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SYLLABUS

SEMESTER III COURSE INFORMATION SHEET

COURSE INFORMATION SHEET
Course code: MA205
Course title: Discrete Mathematics
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:1 P:0 C: 4
Class schedule per week: 3 Lectures, 1 Tutorial
Class: I. M.Sc. /B. Tech
Semester / Level: 2
Branch: CSE/AIML
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Be exposed to a wide variety of mathematical concepts that are used in the computer science discipline.
2.	Learn about a number of theorems and the proofs using various techniques.
3.	Gain knowledge about the various graphs algorithms along with its analysis.
4.	Apply graph theory based tools in solving practical problems.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Model and analyze computational processes using analytic and combinatorial methods
CO2	Solve the various problems of recurrence relations.
CO3	Attain knowledge about sets, relations, and growth of functions.
CO4	Apply counting techniques to solve combinatorial problems.
CO5	Apply graph theory in the areas of computer science.

SYLLABUS

Module 1: **[8 Lectures]**
Mathematical logic and Mathematical Reasoning, Compound Statements, Propositional Equivalences, Predicates and Quantifiers, Methods of Proof, Mathematical Induction, Well-ordering principal, Recursive Definition and Algorithms.

Module 2: **[8 Lectures]**
Recurrence Relations, Classification of Recurrence Relations and their solutions by Characteristic Root method, Generating function and their various aspects, Utility of Generating function in solving Recurrence Relations.

Module 3: **[8 Lectures]**
Set, Operations on Set, Computer representation of Set, Relations, Properties/Classification of Relations, Closure operations on Relations, Matrix representation of Relations, Digraphs. Functions and their Representation, Classification of Functions, Warshall's algorithm, Discrete Numeric Functions, Growth of Functions, Big O, Big Q, Hash Function, Growth Functions.

Module 4: **[8 Lectures]**
Binary Operations, Groups, Product and Quotients of Groups, Semi group, Products and Quotients of Semi groups, Permutation Group, Composition of Permutation, Inverse Permutation, Cyclic Permutation, Transposition, Even and Odd Permutation, Coding of Binary Information and Error Correction, Decoding and Error Correction.

Module 5: **[8 Lectures]**
Introduction to Graph, Graph Terminologies and their Representation, Connected & Disconnected graphs, Isomorphic Graph, Euler & Hamilton graphs. Introduction to Trees, Versatility of Trees, Tree traversal. Spanning Trees, Minimum Spanning Tree.

Text Books:

1. Mott, Joe L., Abraham Kandel, and Theodore P. Baker Discrete Mathematics for Computer Scientists & Mathematicians, PHI, 2^{nd} edition 2002.
2. Swapan Kumar Chakraborty and Bikash Kanti Sarkar: Discrete Mathematics, Oxford Univ. Publication, 2010.
3. Kolman, Bernard, Robert C. Busby, and Sharon Ross. Discrete Mathematical Structures, Prentice-Hall, Inc., 2003.

Reference Books:

1. Bikash Kanti Sarkar and Swapan Kumar Chakraborty, Combinatorics and Graph Theory, PHI,2016.
2. Seymour Lipschuz and Mark Lipson,Discrete Mathematics, Shaum’s outlines, 2003.
3. Liu, Chung Laung, Elements of Discretemathematis, Mcgraw Hill, 2ndedition, 2001.
4. Bondy and Murty, Grapg Theory with Applications, American Elsevier,1979.
5. Robin J. Wilson, Introduction to Graph Theory, Pearson, 2010.
6. J. P. Tremblay , P. G. Sorenson – An Introduction to Data Structures With Applications, 2nd Edn, McGraw-Hill, Inc. New York, NY, USA.
7. Seymour Lipschutz – Data Structures, 6th Edn, 9th Reprint 2008, Tata McGraw-Hill.

