GMRIT

Curriculum
2023

M. Tech.
Computer Science and Engineering

(Duration of Study: 2 years)

GMRIT
Training Tomorrow's Engineers Today

Department of Computer Science and Engineering
GMR Institute of Technology
Rajam, Andhra Pradesh
(An Autonomous Institute Affiliated to JNTU-GV, Vizianagaram, AP)
NBA Accredited and NAAC Accredited

Department of Computer Science and Engineering
M. Tech : Computer Science and Engineering
[Minimum Credits to be earned: 68]

First Semester							
No	**Course Code**	**Course**	**POs**	**Periods**			
				L	**T**	**P**	**C**
1	21MEX101	Advanced Optimization Techniques		4	-	-	4
2	23CSE101	Advanced Data Structures and Algorithms		4	-	-	4
3		**Elective I**		4	-	-	4
4		**Elective II**		4	-	-	4
5		**Elective III**		4	-	-	4
6	23CSE102	Data Structures and Algorithms Lab		-	-	3	1.5
7	23CSE103	Term Paper		-	-	3	1.5
			Total	**20**	-	**6**	**23**
Second Semester							
1	23CSE201	Advanced Database Management Systems		4	-	-	4
2	23CSE202	Internet of Things		4	-	-	4
3		**Elective IV**		4	-	-	4
4		**Elective V**		4	-	-	4
5		**Elective VI**		4	-	-	4
6	23CSE203	Database Management Systems lab		-	-	3	1.5
7	23CSE204	Internet of Things Lab		-	-	3	1.5
			Total	**20**	**-**	**6**	**23**
Third Semester							
No	**Course Code**	**Course**	**POs**	**Periods**			
				L	**T**	**P**	**C**
1	23CSE301	Internship		-	-	-	4
2	23CSE302	Project Work		-	-	-	-
3		Research Methodology and IPR (Audit course)		-	-	-	0
			Total	-	-	-	**4**
Fourth Semester							
1	23CSE302	Project Work		-	-	-	18
			Total	-	-	-	**18**

List of Elective Courses

Elective I							
No	**Course Code**	**Course**	**POs**	**Periods**			
				L	**T**	**P**	**C**
1	23CSE001	Mathematical Foundations of Data Science with Python		4	-	-	4
2	23CSE002	Computer Organization and Architecture		4	-	-	4
3	23CSE003	Advanced Operating Systems		4	-	-	4
Elective II							
1	23CSE004	Data Pre-processing for Data Analytics and Machine Learning		4	-	-	4
2	23CSE005	Fundamentals of cyber security		4	-	-	4
3	23CSE006	Object Oriented Software Engineering		4	-	-	4
Elective III							
1	23CSE007	Artificial Intelligence and Machine Learning		4	-	-	4
2	23CSE008	Soft Computing Techniques		4	-	-	4
3	23CSE009	Cryptography and Network Security		4	-	-	4
Elective IV							
1	23CSE010	Data Visualization techniques		4	-	-	4

2	23CSE011	Social Networks and Semantic Web		4	-	-	4
3	23CSE012	Web Application Developments Framework		4	-	-	4
Elective V							
1	23CSE013	Computer Vision & Pattern Recognition		4	-	-	4
2	23CSE014	Natural Language Processing		4	-	-	4
3	23CSE015	Predictive Analytics		4	-	-	4
Elective VI							
1	23CSE016	Deep Learning with Neural Networks		4	-	-	4
2	23CSE017	Fundamentals of Social Networks Analysis		4	-	-	4
3	23CSE018	Cloud Architecture and Security		4	-	-	4

21MEX101 Advanced Optimization Techniques

4 0 0 4

Course outcomes

1. Design of mechanical systems and interdisciplinary engineering applications and business solutionsusing suitable optimization technique
2. Apply numerical or iterative techniques in power systems for optimal power flow solutions
3. Optimize the parameters in control systems for desired steady state or transient response
4. Optimize the cost function in deciding economic factors of power systems
5. Design of electrical systems optimally using suitable techniques like univariate method, steepest descent method etc
6. Design of electrical systems optimally using, steepest and descent method etc

Unit I **11+4 Hours**

Linear programming and Assignment Problem

Linear programming-Two-phase simplex method, Big-M method, duality, interpretation, applications, Assignment problem- Hungarian's algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem

Applications of assignment problems

Unit II **11+4 Hours**

Classical and Numerical Optimization Techniques

Classical optimization techniques-Single variable optimization with and without constraints, multi–variable, optimization without constraints, multi–variable optimization with constraints–method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical methods for optimization-Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints

Exterior penalty function method for handling constraint

Unit III **11+4 Hours**

Genetic algorithm and Programming

Genetic algorithm (GA)-Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA.

Genetic Programming (GP)-Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Solving differential equations using GP

Unit IV **12+3 Hours**

Multi-Objective GA

Multi-ObjPareto's analysis, Non-dominated front, multi–objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems

Basic Problem solving using Genetic algorithm, Genetic Programming & Multi Objective GA and simple applications of optimization for engineering systems.
Simple applications of optimization for engineering systems

Total 45+15 Hours

Reading material

1. J. S. Arora, Introduction to Optimum Design, McGraw Hill International Ed., NY, 1989
2. K. Deb, Optimization for Engineering Design: Algorithms and Examples, 2nd Ed., PHI, 1995
3. S. S. Rao, Engineering Optimization: Theory and Practice, New Age International (P) Ltd., 2001
4. D. E. Goldberg, Genetic Algorithms in Search and Optimization, Pearson publication, 1990
5. J. R. Koza, Genetic Programming, MIT Press, 1993
6. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, Wiley, 2001

