

#### Analyze

1. Compare raster scan and random scan systems
2. Write the functionalities of B-spline curves
3. Test the Bresenham’s line drawing algorithm to draw a line between the points (20,10) and (30,18)
4. Compare and contrast parallel and perspective projection

### Open Book Exam

#### Question 1:

- a) Write a procedure to compute the elements of the matrix for transforming object descriptions from one Cartesian coordinate system to another. The second coordinate system is to be defined with an origin point  $P_o$  and a vector  $V$  that gives the direction for the positive y-axis of this system
- b) Develop a procedure, based on a back-face detection technique, for identifying all the visible faces of a convex polyhedron that has different-colored surfaces. Assume that the object is defined in a right-handed viewing system with the xy-plane as the viewing surface.

#### Question 2:

- a) Write a procedure to display a line graph for any input set of data points in any selected area of the screen, with the input data set scaled to fit the selected screen area. Data points are to be displayed as asterisks joined with straight line segments, and the x and y axes are to be labeled according to input specifications. (Instead of asterisks, small circles or some other symbols could be used to plot the data points.)
- b) Write a routine to visualize a two-dimensional, vector data set using an arrow representation for the vector values. Make all arrows the same length, but display the arrows with different colors to represent the different vector magnitudes

**21CSH42 Multimedia Systems****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to

1. Explain the different realizations of multimedia tools.
2. Interpret the types of signals.
3. Make use of the Action Scripts to design multimedia systems
4. Illustrate various multimedia applications
5. Categorize various compression techniques.
6. Choose a video compression technique for real time application.

**COs – POs Mapping**

| COs | PO <sub>3</sub> | PO <sub>4</sub> |
|-----|-----------------|-----------------|
| 1   | 3               | 2               |
| 2   | 3               | 3               |
| 3   | 3               | 2               |
| 4   | 2               | 2               |
| 5   | 3               | 2               |
| 6   | 3               | 3               |

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

**UNIT-I****12 Hours**

Fundamental concepts in Text and Image: Multimedia and hypermedia, World Wide Web, overview of multimedia software tools. Graphics and image data representation graphics/image data types, file formats

Colour in image and video: colour science, color models in images, colour models in video.

Fundamental concepts in video and digital audio: Types of video signals, analog video, digital video, digitization of sound, MIDI

**UNIT – II****12 Hours**

Action Script I: ActionScript Features, Object-Oriented ActionScript, Datatypes and Type Checking, Classes, Authoring an ActionScript Class.

Action Script II: Inheritance, Authoring an ActionScript 2.0 Subclass, Interfaces, Packages, Exceptions.

**UNIT – III****12 Hours**

Application Development: An OOP Application Framework using Components with Action Script Movie Clip Subclasses.

Multimedia Data Compression: Lossless compression algorithm: Run-Length Coding, Variable Length Coding, Dictionary Based Coding, and Arithmetic Coding.

**UNIT – IV****12 Hours**

Basic Video Compression Techniques: Introduction to video compression, video compression based on motion compensation, search for motion vectors, MPEG.

**Total: 48 Hours****TEXT BOOKS:**

1. Fundamentals of Multimedia by Ze-Nian Li and Mark S. Drew PHI/Pearson Education.
2. Essentials ActionScript 2.0, Colin Moock, SPD O, REILLY.

**REFERENCES:**

1. Digital Multimedia, Nigel chapman and jenny chapman, Wiley-Dreamtech
2. Macromedia Flash MX Professional 2004 Unleashed, Pearson.
3. Multimedia and communications Technology, Steve Heath, Elsevier (Focal Press).

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam (%) |
|-----------------|-----------------|-----------------|--------------------|
| Remember        | 45              | 40              | --                 |
| Understand      | 35              | 30              | --                 |
| Apply           | 20              | 30              | 50                 |
| Analyze         | --              | --              | 50                 |
| Evaluate        | --              | --              | --                 |
| Create          | --              | --              | --                 |
| Total (%)       | 100             | 100             | --                 |

### SAMPLE QUESTION (S)

#### Remember

1. Define Multimedia.
2. What is Hypermedia?
3. Define Inheritance.
4. Define Video.

#### Understand

1. Illustrate ActionScript Features
2. Illustrate Object-Oriented ActionScript
3. Formulate overview of interaction diagrams

#### Apply

1. Choose the best algorithm for data compression.
2. Demonstrate an Authoring script in ActionScript Class
3. Construct a sample Action Script for a small movie.

#### Analyse

1. Categorise the different Action Script features.
2. Examine the suitability of the different colour schemes applied in the application.

**21CSH43 Human Computer Interaction****4 0 0 4****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. Interpret typical human-computer interaction (HCI) models, styles, and various historic HCI paradigms.
3. Choose an interactive design process and universal design principles to designing HCI systems
4. Make use of HCI design principles, standards and guidelines.
5. Examine and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems
6. Categorize and discuss HCI issues in groupware, ubiquitous computing, virtual reality, multimedia, and Word Wide Web-related environments.

**COs-POs Mapping**

| COs | PO2 | PO3 |
|-----|-----|-----|
| 1   | 1   | 1   |
| 2   | 1   | 1   |
| 3   | 2   | 2   |
| 4   | 1   | 2   |
| 5   | 2   | 1   |
| 6   | 2   | 2   |

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

**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.

**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.

**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.

**Unit IV****12 Hours****Software tools & Interaction Devices**

Specification methods, interface-Building Tools, Keyboard and function keys, pointing devices-speech recognition digitization and generation-image and video displays-drivers.