Course delivery methods	
Lecture by use of boards/lcd projectors/ohp projectors	√
Tutorials/assignments	√
Seminars	
Mini projects/projects	√
Laboratory experiments/teaching aids	
Industrial/guest lectures	
Industrial visits/in-plant training	
Self- learning such as use of nptel materials and internets	√
Simulation	

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment tool	% contribution during co assessment
Mid semester examination	25
End semester examination	50
Quiz (s)	10+10
Assignment	5

Assessment components	CO1	CO2	CO3	CO4	CO5
Mid semester examination	√	√	√		
End semester examination	√	√	√	√	√
Quiz (s)	√	√	√		
Assignment	√	√	√	√	

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	High	Medium	Medium	Low	Medium	Low	Low	Low	Low	Low	Low	Medium	High	High	Low
CO2	Medium	High	High	Low	Low	Medium	Low	Low	Low	Low	Low	Medium	Medium	Medium	Medium
CO3	Medium	High	High	High	Medium	Low	Low	Medium	Low	Medium	Low	Low	Medium	Medium	Low
CO4	High	High	Medium	Low	Low	Low	Low	Low	Medium	Medium	Low	Medium	High	Medium	Low
CO5	High	Medium	Medium	Low	High	Low	Medium	Medium	Low	Medium	Medium	Medium	High	High	Medium

If satisfying and < 34% = Low, 34-66% = Medium, > 66% = High

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET
Course code: EC203
Course title: Digital System Design
Pre-requisite(s): EC101 Basics of Electronics & Communication Engineering
Co- requisite(s):
Credits: L:3 T:0 P:0 C: 3
Class schedule per week: 3 Lectures, 1 tutorial
Class: B. Tech
Semester / Level: III/02
Branch: CSE/AIML
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Understand the basics of the digital electronics.
2.	Apply the knowledge of digital electronics to construct various digital circuits.
3.	Analyse the characteristics and explain the outputs of digital circuits.
4.	Evaluate and asses the application of the digital circuits.
5	Design digital machine for simple computing and control.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Explain the concept of digital electronics.
CO2	Apply the knowledge to produce digital electronics circuits.
CO3	Analyse and categorize digital circuits.
CO4	Justify the uses of different digital circuits.
CO5	Schematize and demonstrate simple computing machines.

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Module 1: **[9Lectures]**

Basics of Digital Electronics: Number representation, Binary number system, Number base conversion, Octal, Hexadecimal and BCD codes, binary Arithmetic, Logic gates, Introduction to VHDL and Verilog, VHDL Models, Logic Families: TTL, ECL, and CMOS Logic Circuits, Logic levels, voltages and currents, fan-in, fan-out, speed, power dissipation. Comparison of logic families.

Module 2: **[9Lectures]**

Simplification of Boolean functions: Boolean Algebra, Basic theorems and Properties, De Morgan's theorem, Canonical & Standard forms, Simplification of Boolean function using Karnaugh map, POS& SOP simplification, Prime implicant, NAND and NOR implementation.

Module 3: **[9Lectures]**

Design of Combinational Circuits: Analysis and design procedure, Parity Generators and Checkers, Adders, Subtractors, Look ahead carry, Adder, 4-bit BCD adder/subtractor, Magnitude comparator, Decoders, Encoders, Multiplexers, De-multiplexers, , Design of 1 bit ALU for basic logic and arithmetic operations.

Module 4: **[9Lectures]**

Design of Sequential Circuits and Memories: Basic Latch, Flip-Flops (SR, D, JK, T and Master-Slave), Triggering of Flip Flops, Synchronous and asynchronous counters, Registers, Shift Registers, Memories and Programmable Logic design, Types of memories, Memory Expansion and its decoding, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL).

Module 5: **[9Lectures]**

Design of simple computing machines: SAP-I concepts with stress on timing diagrams, Microinstructions, Fetch and Execution cycle variable machine cycle, Hardware control Matrix, Macroinstructions, Microprogramming , Bus concepts, Multiplexed Minimum system. Pipelining concepts.

Text

Books:

1. "Digital Design", Morris Mano and Michael D. Ciletti ,5th edition PHI
2. "Digital System Design using VHDL", Charles H Roth, Thomson Learning

Reference Books:

1. Digital computer Electronics AP Malvino, 3rd Edition Mc Graw Hill

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	High	Medium	Medium	Low	Medium	Low	Low	Low	Low	Low	Low	Medium	High	High	Low
CO2	Medium	High	High	Low	Low	Medium	Low	Low	Low	Low	Low	Medium	Medium	Medium	Medium
CO3	Medium	High	High	High	Medium	Low	Low	Medium	Low	Medium	Low	Low	Medium	Medium	Low
CO4	High	High	Medium	Low	Low	Low	Low	Low	Medium	Medium	Low	Medium	High	Medium	Low
CO5	High	Medium	Medium	Low	High	Low	Medium	Medium	Low	Medium	Medium	Medium	High	High	Medium

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD6, CD7
CO2	CD1, CD2, CD3, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD2, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD6, CD7