23CSE101 Advanced Data Structures and Algorithms

4 0 0 4

Course Outcomes

1. Describe the operations and implementation of Linear Data Structures.
2. Understand the operations of Heap Structures
3. Comprehend the operations and implementation of tree and graph data structure
4. Analyze the time and space complexity of algorithms using mathematical tools, big-O notation, and asymptotic analysis
5. Design efficient algorithms for a variety of problem-solving using Decrease and Conquer, Divide and Conquer, and Transform and Conquer approaches
6. Develop problem-solving skills by tackling complex computational problems using greedy approaches and dynamic programming

Unit I **11+4 Hours**

Linear Data Structures and Heap Structures

List ADT–Linked list –Singly linked lists- Doubly-linked lists – Stack ADT –Queue ADT. Heap Structures Introduction, Min-Max Heaps, Leftist trees, Binomial Heaps, Fibonacci heaps.
Applications of Stack, Hashing

Unit II **11+4 Hours**

Trees and Graphs

Trees: Introduction, Terminology, Binary Trees, Representation of Binary Trees using arrays and linked lists, Binary tree traversals. Binary Search Trees, Self-Balancing Trees: AVL Trees, M-way Search Trees, B-Trees, B+ Trees, Red-Black Trees; Graph: Terminology, Graph Traversals: Depth First Search and Breadth First Search.
Trie, Graph Coloring

Unit III **11+4 Hours**

Algorithm Design Techniques - I

Fundamentals of algorithmic problem solving – Analysis Framework, Performance Analysis- Space Complexity, Time Complexity, Growth of Functions and Asymptotic Notations. Mathematical Analysis of Non-recursive algorithms – Mathematical Analysis of Recursive algorithms - Brute Force: Bubble sort – Sequential search. Decrease and Conquer: Insertion sort, Topological sorting – Divide and Conquer: Merge sort, Quick sort, Fibonacci search – Transform and conquer: Heap Sort.

Disjoint Set Data Structure, Union-Find Operations

Unit IV **12+3 Hours**

Algorithm Design Techniques - II

Greedy method: 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: Matrix chain multiplication, 0/1 knapsack problem. NP, NP complete and NP hard problems.
N queen's problem, Longest Common Subsequence, Optimal BST

Total: 45+15 Hours

Textbook (s)

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education,2002
2. Michael Main, Walter Savitch, Data Structures and other objects using C++, 4thEdition, Addison Wesley,2018

3. Introduction to The Design and Analysis of Algorithms, 3rd. Edition, Anany Levitin, Pearson Education, 2017.
4. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L. Rivest, and C.Stein, PHI Pvt. Ltd./ Pearson Education

Reference (s)

1. S. Tanenbaum, Y. Langsam and M.J. Augenstein,, Data Structures using C and C++, 2ndEdition, Pearson Education,2015
2. R. F. Gilberg, B. A. Forouzan, Data Structures A Pseudocode Approach with C, 2nd Edition, CENGAGE Learning,2005
3. Design and Analysis of algorithms, Aho,Ullman and Hopcroft, Pearsoneducation.

23CSE102 Data Structures and Algorithms Lab

0 0 3 1.5

Course Outcomes

1. Implement stack and queue data structures using array and linked list
2. Implement binary tree, binary search tree and tree traversals
3. Solve graph problems using appropriate data structure
4. Applying algorithmic paradigms using brute force, Decrease and Conquer, Divide and Conquer, and Transform and Conquer approaches
5. Design efficient algorithms for a variety of problem-solving using greedy approaches
6. Develop problem-solving skills by tackling complex computational problems using dynamic programming

List of Experiments

1. Implement Linked List
2. Implement Stack and Queue data structures
3. Implement Heap data structure
4. Implement Binary Search Tree
5. Implement AVL Tree
6. Implement Graph traversal
7. Analysis of Recursive algorithms and Non-recursive algorithms
8. Solve the Sorting problem using Brute Force approach and Divide and Conquer approach
9. Solve sorting problem Transform and Conquer approach
10. Find the minimum cost spanning tree for a given graph using Greedy approach
11. Implement Dijkstra's algorithm using Greedy approach
12. Find the Optimal parenthesization solution for matrix chain multiplication problem using Dynamic programming.

23CSE103 Term Paper

0 0 3 1.5

Course Outcomes

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

1. Interpret the li**t**erature 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

Term Paper: The Term Paper is a self-study report and shall be carried out during 1st semester. 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.

23CSE201 Advanced Database Management System

4 0 0 4

Course Outcomes

1. Apply normalization process on existing database for eliminating redundancy.
2. Carryout initial database design for large enterprises by learning feature of ER-Models.
3. Apply the recovery techniques for managing the database effectively and avoid the data loss.
4. Design database for large enterprises by learning eliminate redundancy by using the features of Normal Forms.
5. Develop efficient database management systems.
6. Choose various algorithms and techniques for deadlock and recovery in Distributed database

Unit I **11+4 Hours**

Introduction

Basics of database systems, Traditional file oriented approach, Motivation for database approach, Evolution of database systems, Database basics, Views of data, Three level architecture of DBMS, Relational database systems, Data models, Database languages, Client-server and multi-tier architectures, Multimedia data, Information integration, Data-definition language commands, Overview of query processing, Storage and buffer management, Transaction processing, The queryprocessor. Use of SQL, DDL Statements, DML Statements, View Definitions, Constraints and Triggers Keys and Foreign Keys, Constraints on Attributes and Tuples, Modification of Constraints, Cursors, Dynamic SQL.

Data Models - Data Model, Introduction of entity Relationship model, Elements of the E/R Model, Requirement, Relationship, Entity-Relationship Diagrams, Multiplicity of Binary E/R Relationships, Design Principles, Avoiding Redundancy, Simplicity Counts, Extended ER Models.

Relational Model - The Relational Data Model: Basics of the Relational Model, Relation Instances, Functional Dependencies, Rules about Functional Dependencies, Design of Relational Database Schemas.