**Total: 48 Hours****Textbook (s)**

1. Wilbert O Galitz, Wiley Dream Tech, The essential guide to user interface design, 3rd Edition, 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.,4th Edition, Pearson Education, 2018

### Internal Assessment Pattern

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Examination(%) |
|-----------------|-----------------|-----------------|--------------------------|
| Remember        | 40              | 30              | --                       |
| Understand      | 40              | 40              | --                       |
| Apply           | 20              | 30              | 50                       |
| Analyze         | --              | --              | 50                       |
| 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

#### Analyze

1. Distinguish the Focus and Emphasis of visual elements in web page design.
2. Categorize the Formatting of Menus.
3. Analyze organizational structure of Keyboard layouts

**21CSH44 Mobile Programming****4 0 0 4****Course Outcomes**

At the end of the course, students will be able to:

1. Understand the basic concepts and principles in Mobile Computing
2. Demonstrate the use of various frameworks of Mobile Programming
3. Understand the basic OS architecture and building Applications
4. Explain the Mobile application frameworks and handling the Power Management
5. Apply the Augmented Reality for Mobile Applications
6. Understand the security issues in Mobile Applications

**COs-POs Mapping**

| COs | PO3 | PO4 |
|-----|-----|-----|
| 1   | 1   | 1   |
| 2   | 1   | 1   |
| 3   | 2   | 2   |
| 4   | 1   | 2   |
| 5   | 2   | 1   |
| 6   | 2   | 2   |

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

**Unit I****12 Hours****Introduction to Mobile Devices:**

Mobile vs. desktop devices and architecture -Power Management-Screen resolution -Touch interfaces - Application deployment -App Store, Google Play, Windows Store -Development environments-XCode-Eclipse -VS2012-PhoneGAP-Native vs. web applications

**HTML5/JS/CSS3**

Quick recap of technologies -Mobile-specific enhancements -Browser- detection-Touch interfaces - Geolocation -Screen Orientation-Mobile browser “interpretations”(Chrome/Safari/Gecko/IE)- Case studies.

**Unit II****12 Hours****Mobile OS Architecture**

Comparing and Contrasting architectures of all three – Android, iOS and Windows-Underlying OS (Darwin vs. Linux vs. Win 8) -Kernel structure and native level programming -Runtime (Objective-C vs. DalvikvsWinRT) -Approaches to power management - Security

**Android/iOS/Win 8 Survival and basic**

Building Application(iOS, Window, Android).- App structure, built-in Controls, file access, basic graphics Android/iOS/Win8 inbuilt APP- DB access, network access, contacts/photos

**Unit III****12 Hours****Underneath the frameworks:**

Native level programming on Android -Low-level programming on (jailbroken) iOS-Windows low level APIs

**Power Management:**

Wake locks and assertions -Low-level OS support -Writing power-smart applications

**Unit IV****12 Hours****Augmented Reality (AR) and Mobile Security:**

Web and AR-User interface-Mobile AR-evaluation of AR- standardization-GPS-Accelerometer - Camera -Mobile malware -Device protections - Mobile Security - overview of the current mobile threat landscape-An assessment of your current mobile security solution- complete analysis of your current risks- Recommendations on how to secure your company's mobile devices from advanced threats and targeted attacks

**Total: 48 Hours**

**Text Book(s):**

1. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK3 for Dummies,Wiley, 2011.

**Reference Books**

1. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.
2. Brian Fling, Mobile Design and Development O'Reilly Media,2009
3. MaximilianoFirtman, Programming the Mobile Web, O'Reilly Media, 2010.
4. Christian Crumlish and Erin Malone, Designing Social Interfaces, O'Reilly Media, 2009

**Internal Assessment Pattern**

| <b>Cognitive Level</b> | <b>Int. Test 1(%)</b> | <b>Int. Test 2(%)</b> | <b>Assignment Test4 (%)</b> |
|------------------------|-----------------------|-----------------------|-----------------------------|
| Remember               | 30                    | 20                    | -                           |
| Understand             | 35                    | 30                    | -                           |
| Apply                  | 30                    | 30                    | -                           |
| Analyze                | 15                    | 20                    | 50                          |
| Evaluate               | --                    | --                    | 50                          |
| Create                 | --                    | --                    | -                           |
| Total (%)              | 100                   | 100                   | 100                         |

**Remember**

1. Why XML is used for frontend development in Android?
2. What's Activity in Android?
3. Define AR.

**Understand**

1. Explain the components of the Android Application?
2. Explain the working structure of Android App.
3. Illustrated the Service in android?
4. Explain the various security issues of Mobile Programming.

**Apply**

1. Utilize the Android Kernel structure for your program.
2. Select the best language among HTML5/JS/CSS3 to design mobile applications and give the benefits.

**Analyse**

1. Examine the various current mobile security solutions.

# Minor Courses-AR 21

## Minor Courses Syllabus



**GMR Institute of Technology**  
Rajam 532 127, Andhra Pradesh  
Accredited by NAAC & NBA

**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 Learning |             |                                                       |                |
| 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, GPCCL
- 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 on-conventional energy systems
6. Understand the environment and energy correlation and its impact on climate change

**COs-POs Mapping**

| COs | PO <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>5</sub> | PO <sub>7</sub> | PO <sub>12</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| 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; 3<sup>rd</sup> 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, 3<sup>rd</sup> Ed, Oxford University Press. 2012
6. Stephen Peake, Renewable Energy: Power for a Sustainable Future,, 4<sup>th</sup> 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.