COURSE INFORMATION SHEET

Course code: CS231
Course title: Data Structures
Pre-requisite(s): Programming for problem Solving
Co- requisite(s): Data Structure Lab
Credits: L:3 T:1 P:0
Class schedule per week: 3 Lectures, 1 Tutorial
Class: I. M.Sc. /B. Tech
Semester / Level: 2
Branch: CSE/AIML
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Be familiar with basic techniques of algorithm analysis.
2.	Understand basic concepts about arrays, stacks, queues, linked lists, trees and graphs.
3.	Understand concepts of searching and sorting techniques.
4.	Develop and understanding of various linear and non-linear data structures.
5.	Assess how the choice of data structures impacts the performance of a program.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Define various linear and non-linear data structures like stack, queue, linked list, tree and graph.
CO2	Explain operations like insertion, deletion, traversal, searching, sorting etc. on various data structures.
CO3	Design various data structures and their operations.
CO4	Analyze the performance of data structure based operations including searching and sorting.
CO5	Justify the choice of appropriate data structure as applied to specified problem definition.

SYLLABUS

Module 1: Basic Concepts & Definitions	**[8 Lectures]**
Data Structure, ADT, Algorithms, Time and Space Complexity, Asymptotic Notations (O, θ, Ω), Time complexity computation of non-recursive algorithms (like Matrix addition, Selection sort – using step count), Array – basic operations, concept of multi-dimensional array, Polynomial operations using Array, Sparse Matrix.	

Module 2: Stacks & Queues	**[8 Lectures]**
Stack ADT: basic operations, Queue ADT: basic operations, Circular Queue, Evaluation of Expressions, Another application or Mazing Problem.	

Module 3: Linked Lists	**[8 Lectures]**
Singly Linked List: concept, representation and operations, Circular Linked List, Polynomial and Sparse Matrix operations using LL, Doubly Linked List: basic concept.	

Module 4: Trees & Graphs	**[8 Lectures]**
Basic concepts and terminologies, Binary Search Tree and Heap, Disjoint Set, Graph: concept and terminologies, Concept of BFS, DFS, Spanning Tree, Connected Components.	

Module 5: Searching & Sorting	**[8 Lectures]**
Sequential Search and Binary Search, Insertion Sort, Heap Sort, Radix Sort, External Sorting: k-way merging approach.	

Text Books:

1. Sahni Horwitz,, Freed Anderson, Data Structures in C, 2nd Edition (or latest) , University Press.

Reference Books:

1. Thareja Reema, Data Structures Using C, 2nd Edition, Oxford University Press.
2. Tanenbaum, Langsam, Augenstein, Data Structures using C, Pearson.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment tool	% contribution during co assessment
Mid semester examination	25
End semester examination	50
Quiz (s)	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect assessment

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low	Low
CO2	Medium	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
CO3	High	High	High	Low	Medium	Low	Low	Low	Low	Low	Low	Medium	Medium	Medium	Low
CO4	High	High	Medium	Low	Medium	Low	Low	Low	Low	Low	Low	Medium	Medium	High	Low
CO5	Medium	Medium	High	Medium	Medium	Low	Low	Medium	Low	Low	Low	Medium	High	Medium	Low

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course code: CS233

Course title: Object Oriented Programming and Design Patterns

Pre-requisite(s): Data Structure

Co- requisite(s):

Credits: L:3 T:0 P:0

Class schedule per week: 3 Lectures, 1 tutorial

Class: I. M.Sc. /B. Tech

Semester / Level: II/2

Branch: CSE/AIML

Name of Teacher:

Course Objectives

This course enables the students to:

1.	Understand the basic tenets of OOP.
2.	Exemplify the basic syntax and constructs of JAVA.
3.	Understand the application OOP principles in various use cases.
4.	Learn the basic JAVA GUI components and their working.
5.	Be exposed to newer JAVA constructs like NIO, Lambdas etc.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Identify the difference between procedural and OO programming.
CO2	Construct programs using various OOP principles.
CO3	Design UI using JAVA GUI components.
CO4	Operate on files and strings in real life scenarios.
CO5	Analyze thread performance and inter thread communication issues

SYLLABUS

Module 1: Introduction to Classes, Objects and Java	**[8 Lectures]**
Introduction to Object Technology, Java, Understanding the Java development environment, Programming in Java, Memory concepts, Doing basic Arithmetic, Comparing entities, Classes, Objects, Methods, Strings, Primitive vs reference types.	