Unit II **11+4 Hours**

Representing Data Elements- Data Elements and Fields, Representing Relational Database Elements, Records, Representing Block and Record Addresses, Client-Server Systems, Logical and Structured Addresses, Record Modifications, Index Structures, Indexes on Sequential Files, Secondary Indexes, B-Trees, Hash Tables.

Relational Algebra - Relational Algebra: Basics of Relational Algebra, Set Operations on Relations, Extended Operators of Relational Algebra, Constraints on Relations, Modification of the Database, Views Relational Calculus, Tuple Relational Calculus, Domain Relational Calculus.

Normalization - Normalization, First Normal form, Second Normal Form, Third Normal Form, BCNF, Multi-valued dependency, Fifth Normal Form.

Unit III **11+4 Hours**

Query Execution - Introduction to Physical-Query-Plan Operators, One-Pass Algorithms for Database Operations, Nested-Loop Joins, Two-Pass Algorithms Based on Sorting, Two-Pass Algorithms Based on Hashing, Index-Based Algorithms, Buffer Management, Parallel Algorithms for Relational Operations, Using Heuristics in Query Optimization, Basic Algorithms for Executing Query Operations.

Concurrency Control - Serializability, Enforcing Serializability by Locks, Locking Systems With Several Lock Modes, Architecture for a Locking Scheduler Managing Hierarchies of Database Elements, Concurrency Control by Timestamps, Concurrency Control by Validation.

Unit IV **11+4 Hours**

Transaction Management - Introduction of Transaction management, Serializability and Recoverability, View Serializability, Resolving Deadlocks, Distributed Databases, Distributed Commit, Distributed Locking.

Database System Architecture - Centralized and Client-Server Architectures, Server System Architectures, Parallel Systems, Distributed Systems, Network Types.

Distributed Database - Homogeneous and Heterogeneous Database, Distributed Data Storage, Distributed Transaction, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Heterogeneous.

Total: 45+15 Hours

Text Books:-

1. Raghu Ramakrishnan/Johannes Gehrke, Database Management Systems, Tata McGraw Hill.
2. Silber Schatz. Korth, Database System Concepts, Tata McGraw Hill.

Reference Books:-

1. Introduction to Database Systems, 8/e, C.J.Date, Pearson.
2. Database System design, Implementation, and Management, 5/e, Rob, Coronel, Thomson.
3. ShamKanth B. Navathe, Fundamental of Database System, Pearson Education.

23CSE202 Internet of Things

4 0 0 4

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

Unit I **11+4 Hours**

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 **11+4 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 **11+4 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+3 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: 45+15 Hours

Textbook:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles". TMH Publications, 2017.

2. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st 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.

23CSE203 Database Management Systems lab

0 0 3 1.5

Course Outcomes

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

List of Experiments

1. Design ER Model for a given application & Convert ER model to Relational Model.
2. Creating users - roles and Granting privileges.
3. Creating and altering tables for various relations in SQL using Integrity Constraints.
4. Implementing queries in SQL using
    a. Insertion
    b. Retrieval (operations like union - intersect - minus - in - exists - group by and having etc.)
    c. Updation
    d. Deletion
5. Implementing the concepts of Rollback – commit, checkpoints and Views
6. Implementing joins - sub queries - nested and co related nested queries.
7. Experiment with built in functions in oracle (Numeric, String, Date, Aggregate functions etc.)
8. Implementing operations on relations using PL/SQL.
9. Implementing functions, stored procedures using PL/SQL
10. Implementing cursors using PL/SQL
11. Implement Exception Handling using PL/SQL
12. Creating triggers using PL/SQL

23CSE204 Internet of Things Lab

0 0 3 1.5

Course Outcomes

1. Study of various sensory elements and the required hardware and software used in IoT.
2. Implement the interfacing methods with MicroController Unit (MCU)
3. Implement a few Embedded programming in Ubimote device
4. Demonstrate the data acquisition by interfacing with various Sensors with MCU using Ubimote
5. Develop WSN application with different network topologies
6. Demonstrate the data acquisition by interfacing with various Sensors with MCU using Wi-Fi Mote

List of Experiments

1. Study of IoT development boards
2. Study of Sensors that are attached with development boards
3. Study of the fundamentals of Arduino and Raspberry Pi
4. Basic experiments using Arduino like LED
5. Implement LED Fading using Arduino
6. Implement a program in Arduino to raise Buzzer sound based on distance of the object identified by Ultrasonic Sensor
7. Study of Ubimote, BLE Mote and WiFi mote and the installation of required compiler in Linux
8. Embedded Programming
    a. Toggling LEDs
    b. Transmitting a string through UART
    c. Controlling LEDs blinking pattern through UART
9. Embedded Programming
    a. Echo each character typed on serial terminal.
    b. Digital IO configuration.
    c. Timer based LED Toggle.
10. Point to point communication of two Ubimotes over the radio frequency
11. Reading Temperature, Light Intensity and Relative Humidity value from the sensor using BLE Mote
12. Reading Temperature, Light Intensity and Relative Humidity value from the sensors using Wi-Fi Mote

23CSE001 Mathematical Foundations of Data Science with Python

4 0 0 4

Course Outcomes

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

Unit I **11+4 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*

Unit II **11+4 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

Unit III **11+4 Hours**

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

Unit IV **12+3 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

Total: 45 +15 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.

23CSE002 Computer Organization and Architecture

4 0 0 4

Course Outcomes

1. Apply knowledge of number systems, codes and Boolean algebra to the analysis and design of digital logic circuits
2. Design a digital system, components or process to meet desired needs within realistic constraints by forming multi-disciplinary teams.
3. Evaluate quality of modern computing systems
4. Assess functionality of their components, design of instruction sets and their underlying execution.
5. Analyze the performance of computer systems and know how to improve their efficiency (pipelining, caches, etc).
6. Apply cache design to solve performance problems in other aspects of computer design.

