ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES (A)
(UGC Autonomous)
Approved by AICTE, Affiliated to Andhra University, Accredited by
N.B.A. & NAAC with 'A' Grade
(Estd : 2001)

2021-22

Academic Regulations (R20-CSE)

Curriculum & Syllabi (II Year I&II Semesters)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VISION

Our vision is to emerge as a world class Computer Science and Engineering department through excellent teaching and strong research environment that responds swiftly to the challenges of changing computer science technology and addresses technological needs of the stakeholders.

MISSION

To enable our students to master the fundamental principles of computing and to develop in them the skills needed to solve practical problems using contemporary computer-based technologies and practices to cultivate a community of professionals who will serve the public as resources on state-of-the-art computing science and information technology.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-1	Employability	Work as Competent Computer Engineer either globally or locally by engaging in professional practice in a variety of roles with ability to serve as a team or individual.
PEO-2	Higher studies	Prepared to pursue masters or research programmes in computer science or other disciplines.
PEO-3	Entrepreneurship	Become successful Entrepreneurs who demonstrate strong technical and leadership skills to bring out innovative designs/products that also addresses social issues.
PEO-4	Lifelong learning and ethics	Adapt to rapidly changing technology in engineering domains through continuous learning and practice code of ethics.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1	Programming and software Development skills: Ability to acquire programming efficiency to analyze, design and develop optimal solutions, apply standard practices in software project development to deliver quality software product.
2	Computer Science Specific Skills: Ability to formulate, simulate and use knowledge in various domains like data engineering, image processing and information and network security, artificial intelligence etc., and provide solutions to new ideas and innovations

PROGRAM OUTCOMES (POs)

Graduate Attribute1:	Engineering Knowledge
PO-1	Apply the knowledge of basic engineering sciences, humanities, core engineering and computing concept in modeling and designing computer based systems.
Graduate Attribute2:	Problem Analysis
PO-2	Identify, analyze the problems in different domains and define the requirements appropriate to the solution.
Graduate Attribute3:	Design/Development of Solution
PO-3	Design, implement & test a computer based system, component or process that meet functional constraints such as public health and safety, cultural, societal and environmental considerations.
Graduate Attribute4:	Conduct Investigations of Complex Problems
PO-4	Apply computing knowledge to conduct experiments and solve complex problems, to analyze and interpret the results obtained within specified timeframe and financial constraints consistently.
Graduate Attribute5:	Modern Tool Usage
PO-5	Apply or create modern techniques and tools to solve engineering problems that demonstrate cognition of limitations involved in design choices.
Graduate Attribute6:	The Engineer and Society
PO-6	Apply contextual reason and assess the local and global impact of professional engineering practices on individuals, organizations and society.
Graduate Attribute7:	Environment and Sustainability
PO-7	Assess the impact of engineering practices on societal and environmental sustainability.
Graduate Attribute8:	Ethics
PO-8	Apply professional ethical practices and transform into good responsible citizens with social concern.
Graduate Attribute9:	Individual and Team Work
PO-9	Acquire capacity to understand and solve problems pertaining to various fields of engineering and be able to function effectively as an individual and as a member or leader in a team.

Graduate Attribute10:	Communication
PO-10	Communicate effectively with range of audiences in both oral and written forms through technical papers, seminars, presentations, assignments, project reports etc.
Graduate Attribute11:	Project Management and Finance
PO-11	Apply the knowledge of engineering, management and financial principles to develop and critically assess projects and their outcomes in multidisciplinary areas.
Graduate Attribute12:	Life-long Learning
PO-12	Recognize the need and prepare oneself for lifelong self learning to be abreast with rapidly changing technology.

ANITS-CSE CURRICULUM – REGULATIONS –R20

I Year Course structure – CSE

Semester - I

Course Code	Title of the course	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE111	EngineeringMathematics – I	BS	3	0	0	1	6	10	40	60	100	3
CSE112	English Language	HS	3	0	0	0	3	6	40	60	100	3
CSE113	BASIC ELECTRONICS	ES	3	0	0	1	3	7	40	60	100	3
CSE114	PROBLEM SOLVING WITH C	ES	3	0	0	0	3	6	40	60	100	3
CSE115	Digital Logic Design	ES	3	0	0	1	3	7	40	60	100	3
CSE116	Language Laboratory	HS	0	0	3	0	3	6	50	50	100	1.5
CSE117	Problem solving with C – lab.	ES	0	0	3	0	3	6	50	50	100	1.5
CSE118	Environmental Science (Mandatory non-credit course)	BS	3	0	0	0	1	4	50	-	50	-
		Total	**18**	**0**	**6**	**3**	**25**	**52**	**350**	**400**	**750**	**18**

I Year Course structure – CSE

Semester - II

Course Code	Title of the course	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE121	Engineering Mathematics – II	BS	3	0	0	1	6	10	40	60	100	3
CSE122	Engineering Physics	BS	3	0	0	1	4	8	40	60	100	3
CSE123	Engineering Chemistry	BS	3	0	0	1	4	8	40	60	100	3
CSE124	ELEMENTS OF ELECTRICAL ENGINEERING	ES	3	0	0	1	4	8	40	60	100	3
CSE125	Engineering Drawing	ES	2	0	3	1	3	9	40	60	100	3.5
CSE126	Engineering Physics Lab.	BS	0	0	3	0	1	4	50	50	100	1.5
CSE127	Engineering Chemistry Lab.	BS	0	0	3	0	1	4	50	50	100	1.5
CSE128	Engineering Workshop	ES	0	0	3	0	1	4	50	50	100	1.5
CSE129	Human Values and Professional Ethics (Mandatory non-credit course)	HS	3	0	0	0	1	4	50	0	50	-
		Total	**17**	**0**	**12**	**5**	**25**	**59**	**400**	**450**	**850**	**20**

II Year Course structure – CSE

Semester - I

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE 211	DATA STRUCTURES&ALGORITHMS	PC	2	1	0	1	4	8	40	60	100	3
CSE 212	COMPUTER ORGANIZATION	PC	3	0	0	1	4	8	40	60	100	3
CSE 213	JAVA PROGRAMMING	PC	3	0	0	1	4	8	40	60	100	3
CSE 214	DATA COMMUNICATION	PC	3	0	0	1	4	8	40	60	100	3
CSE 215	DISCRETE MATHEMATICAL STRUCTURES	BS	3	0	0	1	4	8	40	60	100	3
CSE 216	DESIGN THINKING & PRODUCT INNOVATION	ES	2	0	2	1	3	8	40	60	100	3
CSE 217	***JAVA PROGRAMMING LAB***	***PC***	0	0	***3***	0	2	5	***50***	***50***	***100***	1.5
CSE 218	***DATA STRUCTURES LAB USING C***	***PC***	0	0	***3***	0	2	5	***50***	***50***	***100***	1.5
CSE 219	Constitution of Indian & - Intellectual Property Rights (Mandatory non-credit course)	HS	2	0	0	0	1	3	50	0	50	-
	Total		**18**	**1**	**8**	**6**	**28**	**61**	**390**	**460**	**850**	**21**

II Year Course structure – CSE

Semester - II

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE 221	PROBABILITY , STATISTICS AND QUEUEING THEORY	BS	3	0	0	1	6	10	40	60	100	3
CSE 222	MICROPROCESSOR & INTERFACING	PC	2	1	0	2	4	9	40	60	100	3
CSE 223	OPERATING SYSTEMS	PC	3	0	0	1	4	8	40	60	100	3
CSE 224	COMPUTER NETWORKS	PC	3	0	0	1	4	8	40	60	100	3
CSE 225	COMPUTER GRAPHICS	PC	2	1	0	1	4	8	40	60	100	3
CSE 226	FORMAL LANGUAGES AND AUTOMETA THEORY	PC	2	1	0	1	4	8	40	60	100	3
CSE 227	***MICRO PROCESSOR INTERFACING LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
CSE 228	***OPERATING SYSTEM LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
	Total		**15**	**3**	**6**	**7**	**28**	**59**	**340**	**460**	**800**	**21**

III Year Course structure – CSE (Tentative)

Semester - I

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE 311	OPEN ELECTIVE-I*	OE	3	0	0	1	2	6	40	60	100	3
CSE 312	PROFESSIONAL ELECTIVE -I	PE	3	0	0	1	2	6	40	60	100	3
CSE 313	COMPETITIVE PROGRAMMING	SOC	2	1	0	1	2	6	40	60	100	3
CSE 314	COMPILER DESIGN	PC	2	1	0	1	5	9	40	60	100	3
CSE 315	DATA BASE MANAGEMENT SYSTEMS	PC	3	0	0	1	4	8	40	60	100	3
CSE 316	DESIGN & ANALYSIS OF ALGORITHMS	***PC***	2	1	0	***0***	1	4	40	60	100	3
CSE 317	***DATA BASE MANAGEMENT SYSTEMS LAB***	***PC***	0	0	***3***	***0***	1	4	***50***	***50***	100	1.5
CSE 318	***COMPETITIVE PROGRAMMING LAB***	***SOC***	0	0	***3***	0	1	4	***50***	***50***	100	1.5
CSE 319	***QA&VA-I***	***HS***	0	0	3	0	1	4	***100***	***0***	100	1.5
CSE31A	***SUMMER INTERNSHIP-INDUSTRY-1***	***PR***	0	0	***0***	***0***	***1***	1	***100***	***0***	***100***	2
Total			**15**	**3**	**9**	**5**	**20**	**52**	**540**	**460**	**1000**	**24.5**

III Year Course structure – CSE

Semester - II

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE 321	OPEN ELECTIVE -II*	OE	3	0	0	1	2	6	40	60	100	3
CSE 322	PROFESSIONAL ELECTIVE -II	PE	3	0	0	1	2	6	40	60	100	3
CSE 323	PROFESSIONAL ELECTIVE -III	PE	3	0	0	1	4	8	40	60	100	3
CSE 324	OBJECT ORIENTED SOFTWARE ENGINEERING	PC	3	0	0	1	4	8	40	60	100	3
CSE 325	WEB TECHNOLOGIES	SOC	2	1	0	1	4	8	40	60	100	3
CSE 326	CRYPTOGRAPHY AND NETWORK SECURITY	PC	3	0	0	1	4	8	40	60	100	3
CSE 327	***WEB TECHNOLOGIES LAB***	***SOC***	0	0	***3***	***0***	***1***	4	***50***	***50***	100	1.5
CSE 328	***OBJECT ORIENTED SOFTWARE ENGINEERING LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	100	1.5
CSE 329	**QA-II& SoftSkills**	HS	0	0	3	0	1	4	***100***	***0***	100	1.5
		Total	**17**	**1**	**9**	**6**	**23**	**56**	**440**	**460**	**900**	**22.5**

IV Year Course structure – CSE (Tentative)

Semester - I

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE 411	OPEN ELECTIVE -III*	OE	3	0	0	1	2	6	40	60	100	3
CSE 412	PROFESSIONAL ELECTIVE -IV	PE	3	0	0	1	2	6	40	60	100	3
CSE 413	PROFESSIONAL ELECTIVE -V	PE	3	0	0	1	3	7	40	60	100	3
CSE 414	MANAGEMENT PRINCIPLES	HS	3	0	0	0	2	5	40	60	100	3
CSE 415	DATA ANALYTICS	PC	2	1	0	1	4	8	40	60	100	3
CSE 416	***CRYPTOGRAPHY & NETWORK SECURITY LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
CSE 417	***DATA ANALYTICS LAB***	***PC***	0	0	***3***	***0***	***1***	4	***50***	***50***	***100***	1.5
CSE 418	***PROJECT PHASE-I***	***PR***	0	0	***3***	***0***	***1***	4	***100***	***0***	***100***	2
CSE 419	***SUMMER INTERNSHIP-INDUSTRY-2***	***PR***	0	0	***0***	***0***	***1***	1	***100***	***0***	***100***	2
		Total	**14**	**1**	**9**	**4**	**17**	**45**	**500**	**400**	**900**	**22**

IV Year Course structure – CSE

Semester - II

CODE	SUBJECT NAME	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CSE 421	OPEN ELECTIVE -IV*	OE	3	0	0	1	3	7	40	60	100	3
CSE 422	***PROJECT PHASE 2& INTERNSHIP IN INDUSTRY***	***PR***	0	0	9	0	2	11	***100***	***100***	***200***	8
		Total	**3**	**0**	**9**	**1**	**5**	**18**	**140**	**160**	**300**	**11**

Total Credits **160**

*Open Elective can be Inter Department Disciplinary Course,Emerging Courses or MOOC. Final decision will be taken by the department.