Module 2: Control Statements, Methods and Arrays	**[8 Lectures]**
Basic selection statements, Iterative constructs, Relative and Logical operators, break, continue, Methods, static methods, parameter passing, argument promotion and casting, scopes, method overloading. Arrays and ArrayList in Java, Enhanced for statement, Passing arrays to methods, Multidimensional arrays, Using command line arguments.	

Module 3: Object Oriented Concepts: Polymorphism & Inheritance	**[8 Lectures]**
Controlling access to class members, the use of this keyword, getters and setters, Composition, enum, the use of static and final, Garbage collection. Superclass and subclass, protected members, constructors in subclass, the Object class, Introduction to polymorphism, Abstract classes and methods, Assignment between subclass and superclass variables, Creating and using interfaces.	

Module 4: Exception Handling & GUI Design	**[8 Lectures]**
When to use exception handling, Java exception hierarchy, finally block, Stack unwinding, Chained exceptions, Declaring new exception types, Assertions, try with resources. Simple I/O with GUI, Basic GUI Components, GUI Event handling, Adapter classes, Layout managers, Using panels.	

Module 5: String, Characters & Files	**[8 Lectures]**
Working with the String and StringBuilder class, Character class, Tokenizing strings, Regular Expressions, Files and Streams, Using NIO classes, Sequential file handling, Object serialization, JFileChooser, Introduction to threading, Introduction to Generics and lambda expressions.	

Text Books:

1. Deitel P., Deitel H., Java How to Program, 10th Edition, Pearson Publications, 2016

Reference Books:

1. Wu C. T., Object Oriented Programming in Java, 5th Edition, McGraw Hill Publications, 2010

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment tool	% contribution during co assessment
Mid semester examination	25
End semester examination	50
Quiz (s)	10+10
Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	
Semester End Examination	√	√	√	√	√

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	Medium	Low	Medium	Medium	High	High	Medium	Low	Low	Low	Low	Medium	High	Medium	Medium
CO2	Medium	Low	Medium	Medium	High	High	Medium	Low	Low	Low	Low	Medium	High	Medium	Medium
CO3	Medium	Low	High	High	High	High	Medium	Low	Low	Low	Low	Medium	High	Medium	High
CO4	Medium	Low	High	High	High	High	Medium	Low	Low	Low	Medium	High	High	Medium	High
CO5	Medium	Low	High	High	High	High	Medium	Low	Low	Low	Medium	High	High	Medium	High

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course code: CS235
Course title: Computer Organization Architecture
Pre-requisite(s): Digital Logic
Co- requisite(s):
Credits: L: 3 T: 1 P: 0
Class schedule per week: 4
Class: B. Tech
Semester / Level: II
Branch: CSE/AIML
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Understand the basic architecture and organization of systems along with their performances.
2.	Familiarize with Digital Logic circuits, Data representation and Instruction Set Architecture.
3.	Build a complete data path for various instructions.
4.	Understand the pipeline concepts and Hazards.
5.	Familiarize with Memory and I/O Organization.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Explain the merits and pitfalls in computer performance measurements and analyze the impact of instruction set architecture on cost-performance of computer design
CO2	Explain Digital Logic Circuits, Data Representation, Register and Processor level Design and Instruction Set architecture
CO3	Solve problems related to computer arithmetic and Determine which hardware blocks and control lines are used for specific instructions
CO4	Design a pipeline for consistent execution of instructions with minimum hazards
CO5	Explain memory organization, I/O organization and its impact on computer cost /performance.

SYLLABUS

Module I: Basic Structures of Computers **[5 Lectures]**

Introduction to Digital Logic, Basic Structure of Computers: Computer Types, Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts: Fixed and floating point Representation and Arithmetic Operations, Performance, Historical Perspective.

Module II: Instruction Set Architecture **[5 Lectures]**

Memory Locations and Addresses: Byte Addressability, Big-Endian and Little-Endian Assignments, Word Alignment, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Subroutines, Additional Instructions, Dealing with 32-Bit Immediate Values.

Module III: Basic Processing Unit & Pipelining **[10 Lectures]**

Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control, CISC-Style Processors.

Pipelining**:** Basic Concept, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays, Pipeline Performance Evaluation.

Module IV: Memory Organization **[10 Lectures]**

Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Memory Hierarchy, Cache Memories, Performance Considerations, Virtual Memory, Memory Management Requirements, Secondary Storage.