Unit I **11+4 Hours**

Number Systems and Computer Arithmetic-Signed and unsigned numbers Addition & subtraction, multiplication division, Floating point representation logical operation, Gray code, BCD codes, Error detecting codes. Boolean algebra ,Simplification of Boolean expressions - Maps.
Combinational and Sequential Circuits- Decoders, Encoders, Multiplexers, Half and Full adders, shift registers, flip-flops, binary counters, memory Unit.

Unit II **11+4 Hours**

Memory Organization-Memory hierarchy , Main memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory Concept.
Intel 8086 CPU Architecture- Diagram, code and segment registers, internal operations , machine language instructions (addressing modes, instruction formats), Instruction execution timing.

Unit III **11+4 Hours**

Intel 8086 Assembly Language Instructions- Data transfer instructions - input output instructions, address transfer Flags, arithmetic, logical shift and rotate instructions.
Intel 8086 Assembly Language Programming-Conditional and unconditional transfer, iteration control, interrupts and process control instructions assembler directives Programming with assembly language instructions.

Unit IV **12+3 Hours**

ALU Design- Addition and subtraction sign and unsigned numbers, multiplication and division algorithms, BCD Adders.
Input-Output Organization- Peripheral devices, input-output interface, Asynchronous data transfer, Modes of transfer , priority interrupts, DMA, Input output processor, Serial communication.

Total: 45+15 Hours

Text Books:

1. Computer System Architecture, 3/e, Moris Mono, Pearson / PHI.
2. Microprocessor and interfacing , 2/e, Douglas V. Hall, TMH.

Reference Books:

1. Digital Logic and computer organization, Rajaraman, Radha Krishnan, PHI.
2. Microcomputer systems: 8086/8088 family, 2/e, Liu, Gibson, PHI
3. Computer Organization and Architecture, 7/e, stallings, pearson

4. Computer Organization, 5/e, Hamacher, Vranesic, TMH
5. Computer systems organization and architecture, carpinellipearson
6. Computer organization and Design, pal chowdary, PHI
7. Computer system organization, jotwani, TMH

23CSE003 Advanced Operating Systems

4 0 0 4

Course Outcomes

1. Understand functions, objectives services of Operating Systems
2. Understand the issues related to concurrency mechanisms
3. Implement Bankers Algorithms to handle deadlocks
4. Design and Analyze mechanisms used in memory management
5. Understand about design issues related to processor scheduling
6. Understand Distributed Operating Systems to some extent

Unit I **11+4 Hours**

Introduction to Operating Systems - System components ,Evaluation of OS -Simple Batch Processing, Multiprogrammed, Time-shared, Personal computer, Parallel and Distributed Systems, OS Objectives and functions , Virtual machines.
Overview - Introduction, design approaches, why advanced operating systems, types of advanced operating systems. Distributed Systems – Hardware and Software concepts, Architectures of Distributed Systems - System Architecture types, issues in distributed operating systems.

Unit II **11+4 Hours**

REAL TIME OPERATING SYSTEM - Task & Task States – Tasks & Data – Semaphores & Shared Data – Operating System Services – Message Queues – Timer Functions – Event Memory Management – Interrupt Routines & RTOS Environment – Basic design Using RTOS.
Process description and control - process states, process description, process control , CPU Scheduling - Scheduling criteria, Types of processor scheduling and Scheduling algorithms, Multiple-processor Scheduling , Process and Threads- Multi threading ,ULTS and KLTS.

Unit III **11+4 Hours**

Memory Management and Virtual Memory- Logical Vs Physical address space, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging, Demand paging, Performance of demand paging, Page Replacement algorithms.
Process management and Synchronization - The Critical Section problem, Synchronization Hardware, Semaphores and Classical problem of Synchronization, Critical regions, Monitors. message passing ,Readers / Writers problem. Synchronization in Solaris.

Unit IV **12+3 Hours**

I/O management and disk scheduling – I/O devices, organization of I/O functions; I/O buffering, disk scheduling, Disk cache, File management – organization, directories, file sharing, record blocking, secondary storage management; case studies-LINUX I/O.
SHARED MEMORY AND FILE SYSTEMS
Shared memory : Consistency models – Page based distributed shared memory – Shared variables – Object based distributed shared memory; Distributed shared memory: Architecture–algorithms for implementing DSM–memory coherence.

Total: 45 +15 Hours

Text Books:

1. William Stallings, "Operating Systems – internals and design principles ", Prentice Hall India, 5th Edition, 2005.
2. Andrew S Tanenbaum , " Distributed Operating Systems " , Pearson Education India,

Reference Books:

1. Operating Systems Concepts, 5/e, Abraham Silberschatz, Galvin, John Wiley & Sons Inc.
2. Mukesh Singhal, Niranjan G Shivratri , " Advanced Concepts in Operating Systems", McGraw Hill International, 1994.
3. Operating Systems, 2/e, Dhamdhere, TMH

23CSE004 Data Pre-processing for Data Analytics and Machine Learning

4 0 0 4

Course Outcomes

1. Understand the distinctions between data preprocessing strategies for data analytics and machine learning.
2. Apply strategies for cleaning up data tables, including reindexing and handling missing values and outliers.
3. Discuss challenges and future directions in data integration and fusion.
4. Apply various data reduction techniques, including random sampling, stratified sampling, and dimensionality reduction methods such as PCA, to optimize data for analysis.
5. Evaluate the impact of data reduction on the quality and efficiency of data for analysis and modeling.
6. Develop feature engineering strategies into generate new variables that capture valuable information from raw data.