Hours Tracks	2nd Yr-Sem -2	3rd Yr-Sem -1	3rd Yr-Sem	4th Yr Sem -1
Programming and Application Development	Mobile Application Development	Full Stack Web Development	Cloud Application Development and Deployment	Microservices
Security Engineering Track	Information Security & Auditing	System Secure Engineering	Cyber Security	Hardware Security
Soft Computing techniques	Introduction to SoftComputing	Evolutionary techniques	Optimization techniques	Fuzzy Computing
Computer Networks and Engineering	Mobile and Cellular Networks	4G/5G Networks	Wireless Sensor Networks	Network Management

Professional Electives	
PE1	•CSE 312(A)Smart Systems Design & Programming •CSE312(B)Advanced Data Structures •CSE312(C)Digital ImageProcessing .CSE 312(D)Artificial Intelligence
PE2	•CSE322(A)Machine Learning •CSE 322(B) Mobile Computing .CSE322(C)No SQL Data Bases .CSE322(D)Data warehousing and Data mining
PE3	• CSE323(A)Distributed Operating Systems • CSE323(B)Embedded Systems • CSE323(C)Neural Networks &Deep Learning • CSE323(D)Pattern Recognition
PE4	.CSE412(A)Computer vision • CSE412(B)Bioinformatics .CSE 412(C)High Performance Computing • CSE415(D)Principles Of Programming Languages
PE5	.CSE413(A)IOT • CSE413(B)Fuzzy Computing • CSE413(C)Social Network Analysis • CSE413(D) Cloud Computing

DATA STRUCTURES & ALGORITHMS	
CSE 211	**Credits : 3**
Instruction : 2 Periods & 1 Tut/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Basic Knowledge of Programming Fundamentals
- Knowledge of Programming Languages (C)

Course Objectives:

The course should enable the students:

- To acquire knowledge on several linear and nonlinear data structures like stacks, queues, linked list, trees and graphs.
- To have better insight into to learn various sorting and searching techniques.
- To exercise the applications of data structures.
- To have a good understanding of problem solving using data structure tools and techniques.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Analyze the complexities of recursive and Non recursive algorithms and Implement linear, binary, interpolation, hashing searching techniques and sorting techniques namely bubble, insertion, selection, quick, merge sort.
2.	Apply ADT concepts such as stacks and queues for solving infix to post fix, postfix evaluation, priority queues.
3.	Apply the concepts of dynamic memory allocation for reducing the time and space complexity of algorithms.
4.	Design and implement the Nonlinear data structures (trees) to optimize the solution.
5.	Design and Implement Warshall's Algorithm, Shortest path Algorithm-Dijkstra's Algorithm, Minimum cost spanning trees (Prims and Kruskal's algorithms),Graph traversals (Breadth first search and Depth first Search algorithms.)

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	3	-	-	-	-	-	-	-	1	3	0
2	2	2	3	2	-	-	-	-	-	-	-	1	2	0
3	2	2	3	2	-	-	-	-	-	-	-	1	3	0
4	2	2	3	2	-	-	-	-	-	-	-	1	2	0
5	2	3	3	3	-	-	-	-	-	-	-	1	3	0

SYLLABUS

UNIT-I: 15 periods

Introduction: Basic Terminology, Elementary Data Organization, Data Structure operations, Fundamentals of analysis of algorithms and efficiency – Asymptotic Notations and Basic Efficiency classes.

Arrays: Array Definition, Representation and Analysis, Single and Multidimensional Arrays, address calculation, application of arrays, Character String in C, Character string operation, Array as Parameters, Sparse Matrices.

Searching &Sorting: Sequential search, binary search, Interpolation Search, comparison and analysis, Hash Table, Hash Functions. Complexity of Search Algorithm, Insertion Sort, Bubble Sort, Selection Sort, Quick Sort, Merge Sort.

Learning Outcomes:

1. Analyze the complexity of Algorithms, Implement searching and soring algorithms.
2. Implement the searching and soring algorithms.

UNIT-II: 12 periods

Stacks: Array Representation and Implementation of stack, Operations on Stacks: Push & Pop, Applications of stack: Conversion of Infix to prefix and Postfix Expressions, Evaluation of Postfix & Prefix expressions using stack, Recursion, Towers of Hanoi Problem.

Queues: Array representation and implementation of queues, Operations on Queue: Insert, Delete, Full and Empty. Circular queue, De-queue, and Priority Queue, Applications of Queues.

Learning Outcomes:

1. Implement stacks and queues using ADT and Implement the applications of Stacks and queues (solving infix to post fix, postfix evaluation, priority queues.)
2. Apply ADT and implement Stack and queue and applications of stack and queue.

UNIT-III: 12 periods

Linked list: Representation and Implementation of Singly Linked Lists, Traversing and Searching of Linked List, Insertion and deletion to/from Linked Lists, Doubly linked list, Circular doubly linked list, implementing priority queue using Linked List, Polynomial Representation using Linked list & addition.

Learning Outcomes:

1. Implement singly linked list, Doubly Linked List, Circular doubly linked list and applications.
2. Implement Linked Lists and applications of Linked Lists.

UNIT-IV: 12 periods

Trees: Basic terminology, Binary Trees, Binary tree representation, Almost Complete Binary Tree, Complete Binary Tree, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees. Binary Search Tree (BST), Insertion and Deletion in BST, AVL Trees-Rotations in AVL trees, Insertion and Deletion in AVL.

Learning Outcomes:

1. Design and implement BST, AVL trees.
2. Implement BST, AVL tree along with various operations performed on BST and AVL tree.

UNIT-V: **12 periods**

Graphs: Terminology & Representations- Graphs, Directed Graphs, Adjacency Matrices, Path OR Transitive Closure of a Graph, Warshall's Algorithm, Shortest path Algorithm-Dijkstra's Algorithm, Connected Component and Spanning Trees, Minimum Cost Spanning Trees, Graph Traversals.

Learning Outcomes:

1. Implement Graph Traversals algorithm and Minimum Cost Spanning Trees algorithms.
2. Implement Warshall's Algorithm, Shortest path Algorithm-Dijkstra's Algorithm and Minimum Cost Spanning Trees algorithm

TEXT BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2nd Edition, 1996

REFERENCE BOOKS

1. E.Horowitz and Sahani, "Fundamentals of Data Structures", W H Freeman & Co Publication, 1983.
2. S. Lipschutz, "Data Structures", McGraw Hill Publications, 1986.
3. P. Dey & M. Ghosh, "Programming in C" , Oxford Univ. Press, 2012
4. ISRD Group, "Data Structures through C++", McGraw Hill, 2011.

Web Resources:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/learn/data-structures?specialization=data-structures-algorithms
3. https://www.udacity.com/course/data-structures-and-algorithms-nanodegree--nd256

COMPUTER ORGANIZATION	
CSE 212	**Credits : 3**
Instruction : 3 Periods / Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Digital Logic Design

Course Objectives:

- To understand the basics of computer hardware and how software interacts with computer hardware.
- To understand the structure, function and characteristics of computer systems.
- To understand the basic structure and operation of digital computer.
- To study the design of arithmetic and logic unit.
- To study the two types of control unit techniques and the concept of pipelining.
- To understand the hierarchical memory system including cache memories and virtual memory.
- To understand the different ways of communicating with I/O devices and standard I/O interfaces.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Identify the basic principles and apply to arithmetic for ALU implementation.
2.	Examine the functional aspects of processor unit.
3.	Compare and assess the working principles of hardwired and microprogrammed control unit
4.	Inspect addressing modes, instruction formats in various CPU organizations and Assess the performance implications of processing techniques.
5.	Infer the design issues in memory and I/O organizations.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	1	-	-	-	-	1	1	-	1	1	1
2	2	2	2	1	-	-	-	-	-	-	-	-	1	2
3	1	3	2	3	-	-	-	-	-	-	-	-	1	1
4	2	2	2	2	-	-	-	-	-	-	-	-	1	2
5	2	3	3	3	-	-	-	-	1	1	-	1	2	2

SYLLABUS

UNIT-1 **12 Hours**

Register Transfer and Micro operations :

Register Transfer Language, Bus and Memory Transfers, Arithmetic, Logic and Shift Micro operations, Arithmetic Logic Shift Unit,

Computer Arithmetic:

Introduction, Addition and Subtraction, Booth Multiplication, Division & Decimal Arithmetic Unit Hardware Implementation & Algorithms.

Learning Outcomes:

1. Identify the basic principles of a computer & its Memory Transfers.
2. Apply Arithmetic operations for ALU Implementation.

UNIT-2 **10 Hours**

Basic Computer Organization

Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Complete Computer Description.

Learning Outcomes:

1. Analyze the computer Instruction, Instruction codes, Instruction Cycle.
2. Examine the procedure of an Instruction Cycle.

UNIT-3 **9 Hours**

Control Design:

Hardwired & Micro Programmed (Control Unit), Control Memory, Address Sequencing, Conditional and Unconditional Branching, Micro program Example.

Learning Outcomes:

1. Specify the design of a control unit in a computer.
2. Distinguish between Hardwired & Micro programmed control unit.

UNIT-4 **12 Hours**

Central Processing Unit:

Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes with numerical examples, Data Transfer and Manipulation, Program Control, Program Interrupt, Types of interrupts, CISC Characteristics, RISC Characteristics. Introduction to Parallel Processing, Pipelining – General Considerations.

Learning Outcomes:

1. Examine addressing modes, Instruction formats in various CPU Organizations.
2. Analyze the Data processing operations of CPU.

UNIT-5 **17 Hours**

Input-Output Organization:

Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access.

Memory Organization:

Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

Learning Outcomes:

1. Deduce the design issues of Input-output organization.
2. Conclude the Design issues in memory organization of a computer.

TEXT BOOK

1. M.Morris Mano, “Computer System Architecture”, Pearson Education Inc., 2003, Third Edition.

REFERENCE BOOKS

1. William Stallings, Computer Organization and Architecture, 6th Edition, Pearson/PHI, 2007.
2. Andrew S. Tanenbaum, Structured Computer Organization, 5th Edition, PHI/Pearson, 2007.

ONLINE WEB RESOURCES

1. https://nptel.ac.in/courses/106/103/106103068/
2. https://freevideolectures.com/course/2277/computer-organization

JAVA PROGRAMMING	
CSE 213	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Pre requisites:

- Basic knowledge of computer fundamentals.
- Student must have knowledge of some programming languages (such as C, C++)

Course Objectives:

- To Understand Object Oriented Programming Concepts and Apply Them in Problem Solving.
- To Learn The Basics of Java Console and GUI Based Programming.

Course Outcomes:

At the end of the course the student will be able to

CO1	Design Classes for Real Time Applications.
CO2	Establish The Connectivity Among The Classes Using Inheritances And Interfaces.
CO3	Modularize The Application Using Packages and apply threads on classes to achieve parallelism through synchronization.
CO4	Develop Test Cases By Including The Runtime Errors Using Exceptions Handling Mechanism and multi Threading
CO5	Identify AWT components to Design the GUI Using Applet & AWT Frameworks.

CO-PO MAPPING:

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1	2	3	1	1	-	-	-	-	-	1	1	2	-
2	2	3	3	2	1	-	-	-	-	-	1	1	2	-
3	1	3	3	1	1	-	-	-	-	-	1	1	2	-
4	1	2	3	2	1	-	-	-	-	-	1	1	2	-
5	2	1	3	2	1	-	-	-	-	-	1	1	2	-

Correlation Levels 1 2 3 Defined as Below

1 High: Strong Correlation

2 Medium: Moderate Correlation

3 Low: Slight

SYLLABUS

UNIT-I **10-12hours**

Fundamentals of Object Oriented Programming : Introduction, object oriented paradigm, object and classes, Data Abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Applications of OOP.

Java programming - History of Java, Java Buzzwords, Data types, variables, operators. Control structures, arrays, console input and output, Simple programs on java. Introduction to Classes, objects, constructors, methods, parameter passing, overloading constructors and methods, static fields and methods, this reference, final keyword, garbage collection, finalize method, inner class, String handling.

Learning Outcomes: At the end of this unit the Students will be able to

1. Identify the object and understand object oriented principles
2. Create class, constructor and can handle string operations

UNIT – II **10-12 hours**

Inheritance – Basics, using super keyword, multilevel hierarchy, Member access rules, preventing inheritance- using final, the Object class and its methods.

Polymorphism - dynamic binding, method overriding, abstract class and methods. Interfaces - Interfaces vs. Abstract class, defining an interface, implementing interfaces, accessing implementations through interface references, extending interfaces.

Packages - Defining, Creating and Accessing a Package, importing packages

Learning Outcomes: At the end of this unit the Students will be able to

1. Derive a class from existing class or from interface
2. Define a package and importing class from package

UNIT –III **10-12 hours**

I/O: I/O basics, byte and character streams, read/ write console input/output, reading and writing files.

Exception handling – Fundamentals, Exception types, use of try and catch, throw, throws, finally, multiple catches, built-in exceptions, user defined exceptions.