Module V: Input Output & Parallel Processing **[10 Lectures]**

Basic Input Output Accessing I/O Devices, Interrupts, Input Output Organization Bus Structure, Bus Operation, Arbitration, Interface, Interconnection Standards.Parallel Processing, Hardware Multithreading, Vector (SIMD) Processing, Shared-Memory Multiprocessors, Cache Coherence, Message-Passing Multicomputers, Parallel Programming for Multiprocessors, Performance Modeling.

Text Book:

1. Patterson David A., Hennessy John L., Computer Organization and Design: The Hardware / Software Interface, 5th Edition, Elsevier.

Reference Books:

1. Hamachar Carl et. al, Computer Organization and Embedded Systems, 6th Edition, McGraw Hill.
2. Mano M. Morris, Computer System Architecture, Revised 3rd Edition, Pearson.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and the internets
CD7	Simulation

Mapping Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	High	Low	Low	Low	Medium	Low	Medium	Low	Medium	Low	Medium	Medium	High	High	High
CO2	High	Low	Low	Low	Medium	Low	Medium	Low	Medium	Low	Medium	Medium	High	High	High
CO3	High	Medium	Medium	Medium	High	Low	Medium	Low	Medium	Low	Medium	Medium	High	High	High
CO4	High	Medium	Medium	Medium	High	Low	Medium	Low	Medium	Medium	High	High	High	High	High
CO5	High	Medium	High	High	High	Low	Medium	Low	High	Low	High	High	High	High	High

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method

CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course code: EC204
Course title: Digital System Design Lab
Pre-requisite(s): EC101 Basics of Electronics & Communication Engineering
Co- requisite(s):
Credits: L:0 T:0 P:3 C:1.5
Class schedule per week: 3
Class: B. Tech
Semester / Level: III/02
Branch: CSE/AIML
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Understand the basics of logic gates, input, output, power supply and gates IC's.
2.	Apply the knowledge of digital electronics to construct combinational and sequential circuits.
3.	Analyse controlled digital circuits with different Boolean function.
4.	Evaluate combinational/sequential circuits and memories.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Describe the knowledge of basic logic gates and their design using universal gates.
CO2	Demonstrate the working of combinational and sequential circuits.
CO3	Integrate and experiment with controlled digital circuits.
CO4	Appraise combinational/sequential circuits and memories.
CO5	Schematize, simulate and implement combinational and sequential circuits to solve real world problems using VHDL systems.

SYLLABUS

List of experiments:

1. Design and implement a controlled CMOS Inverter.
2. To study and verify the truth table of NAND and EX-OR gate using IC 7400.
3. Design and implement SEVEN segment display unit.
4. Design and verify half adder and full Adder circuits using gates and IC 7483.
5. Design and implement a 3:8 Decoder.
6. Design and implement 8:3 priority encoder.
7. Design a 4 bit magnitude comparator using combinational circuits.
8. Design and implement 8:1 multiplexer and 1:4 demultiplexer.
9. Design ALU with functions of ADD, SUB, INVERT, OR, AND. XOR, INC, DEC and CMP.
10. Design and verify decade Counter.
11. Design a ROM (8X4) using decoder, gates and diodes.
12. Design of pre settable up/down counter.

Implement all the above experiments using VHDL platform and verify.

Text Books:

1.“Digital Design”, Morris Mano and Michael D. Ciletti ,5th edition PHI

2.“Digital System Design using VHDL”, Charles H Roth, Thomson Learning

Reference Books:

1. Digital computer Electronics AP Malvino, 3rd Edition Mc Graw Hill

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40
Continuous Internal Assessment	**% Distribution**
Day to day performance & Lab files	30
Quiz(zes)	10
Viva	20
Semester End Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√

Semester End Examination	√	√	√	√	√

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	Medium	Medium	Medium	Low	Low	Low	Medium	Medium	Low	Medium	Low	Low	Low	Low	Low
CO2	High	High	High	Low	Medium	Medium	Medium	Medium	Low	Medium	Low	Low	Medium	Low	Low
CO3	High	High	High	Medium	Medium	Medium	Medium	Medium	Low	Medium	Low	Low	High	Medium	Low
CO4	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	High	Medium	Low
CO5	High	High	High	High	High	Medium	High	High	High	High	Medium	Medium	High	High	Medium

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3, CD6, CD7
CO2	CD1, CD3, CD6, CD7
CO3	CD1, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD3, CD6, CD7

COURSE INFORMATION SHEET

Course code: CS234

Course title: OOPDP Lab

Pre-requisite(s):
Co- requisite(s): Object Oriented Programming & Design Principles
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class: B. Tech
Branch: CSE/AIML

Course Outcomes

After the completion of this course, students will be able to:

CO1	Work in any object oriented environment and program using those features.
CO2	Student will have hands on experience with all basic concepts of Java programming
CO3	Analyse the design pattern of the given problem and further solve with less complexity.
CO4	Use his/her programming skills to resolve the issues coming while programming for bigger problems.
CO5	Work in industry environment with good enough knowledge about Java and OOPs.