Unit I **11+4 Hours**

Data and Database

Data: Introduction to data- DIKW pyramid: Data, Information, Knowledge, Wisdom - Differentiating data preprocessing for data analytics versus data preprocessing for machine learning- Types of data and formats - Information versus pattern in data. Databases: Introduction to databases- Types of databases - Connecting to and pulling data from databases.
Data Visualization

Unit II **11+4 Hours**

Data Cleaning, Data Fusion and Data Integration

Data Cleaning - Cleaning up the table: unwise data collection - Reindexing and multi-level indexing. - Unpacking, restructuring, and reformulating the table - Dealing with missing values, outliers, and errors.
Data Fusion and Data Integration - Data Fusion Techniques- Data Integration Strategies - challenges regarding data fusion and integration.
Data Quality Assessment

Unit III **11+4 Hours**

Data Reduction and Data Redundancy

Data Reduction - Types of data reduction - Numerosity data reduction: random sampling, stratified sampling, and random over/undersampling. Dimensionality reduction methods: regression, decision tree, random forest, computational dimension reduction, functional data analysis (FDA), and principal component analysis (PCA).
Feature Selection

Unit IV **12+3 Hours**

Data Transformation and Massaging

Introduction to Data Transformation and Massaging - data transformation versus data massaging- Normalization and standardization techniques - Binary coding, ranking transformation, and discretization- Attribute construction - feature extraction - Log transformation, smoothing, aggregation, and binning.
Data Augmentation

Total: 45+15 Hours

Textbook (s)

1. Jafari, Roy. Hands-On Data Preprocessing in Python. Packt Publishing, 2022. ISBN-13: 978-1-80107-213-7.
2. Provost, Foster, and Tom Fawcett. Data Science for Business: What you need to know about data mining and data-analytic thinking. " O'Reilly Media, Inc.", 2013.

Reference (s)

1. Navlani, Avinash, Armando Fandango, and Ivan Idris. Python Data Analysis: Perform data collection, data processing, wrangling, visualization, and model building using Python. Packt Publishing Ltd, 2021.
2. Zheng, Alice, and Amanda Casari. Feature engineering for machine learning: principles and techniques for data scientists. " O'Reilly Media, Inc.", 2018.
3. García, Salvador, Julián Luengo, and Francisco Herrera. Data preprocessing in data mining. Vol. 72. Cham, Switzerland: Springer International Publishing, 2015.

23CSE005 Fundamentals of 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 cyber-crimes, IT laws and acts.

Unit I **11+4 Hours**

Introduction to Cyber Security
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

Unit II **11+4 Hours**

Web security
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.

Unit III **11+4 Hours**

Intrusion Detection System
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

Unit IV **12+3 Hours**

Cyber Laws and Digital Forensics
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

Total: 45+15 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

23CSE006 Object Oriented Software Engineering

4 0 0 4

Course Outcomes

1. Understand about process models and learn how to specify software requirements.
2. Develop a sketch of an idea on a blackboard or a scrap of paper in order to visualize a part of a system.
3. Analyze different software process and lifecycle models, evaluating their strengths and weaknesses in various contexts.
4. Design and develop real-time software projects with effective cost estimation and planning.
5. Create project management plans based on real-world case studies, applying your knowledge of software engineering principles.
6. Design real-world projects to ensure project success.

Unit I **11+4 Hours**

Introduction to Classical software engineering - Historical, Economic and Maintenance aspects. introduction to Object Oriented Paradigm. Different phases in structured paradigm and Objective Oriented Paradigm. Software Process and different life cycle models and corresponding strengths and weaknesses.
Planning and Estimation -Estimation of Duration and Cost, COCOMO components of software. Project Management plan, one case Study.

Unit II **11+4 Hours**

Tools for step wise refinement - Cost - Benefit analysis, Introduction to software metrics and CASE tools. Taxonomy and scope of CASE tools. Introduction to testing, with focus on Utility, Reliability, Robustness, Performance, Correctness.
Modules to objects -Cohesion and Coupling, Data Encapsulation and Information hiding aspects of Objects. Inheritance, polymorphism and Dynamic Binding aspects. Cohesion and coupling of objects. Reusability, Portability and Interoperability aspects.

Unit III **11+4 Hours**

Requirement phase - Rapid Prototyping method, Specification phase , Specification Document, Formal methods of developing specification document, Examples of other semi - formal methods of using Finite-State- Machines, Petri nets.
Analysis phase -Use case Modeling, Class Modeling, Dynamic Modeling.

Unit IV **12+3 Hours**

Design phase -Data oriented design, Object Oriented design, Formal techniques for detailed design. One case study.
IIM Phases - Implementation, Integration and maintenance phases.

Total: 45+15 Hours

Textbook (s)

1. Object oriented and Classical Software Engineering, 7/e, Stephen R. Schach, TMH
2. Object oriented and classical software Engineering, Timothy Lethbridge, Robert Laganiere, TMH

Reference (s)

1. Component-based softwareengineering:7thinternational symposium, CBSE 2004, IvicaCrnkovic, Springer

23CSE007 Artificial Intelligence and Machine Learning

4 0 0 4

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

Unit I **11+4 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 **11+4 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 **11+4 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+3 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: 45+15 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
3. Stephen Marsland- Machine Learning – An Algorithmic Perspective – Second Edition – Chap Man & Hall CRC Press, 2015

Reference (s)

1. E. Rich K. Knight and B.Nair – Artificial Intelligence– Third Edition – Tata McGraw Hill, 2017
2. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

23CSE008 Soft Computing Techniques

4 0 0 4

Course Outcomes

1. Understand the fundamental concepts of soft computing, encompassing fuzzy logic, neural networks, and evolutionary computing.
2. Understand artificial neural networks, their basic models, learning laws, and various network types, and effectively apply them in supervised learning tasks.
3. Understand unsupervised learning networks and utilize these concepts for various pattern recognition tasks.
4. Apply fuzzy relations to solve real-world problems effectively.
5. Apply genetic algorithms to address complex optimization and search challenges.
6. Apply Soft Computing techniques to practical scenarios, including applications in flood area analysis, optimization problems, and control of flexible robots.