- 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 ( $\rho$ ) = 3000 kg/m<sup>3</sup> and the specific heat capacity ( $C_p$ ) = 800 J/kg°C.
- 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
- Calculate the Wobb's index of natural gas comprising of 89% CH<sub>4</sub>, 8% C<sub>2</sub>H<sub>6</sub>, 2% C<sub>3</sub>H<sub>8</sub> and 1% C<sub>4</sub>H<sub>10</sub> by Volume. The calorific values (K-cal/N-m<sup>3</sup>) of the constituents are as given below: CH<sub>4</sub> = 9500, C<sub>2</sub>H<sub>6</sub> = 16644, C<sub>3</sub>H<sub>8</sub> = 23688, C<sub>4</sub>H<sub>10</sub> = 30714

### Analyze

- Differentiate between extraneous and inherent mineral matter of the coal and how they can be removed.
- Differentiate between the proximate and ultimate analysis of a Lignite and Bituminous coal.
- What are the different types of catalytic cracking processes? Explain Houdry's fixed bed catalytic cracking process with a neat flow sheet.

### Open Book Question(s)

- 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.
- A school in a remote place has the following energy requirements.
  - 10 lamps each of 100 cp that operate for 4 hrs daily
  - 6 computers, each of 250 W, that operate 6 hrs. daily by a dual fuel engine driven
  - 2 HP water pump driven by dual 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.

- 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° C. The wind velocity is 15 m/s. Calculate
  - The total power density in the wind stream.
  - The maximum obtainable power density
  - A reasonable obtained power density
  - The total power
  - The torque and axial thrust

- 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 <sup>-1</sup>      |
| Thickness of glass cover                  | : 4 mm                      |
| Refractive index of glass relative to air | : 1.526                     |
| Location of collector                     | : Pune (18°32' N, 73°51' E) |
| Date                                      | : May 15                    |
| Time                                      | : 12 noon (IST)             |
| Collector tilt                            | : latitude angle            |
| Surface azimuth angle                     | : 0°                        |
| Intensity of beam radiation ( $I_b$ )     | : 725 W/m <sup>2</sup>      |
| Intensity of diffuse radiation ( $I_d$ )  | : 230 W/m <sup>2</sup>      |
| Adhesive resistance                       | : Negligible                |
| Fluid to tube heat transfer coefficient   | : 205 W/m <sup>2</sup> -K   |

|                                         |              |
|-----------------------------------------|--------------|
| Water flow rate                         | : 70 kg/h    |
| Water inlet temperature                 | : 60°C       |
| Ambient temperature                     | : 25°C       |
| 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.  $(\tau\alpha)_b$  and  $(\tau\alpha)_d$
- 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>4</sub> | PO <sub>5</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|-----------------|
| 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, 3<sup>rd</sup> 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, 1<sup>st</sup> Ed., Elsevier, 2017.

- Rogoff, M. J. and Screve, F., Waste-to-Energy technologies and project implementation, 3<sup>rd</sup> 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**

- What is composting? Distinguish between aerobic and anaerobic composting?
- What is leachate?
- List the five important components of HPLC

**Understand**

- What is Incineration? With the help of a neat sketch, explain incineration process.
- Explain the 3Ts of Incineration process.
- Discuss the governing factors considered in design of an incinerating system.
- Enumerate and discuss the factors affecting aerobic composting.
- Explain the area method of landfilling technique.

**Apply**

- Determine the landfill area required for a population of 50000, given the following data.
  - Solid waste generation: 1.5 kg/person/day
  - Compacted density of solid waste in landfill: 500kg/m<sup>3</sup>
  - Average compacted depth of solid waste:
- 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 <sup>*</sup> , Kg/m <sup>3</sup> | Energy <sup>**</sup> , 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**

- 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.
- 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, 2<sup>nd</sup> 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Examination (%)</b> |
|------------------------|------------------------|------------------------|----------------------------------|
| 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>7</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|
| 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 NO<sub>x</sub> 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, ohmic resistance, limiting current*

**15 Hours****Total: 60 Hours****Textbook(s)**

1. Barbir, Frano. PEM fuel cells: Theory and Practice, 1<sup>st</sup> 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



- 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**

- List any two types of fuel cells and their uses.
- What is open circuit voltage?
- Define limiting current.
- Define glass transition temperature.

**Understand**

- Distinguish high temperature fuel cell and low temperature fuel cells.
- Explain in detail hydrogen production plants.
- Explain about fuel cell characterization.
- Discuss about portable energy storage systems.

**Apply**

- A company is developing a new car powered by a fuel cell system that runs on H<sub>2</sub>. You have been asked to consider generating the H<sub>2</sub> by electrolysis with a fuel cell. The H<sub>2</sub> tank to be used is 10 liters in volume and a fill-up requires a pressure of 34 atm.