Multithreading – Thread Priorities, synchronization, messaging, reading a thread, creating multiple threads, use of alive and join, inter-thread communication- suspending resuming and stopping threads, producer-consumer problem with multithreading.

Learning Outcomes: At the end of this unit the Students will be able to

1. Handle predefined Exceptions and can define custom exceptions
2. Split a complex task into multiple threads.

UNIT-IV **10-12 hours**

Applets- Simple HTML tags, Difference between Application and Applet ,Applet class, Applet structure, An Example Applet Program, Applet Life Cycle, paint(),update() and repaint().

Swing-Introduction , JFrame, JApplet, JPanel, Components in swings, JList and JScroll Pane, Split Pane, JTabbedPane, Dialog Box.

Layout Managers: java. awt. Border Layout, Flow Layout, Grid Layout, Card Layout, GridBagLayout.

Learning Outcomes: At the end of this unit the Students will be able to

1. Design Swing Applet class with html tag
2. Arrange components in Layouts

UNIT-V **10-12 hours**

Abstract Window Toolkit

Why AWT?, java. Awt package, Components and Containers, Button, Label, Checkbox, Radio buttons, List boxes, Choice boxes, Text field and Text area, container classes, Layouts, Menu, Scroll bar.

Event Handling: The Delegation event model, Event classes, Event Listener interfaces, handling Action event, Item Event, Mouse Event, keyboard event and Window Events.

Learning Outcomes: At the end of this unit the Students will be able to

1. Design GUI components using AWT.
2. Define Event Handling on the components using Delegation event model.

TEXT BOOKS

1. Herbert Schildt, "JAVA The Complete Reference", TataMcGraw Hill,seventh edition.
2. E Balagurusamy, "Programming with JAVA - A Primer" – Third Edition.

REFERENCES BOOKS

1. P.J. Deitel and H.M. Deitel, "Java for Programmers", Pearson education (OR) P.J. Deitel and H.M. Deitel, "Java: How to Program", PHI.
2. P. Radha Krishna, "Object Orientd Programming through Java", Universities Press.
3. Bruce Eckel, "Thinking in Java", Pearson Education
4. Bruce Eckel, "Programming in Java", Pearson Education
5. S. Malhotra and S. Choudhary, "Programming in Java", Oxford Univ. Press.

DATA COMMUNICATIONS	
CSE 214	**CREDITS:3**
INSRUCTION: 3 Periods /Week	**SESSIONAL MARKS: 40**
FINAL EXAM: 3Hours	**FINAL EXAM MARKS: 60**

Pre requisites:

- Basic knowledge of Computer fundamentals.

Course Objectives:

- To educate concepts, vocabulary and techniques currently used in the area of Data Communications.
- To interpret the Digital encoding Techniques in Data Communication.
- To familiarize the student with the basic terminology of the Data, Signals, Signal Transmission, and Transmission Impairments.
- To acquire the knowledge of Data Link Layer concepts.
- To gain knowledge in different mediums used for data transfer.
- To analyse the concepts of multiplexing and spread spectrum.

Course Outcomes:

By the end of the course Students will be able to

CO1	Explain the basic data communications model, comparing OSI and TCP/IP models by examining the transmission impairments.
CO2	Analyse the features of Transmission media with various encoding techniques.
CO3	Apply the error correction and detection techniques.
CO4	Analyse the performance issues of different types of LANs.
CO5	Retrieve the characteristics of multiplexing and spread spectrum.

CO-PO Mapping:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	-	-	-	1	1	-	-	1	-	1	1	2
2	3	2	2	-	1	-	1	-	-	1	-	1	1	2
3	3	2	3	2	1	-	-	-	-	1	-	-	2	2
4	1	3	1	1	1	-	-	-	-	1	-	-	1	1
5	2	2	2	1	1	-	-	-	-	1	-	-	-	1

SYLLABUS

UNIT-I **12 Hours**

Introduction: Data Communications, Internetworking: A Communications Model, Data Communications, Networks, The Internet, An Example Configuration. Protocol Architecture, The Need for a Protocol Architecture: The TCP/IP Protocol Architecture, The OSI Model, Traditional Internet-Based Applications, Characteristics of Data, Transmission: Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments.

Learning Outcomes: At the end of this unit Students will be able to

1. Explain the Representations used for defining data communications with the state of art.
2. Analyse the performance comparison between ISO-OSI model and TCP/IP models.

UNIT- II **12 Hours**

Transmission Media: Guided Transmission Media, Wireless Transmission, Data Encoding-Digital Data, Digital Signals, Analog Signals, Analog Data.

Learning Outcomes: At the end of this unit Students will be able to

1. Describe the characteristics of guided and unguided media with representation.
2. Analyse the signals with encoding techniques to present the target data.

UNIT-III **12 Hours**

The Digital Data Communication Techniques: Asynchronous and Synchronous Transmission, Line Configurations, Interfacing. Data Link Control, Flow Control, Types of Errors, Error Detection, Error Control, High-Level Data Link Control (HDLC).

Learning Outcomes: At the end of this unit Students will be able to

1. Classify the state and types of digital transmissions.
2. Analyse the flow and error control methods.

UNIT-IV **12 Hours**

Bit Local Area Network: Overview, LAN Protocol Architecture, Bridges, Layer 2 and Layer 3 Switches. **High-Speed LANs:** The Emergence of High-Speed LANs. **Wireless LANs:** Overview, Wireless LAN Technology, IEEE 802.11-Architecture and Services, Modems and Types.

Learning Outcomes: At the end of this unit the Students will be able to

1. Define and interpret the LAN architecture and its variants.
2. Recognize the importance of High speed LAN and its applications.

UNIT-V **12 Hours**

Multiplexing: Frequency-Division Multiplexing, **Synchronous Time-Division Multiplexing:** Characteristics, TDM Link Control, Digital Carrier Systems **Statistical Time-Division Multiplexing:** Characteristics, The Concept of Spread Spectrum, Frequency Hopping Spread Spectrum, Direct Sequence Spread Spectrum, Code-Division Multiple Access.

Case Study: Analog services and Digital services

Learning Outcomes: At the end of this unit the Students will be able to

1. Compare the multiplexing techniques with respect to Frequency and time.
2. Discuss the spread spectrum techniques.

Text Books:

1. William Stallings, "Data and Computer Communications", 8th Edition, Pearson Education Inc., 2010.

Reference Books:

1. Behrouz A Forouzan "Data Communications and Networking", 5th Edition, Tata McGraw-Hill, 2012.

Online Resources:

1. https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.Communications.8e.WilliamStallings.pdf

DISCRETE MATHEMATICAL STRUCTURES	
CSE 215	**CREDITS:3**
INSRUCTION: 3 Periods/Week	**SESSIONAL MARKS: 40**
FINAL EXAM: 3Hours	**FINAL EXAM MARKS: 60**

Prerequisites:

- Elementary knowledge of Set theory, Matrices and Algebra.

Course Objective :

The main objectives of the course are to:

- Introduce concepts of mathematical logic for analyzing propositions and proving theorems.
- Use sets for solving applied problems binary relations and introduce concepts of algebraic
- structures
- Work with an ability to solve problems in Combinatorics

Course Outcomes: At the end of the course student should be able to

1	Apply mathematical logic, mathematical reasoning and to study about the validity of the arguments and also prove mathematical theorems using mathematical induction.
2	Determine properties of binary relations; identify equivalence and partial order relations, sketch relations and Familiarize with algebraic structures.
3	Apply counting techniques to solve combinatorial problems and identify, formulate, and solve computational problems in various fields.
4	Identify the Recurrence relation, generating functions and know the methods for solving problems involving recurrence equations.
5	Familiarize with the applications of graphs, trees and algorithms on minimal spanning tress and apply graph theory in solving computing problems

CO – PO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2	1	-	-	-	-	-	-	-	-	1	3	2
2	3	2	1	-	-	-	-	-	-	-	-	1	3	2
3	3	2	1	-	-	-	-	-	-	-	-	1	3	2
4	3	2	1	-	-	-	-	-	-	-	-	1	3	2
5	3	2	1	-	-	-	-	-	-	-	-	1	3	2

SYLLABUS

UNIT - I: MATHEMATICAL LOGIC (12Periods)

Fundamentals of logic – Logical inferences – Methods of proof of implication – First order logic and other proof methods – Rules of inference for quantified propositions – Mathematical induction.

Sections: 1.5 to 1.10 of Text book [1].

Learning outcomes: At the end of this unit, student will be able to

1. Apply inference theory to verify the consistence of data.
2. Construct logical statements from informal language to propositional logic expressions.

UNIT - II: RELATIONS AND ALGEBRAIC SYSTEMS (12 Periods)

RELATIONS : Cartesian products of sets – Relations – Properties of binary relations in a set –Relation matrix and graph of a relation– Partition and covering of set – Equivalence relations– Composition of binary relations–Transitive closure of a relation–Partial ordering – Partially ordered set.

Sections: 2-1.9, 2-3.1 to 2-3.5, 2-3.7, 2-3.8, 2-3.9 of Text book [2].

ALGEBRAIC SYSTEMS: Definitions and simple examples on Semi groups – Monoids – Group – Ring and Fields.

Sections: 3-1.1, 3-2.1,3-2.2, 3-5.1,3-5.11and 3-5.12 of Text book [2].

Learning outcome: At the end of this unit, student will be able to

1. Determine properties of relations, identify equivalence and partial order relations, sketch relations.
2. Identify Semi group, Monoid, Group, Ring and Field for a given algebraic structure

UNIT - III: ELEMENTARY COMBINATORICS (10 Periods)

Basics of counting – Combinations and permutations – Their enumeration with and without repetition – Binomial coefficients – Binomial and multinomial theorems – The principle of inclusion and exclusion.

Sections: 2.1 to 2.8 of Text book [1].

Learning outcome: At the end of this unit, student will be able to

1. Solve problems on binomial and multinomial coefficients.
2. Solve counting problems by using principle of inclusion-exclusion.

UNIT - IV: RECURRENCE RELATIONS (10 Periods)

Generating functions of sequences – Calculating their coefficients – Recurrence relations – Solving recurrence relations – Method of characteristic roots – Non-homogeneous recurrence relations and their solutions.

Sections: 3.1to 3.6 of Text book [1].

Learning outcome: At the end of this unit, student will be able to

1. Formulate recurrence relations of the sequences and solve problems on generating functions.
2. Evaluate complementary function and particular integral for non- homogeneous linear recurrence relations.

UNIT – V: GRAPHS **(16 Periods)**

Introduction to graphs – Types of graphs – Graphs basic terminology and special types of simple graphs – Representation of graphs and graph isomorphism – Euler paths and circuits – Hamilton paths and circuits – Planar graphs – Euler's formula.

Introduction to trees and their properties – Spanning trees – Minimum spanning trees – Kruskal's algorithm .

Sections: 5.1 to 5.4, 5.7, 5.8, 5.9, and 5.10 of Text book [1].

Learning outcome: At the end of this unit, the student will be able to

1. Identify different graphs and their properties.
2. Build minimal spanning tree by using different algorithms.

TEXT BOOKS:

1. **Joe L. Mott, Abraham Kandel & T. P. Baker**, Discrete Mathematics for computer scientists &Mathematicians, Prentice Hall of India Ltd, New Delhi., 2008

2. **J. P. Tremblay, R. Manohar**, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Publishing Company Limited,1997

REFERENCE BOOKS:

1. **Keneth. H. Rosen**, Discrete Mathematics and its Applications, 6/e, Tata McGraw-Hill, 2009.

2. **Richard Johnsonburg**, Discrete mathematics, 7/e, Pearson Education, 2008.

ANITS (A)
CSE - DEPARTMENT
II YEAR – I SEMESTER R20

DESIGN THINKING AND PRODUCT INNOVATION											
Code	**Category**	**Periods**						**Sessional Marks**	**End Exam Marks**	**Total Marks**	**Credits**
		L	**T**	**P**	**E**	**O**	**Total**				
CSE 216	**ES**	**2**	**0**	**2**	**1**	**3**	**8**	**40**	**60**	**100**	**3**

Prerequisite: NIL

Course Objectives:

The course titled Innovation, Business Models and Entrepreneurship are designed to give an in-depth Understanding on Various aspects of Innovation, Creativity, evolving business models, incubation and entrepreneurship. Come up with exposure to design thinking for designing innovative products. The course is a blend of theory and practice therefore this course does not require any prerequisite and will be useful to understand innovation and its applications in different spheres of development and growth. Driven by a vision to empower students with design thinking skills to be able to bring innovation and personal effectiveness to solve problems for the organization and society.