Unit I **11+4 Hours**

Basic elements of soft Computing – Introduction to soft computing, Fuzzy logic, Neural Networks and Evolutionary Computing, Approximations of Multivariate functions, Non – linear Error surface and optimization.
Artificial Neural Networks- Introduction, Basic models of ANN, important terminologies, Basic Learning Laws, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Backpropagation Network. Radial basis function network and Hopfield Networks.

Unit II **11+4 Hours**

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks-Introduction to various networks.
Introduction to Classical Sets and Fuzzy Sets- Crisp Sets and Fuzzy Sets- operations. Classical Relations and Fuzzy Relations- Cardinality, Properties and composition. Tolerance and equivalence relations. Membership functions- Features, Fuzzification, membership value assignments, Defuzzification.

Unit III **11+4 Hours**

Fuzzy Logic-Classical& Fuzzy logic, Operations, Boolean Logic, Multivalued Logics, Fuzzy Rule Base and Approximate Reasoning ,Fuzzy Decision making ,Fuzzy Logic Control Systems.
Genetic Algorithm- Introduction, Traditional Optimization and search techniques, Search space, Operators: Encoding, Selection, Crossover and Mutation. Stopping Condition of GA.

Unit IV **12+3 Hours**

Support Vector Machine -Introduction, optimal hyper plane for linearly separable pattern, linear classifier, nonlinear classifier problem, optimal plane for non-separable pattern, example XOR problem, support vector machine for non-linear regression, summary and discussion.
Applications of Soft Computing - A fusion Approach of Multispectral Images with SAR Image for flood area analysis, Optimization of TSP using GA Approach and GA-Fuzzy system for Control of flexible Robots.

Total: 45+15 Hours

Textbook (s)

1. Principles of Soft Computing- S N Sivanandam, S N Deepa, Wiley India, 2011
2. V. Kecman, “Learning and Soft computing”, Pearson Education, India

Reference (s)

1. Soft Computing and Intelligent System Design -Fakhreddine O Karray, Clarence D Silva,. Pearson Edition, 2004.
2. Introduction to Fuzzy Systems, Guanrong Chen, Trung Tat Pham, Chapman & Hall/CRC, 2009.
3. S. Haykins,“Neural networks: a comprehensive foundation”. Pearson Education, India..

23CSE009 Cryptography and Network Security

4 0 0 4

Course Outcomes

1. understand the concepts of network security, encryption techniques, and cryptographic algorithms.
2. implement security mechanisms to protect data, and recognize and address potential security threats
3. design and evaluate secure communication systems, safeguard data integrity, and establish secure channels for information exchange.
4. apply authentication standards in various applications.
5. assess the security of authentication systems and email encryption methods in real-world scenarios.
6. design secure network systems, protecting against various threats and vulnerabilities.

Unit I **11+4 Hours**

Introduction -Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Inter-network security, Session Hijacking and Spoofing, Buffer overflow.
Cryptography - Symmetric Cipher Model, Substitution Techniques, Confusion, Diffusion Steganography, Water mark security, Classical Encryption Techniques.
Secret Key Cryptography -Simplified DES, Block Cipher principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design, Principles and Modes of operation, Algorithms: Triples DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, Characteristics of Advanced Symmetric block ciphers.

Unit II **11+4 Hours**

Number Theory-Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's Theorems, Testing for primarily, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.
Public Key Cryptography-Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.
Message Authentication and Hash Functions- Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.
Hash and MAC algorithms-MD file, Message digests Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC.

Unit III **11+4 Hours**

Digital Signatures and Authentication Protocols- Digital signatures, Authentication protocols, Digital signature Standards, Digital signature through Elliptic curve cryptosystem.
Authentication Applications -Kerberos, X.509 directory Authentication Service. Electronic Mail Security: Pretty Good Privacy, S/MIME.

Unit IV **11+4 Hours**

IP Security -Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management.
Web Security: Web Security requirements, secure sockets layer and Transport layer security, Secure Electronic Transaction.
Intruders, Viruses and Worms-Intruders, Viruses, Worms, Bacterias.
Fire Walls: Fire wall Design Principles, Trusted systems.

Total: 45+15 Hours

Textbook (s)

1. William Stallings,Cryptography and Network Security: Principles and Practice, 5th Edition, William Stallings, Pearson Education, 2011.

2. Cryptography and Network Security, Behrouz A. Forouzan and DebdeepMukhopadhay, Tata McGraw-Hill, 2010.

Reference (s)

1. Eric Maiwald ,Fundamentals of Network Security (Dreamtech press)
2. Charlie Kaufman, Radia Perlman and Mike Speciner,Network Security – Private Communication in a Public World, Pearson/PHI.
3. Whitman, Principles of Information Security, Thomson.
4. Robert Bragg,Network Security The Complete reference, Mark Rhodes, TMHBuchmann,Introduction to Cryptography, Springer.
5. Applied Cryptography, 2nd edition, Bruce Schneier.

23CSE010 Data Visualization Techniques

4 0 0 4

Course Outcomes

1. explain the fundamental principles of visual perception
2. Interpret and analyze complex data, enabling informed decision-making and the extraction of valuable insights.
3. apply visualization techniques to execute various data analysis tasks effectively
4. Apply data analysis skills by describing data distributions, identifying distribution patterns, and employing effective distribution displays.
5. evaluate correlations and multivariate relationships in data through correlation analysis techniques.
6. design information dashboards that facilitate clear and concise data presentation.