**Open Book Question(s)**

- Consider the following specifications of the system. 60% conversion of H<sub>2</sub>O  $E_0 = 1.172$  V The cathode pressure is maintained at 1 atm. The anode pressure is maintained at 1 atm Membrane thickness = 100  $\mu\text{m}$  Membrane conductivity ( $\sigma$ ) = 0.1 S/cm ( $S = 1/\Omega$ ) Electrolysis T = 373 K (assume water is in the gas phase) H<sub>2</sub> storage tank T = 298 K
  - Calculate the current required to operate at a voltage of 1.8V.
  - Calculate the rate of hydrogen production per membrane area and the total membrane area required to fill the tank in 2 minutes.
  - 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 21<sup>st</sup> 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 21<sup>st</sup> 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>7</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|
| 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 – Bravais 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- Nanolithography 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-Solvothermal-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<sub>2</sub>. You have been asked to consider generating the H<sub>2</sub> by electrolysis with a fuel cell. The H<sub>2</sub> 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<sub>2</sub>O E<sub>o</sub> = 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) H<sub>2</sub> 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 <sub>1</sub> | PO <sub>3</sub> | PO <sub>4</sub> | PO <sub>5</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|
| 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 C<sub>60</sub> – 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 nanomaterials 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 materials compared to bulk. Explain with an example for each.
3. What are the various carbon nano materials available? Describe one method 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<sub>2</sub> 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 material 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, reagent 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 – Dendrimers – 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

- David J. Lockwood, Nanostructured Materials for Electrochemical Energy Production and Storage, Springer, 2009
- Lens, Piet, Nanotechnology for water and wastewater treatment. Iwa Publishing, 2013

**Reference (s)**

- Hornyak, Gabor L., et al. Fundamentals of nanotechnology. CRC press, 2018. Gupta R. B, Hydrogen Fuel: Production, Transport and Storage, CRC Press, 2008
- Mendelson, Mel I. Learning Bio-micro-nanotechnology. CRC Press, 2019
- 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**

- List any two types of Biodegradable polymers.
- What is Perovskite solar cell?
- Define limiting current.
- Define glass transition temperature.

**Understand**

- Explain in detail Nano Biosensors for Plant Pathogen Detection.
- Distinguish high temperature fuel cell and low temperature fuel cells.
- Explain about fuel cell characterization.
- Discuss about Electrochemical super capacitors.

**Apply**

- 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  $H_2O$   $E_0 = 1.172$  V The cathode pressure is maintained at 1 atm. The anode pressure is maintained at 1 atm Membrane thickness = 100  $\mu m$  Membrane conductivity ( $\sigma$ ) = 0.1 S/cm ( $S = 1/\Omega$ ) Electrolysis  $T = 373$  K (assume water is in the gas phase)  $H_2$  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**

- 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 devices logic 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, Pentagon 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Examination (%)</b> |
|------------------------|------------------------|------------------------|----------------------------------|
| 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 waste 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 pursue 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, Silviculture, 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 <sub>3</sub> | PO <sub>6</sub> | PO <sub>7</sub> |
|-----|-----------------|-----------------|-----------------|
| 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Exam (%)</b> |
|------------------------|------------------------|------------------------|---------------------------|
| 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 hazardous 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 <sub>1</sub> | PO <sub>3</sub> | PO <sub>6</sub> | PO <sub>7</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|
| 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 Tchobanogous, 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<sup>3</sup>, 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 m<sup>3</sup> 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/m<sup>3</sup>, 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. Glasston, 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 Learning)**

**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 pursue 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 pursue 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, 4<sup>th</sup> Edition, Pearson Education 2021
2. Stephen Marsland- Machine Learning – An Algorithmic Perspective – 2<sup>nd</sup> Edition – Chap Man & Hall CRC Press, 2015
3. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3<sup>rd</sup> 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 Raschka, Vahid Mirjalili -- Python Machine Learning – Third Edition –Packt, 2019

**Internal Assessment Pattern**

| Cognitive Level | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Exam <sup>5</sup> (%) |
|-----------------|-----------------|-----------------|---------------------------------|
| 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 <sup>5</sup> (%) |
|-----------------|-----------------|-----------------|---------------------------------|
| 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, Measurement 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 tendency, 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, 2<sup>nd</sup> 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. Investigation 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, 3<sup>rd</sup> 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, 3<sup>rd</sup> 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Exam (%)</b> |
|------------------------|------------------------|------------------------|---------------------------|
| 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:** Introduction, 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) , Web servers ( Nmap & Metasploit for securing web servers), 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 and Practice, 3<sup>rd</sup> 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 intruder.
2. Apply snort rules to detect intrusion
3. Identify open ports in a network using nmap.
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 port 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:

- Write an nmap command to check/find list of open ports for “gmrit.org” website.
- Nmap to reveal open services and ports by IP address as well as by domain name(Note: IP number is of your choice).
- Nmap command to scan multiple hosts at once.
- Nmap command to find OS information of a host(host IP address is of your choice).
- 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.

**Unit 4:****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 Classifier-Nearest-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, 1<sup>st</sup> Edition, Pearson Addison Wesley, 2005
2. Jiawei Han & Micheline Kamber, Data Mining Concepts and Techniques, 2<sup>nd</sup> Edition, Morgan Kaufmann, 2006

**Reference (s)**

1. Margaret H Dunham, Data Mining Introductory and advanced topics, 2<sup>nd</sup> Edition, Pearson Education, 2004
2. Arun K Pujari, Data Mining Techniques, 2<sup>nd</sup> Edition, University Press, 1999.
3. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, 3<sup>rd</sup> Edition, Morgan Kaufmann Publishers, 2011

**Sample Question (S)****Internal Assessment Pattern**

| <b>Cognitive Level</b> | <b>Internal Test 1 (%)</b> | <b>Internal Test 2 (%)</b> | <b>Open Book Examination (%)</b> |
|------------------------|----------------------------|----------------------------|----------------------------------|
| 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, Grammar, 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**

- List any two types of energy storage devices and their applications.
- Define self-discharge and sulphation.
- List the role of battery in automotive application.