Course Outcomes:

The Student will be able to:

CO-1	Identify the Principles and Elements of Design; gain knowledge of the Need and charectestics of Design Thinking.
CO-2	Apply the Design Thinking process and use tools like Persona, Empathy Map for solving problems in user centric way.
CO-3	Develop skills in Brainstorming, prototype, testing and implementation for Product Design and Development.
CO-4	Create the Innovative Products by applying Lateral - Divergent and Convergent Thinking. Implementing design thinking for better process
CO-5	Apply the Design thinking Techniques for solving problems in various sectors like Education , I.T. , Finance and Management

Mapping of Course Outcomes with Programme Outcomes.
High-3, Medium-2, Low-1

COURSE OUTCOMES	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**2**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**
CO3	**3**	**3**	**2**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**
CO4	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**
CO5	**3**	**3**	**2**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**

Course Outcomes	PSO1	PSO2
CO-1	2	1
CO-2	2	1
CO-3	2	1
CO-4	2	1
CO-5	2	1

SYLLABUS

UNIT-I

Introduction to Design Thinking: 6L+4P=10Periods

Introduction to elements and principles of Design, Introduction to design thinking, history and need of design thinking. 7 characteristics that define design thinking, comparison of design thinking to other ways of thinking, 5 characteristics of action plan. Problem statement.

Learning Outcomes

1. Explain the concept of design and its history
2. Describe the need of Design Thinking
3. Elucidate the charectestics of Design Thinking

UNIT-II 6L+8P=14Periods

Design Thinking process and Tools:

Design Thinking process empathize, analyze, ideate, prototype & Test. Implementing the process in driving inventions, design thinking in social innovations. Tools of Design Thinking - Ask 5x why, 5W+H questions, Empathy map, persona, costumer journey map for solving problems in user centric way.

Learning outcomes

1. Describe the ideas and tools required to solve a problem
2. Explain the design process
3. Solve a problem as a team
4. Identify the roles and responsibilities as a team member

UNIT – III 6L+4P=10Periods

Methods and Tools Implementation: -

Brain storming - How might we -question, Storytelling. Critical Function Prototype (CFP). Testing sheet, Feedback , Powerful questions in experience testing, Road map for implementation.

Product Design: problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications, Product development.

Learning Outcomes

1. Identify innovative problem solutions
2. Analyze the solution
3. Design Prototype and Testing methods
4. Design an innovative product

UNIT –IV 6L+6P=12Periods

Product strategic Innovation: Innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Innovative Products by applying Lateral-Divergent and Convergent Thinking. Implementing design thinking for better process.

Learning Outcomes

1. Identify skills for innovation
2. Design with empathetic experience
3. Solve a problem innovatively

UNIT-V **6L+8P=14Periods**

Design thinking in various sectors: Design thinking for Startups. Double Dimond method - discover, define, develop and deliver. Case studies in Information Technology, Finance, Education and Management

Learning Outcomes

1. Apply Design thinking for Startups.
2. Apply Double Diamond method for various sectors
3. Perform case studies on various sectors.

Case study learning outcomes:

1. Make use of practical design thinking methods in every stage of problem with the help of method templates.
2. Apply design thinking to a problem in order to generate innovative and user-centric solutions.
3. Empathize with end user and initiate a new working culture based on user-centric approach.
4. Prototype and run usability tests for unbiased examination of the product in order to identify problem areas.

TEXT BOOKS:	
1.	Daniel Ling "*Complete Design Thinking Guide for Successful Professionals*", Emerge Creatives Group LLP, Print ISBN: 978-981-09-5564-9.
2.	Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall
3.	Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox, John Wiley & Sons, 2020.

REFERENCE BOOKS:	
1.	Michael G. Luchs, Scott Swan, Abbie Griffin , *"Design Thinking: New Product Development Essentials from the PDMA"*, ISBN-13 : 978-1118971802
2.	Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*, HarperCollins e-books, 2009.
3.	Beverly Rudkin Ingle, *"Design Thinking for Entrepreneurs and Small Businesses"*, Apress, ISBN: 9781430261827
4.	Jose Betancur *"The Art of Design Thinking: Make More of Your Design Thinking Workshops",* ISBN: 9781522095378
5.	Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Playbook, John Wiley & Sons, 2018
6.	Jeanne Liedtka, Andrew King, And Kevin Bennett, "*Solving Problems with Design Thinking"* , Columbia University Press Publishers, E-ISBN 978-0-231-53605-9

WEB RESOURCES:	
1.	https://dschool.stanford.edu/resources/design-thinking-bootleg
2.	https://www.ideo.com/post/design-thinking-for-educators
3	https://nptel.ac.in/courses/110/106/110106124/#

JAVA PROGRAMMING LAB	
CSE 217	**CREDITS:1.5**
INSTRUCTION: 3 Periods/Week	**SESSIONAL MARKS: 50**
FINAL EXAM: 3Hours	**FINAL EXAM MARKS: 50**

Prerequisites:

- Basic knowledge of computer fundamentals.
- Student must have knowledge of some programming languages (such as C, C++)

Course Objectives:

- To understand object oriented programming concepts, and apply them in problem solving.
- To learn the basics of java Console, GUI based programming and networking programming.

Course Outcomes:

Student will be able to

CO1	Solve the given problem using basics of Java programming.
CO2	Develop the program using class and object.
CO3	Implement the solution using Inheritance and modularize the application using packages.
CO4	Apply multi threading, Exception handling, File Handling and Design GUI applications using java AWT and applets**.**

CO-PO Mapping:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1	2	1	-	-	-	-	-	1	2	3	2
2	2	3	3	3	1	-	-	-	-	-	1	2	2	2
3	1	2	3	3	1	-	-	-	-	-	1	2	2	2
4	2	1	3	1	1	-	-	-	-	-	1	2	2	2

JAVA LAB PROGRAMS

1. Write a java program which reads your name and other details through command line and print them. CO1
2. Arrays CO1

Write a to find the Valid program Parentheses

Given a string containing just the characters '(', ')', '{', '}', '[' and ']', determine if the input string is valid. An input string is valid if:

1. Open brackets must be closed by the same type of brackets.
2. Open brackets must be closed in the correct order.

Note that an empty string is also considered valid. Input:( ) output:valid

Input: ({) } Output: Not valid

3. Letter Combinations of a Phone Number CO1

Given a string containing digits from 2-9 inclusive, return all possible letter combinations that the number could represent.
A mapping of digit to letters (just like on the telephone buttons) is given below. Note that 1 does not map to any letters.

Example: Input: "23"
Output: ["ad", "ae", "af", "bd", "be", "bf", "cd", "ce", "cf"].

4. Strings CO2

Write a program to find the longest Substring without Repeating Characters
Input: abcabcbb output:3 string: abc
Input: pwwkew output:3 string: wke Note: pwke is not a substring , it is a subsequence

5. Classes and Objects CO2

Design a "farm animals" java application with the details of animals like cow, pig, horse.Consider the following details like where they stay, what they eat,the sound they make by using classes and objects.

6. Constructor overloading CO2

An organization is maintaining the data of employee according to cadre of employee with following parameters name,id,designation,salary,promotion status. Apply the constructor overloading to implement it.

7. Method overriding CO3

All the banks operating in India are controlled by RBI. (e.g. minimum interest rate, minimum balance allowed, maximum withdrawal limit etc) which all banks must follow. For example, suppose RBI has set minimum interest rate applicable to a saving bank account to be 4% annually. however, banks are free to use 4% interest rate or to set any rates above it.

Write a JAVA program to implement bank functionality in the above scenario and demonstrate the dynamic polymorphism concept. Note: Create few classes namely Customer, Account, RBI (Base Class) and few derived classes (SBI, ICICI, PNB etc). Assume and implement required member variables and functions in each class.

Testcase1:
Enter the Bank name to find the rate of Interest : RBI
RBI rate of interest is : 4%

Testcase2:
Enter the Bank name to find the rate of Interest : SBI
RBI rate of interest is : 7%

8. Interfaces: CO3

Different categories of employees are working in a software company like Regular Employees, Contract Employees and Vendors. And their pay roll is different for regular and contract employees. For the regular employees Basic pay is 25000, HRA is 15000rs and TA is 5000. For the Contract employees Basic pay is 12000 TA is 3000rs and there is no HRA. Find the monthly salary details of Employee. If input is Regular Employee display the Regular employee salary details. If input is Contract based display the Contract salary details.

TestCase1: Input: Enter Employee Id: R101
Output: Salary Details:
Basic Pay: 25000 HRA: 15000 T.A: 5000 Total Amount: 45000

9. Packages CO3

Define a package **number** and in that define **Roman class** and implement **romanToInteger()** and import the method in another class.

Input: "LVIII" **Output:** 58
Explanation: L = 50, V= 5, III = 3.

10. File Handling CO4

Write the below text in the file called sample.txt and then find the frequency count of the patterns 'pe', and 'pi'

Peter Piper picked a peck of pickled peppers
A peck of pickled peppers Peter Piper picked
If Peter Piper picked a peck of pickled peppers
Where's the peck of pickled peppers Peter Piper picked?

Expected Output:
'pe' – no of occurrences - 20
'pi' – no of occurrences – 12

11. Exception Handling CO4

Input a mobile number and check the given number is valid mobile number or not.

- A valid mobile number is a combination of (0-9) digits of length exactly 10.
- If the given Number Exceeds length of 10 raise Invalid Mobile Number-ArrayIndexOutofBounds Exception
- If the given Number less than the length of 10 raise Invalid Mobile Number – LengthNotSufficientException
- If the given Number contain any character other than digit raise Invalid Mobile Number –NumberFormatException

Sample Input	Expected Output – 1
9885089465	Valid number
98567890121	Invalid Mobile Number-ArrayIndexOutofBounds Exception
88664433	Invalid Mobile Number – LengthNotSufficientException
98ab@123	Invalid Mobile Number –NumberFormatException

12. Multi Threading CO4

Implement a Reservation system which allows the persons to book seats. Define reserve method initially with 100 seats. Now create one or more person threads to book seats. At any time it should allow only one person thread to access the reserve method.

Expected Output:

```
Person-1 entered.
Available seats: 10 Requested seats: 5
Seat Available. Reserve now :-)
5 seats reserved.
Person-1 leaving.
---------------------------------------------
Person-2 entered.
Available seats: 5 Requested seats: 2
Seat Available. Reserve now :-)
2 seats reserved.
Person-2 leaving.
---------------------------------------------
Person-3 entered.
Available seats: 3 Requested seats: 4
Requested seats not available :-(
Person-3 leaving.
---------------------------------------------
```

13. Design a mini application using the java components. C01,CO2,CO3,CO4

DATA STRUCTURES LAB USING C	
CSE 218	**CREDITS:1.5**
INSTRUCTION: 3 Periods/Week	**SESSIONAL MARKS: 50**
FINAL EXAM: 3 Hours	**FINAL EXAM MARKS: 50**

Prerequisite:

- Basic knowledge about problem solving
- Require programming knowledge through C language

Course Objectives:

- The course is designed to develop skills to design and analyse simple linear and non-linear data structures.
- It strengthens the ability of the students to identify and apply the suitable data structure for the given real-world problem.
- It enables them to gain knowledge in practical applications of data structures.

Course Outcomes of the Lab:

CO1	Implement the techniques for searching and sorting (quick and merge).
CO2	Implement of stack and queue and Linked list data structures and their applications.
CO3	Implement operations like insertion, deletion, search and traversing mechanism on binary search tree
CO4	Apply BFS and DFS algorithms to implement graph traversal.