Unit I **11+4 Hours**

Core Skills for Visual Analysis

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

Unit II **11+4 Hours**

Time-Series, Ranking, and Deviation Analysis

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

Unit III **11+4 Hours**

Distribution, Correlation, and Multivariate Analysis

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

Unit IV **12+3 Hours**

Information Dashboard Design

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence. Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

Total 45+15 Hours

Textbook (s)

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.

4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Reference (s)

1. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
2. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
3. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
4. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

23CSE011 Social Networks and Semantic Web

4 0 0 4

Course Outcomes

1. demonstrate a Profound Understanding of Semantic Web Development
2. apply Key Concepts and Measures in Social Network Analysis
3. understand the role of ontologies in the Semantic Web, be proficient in various ontology languages
4. develop Social-Semantic Applications with social network features
5. explain the state-of-the-art methods for representing network data
6. apply a comprehensive methodology for conducting social network analysis in scientific contexts..

Unit I **11+4 Hours**

Introduction -The World Wide Web ,Limitations of Today's Web, The Next Generation Web, Development of semantic web, Semantic Web Road Map, Logic on the semantic Web .
Social Network Analysis- What is networks analysis?, Development of Social Networks Analysis, Key concepts and measures in network analysis.

Unit II **11+4 Hours**

Electronic Sources for Network Analysis- Electronic Discussion networks, Blogs and Online Communities, Web-based networks. Modeling and aggregating social network data.
Knowledge Representation for the Semantic Web- Ontology's and their role in the semantic web, Ontology's Languages for the Semantic Web –Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL),UML,XML/XML Schema.

Unit III **11+4 Hours**

Modeling and aggregating social network data-State-of-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data.
Developing social-semantic applications- Building Semantic Web Applications with social network features, Flink: the social networks of the Semantic Web community, Open academia: distributed. Semantic based publication management

Unit IV **12+3 Hours**

Evaluation of web-based social network extraction- Differences between survey methods and electronics data extraction , context of the empirical study, data collection, preparing the data, optimizing goodness of fit, comparison across methods and networks, Predicting the goodness of fit, evaluation through analysis.
Semantic-based Social Network Analysis in the sciences Methodology - Data acquisition, Representation, storage and reasoning, Visualization and Analysis, Results – Descriptive analysis, Structural and cognitive effects on scientific performance.

Total 45+15 Hours

Textbook (s)

1. Social Networks and the Semantic Web ,Peter Mika,Springer,2007.
2. Thinking on the Web - Berners Lee, Godel and Turing, Wiley interscience,2008.

Reference (s)

1. Semantic Web Technologies ,Trends and Research in Ontology Based Systems, J.Davies, RudiStuder, PaulWarren, JohnWiley&Sons.
2. Semantic Web and Semantic Web Services -LiyangLuChapman and Hall/CRC Publishers,(Taylor & Francis Group).
3. Information Sharing on the semantic Web - HeinerStuckenschmidt;Frank Van Harmelen, Springer Publications.
4. Programming the Semantic Web,T.Segaran,C.Evans,J.Taylor,O'Reilly,SPD.

23CSE012 Web Application Developments Framework

4 0 0 4

Course Outcomes

1. Understand the fundamentals of web framework.
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. Understand and analyze how modern-day web applications are different from web sites.
6. Learn the technologies of Python web framework.

Unit I **11+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

Unit II **11+4 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

Unit III **11+4 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.

Unit IV **12+3 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

Total 45+15 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.

23CSE013 Computer Vision & Pattern Recognition

4 0 0 4

Course Outcomes

1. Explain the fundamental concepts and principles of computer vision, including its applications and challenges.
2. Apply various point operators, linear filtering, and neighborhood operators to perform basic image processing tasks
3. Explain the principles, algorithms, and techniques used in feature detection, matching, and segmentation.
4. Describe the concepts of pattern recognition and its applications.
5. Understand and apply supervised and unsupervised learning methods to discover patterns and group similar data points.
6. Understand and apply Recognition and object detection techniques to locate and identify objects in images or video sequences.

Unit I **11+4 Hours**

Introduction to Computer Vision and Image Processing

Computer Vision: Overview and introduction - Image formation: Geometric primitives, transformations, and photometric image formation - Sampling and aliasing in images - Image processing: Point operators, linear filtering, neighborhood operators - Multi-resolution representations and wavelets.

Image registration and content-based image retrieval.

Unit II **11+4 Hours**

Feature Detection, Matching, and Segmentation

Feature detection and matching: Points and patches – Feature detector, feature descriptors, feature Matching, Edges - Edge detection and linking. Lines - Piecewise linear, Hough transform. Segmentation techniques: Active contours (snakes), split and merge, region merging - Mean shift and mode finding and K-means based segmentation.

Graph cuts and energy-based methods, Medical image segmentation.

Unit III **11+4 Hours**

Pattern Recognition and Machine Learning

Introduction to pattern recognition - Training and learning in PR systems- Different approaches to pattern recognition - Statistical pattern recognition - Supervised learning with parametric and nonparametric methods - Unsupervised learning and clustering - Neural pattern recognition: Neural network structure for pattern recognition applications, feed-forward neural networks.

Dimensionality reduction methods- PCA (Principal Component Analysis) and LDA (Linear Discriminant Analysis)

Unit IV **12+3 Hours**

Recognition, Tracking, and Motion Estimation

Object detection - Face recognition - Instance recognition – Image Classification – Semantic segmentation - Tracking and motion estimation: Optical flow, activity recognition, motion estimation, and tracking.

Deep learning object detection using CNNs, YOLO, and SSD

Total: 45+15 Hours

Textbook (s)

1. Richard Szeliski, Computer Vision: Algorithms and Applications , Springer, 2022, ISBN: 978-1848829343
2. Rober.J. Shelkoff, John Wiley & Sons , Pattern Recognition- Statistical, Structural and Neural Approaches, Wiley, 2007, ISBN: 978-8126513703.