**Understand**

- Explain the performance curve during discharge of a lead acid battery.
- Explain with suitable diagram, the charging circuit in a hybrid electric vehicle.
- Discuss the effects of unauthorized disposal of lead acid batteries on environment.

**Apply**

- Justify the role of government in controlling unorganized sector for batteries in India.
- Differentiate between the application of flat plate and tubular batteries.
- Differentiate between constant current and constant voltage charging characteristics.

**Analyze**

- Which of the following battery is more suitable for deep discharge application and why?  
(a) Flat plate (b) Tubular plate
- Which is the most economically viable energy storage system? Give reasons.
- How do you increase the efficiency of a Fuel Cell?

**Open book Question(s)**

- 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, 3<sup>rd</sup> 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, 3<sup>rd</sup> 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++, 4<sup>th</sup> 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++, 2<sup>nd</sup> Edition, Pearson Education, 2015
3. R. F. Gilberg, B. A. Forouzan, Data Structures A Pseudocode Approach with C, 2<sup>nd</sup> 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, 3<sup>rd</sup> Edition, 2003
2. Silberschatz Korth, Database System Concepts, McGraw hill, 7<sup>th</sup> Edition, 2019

**Reference (s)**

1. Elmasri & Navatha, Fundamentals of Database Systems, Pearson Education, 7<sup>th</sup> Edition, 2016
2. C.J.Date, An Introduction to Database Systems, Pearson Education, 8<sup>th</sup> 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  $AB \rightarrow D$ ,  $E \rightarrow C$ ,  $AF \rightarrow B$ . 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, 3<sup>rd</sup> Edition, 2005
2. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 3<sup>rd</sup> Edition, 1999
3. Michael john Sebastian smith, Application specification integrated circuits, Addison Wesley, 1<sup>st</sup> Edition, 1997
4. John.P.Uyemura, Introduction to VLSI Circuits & Systems, John Wiley 1<sup>st</sup> Edition, 2009

### Reference (s)

1. Wayne Wolf, Modern VLSI Design, Pearson Education, 3<sup>rd</sup> Edition, 1997
2. Jan M Rabaey, A. Chandrakasan, B.Nikolic, Digital Integrated Circuits, Pearson, 3<sup>rd</sup> Edition, 2008
3. Richa Jain, Amrita Rai, Principles of VLSI and CMOS Integrated Circuits, S.Chand & Co Ltd, 1<sup>st</sup> Edition, 2012
4. John F. Wakerly, Digital Design Principles & Practices, PHI/ Pearson Education Asia, 3<sup>rd</sup> 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  $\lambda$  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  $10k\Omega$  and pchannel sheet resistance is  $25k\Omega$
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 resistance path 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 and Functions, 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, 3<sup>rd</sup> Edition, 2005

**Reference (s)**

1. Stephen. Brown and Zvonko Vranesic, 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, 2<sup>nd</sup> 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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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 programming 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, 1<sup>st</sup> 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, 1<sup>st</sup> 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<br>-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, 2<sup>nd</sup> Edition, John Wiley Publications, 2011.

2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2<sup>nd</sup> 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|-----------------|
| 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, 2<sup>nd</sup> Edition, 2007
2. Kenneth J Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Thomson Publishers, 3<sup>rd</sup> Edition, 2004

**Reference (s)**

1. N. Sentil Kumar, M Sarvanan, S Jeevananthan, Microprocessors and Microcontrollers, Oxford University Press, 1<sup>st</sup> 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 1<sup>st</sup> 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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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, 2<sup>nd</sup> 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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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**

| <b>Cognitive Level</b> | <b>Int. Test 1(%)</b> | <b>Int. Test 2 (%)</b> | <b>Open book Examination</b> |
|------------------------|-----------------------|------------------------|------------------------------|
| 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|-----------------|
| 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, Shape 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Exam (%)</b> |
|------------------------|------------------------|------------------------|---------------------------|
| 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. Assess 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, 4<sup>th</sup> Edition, 2009
2. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley, 2005.

**Reference(s)**

1. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, 3<sup>rd</sup> Edition, McGraw-Hill, 2008
2. Wayne Tomasi, Electronic communication systems, Pearson, 5<sup>th</sup> 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, 5<sup>th</sup> 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**

Uncertainty, 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, 2<sup>nd</sup> Edition, Prentice Hall,2001.
3. Simon Haykin, Communication Systems, 4<sup>th</sup> Edition, John Wiley and Sons, 2001.

**Reference (s)**

1. John G.Proakis, Digital communication, 4<sup>th</sup> Edition, McGraw Hill, 2001.
2. R.P. Singh, SP Sapre, Communication Systems, 3<sup>rd</sup> Edition, TMH, 2017.