CO-PO Mapping:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2	1	-	-	-	-	-	-	-	1	1	-
2	1	2	2	1	-	-	-	-	-	-	-	1	1	-
3	2	2	2	1	-	-	-	-	-	-	-	1	2	1
4	2	2	2	1	-	-	-	-	-	-	-	1	2	-

Experiments:

1. Write a program to sort the given array of N elements using divide and conquer method (merge sort and quick sort algorithms) **CO1**

Constraints: 1<N<1000
Sample Input array: 87, 36, 9, 12, 24, 5, 78, 567, 456, 34, 96, 45, 39, and 89,123
Sample Output array: 5, 9, 12, 24, 34, 36, 39, 45, 78, 87, 89, 96, 123, 456, and 567

2. Write a C Program to search whether an item K present in an array of N elements (Using Linear and binary Search algorithms) **CO1**

Constraints: 1<K<1000
1<N<1000
Sample Input array: 45, 78,123, 48, 34, 89, 67, 54, and 74,543
Search Item: 34 Search Item: 343
Output: Key Found Output: Key Not Found

3. Write a C program to store k keys into an array of size n at the location computed using a hash function, loc = key % n, where k<=n and k takes values from [1 to m], m>n. **CO1**

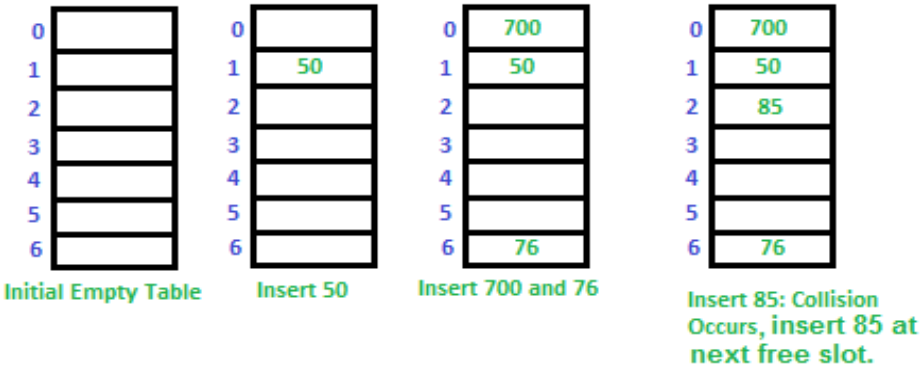
4. Design, Develop and Implement a C program to handle the collisions using the following collision resolution Technique **CO1**

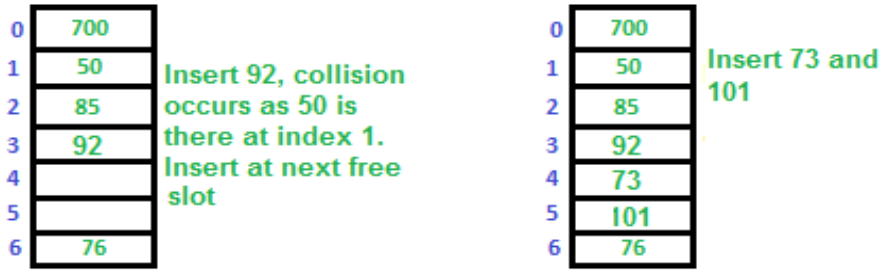
a) **Linear probing**: In linear probing, we linearly probe for next slot, let store k keys into an array of size S at the location computed using a hash function, hash(x) where k<=n and k takes values from [1 to m], m>n.

Constraints: If slot hash(x) % S is full, then we try (hash(x) + 1) % S
If (hash(x) + 1) % S is also full, then we try (hash(x) + 2) % S
If (hash(x) + 2) % S is also full, then we try (hash(x) + 3) % S
.....
.....

Sample Test Case:

Let us consider a simple hash function as "key mod 7" and sequence of keys as 50, 700, 76, 85, 92, 73, 101.

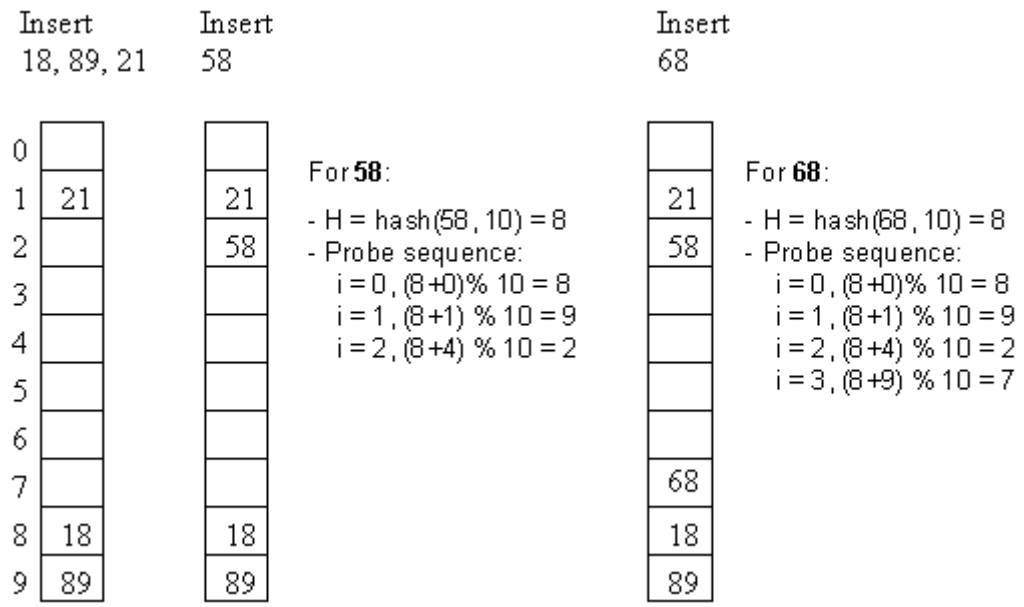




b) Quadratic probing: Quadratic Probing we look for i2'th slot in i'th iteration, let store k keys into an array of size S at the location computed using a hash function, hash(x) where k<=n and k takes values from [1 to m], m>n.

Constraints: let hash(x) be the slot index computed using hash function.
If slot hash(x) % S is full, then we try (hash(x) + 1*1) % S
If (hash(x) + 1*1) % S is also full, then we try (hash(x) + 2*2) % S
If (hash(x) + 2*2) % S is also full, then we try (hash(x) + 3*3) % S
.....

Sample Test Case:

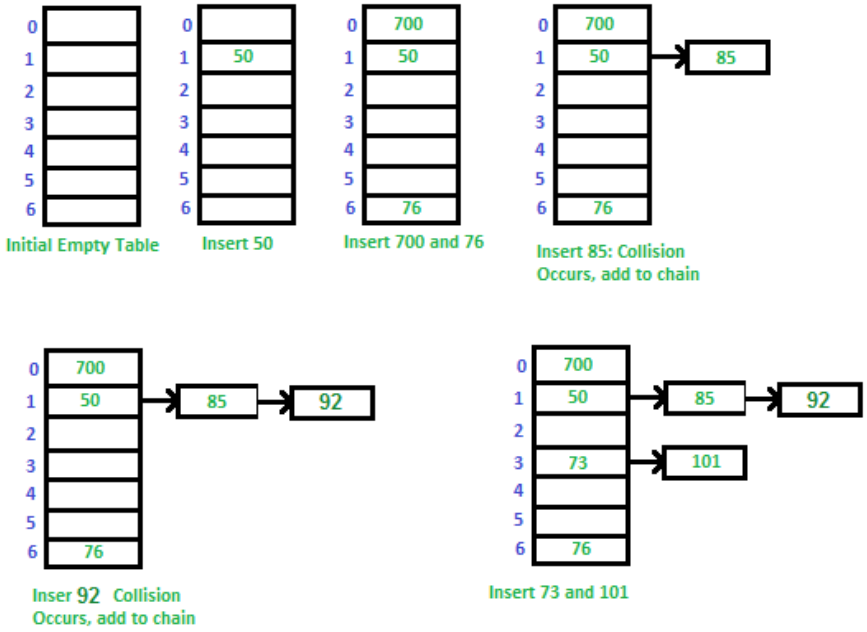


c) Separate Chaining: The idea is to make each cell of hash table points to a linked list of records that have same hash function value.

Let us store K keys into hash table of size S, where k<=n and k takes values from [1 to m], m>n.

Sample Test Case:

Let us consider a simple hash function as "key mod 7" and sequence of keys as 50, 700, 76, 85, 92, 73, 101.



5. Design, Develop and Implement a menu driven Program in C for the following. **CO2**

a) Operations on **STACK** of Integers (Array Implementation of Stack with maximum size **MAX**)

1. ***Push*** an Element on to Stack

2. ***Pop*** an Element from Stack
3. Demonstrate ***Overflow*** and ***Underflow*** situations on Stack
4. Display the status of Stack
5. Exit

b) Operations on **QUEUE** of Characters (Array Implementation of Queue with maximum size **MAX**)

1. Insert an Element on to QUEUE
2. Delete an Element from QUEUE
3. Demonstrate ***Overflow*** and ***Underflow*** situations on QUEUE
4. Display the status of QUEUE
5. Exit

Note: Support the program with appropriate functions for each of the above operations

6. Design, Develop and Implement a C program to do the following using a singly linked list.

CO2

a) Stack- In single linked list store the information in the form of nodes .Create nodes using dynamic memory allocation method. All the single linked list operations perform based on Stack operations LIFO (last in first out).

A stack contains a top pointer. Which is "head" of the stack where pushing and popping items happens at the head of the list. first node have null in link field and second node link have first node address in link field and so on and last node address in "top" pointer.

Stack Operations:

1. push() : Insert the element into linked list nothing but which is the top node of Stack.
2. pop() : Return top element from the Stack and move the top pointer to the second node of linked list or Stack.
3. peek(): Return the top element.
4. display(): Print all element of Stack.

b) Queue- All the single linked list operations perform based on queue operations FIFO (First in first out).

In a Queue data structure, we maintain two pointers, *front* and *rear*. The *front* points the first item of queue and *rear* points to last item.

1. enQueue() This operation adds a new node after *rear* and moves *rear* to the next node.
2. deQueue() This operation removes the front node and moves *front* to the next node.
3. Display() Display all elements of the queue.

Note: Sample node information: Student Data with the fields: *USN, Name, Branch, Sem, PhNo.*

7. Design, Develop and Implement a Program in C for the following **CO2**

a) Converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^(Power) and alphanumeric operands.

b) Evaluation of postfix expression with single digit operands and operators: +,-, *, /, %, ^

8. Design, Develop and Implement a menu driven Program in C for the following: **CO2**

a) Circular Queue

1. Insert an Element on to Circular QUEUE
2. Delete an Element from Circular QUEUE
3. Demonstrate *Overflow* and *Underflow* situations on Circular QUEUE
4. Display the status of Circular QUEUE
5. Exit

b) Priority Queue

1. Insert an Element on to Priority QUEUE
2. Delete an Element with highest priority from Priority QUEUE
3. Demonstrate *Overflow* and *Underflow* situations on Priority QUEUE
4. Display the status of Priority QUEUE
5. Exit

Support the program with appropriate functions for each of the above operations

9. Design, Develop and Implement a menu driven C program to Perform Operations on dequeue (double ended queue) using circular array. **CO2**

a) insertFront(): Adds an item at the front of Deque.
b) insertRear(): Adds an item at the rear of Deque.
c) deleteFront(): Deletes an item from front of Deque
d) deleteRear(): Deletes an item from rear of Deque
e) getFront(): Gets the front item from queue
f) getRear(): Gets the last item from queue
g) isEmpty(): Checks whether Deque is empty or not
h) isFull(): Checks whether Deque is full or not

Support the program with appropriate functions for each of the above operations

10. Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers **CO3**

a. Create a BST of N Integers: 13, 3, 4, 12, 14, 10, 5, 1, 8, 2, 7, 9, 11, 6, 18
b. Traverse the BST(either inorder, predorder or postorder)
c. Search the BST for a given element (KEY) and report the appropriate message
d. Exit

11. Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers **CO3**

a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
b. Traverse the BST in Inorder, Preorder and Post Order using non-recursive functions
c. exit

12. Design, Develop and Implement a Program in C for the following operations on Graph(G) of Cities. **CO4**

a. Create a Graph of N cities using Adjacency Matrix.
b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method

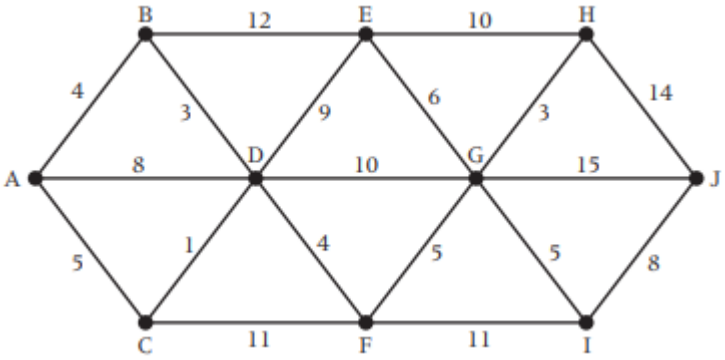
13. Design, Develop and Implement a C Program to the problem is to find shortest distances between every pair of vertices in a given edge weighted directed Graph using Warshall's Algorithm. The Graph is represented as Adjacency Matrix, and the Matrix denotes the weight

of the edges (if it exists) else INF (1e7). **CO4**

Input:
The first line of input contains an integer **T** denoting the no of test cases. Then T test cases follow. The first line of each test case contains an integer V denoting the size of the adjacency matrix. The next V lines contain V space separated values of the matrix (graph). All input will be integer type.
Output:
For each test case output will be V*V space separated integers where the i-jth integer denote the shortest distance of ith vertex from jth vertex. For INT_MAX integers output INF.