Reference (s)

1. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, Wiley India, 2006, ISBN: 978-8126511167.
2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012, 78-1107011793
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, Brooks/Cole, 2007, ISBN: 978-0495082521.

23CSE014 Natural Language Processing

4 0 0 4

Course Outcomes

1. Understand the fundamentals & building blocks of Natural Language Processing
2. Understand different text representations &labelling methods
3. Apply different Natural Language models and named entities
4. Understand Recurrent neural network for NLP
5. Make use of GRUs and LSTM models for translation
6. Understand different applications of NLP

Unit I **11+4 Hours**

Introduction to NLP:
Definition, 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 **11+4 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 **11+4 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+3 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 LabelingLexicons for Sentiment, Affect, and Connotat.

Total: 45+15 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, BodhisattwaMajumder, Anuj Gupta, and HarshitSurana. Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems. O'Reilly Media, 2020.

Reference (s)

1. Rajesh Arumugam, RajalingappaaShanmugamani :Hands-On Natural Language Processing with Python

2. Manning C.,SchützeH ,Foundations of Statistical Natural Language Processing–.(MITPress)
3. Jacob Eisenstein. Natural Language Processing.

23CSE015 Predictive Analytics

4 0 0 4

Course Outcomes

1. demonstrate the concepts and importance of predictive analytics
2. describe data wrangling, and the process of preparing data for the models
3. use statistical and visualization techniques for predictive models
4. analyze performance of various regression and clustering techniques
5. apply regression and classification model on applications for decision making
6. build time series forecasting models in a variety of business contexts

Unit I **11+4 Hours**

Introduction

Data Analytics in the Modern Enterprise - Evolution of Data Analytics- Different Types of Data Analytic s- Introduction to predictive modeling - Scope of predictive modeling - Applications of predictive modeling - Data Cleaning - Handling missing values - Imputation. Data Wrangling: Sub setting a dataset - Generating random numbers and their usage - Generating random numbers following probability distributions - Grouping the data - Random sampling – splitting a dataset in training and testing datasets - Merging operations.

Unit II **11+4 Hours**

Statistical concepts and regression techniques

Random sampling and the central limit theorem - Hypothesis testing - Different types of hypothesis test – Chi-square tests. Regression Analysis for Predictive Modeling - Types of Regression Analysis: Linear regression, Multiple linear regression, Logistic Regression - Linear regression versus logistic regression.

Unit III **11+4 Hours**

Clustering and Trees

Introduction to clustering – Distances metrics - Normalizing distances - Linkage methods - Hierarchical clustering - K-means clustering –Fine tuning clustering -The Elbow method, Silhouette Coefficient. Trees and Random Forests: Introduction to decision tree and Random Forests – Mathematical concepts behind decision trees: Homogeneity, Entropy, Information gain - ID3 algorithm for decision tree construction- Gini index - Reduction in Variance - Pruning decision tree - Cross-validation and pruning decision tree –Regression tree algorithm - Random forest algorithm - Important parameters for random forests

Unit VI **12+3 Hours**

Forecasting and Time series Analysis

Introduction to Forecasting and Time Series Analysis - Time Series Data - Time Series Decomposition methods: Additive & Multiplicative models- Autocorrelation and Partial Autocorrelation- ACF and PACF plots - Forecasting Methods: Exponential smoothing techniques, ARIMA (AutoRegressive Integrated Moving Average) - Forecasting Accuracy - Forecasting with Long and Short Time Series.

Total: 45+15 Hours

Text Books

1. Ashish Kumar, “Learning Predictive Analytics with Python”, Packt Publishing, 2016, ISBN: 978-1783983261.
2. Nooruddin Abbas Ali, Predictive Analytics for the Modern Enterprise, Published by O'Reilly Media, Inc.

Reference Books

1. Anasse Bari, Mohamed Chaouchi, Tommy Jung, "Predictive Analytics for Dummies", 2nd Edition Wiley, 2017, ISBN: 978-8126567935.
2. Ivo D. Dinov., "Data Science and Predictive Analytics: Biomedical and Health Applications using R", Springer, 2018, ISBN: 978-3319723464.
3. Daniel T.Larose and Chantal D.Larose, "Data Mining and Predictive Analytics", 2nd edition Wiley, 2015, ISBN: 978-1-118-11619-7.

23CSE016 Deep Learning with Neural Networks

4 0 0 4

Course Outcomes

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.

Unit I **11+4 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 : Kohnen'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

Unit II **11+4 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

Unit III **11+4 Hours**

Recurrent Networks

One-hot encoding of words and charcters, using word embedings, 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

Unit IV **12+3 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

Total: 45+15 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. Yegnanrayana , "Artificial Neural Networks" , PHI.

Reference (s)

1. FranchoisChollet, 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 GianmarioSpacagna, 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

23CSE017 Fundamentals of Social Networks Analysis

4 0 0 4

Course Outcomes

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. Understand human behaviour in social web and related communities.

Unit I **11+4 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 **11+4 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 **11+4 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+3 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: 45+15 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.

23CSE018 Cloud Architecture and Security

4 0 0 4

Course Outcomes

1. Interpret the architecture and infrastructure models of cloud computing, strengths, and limitations of cloud computing.
2. Understand 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. Understand the concepts of cloud scaling and disaster recovery
6. Analyze the performance, scalability, and availability of the underlying cloud technologies and software

Unit I **11+4 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 Modal.

Unit II **11+4 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

Unit III **11+4 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,

Unit IV **12+3 Hours**

Cloud Service Providers
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

Total: 45+15 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

Reference (s)

1. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012
2. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010