**Sample Question (S)****Internal Assessment Pattern**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Exam (%)</b> |
|------------------------|------------------------|------------------------|---------------------------|
| 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]**

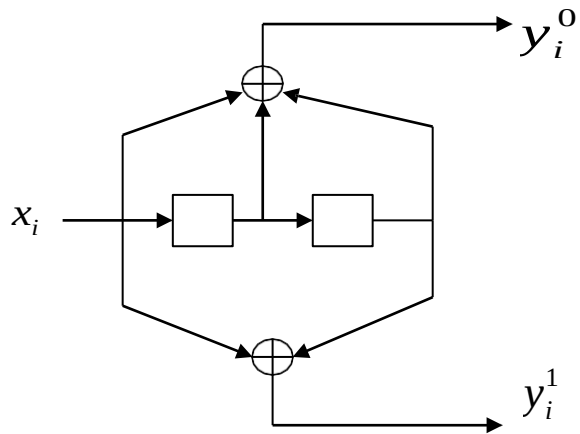
4. Design a feedback shift register encoder for an (8, 5) cyclic code with a generator. Use the encoder to find the codeword for the message 10101 in systematic form.

**[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:
- Output sequence for message sequence  $x_i = \{1\ 0\ 1\ 0\ 1\}$  in both time domain and transform domain approach.
  - 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|-----------------|
| 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|-----------------|
| 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 Transform (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:(1), C:(1), D:(2), E:(3), F:(5), O:(5), H:(10). 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 of such 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 starting 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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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 plane, 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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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 Limiters, 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

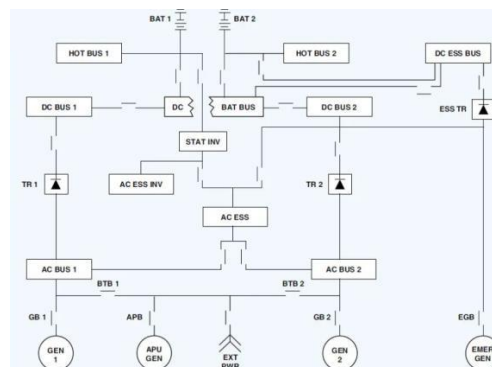
**Understand**

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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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 Scheppeler 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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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**

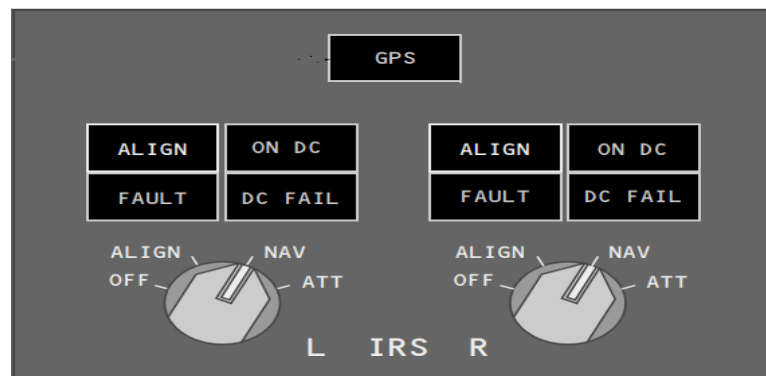
1. State the purpose of ELT
2. State the purpose of voice recorder
3. Recall types of landing systems
4. State the difference between TCAS and ACAS

**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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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, Clíodhna Ni Scanail, 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. Finkenzeuger 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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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, 2<sup>nd</sup> Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, An Introduction Geographical Information Systems, Pearson Education, 2<sup>nd</sup> 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Exam (%)</b> |
|------------------------|------------------------|------------------------|---------------------------|
| 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, Image Enhancement 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 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 and JPEG compression standard.

*Watershed algorithm*

**14 Hours****Total: 60 Hours****Textbook (s)**

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education, 3<sup>rd</sup> Edition 2011
2. S. Sridhar, Digital Image Processing, Oxford publishers, 2<sup>nd</sup> Edition, 2016

**Reference (s)**

1. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson Education, 1<sup>st</sup> Edition, 2015
2. S. Jayaraman, S. Esakirajan, T. Veerakumar, 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 the image

**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 spatial domain 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 and applications

**[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 <sub>1</sub> | PO <sub>2</sub> |
|-----|-----------------|-----------------|
| 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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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 characteristics, 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 characteristics and applications. Induction Motor Drive- Introduction, Construction, Principle of operation, Performance characteristics and applications.

*Various types of starters***15 Hours****Unit IV****Electric Propulsion System-II**

BLDC Motor Drive- Introduction, Construction, Principle of operation, Performance characteristics and applications.

PMSM Drive: Introduction, Construction, Principle of operation, Performance characteristics 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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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  $L=100\text{mH}$ . 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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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 users 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. Adniriluka 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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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 <sub>2</sub> | PO <sub>3</sub> | PO <sub>5</sub> | PO <sub>6</sub> | PO <sub>7</sub> | PO <sub>11</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|
| 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Examination (%)</b> |
|------------------------|------------------------|------------------------|----------------------------------|
| 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 <sub>3</sub> | PO <sub>5</sub> |
|-----|-----------------|-----------------|
| 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", Springer.