Constraints:
1 <= T <= 20
1 <= V <= 100
1 <= graph[][] <= 500

14. Design, Develop and Implement a C Program to Find the shortest distance from A to J on the network below using Dijkstra's Algorithm **CO4**



CONSTITUTION OF INDIA & INTELLECTUAL PROPERTY	
CSE 219	**Credit:0**
INSTRUCTION: 2 Periods/Week	**SESSIONAL MARKS: 50**

Course Objectives

- To impart knowledge in basic concepts of Constitution of India
- To understand the fundamental principles of Intellectual Property Rights and its importance

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

	COURSE OUTCOMES	Bloom's Level
CO-1	Recognise basic knowledge about the Constitution of India	L1
CO-2	Comprehend the Fundamental Rights and Fundamental Duties of the Indian Citizen to implant morality, social values and their social responsibilities.	L2
CO-3	Familiarize with distribution of powers and functions of Local Self Government, state and central policies and amendment procedure	L2
CO-4	Recognise the fundamental principles of IPR	L1
CO-5	Appraise of IP rights like patents, industrial design, trademark, copyrights for effective protection and utilization of their innovations.	L3

SYLLABUS

Unit 1 - Introduction and Basic Information about Indian Constitution: 10hrs

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Indian Constitution and its Salient Features, Preamble of the Constitution.

Unit 2 - Fundamental Rights and Directive Principles 10hrs

Fundamental Rights, Fundamental Duties, Directive Principles of State Policy – Its importance and implementation, Scheme of the Fundamental Right to certain Freedom under Article 19, Scope of the Right to Life and Personal Liberty under Article 21

Unit 3 - Administrative organisation & **Amendments 9hrs**

Indian Federal System , Centre and State Relations , President's Rule , Constitutional Amendments , Parliamentary System in India

Unit 4 - Intellectual Property Rights **10hrs**

Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, Copyrights, Geographical Indications, IPR in India and Abroad , Nature of Intellectual Property, Inventions and Innovations – Important examples of IPR

Unit 5 - Registration of IPR's **9hrs**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Trade Secrets , Industrial Design registration in India and Abroad

TEXTBOOKS:

1.V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, ―Intellectual Property Rights and Copy Rights, Ess Publications, New Delhi,2002
3. Brij Kishore Sharma: *Introduction to the Indian Constitution*, 8th Edition, PHI Learning Pvt. Ltd.
4. Granville Austin: *The Indian Constitution: Cornerstone of a Nation (Classic Reissue),* Oxford University Press.

REFERENCES:

1. Deborah E. Bouchoux, ―Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.
2.PrabuddhaGanguli,Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property,Edward Elgar Publishing Ltd., 2013.
4. Subhash C. Kashyap: *Our Constitution: An Introduction to India's Constitution and constitutional Law*, NBT, 2018.
5. Madhav Khosla: *The Indian Constitution*, Oxford University Press.
6. PM Bakshi: *The Constitution of India*, Latest Edition, Universal Law Publishing

SEM-II

PROBABILITY , STATISTICS AND QUEUING THEORY	
CSE 221	**Credits : 3**
Instruction : 3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Elementary knowledge of Set theory, Combinations, Calculus and basic Statistics.

Course Objective:

- The objective of this course is to provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.

Course Outcomes : At the end of the course student should be able to

CO - 1	Demonstrate basic principles of probability and understand a random variable that describe randomness or an uncertainty in certain realistic situation. It can be of either discrete or continuous type.
CO - 2	Comprehend concepts of discrete, continuous probability distributions and able to solve problems of probability using Binomial, Poisson, Uniform Distribution, Exponential Distribution, Normal distributions.
CO - 3	Compute simple correlation between the variables and fit straight line, parabola by the principle of least squares.
CO - 4	Analyze the statistical data and apply various small or large sample tests for testing the hypothesis.
CO - 5	Study basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

CO – PO MAPPING

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2	1	-	-	-	-	-	-	-	-	1
2	3	2	1	-	-	-	-	-	-	-	-	1
3	3	2	1	-	-	-	-	-	-	-	-	1
4	3	2	1	-	-	-	-	-	-	-	-	1
5	3	2	1	-	-	-	-	-	-	-	-	1

SYLLABUS

UNIT -I: PROBABILITY & MATHEMATICAL EXPECTATIONS (12 Periods)

Introduction to Probability : Definition of random experiment– Events and sample space– Definition of probability – Addition and multiplication theorems– Conditional probability – Baye's theorem– Simple problems on Baye's theorem.

Introduction to Random variable: Discrete and continuous random variables– Distribution function of random variable– Properties, Probability mass function, Probability density function– Mathematical expectation– Properties of mathematical expectation– Moments– Moment generating function– Mean and variance.

Learning outcome: At the end of this unit, student will be able to

1. Calculate probabilities using conditional probability, rule of total probability and Bayes' theorem.
2. Explain the concept of a random variable, probability distributions and different measures of a random variable.

UNIT –II: PROBABILITY DISTRIBUTIONS (14 Periods)

Discrete Distributions : Binomial distribution – Poisson distribution – Mean, Variance, Moment Generating function and problems.

Continuous Probability Distributions: Uniform distribution – Exponential distribution, Memory less property – Normal distribution – Properties of normal distribution – Importance of normal distribution – Area properties of normal curve – MGF – Mean ,variance and simple problems.

Learning outcome: At the end of this unit, student will be able to

1. Recognize the importance of discrete probability distributions Binomial, Poisson and solve the problems about these distributions
2. Recognize the importance of continuous distributions Exponential ,Uniform and Normal and Exponential Distribution and solve the problems about these distributions.

UNIT - III: CURVE FITTING, CORRELATION AND REGRESSION (10 Periods)

Curve Fitting : Principle of least squares – Method of least squares –Fitting of straight lines – Fitting of second degree curves and exponential curves.

Correlation : Definition – Karl pearson's coefficient of correlation – Measures of correlation– Rank correlation coefficients.

Regression : Simple linear regression – Regression lines and properties.

Learning outcome: At the end of this unit, student will be able to

1. Understand the concept of principle of least squares for curve fitting of straight line , second degree curve and exponential curve.
2. Calculate Pearson's correlation coefficient, Spearman's rank correlation coefficient and form the regression lines.

UNIT - IV: TESTING OF HYPOTHESIS (14 Periods)

Introduction– Null hypothesis – Alternative hypothesis – Type –I&II errors – Level of significance – Critical region – Confidence interval – One sided test – Two sided test.

Small Sample Tests: Students t - distribution and its properties – Test of significance difference between sample mean and population mean – Difference between means of two small samples – F- Distribution– Test of equality of two population variances – Chi-square test of goodness of fit .

Large sample Tests: Test of significance of large samples – Tests of significance difference between sample proportion and population proportion & difference between two sample proportions – Tests of significance difference between sample mean and population mean & difference between two sample means.

Learning outcome: At the end of this unit, student will be able to

1. Define null hypothesis, alternative hypothesis, level of significance, test statistic, *p* value, and statistical significance.
2. Perform and analyze hypotheses tests of means, proportions and χ^2 −test using both one- and two-sample data sets.

UNIT - V : QUEUING THEORY (10 Periods)

Structure of a queuing system – Operating characteristics of queuing system – Transient and steady states– Terminology of Queuing systems – Arrival and service processes – Pure Birth-Death process deterministic queuing models – M/M/1 model of infinite queue – M/M/1model of finite queue.

Learning outcome: At the end of this unit, student will be able to

1. Analyze basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
2. Solve problems on queuing models M/M/1 and M/M/n.

TEXT BOOK :

1. **T. Veerarajan**, *Probability, Statistics and Random Processes*, Tata McGraw Hill Publications.

REFERENCE BOOKS:

1. **Kishor S. Trivedi**, *Probability & Statistics with Reliability, Queuing and Computer Applications*, Prentice Hall of India .
2. **B. S. Grewal**, *Higher Engineering Mathematics*, 43rd edition, Khanna publishers, 2017.
3. **Sheldon M. Ross,** *Probability and Statistics for Engineers and Scientists*, Academic Press.
4. **S C Gupta and V.K.Kapoor**, *Fundamentals of Mathematical Statistics*.

MICROPROCESSOR AND INTERFACING	
CSE 222	**Credits : 3**
Instruction : 2 Periods & 1 Tut/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Basic knowledge of Digital Logic Design and Computer Organization.

Course Objectives:

- The objective of this course is to become familiar with the architecture and the instruction set of Intel microprocessors.
- Assembly language programming will be studied for practical implementation of the programs in the trainer kit.
- Learning the concept of interfacing various I/O peripherals like Keyboard/Display, stepper motor etc., with microprocessors using 8255 PPI.
- To provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems.
- The accompanying lab is designed to provide practical hands-on experience with microprocessor software applications and interfacing techniques

Course Outcomes

By the end of the course, the student will be able to:	
1.	Describe the architecture and pin configuration of 8085 Microprocessors and the significance of Addressing modes, timing diagrams and analyze the working of the instruction set.
2.	Demonstrate the programming knowledge for practical implementation of assembly level programming using instruction set of 8085.
3.	Analyzing the working of 8085 interfacing with co-processors are 8255, 8251, 8253, 8259, 8279 and External I/O devices.
4.	Describe the architecture and pin configuration of 8086 Microprocessors and the significance of Addressing modes, Segmented memory and Min-Max mode operations of 8086.
5.	Demonstrate the programming knowledge for practical implementation of assembly level programming using instruction set of 8086.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	-	-	-	-	-	-	3	1	-	-	1	2
2	3	3	2	2	2	-	-	-	1	1	-	-	-	1
3	3	3	3	-	-	-	-	-	2	-	-	-	-	-
4	2	1	2	-	-	-	-	-	-	-	-	-	1	-
5	3	3	2	2	2	-	-	-	1	1	-	-	-	1

SYLLABUS

UNIT I **15 periods**

Introduction to 8085 Microprocessor

Introduction to Microprocessors and Microcomputers, Internal Architecture and Functional / Signal Description of typical 8-bit µP. 8085, Instruction Set, types of Instructions, Addressing modes of 8085 and Timing Diagrams of 8085 µP.

Learning Outcome: At the end of this Unit the students will be able to

1. Draw and describe the basic architecture of 8085 and the functional description of 8085.
2. List the Instruction set; state the addressing modes and timing diagrams of 8085.

UNIT II **10 periods**

8085 µP Assembly Language Programming

Introduction to Assembly Language Programming Techniques: Looping, Counting, and Indexing, Counter and timing Delays, Stack and Subroutines, Code Conversions, BCD Arithmetic operations , 16-bit data Operations, Interrupts and Interrupt Service Routines.

Learning Outcome: At the end of this Unit the students will be able to

1. Develop the assembly language programs using various programming techniques
2. Analyze the simple programs of call instructions, sorting, and string manipulations.

UNIT-III **15 periods**

Interfacing Peripheral ICs to Intel 8085

Programmable peripheral interface (8255A), Programmable communication interface (8251), Programmable Interval timer (8253 and 8254), Programmable Interrupt controller (8259), Programmable Keyboard / Display controller (l 8279).

Learning Outcome: At the end of this Unit the students will be able to

1. Illustrate the different peripherals (8255, 8251, 8253, 8259, 8279.) are interfaced with Microprocessors.
2. Describe the control word formats of all Programmable peripheral interfaces.

UNIT IV **12 periods**

Introduction to 8086 Microprocessor

Internal Architecture and Functional/Signal Description of 8086/8088, Segmented Memory, Maximum-Mode and Minimum-Mode Operation and Addressing Modes of 8086.

Learning Outcome: At the end of this Unit the students will be able to

1. Describe the modes and functional block diagram of 8086 along with pins and their functions.
2. Develop the assembly language programs using various programming techniques.

UNIT V **8 periods**

8086 µP Assembly Language Programming

Instruction Set and Timing Diagrams, Interrupts and Interrupt Service Routines, Assembler Directives, Loops Procedures, Modular programming and Macros, .COM and .EXE formats.

Learning Outcome: At the end of this Unit the students will be able to

1. Used the programming techniques of 8086 to build programs using instruction set.
2. List, describe and use different types of instruction, directives and interrupts.

Case Study: Introduction to Pentium and Multi-Core Processors and Arduino processors.

TEXT BOOKS:

1. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085” Penram International, 6th Edition.
2. John E.Uffenbeck, “The 80x86 Family, Design, Programming and Interfacing 3rdEdition, Pearson Education Inc.”, 2002.

REFERENCE BOOKS:

1. BARRY B. BREY, “The Intel Microprocessors 8086/8088, 80186/80188,80286,80386 and 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and Interfacing”, Pearson Education Inc., 2003,6thEdition.
2. Walter A. Tribel and Avtar Singh,” The 8088 and 8086 Microprocessors, Programming, interfacing, Software, Hardware, and Applications”, Pearson Education Inc., 2003, 4thEdition.
3. Douglass V. Hall, “Microprocessors and Interfacing, Programming and Hardware” , TMH Edition, 1999, 2ndEdition
4. Sanjay K Bose, “Hardware and Software of Personal Computers”, New Age International (P) Ltd., 1991.
5. A.P. Mathur, “Introduction to Microprocessor”, Tata McGraw-Hill Education, 1989.
6. YU-Cheng Liu & Glenn A Gibson, “Microprocessor System, Architecture Programming & Design”.