**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" Springer.

**Internal Assessment Pattern**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Examination (%)</b> |
|------------------------|------------------------|------------------------|----------------------------------|
| 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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Examination (%)</b> |
|------------------------|------------------------|------------------------|----------------------------------|
| 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 of 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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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*”, 1<sup>st</sup> 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**

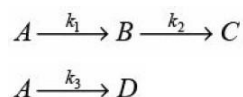
1. What is modeling and simulation?
2. Write the expression of electromagnetic energy of an inductor.
3. What are the advantages and disadvantages of the batch processing over the continuous operation?
4. What is yield factor?

**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  $T_e$  is the temperature of the environment,  $h$  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:



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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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., 2<sup>nd</sup> Edition, 2005.
3. Clarence W Silva, "Sensors and Actuators: Control System Instrumentation", CRC Press, 1<sup>st</sup> 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, 4<sup>th</sup> 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 cm<sup>2</sup>, which are separated by a distance of 0.02cm. A mica sheet of thickness  $0.01 \pm 0.001$  cm is being passed between the plates. Calculate the variation of capacitance if the electric constant of mica is 8 and permittivity of air is  $8.854 \times 10^{-12}$  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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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, 3<sup>rd</sup> 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, 5<sup>th</sup> Edition, 2002.
3. Madhuchand Mitra and Samerjit Sengupta, “Programmable Logic Controllers Industrial Automation an Introduction”, Penram International Publishing (India) Pvt. Ltd.; 2<sup>nd</sup> 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

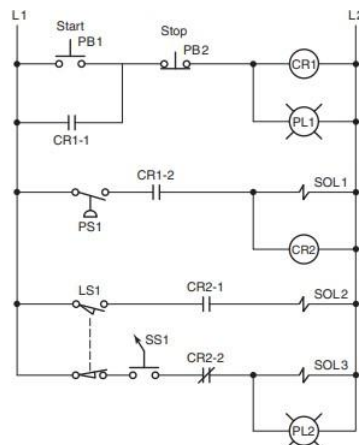


Figure 1

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.

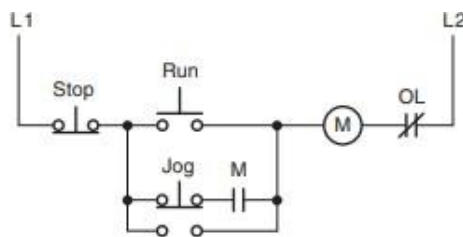


Figure 2

**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 <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|
| 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", 5<sup>th</sup> edition, New Age International Publishers, 2010
2. Katsuhiko Ogata, "Modern Control Engineering", 5<sup>th</sup> Edition, University of Minnesota. Prentice Hall, Upper Saddle River, New Jersey, 2010.

**Reference (s)**

1. George Ellis, "Control System Design Guide", Academic Press, 3<sup>rd</sup> 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 <sub>6</sub> | PO <sub>7</sub> | PO <sub>12</sub> |
|-----|-----------------|-----------------|------------------|
| 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 Services, 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, 1<sup>st</sup> 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 , 1<sup>st</sup> Edition, MK Publishing, 2010
3. David S Linthicum, Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide, 1<sup>st</sup> 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>9</sub> | PO <sub>12</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|------------------|
| 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 <sub>5</sub> | PO <sub>8</sub> | PO <sub>10</sub> |
|-----|-----------------|-----------------|------------------|
| 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, 1<sup>st</sup> Edition, 2020.
2. Cloud Native: Using Containers, Functions, and Data to Build Next-Generation Applications, Boris Scholl , Trent Swanson , Peter jausovec, O'Reilly 1<sup>st</sup> Edition, 2019.

**Internal Assessment Pattern**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Exam (%)</b> |
|------------------------|------------------------|------------------------|---------------------------|
| 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 <sub>5</sub> | PO <sub>8</sub> | PO <sub>10</sub> |
|-----|-----------------|-----------------|------------------|
| 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, 2<sup>nd</sup> Edition, O'Reilly Publications.
2. Beginning React, Greg Lim, 2<sup>nd</sup> Edition, 2020
3. React.js Essentials, Artemij Fedosejev, 1<sup>st</sup> Edition, 2015, Peckt Publishing Ltd.

**Internal Assessment Pattern**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Exam (%)</b> |
|------------------------|------------------------|------------------------|---------------------------|
| 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>B.Tech. (Minor)</b>                          |                    |                                     |               |          |          |          |          |
|-------------------------------------------------|--------------------|-------------------------------------|---------------|----------|----------|----------|----------|
| <b>Title I-Robotics and Automation</b>          |                    |                                     |               |          |          |          |          |
| <b>S.No.</b>                                    | <b>Course Code</b> | <b>Course Name</b>                  | <b>POs</b>    | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| 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        |
| <b>Title II- Industrial Systems Engineering</b> |                    |                                     |               |          |          |          |          |
| 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> |
|-----|-----------------|-----------------|-----------------|
| 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 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, 2<sup>nd</sup> Edition, 2008
3. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic Engineering: An Integrated approach, Prentice Hall, 1<sup>st</sup> Edition, 1989
4. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson/Prentice Hall, 3<sup>rd</sup> Edition, 2005
5. S K Saha, Introduction to Robotics, Tata McGraw-Hill Education, 2<sup>nd</sup> 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>4</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|
| 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, 2<sup>nd</sup> 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, 7<sup>th</sup> 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>4</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|
| 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, 5<sup>th</sup> Ed, 2007.