ONLINE WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc20_ee11
2. https://www.udemy.com/course/microprocessor_8085/
3. https://www.udemy.com/course/interfacing-8086-microprocessor-with-peripheral-devices/

OPERATING SYSTEMS	
CSE 223	**Credits : 3**
Instruction : 3 Periods / Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Basic programming language and Computer Organization.

Course Objectives:

- To understand the main components of an operating system and their functions.
- To understand the basic concept of shell programming.
- To learn the mechanism of an operating system as process manager, memory manager, device manager and file manager.
- To understand the concept of protection related to operating system.

Course Outcomes:

CO	At the end of the course the student will be able to
1.	Illustrate the structure of the operating system, functionality and services provided by the operating system and interpret the basic concept of shell programming, process state and state transitions.
2.	Implement the CPU Scheduling algorithms (Pre-emptive and Non Pre-emptive) and demonstrate the concept of Process synchronization.
3.	Demonstrate the concept of resource allocation. Apply and analyze various memory management mechanisms for contiguous and non-contiguous memory.
4	Demonstrate the structure and organization of the file systems and analyze the implementation of the file systems.
5	Analyze the secondary storage structure, protection of the system.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
2	2	2	2	1	-	-	-	-	-	-	-	-	1	-
3	2	2	2	1	-	-	-	-	-	-	-	-	1	-
4	2	2	2	1	-	-	-	-	-	-	-	-	1	-
5	2	2	2	1	-	-	-	-	-	-	-	-	-	-

Syllabus

UNIT I **(12 Hours)**

Introduction to OS: Operating system Definition, Operating system Functionalities, Types of Operating system, operating system structures, system calls, system programs.

Introduction to Shell Programming: Commands and Shell script.

Processes: Process concept, Process scheduling, Operations on processes, Inter process communication, Communication in client-server systems.

Threads: Overview, Multithreading models.

Learning outcomes: At the end of this Unit, Students will be able to

1. Define the responsibilities of an operating system and implement the basic shell programs.
2. Demonstrate the different modes of communication among processes and multi threading models.

UNIT II **(10 Hours)**

CPU Scheduling: Scheduling criteria, Scheduling algorithms, Algorithm Evaluation.

Process Synchronization: The critical-section problem, Peterson's solution, Synchronization hardware, Mutex Locks, Semaphores, Classic problems of synchronization, Monitors.

Case Study: Linux operating system: Process Management.

Learning outcomes: At the end of this Unit, Students will be able to

1. Analyze the CPU scheduling algorithms and their performance evaluation.
2. Implement the different solutions for process synchronization.

UNIT III **(12 Hours)**

Deadlock: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

Memory Management: Background, Swapping, Contiguous memory allocation, Segmentation, Paging, Structure of the page table.

Virtual Memory: Background, Demand paging, Page replacement, Allocation of frames, Thrashing.

Case Study: Linux operating system: Memory Management.

Learning outcomes: At the end of this Unit, Students will be able to

1. Define the concept of deadlock and Identify the different ways to handle deadlock like prevention, detection, avoiding and recovery.
2. Distinguish between contiguous and non-contiguous memory allocation methods in memory management.

UNIT IV **(10 Hours)**

File Systems Interface: File concept, Access methods, Directory structure, File system mounting, File Sharing, Protection.

Implementing File-Systems: File system structure, File system implementation, Directory implementation, Allocation methods, Free-space management, Efficiency and performance, Recovery.

Learning outcomes: At the end of this unit, students are will be to

1. Demonstrate the concept of file system, various file access methods and Protection in files.
2. Identify and implement the file system and recovery.

UNIT V **(10 Hours)**

Secondary Storage Structure: Mass storage structures, Disk structure, Disk attachment, Disk scheduling, Disk management, Swap space management.

Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights.

Learning outcomes: At the end of this unit, students are will be to

1. Demonstrate the concept of mass storage structures and Analyze the various disk scheduling algorithms
2. State the goal and principles of protection and implement the access matrix.

TEXT BOOKS

1. Silberschatz, Galvin and Gagne, "Operating System Principles", 9th Edition, Wiley India Pvt Ltd, 2015.
2. Sumitabha Das, "Unix Concepts and Applications", 4th Edition. TMH, 2006.
3. Yashwanth Kanitkar, "Unix Shell programming", 1st Edition, BPB Publisher, 2010.

REFERENCES

1. Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Pearson Education, 2015.
2. William Stalling, "Operating Systems: Internals and Design Principles", 9th edition, PHI, 2018.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106144/
2. https://nptel.ac.in/content/storage2/courses/106108101/pdf/PPTs/Mod_13.pdf

COMPUTER NETWORKS	
CSE 224	**Credits : 3**
Instruction : 3 Periods / Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Good Knowledge on Data Communications.

Course Objectives:

- To make the student understand the contemporary technologies in network protocols and network architecture.
- To acquire the knowledge on design principles of network infrastructure.
- To learn and understand the design issues in error handling.
- To gain sufficient knowledge on addressing the nodes in the network and connecting them using the network level protocols.
- To make them familiarize with different application layer protocols and network management services.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Identify the Network Components required to build different types of networks and classify the switching techniques.
2.	Analyze the addressing techniques and control mechanisms.
3.	Contrast connection-oriented and connectionless services for datagram with congestion.
4.	Trace the flow of information from one node to another in the network and classify the network services.
5.	Analyze how to manage the network and achieve security.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	1	3	-	-	-	2	1	-	3	1	2
2	3	3	2	2	1	-	-	-	2	2	-	2	1	2
3	3	3	2	2	1	-	-	-	2	2	-	2	1	2
4	3	3	2	2	1	-	-	-	2	1	-	2	1	2
5	3	3	2	2	1	-	2	-	2	2	-	2	1	2

SYLLABUS

UNIT-I: **12 Hours**

Introduction to Computer Networks:

Overview of Networks – Network Architectures, Network Components, Reference Models - ISO/OSI, TCP/IP, ARPANET, Switching techniques: Circuit switching – packet switching – message switching. Data link control protocols, link Layer protocols, HDLC.

Learning outcomes: At the end of this Unit, Students are able to

1. Define the network components.
2. Demonstrate the different types of switching techniques.

UNIT-II: **15 Hours**

Network Layer:

Packet Switching and Datagram Approach, Protocols, Network Addressing- Classful addressing and Classless addressing, IPv4, IPv6, ARP, RARP, ICMP, IGMP, DHCP, Fragmentation, Routing Algorithms(including RIP, OSPF), Congestion Control Techniques, Tunneling, Security Issues in Network layer.

Learning outcomes: At the end of this Unit, Students are able to

1. Analyse the network layer protocols with addressing.
2. Compare Routing algorithms.

UNIT-III: **12 Hours**

Transport Layer:

Transport Layer Responsibilities, Reliable end to end Protocols: TCP and UDP Protocols Congestion and flow control mechanisms, TCP Extensions, QOS, and Security Issues in Transport layer.

Learning outcomes: At the end of this Unit, Students are able to

1. Differentiate TCP and UDP protocols.
2. Demonstrate Congestion and flow control mechanisms.

UNIT-IV: **12 Hours**

Application Layer:

Protocols: SMTP,POP, FTP, TFTP, BOOTP, HTTP/HTTPS, MIME, S-MIME, Client-Server and Peer-to-Peer Architectures-WWW, DNS.

Learning outcomes: At the end of this Unit, Students are able to

1. Explore the usage of various application layer protocols.
2. Differentiate between HTTP and HTTPS.

UNIT-V: **12 Hours**

Network Services and Management:

SNMP-– Versions- management, Components MIB, Remote monitoring, SNMP-VoIP,

Basics of Network Security: Attacks, Symmetric and Asymmetric Cryptography.

Learning outcomes: At the end of this Unit, Students are able to

1. Define the network management.
2. Explain the benefits of security.

Text Books:

1. Behrouz A Forouzan “Data Communications and Networking”, 5th Edition, Tata McGraw-Hill.
2. William Stallings, “Data and Computer Communications”. 8th edition, Pearson Education

Reference Books:

1. Andrew S. Tanenbaum, “Computer Networks”, 5th edition, Prentice-Hall Publisher.
2. J F Kurose, K W Ross, “Computer Networking: A Top-Down Approach, 5th Edition, Addison-Wesley

Web Resources:

1. https://www.udacity.com/course/computer-networking--ud436

COMPUTER GRAPHICS	
CSE 225	**Credits : 3**
Instruction : 2 Hours & 1 Tut/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Elementary knowledge in C programming, Solving mathematical expressions, algorithm or pseudo code.

Course objectives:

- Understand the applications in the real world and the graphics systems used in developing graphics.
- Exploration of fundamental concepts in 2D and 3D computer graphics.
- Learn two dimensional and three dimensional computer graphics with comprehend advanced software tools of computer graphics

COURSE OUTCOMES:

By the end of the course, the student will be able to:	
1.	Explain computer graphics, applications and contemporary terminology, hardware components etc.
2.	Design 2D objects using various algorithms.
3.	Apply geometric and viewing transformations on 2D objects.
4.	Design 3D objects and apply geometric and viewing transformations on 3D objects.
5.	Compare visible surface methods.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
2	3	2	2	2	-	-	-	-	2	1	-	1	-	2
3	3	2	2	2	-	-	-	-	2	1	-	1	-	2
4	3	2	2	2	-	-	-	-	2	1	-	1	-	2
5	2	1	1	-	-	-	-	-	1	1	-	-	-	2

SYLLABUS

UNIT-I **9Hours**

Introduction: Basics of computer graphics, Applications
Over view of Graphics systems: Video Display Devices, Raster Scan systems, Random scan systems, Graphics monitors and workstations, Input devices, Graphics software.
Learning Outcomes : At the end of this unit, student will be able to

1. Express about the application in the real world and the computer Graphics.
2. Summarize the different graphic systems

UNIT-II **15 Hours**
Output primitives & its attributes: Points and Lines-Line Drawing Algorithms, Loading the Frame buffer, Line function, Circle Generating Algorithms, Ellipse Generating Algorithms, Filled Area Primitives, Filled Area Functions, Cell Array, Character Generation.
Attributes of Output Primitives: Line and Curve Attributes, Color and Gray scale levels, Area Fill Attributes, Character Attributes, Bundled Attributes, Anti-aliasing.
Learning Outcomes : At the end of this unit, student will be able to

1. Observe various 2d output primitive and algorithm
2. Interpret the attributes of output primitives

UNIT –III **15 Hours**
Two Dimensional Geometric Transformations: Basic Transformations, Matrix Representations, Homogeneous Coordinates, Composite Transformations, Other Transformations, Transformations between Coordinate Systems.
Two Dimensional Viewing: The Viewing Pipeline, Viewing Coordinate Reference Frame, Window to Viewport Coordinate Transformation, Two Dimensional Viewing Functions, Clipping Operations, Point Clipping, Line Clipping, Polygon Clipping, Curve Clipping, Text and Exterior Clipping.
Learning Outcomes : At the end of this unit, student will be able to

1. Apply 2-dimensional geometric transformation to the real world scenario
2. Evaluate various clipping algorithms and outline 2D viewing transformation

UNIT-IV **12 Hours**
Three Dimensional Concepts and Object representations & Transformation : 3D display methods, 3D Graphics, Polygon Surfaces, Curved Lines and Surfaces, Quadratic Surfaces, Super Quadrics, Blobby Objects, Spline Representations, Cubic Spline methods, Bezier Curves and Surfaces, B Spline Curves and Surfaces.
Three Dimensional Geometric and Modeling Transformations: Translation, Rotation, Scaling, Other Transformations, Composite Transformations.
Three Dimensional Viewing: Viewing Pipeline, Viewing Coordinates, Projections, View Volumes, General Projection Transformations, Clipping.
Learning Outcomes : At the end of this unit, student will be able to

1. Review the 3d object representations and the analyze various surface representation.
2. Compare the 2D and 3D geometric and modeling transformations and explain the 3D viewing transformation.

UNIT-V **9 Hours**

Visible Surface Detection & Hidden Surface Detection Methods: Classification of visible, Surface detection algorithms, Back face method, Depth buffer method, Scan line method, Depth Sorting Method, Z-buffer method, Area sub-division method, Comparison of hidden surface methods.

Polygon Rendering Methods: Constant-Intensity Method, Gouraud Method, Phong Method.