**Reference(s):**

1. Kuo, B. C., and Golnaraghi, F., Automatic Control Systems, John Wiley & Sons, 8<sup>th</sup> Ed, 2003.
2. Prof. R. C., and Bishop, R. H., Modern Control Systems, Addison Wesley, 7<sup>th</sup> 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 <sub>2</sub> | PO <sub>5</sub> |
|-----|-----------------|-----------------|
| 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 <sub>1</sub> | PO <sub>10</sub> | PO <sub>11</sub> | PO <sub>12</sub> |
|-----|-----------------|------------------|------------------|------------------|
| 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, Departmentation 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, 3<sup>rd</sup> Edition, 2013
2. Teslang Martand, Industrial Engineering and Production Management, S Chand & Co Publications, 1<sup>st</sup> Edition, 2002
3. Phillip E Hicks, Industrial Engineering and Management; a new perspective, TMH publications, 2<sup>nd</sup> Edition, 1994
4. H.T. Amrine, J. A. Ritchey and O.S. Hulley, Manufacturing Organization and Management, , Prentice-Hall, 2<sup>nd</sup> Edition, 1966
5. P.C. Tripathi and P.N. Reddy, Principles of Management, TMH Publications, 4<sup>th</sup> Edition, 2012

**Reference (s)**

1. H. Koontz & H. Weihrich, Essentials of Management, Tata McGraw Hill, 8<sup>th</sup> Edition, 2010
2. Paneer Selvam, Production and Operations Management, PHI, 3<sup>rd</sup> Edition, 2012

**Sample Question (s)****Internal Assessment Pattern**

| Cognitive Level   | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Examinations (%) |
|-------------------|-----------------|-----------------|----------------------------|
| <b>Remember</b>   | 35              | 35              | -                          |
| <b>Understand</b> | 45              | 35              | -                          |
| <b>Apply</b>      | 20              | 30              | -                          |
| <b>Analyze</b>    | -               | -               | 50                         |
| <b>Evaluate</b>   | -               | -               | 30                         |
| <b>Create</b>     | -               | -               | 20                         |
| <b>Total (%)</b>  | <b>100</b>      | <b>100</b>      | <b>100</b>                 |

**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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>5</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|
| 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, poisson arrivals, exponential service times, with infinite population and finite population models, multichannel, poisson arrivals, exponential service times with infinite population single channel poisson 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, 16<sup>th</sup> Edition, 2012
2. FredErick S Hiller & Gerald J Liberman, Introduction to Operations Research, TMH Publications, 7<sup>th</sup> Edition, 2002

**Reference (s)**

1. Handy A Taha, Operations Research: An Introduction, Prentice Hall of India Publications, 6<sup>th</sup> Edition, 1997
2. R. Pannerselvam, Operation Research, PHI Publications, 1<sup>st</sup> Edition, 2002
3. J. K Sharma, Operation Research: Problems and Solutions, McMillan, 1<sup>st</sup> Edition, 2002

**Sample Question (s)****Internal Assessment Pattern**

| Cognitive Level   | Int. Test 1 (%) | Int. Test 2 (%) | Open Book Examinations (%) |
|-------------------|-----------------|-----------------|----------------------------|
| <b>Remember</b>   | 35              | 30              | -                          |
| <b>Understand</b> | 35              | 40              | -                          |
| <b>Apply</b>      | 30              | 30              |                            |
| <b>Analyze</b>    | -               | -               | 60                         |
| <b>Evaluate</b>   | -               | -               | 20                         |
| <b>Create</b>     | -               | -               | 20                         |
| <b>Total (%)</b>  | <b>100</b>      | <b>100</b>      | <b>100</b>                 |

**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 |
|  | 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:

$$\text{Maximize } Z = 3x_1 + 5x_2 + 4x_3$$

$$\text{Subjected to } 2x_1 + 3x_2 \leq 8; 2x_2 + 5x_3 \leq 10; 3x_1 + 2x_2 + 4x_3 \leq 15; x_1, x_2, x_3 \geq 0$$

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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>5</sub> | PO <sub>11</sub> | PO <sub>12</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|------------------|------------------|
| 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 &amp; 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, 2<sup>nd</sup> Edition, 2000

**Reference (s)**

1. Rahul V. Altekhar "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           | -               | -               | -                          |
| <b>Total (%)</b> | <b>100</b>      | <b>100</b>      | <b>100</b>                 |

#### 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 <sub>1</sub> | PO <sub>2</sub> | PO <sub>3</sub> | PO <sub>5</sub> | PO <sub>11</sub> | PO <sub>12</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|------------------|------------------|
| 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, 4<sup>th</sup> 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**

| <b>Cognitive Level</b> | <b>Int. Test 1 (%)</b> | <b>Int. Test 2 (%)</b> | <b>Open Book Examinations (%)</b> |
|------------------------|------------------------|------------------------|-----------------------------------|
| <b>Remember</b>        | 35                     | 30                     | -                                 |
| <b>Understand</b>      | 35                     | 50                     | -                                 |
| <b>Apply</b>           | 30                     | 20                     | 25                                |
| <b>Analyze</b>         | -                      | -                      | 50                                |
| <b>Evaluate</b>        | -                      | -                      | 25                                |
| <b>Create</b>          | -                      | -                      | -                                 |
| <b>Total (%)</b>       | <b>100</b>             | <b>100</b>             | <b>100</b>                        |

**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

# Audit Courses-AR 21

## Audit Courses - Syllabus



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