Learning Outcomes : At the end of this unit, student will be able to

1. Compare and differentiate visible surface detection methods
2. Differentiate various polygon rendering methods.

Text Books:

1. Computer Graphics C Version by Donald Hearn & M. Pauline Baker Pearson Education, New Delhi, 2004

References Books:

1. David F. Rogers "Procedural Elements for Computer Graphics", Tata McGraw Hill Book Company, New Delhi, 2003
2. J. D. Foley, S. K Feiner "Computer Graphics: Principles & Practice in C", A Van Dam F. H John, Pearson Education, 2004

Web References:

1. http://nptel.ac.in/courses/106106090/
2. https://www.coursera.org/courses?languages=en&query=computer+graphics
3. https://courses.edx.org/courses/BerkeleyX/CS-184.1x/2013_October/syllabus/

FORMAL LANGUAGES AND AUTOMATA THEORY	
CSE 226	**Credits: 3**
Instruction: 2 Periods & 1 Tut/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- The students are expected to have a strong background in the fundamentals of discrete mathematics (symbolic logic, set, induction, number theory, summation, series, combinatory, graph, recursion, basic proof techniques, etc.), algorithms and data structures.
- Some knowledge of programming languages, programming, and computer architecture will be helpful.

Course Objectives:

The course should enable the students:

- To provide introduction to some of the central ideas of theoretical computer science from the perspective of formal languages.
- To introduce the fundamental concepts of formal languages, grammars and automata theory.
- Classify machines by their power to recognize languages.
- Employ finite state machines to solve problems in computing.
- To understand deterministic and non-deterministic machines.
- To understand the differences between decidability and undecidability.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Acquire a fundamental understanding of the core concepts in automata theory, construct DFAand NFA. Ability to transform between equivalent finite automata, Construct Epsilon-NFA and transform between equivalent finite automata
2.	Understand the power and the limitations of regular expressions and design regular expressions. Compute transformation between finite automata and regular expressions
3.	Describe and construct Context Free Grammar and Pushdown Automata, transformation between them.
4.	Construct and analyze the use and properties of Turing machines performing simple tasks, with recent trends and applications in the area of finite state machines
5.	Understand the concepts of recursively enumerable languages and undecidability problem.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	3	1	1	-	1	1	3	-	2	3	1
2	2	2	3	2	-	-	-	1	1	2	-	2	2	1
3	2	2	3	2	-	-	-	1	1	2	-	2	3	1
4	2	3	3	2	-	-	-	1	1	2	-	3	2	1
5	2	3	3	3	-	-	-	1	1	2	-	3	3	2

SYLLABUS

UNIT-I: 15 periods

FINITE AUTOMATA (FA): Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA.

NONDETERMINISTIC FINITE AUTOMATA (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.

LEARNING OUTCOMES:

1. An ability to design grammars and automata (recognizers) for different language classes.
2. An ability to prove and disprove theorems establishing key properties of formal languages and automata**.**

UNIT-II: 12 periods

REGULAR EXPRESSIONS (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA are to Regular Expressions, Converting Regular Expressions to Automata, and applications of Regular Expressions.

REGULAR GRAMMARS: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, and Closure properties of regular languages.

LEARNING OUTCOMES:

1. Design Finite Automata's for different Regular Expressions and Languages.
2. Understand the Pumping lemma for proving that languages are not regular.

UNIT-III: 12 periods

CONTEXT FREE GRAMMER (CFG): Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL (Proof's omitted).

LEARNING OUTCOMES:

1. To construct context free grammar for various languages.
2. Describe the language accepted by automata or generated by a regular expression or a context-free grammar.

UNIT-IV: 12 periods

PUSHDOWN AUTOMATA: Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA.

TURING MACHINES (TM): Formal definition and behavior, Languages of a TM, TM as accepters and as a computer of integer functions, Types of TMs.

LEARNING OUTCOMES:

1. To solve various problems of applying normal form techniques, push down automata and Turing Machines.
2. Construct a pushdown automaton for a given context-free language

UNIT-V: **12 periods**

RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES (REL): Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.

LEARNING OUTCOMES:

1. Understand the basic results on computability, including undecidable problems such as the halting and Post correspondence problems, and their significance.
2. Define the various categories of languages and grammars in the Chomsky hierarchy.

TEXT BOOKS

1. Hopcroft H.E. and Ullman J. D. "Introduction to Automata Theory Languages and Computation", Pearson Education.

REFERENCE BOOKS

1. 1.Theory of Computer Science – Automata languages and computation -Mishra and Chandrashekaran, 2nd edition, PHI.
2. Introduction to languages and the Theory of Computation, John C Martin, TMH, 4th edition.

ONLINE WEB RESOURCES

1. https://nptel.ac.in/courses/111103016/

MICROPROCESSOR AND INTERFACING LAB	
CSE 227	**Credits : 1.5**
Instruction : 3 Periods / Week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks :50**

Prerequisites:

- Basic knowledge of Digital Logic Design and Computer Organization.

Course Objectives:

- Developing of assembly level programs and providing the basics of the processors
- To provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems
- To assist the students with sufficient knowledge on the interrupts and working with interrupt driven I/O for communication with external devices.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Possessed a better command over the instruction set of 8085 and 8086 microprocessor for programmatically deployment.
2.	Demonstrate the interfacing of 8085 microprocessors with external I/O devices through 8255 PPI.
3.	Analyze the internal communication of microprocessor with the external devices through the interrupts and working with various types of vector interrupts
4.	Students will possess the knowledge to design and develop a working prototype with various simulators and emulators that they have used throughout the lab sessions.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1	3	1	3	1	1	-	-	2	2	1	-	-	2
2	2	2	1	2	-	1	-	-	-	1	1	-	-	-
3	3	1	1	2	-	-	-	-	-	1	-	-	-	-
4	4	2	1	2	-	1	-	-	-	2	-	-	-	-

ASSEMBLY LANGUAGE PROGRAMMING:

1. **8085 ASSEMBLY LANGUAGE PROGRAMMING** According to theory course using the following: **Using Keyboard Monitor of 8085µP Trainer.** 3 weeks

2. **INTERFACING WITH 8085 TRAINER** 4 weeks
   2.1 8255 STUDY CARD SCENARIOS (I/O and BSR MODE OPERATIONS)
   2.2 8255 MODES using HARDWARE INTERRUPTS
   2.3 KEYBOARD/DISPLAY INTERFACE

3. **INTERFACING WITH PC** 4 weeks

3.1 TRAFFIC LIGHT CONTROLLER
3.2 STEPPER MOTOR CONTROLLER
2.3 LOGIC CONTROLLER

4. **8086 ASSEMBLY LANGUAGE PROGRAMMING** According to theory course using the following: **PC Assembler using TASM or MASM, TD or SYMDEB or CVD (Code View debugger)** 2 weeks

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085" Penram International, 6th Edition.
2. John E.Uffenbeck, "The 80x86 Family, Design, Programming and Interfacing 3rdEdition, Pearson Education Inc.", 2002.

REFERENCE BOOKS:

1. BARRY B. BREY, "The Intel Microprocessors 8086/8088, 80186/80188,80286,80386 and 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and Interfacing", Pearson Education Inc., 2003,6thEdition.
2. Walter A. Tribel and Avtar Singh," The 8088 and 8086 Microprocessors, Programming, interfacing, Software, Hardware, and Applications", Pearson Education Inc., 2003, 4thEdition.
3. Douglass V. Hall, "Microprocessors and Interfacing, Programming and Hardware" , TMH Edition, 1999, 2ndEdition

ONLINE WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc20_ee11/preview
2. https://www.udemy.com/course/microprocessor_8085/
3. https://www.udemy.com/course/interfacing-8086-microprocessor-with-peripheral-devices/

OPERATING SYSTEM LAB	
CSE 228	**Credits : 1.5**
Instruction : 3 Periods per week	**Sessional Marks : 50**
End Exam : 3 Hours	**End Exam Marks : 50**

Prerequisites: Basic programming language

Course objectives:

- To learn and execute the basic shell script, UNIX commands and system calls.
- To understand and implement the process, memory and file management.
- To solve the problems related to process synchronization.

Course Outcomes:
At the end of the course the student will be able to

CO1	Execute the Unix Shell programming on the given system configuration.
CO2	Acquire skill in the various services provided by the system calls.
CO3	Simulate the process scheduling, process synchronization, deadlock avoidance and detection algorithms.
CO4	Simulate memory management techniques and file handling.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	2	2	-	-	-	-	-	-	-	-	-	-	-
2	1	2	2	-	-	-	-	-	-	-	-	-	-	-
3	2	2	3	1	-	-	-	-	-	-	-	-	1	-
4	2	2	3	1	-	-	-	-	-	-	-	-	1	-

LIST OF SAMPLE PROGRAMS

Write a Program for the following

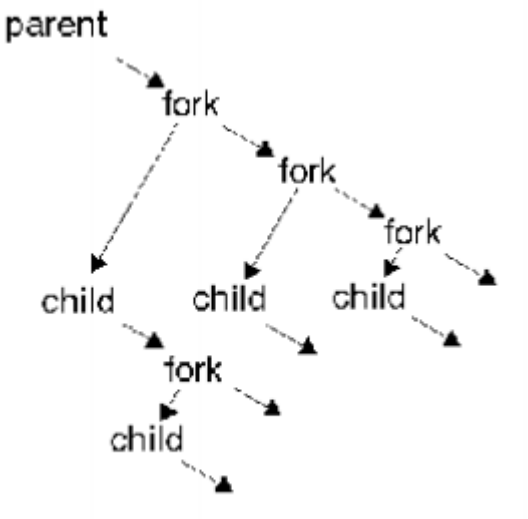
1. Implement basic shell commands. (CO1)

2. Shell programming: Simple logic programs. (CO1)

i) Write a menu driven script using the select statement to print calories for food items such as pizza, burger, Salad, Pasta etc.

ii) Write a shell script that, given a filename as the argument will count vowels, blank spaces, characters, number of line and symbols.

3. i) Analyze the below situation and develop a program for creating processes as required. Print the PID's of each process in a convenient way to understand. (CO2)



ii) Write a program to create two processes P1 and P2. P1 takes a string and passes it to P2. P2 concatenates the received string with another string without using string function and sends it back to P1 for printing. (CO2)

4. CPU Scheduling Algorithms (CO3)

i) A washing machine which requires the process to be executed sequentially. Consider the processes P1, P2, P3, P4 whose arrival times are 1, 5, 9, 10 and burst times are 4, 3, 5, 2 respectively. Implement an appropriate algorithm. Find the CPU idle time, so that the water can be supplied during that period of time.

ii) Implement shortest job first for the following data:

Consider the following set of processes, CPU burst time, Arrival time. Calculate the average waiting time, average response time and average turnaround time.

Process	Burst Time	Arrival Time
P1	3	0
P2	6	2
P3	4	4
P4	5	6
P5	2	8

iii) Implement Round Robin for the following data

Consider the following set of processes and length of the CPU burst time given in milliseconds.

Process	Burst Time
P1	10
P2	1
P3	2
P4	1
P5	5

The processes are assumed to have arrived in the order P1, P2, P3, P4, P5 all at time 0 and time quantum in RR=1.Calculate the average waiting time, response time and turnaround time.

5. Develop a program to provide synchronization among the 5 philosophers in Dining Philosophers problem using semaphore. (CO3)

6. Develop a program to provide synchronization among the producer and consumer rocesses in producer –consumer problem using a monitor. (CO3)

7. Consider the following data: (CO3)

Process	Allocation A B C D	Max A B C D	Available A B C D
P1	0 0 1 2	0 0 1 2	2 1 0 0
P2	2 0 0 0	2 7 5 0	
P3	0 0 3 4	6 6 5 6	
P4	2 3 5 4	4 3 5 6	
P5	0 3 3 2	0 6 5 2	

i) Calculate the need matrix
ii) Is this system currently in a safe or unsafe state?
iii) Is the system currently deadlock or not.
iv) Which process, if any, or may become deadlocked?

8. Consider the following scenario: A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1, 2, 1, 3, 7, 4, 5, 6, 3, 1, 2, 4, 6, 3, 1. Find a page replacement policy which gives the least number of page faults. (CO4)

9. Simulate the Virtual Memory concept. (CO4)

10. Implement the first fit and best fit algorithm in memory management. (CO4)

11. Simulate the Contiguous file allocation method. (CO4)

12. Implement a bit map for the following scenario. (CO4)
For a memory of size 32 blocks ,the allocated blocks are 2,3,4,5,8,9,10,11,12 and display the bitmap pattern.

REFERENCES:

1. Sumitabha Das, "Unix Concepts and Applications", 4th Edition. TMH, 2006.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley & Sons, 2015.
3. William Stalling, "Operating Systems: Internals and Design Principles", 9th edition, PHI, 2018.

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1. https://nptel.ac.in/content/storage2/courses/106108101/pdf/PPTs/Mod_13.pdf
2. https://nptel.ac.in/courses/117106113/