Syllabus

List of Programs as Assignments:

1. **<u>Lab Assignment No: 1</u>**

   Objective: To understand and Implement basic java program concepts using Scanner class.
   Q1. Take input from user a character variable in a program and if the value is alphabet then print "Alphabet" if it's a number then print "Digit" and for other characters print "Special Character"
   Q2. Write a program to add all the values in a given number and check if the sum is prime number or not. Ex: 1234->10, not prime.

2. **<u>Lab Assignment No: 2</u>**
   Objective: To Understand and Implement the concept of arrays in java
   Q1. Write a program to find the largest 2 numbers and the smallest 2 numbers in the array initialized by the user.
   Q2. Write a program to print the element of an array that has occurred the highest number of times Eg) Array -> 10,20,10,30,40,100,99 O/P:10

3. **<u>Lab Assignment No: 3</u>**
   Objective: To Understand and Implement the concept of 2-D arrays in java.

Q1.Write a program to reverse the elements of a given 2*2 array. Four integer numbers needs to be passed as Command Line arguments

Eg: C:\>java Sample 1 2 3 4
O/P Expected :
The given array is : 1 2
3 4
The reverse of the array is : 4 3
2 1

Q2. Write a program to find greatest number in a 3*3 array. The program is supposed to receive 9 integer numbers as command line arguments.

4. **<u>Lab Assignment No: 4</u>**

Objective: To Understand and Implement the concept of classes and Constructors

Q1. Create a class Box that uses a parameterized constructor to initialize the dimensions of a box.(dimensions are width, height, depth of double type). The class should have a method that calculates and returns the volume of the box . Obtain an object and print the corresponding volume in main() function.

Q2. Write a program in Java with class Rectangle with the data fields width, length, area and color. The length, width and area are of double type and color is of string type. The methods are set_length() , set_width() , set_color(), and find_area(). Create two object ofRectangle and compare their area and color. If area and color same for the objects then display "Matching Rectangles" otherwise display "Non Matching Rectangle".

5. **<u>Lab Assignment No: 5</u>**

Objective: To Understand and Implement the concept of Inheritance

Q1.Create a class named 'Animal' which includes methods like eat() and sleep(). Create a child class of Animal named 'Bird' and override the parent class methods. Add a new method named fly(). Create an instance of Animal class and invoke the eat and sleep methods using this object.Create an instance of Bird class and invoke the eat, sleep and fly methods using this object.

Q2. A HighSchool application has two classes: the Person superclass and the Student subclass. Using inheritance, in this lab you will create two new classes, Teacher and CollegeStudent. A Teacher will be like Person but will have additional properties such as salary (the amount the teacher earns) and subject (e.g. "Computer Science", "Chemistry", "English", "Other"). The CollegeStudent class will extend the Student class by adding a year (current level in college) and major (e.g. "Electrical Engineering", "Communications", "Undeclared").

6. **<u>Lab Assignment No: 6</u>**

Objective: To Understand and Implement the concept of Overloading and Overriding

Q1.Create a class Account with two overloaded constructors. First constructor is used for initializing, name of account holder, account number and initial amount in account. Second constructor is used for initializing name of account holder, account number, address, type of account and current balance. Account class is having methods Deposit(), WithDraw(), and GetBalance().Make necessary assumption for data members and return types of the methods. Create objects of Account class and use them.

Q2. Create a base class Fruit which has name ,taste and size as its attributes. A method called eat() is created which describes the name of the fruit and its taste. Inherit the same in 2 other class Apple and Orange and override the eat() method to represent each fruit taste.

7. **<u>Lab Assignment No: 7</u>**

Objective: To Understand and Implement String class in Java

Q1. Reverse the string but not the words. Eg. I/P: Birla institute of technology
O/P: technology of institute birla.

Q2. Find out and print the maximum possible palindrome in a given string. Eg:
I/P: nononsene O/P: nonon

Q3.Given a string and a non-empty word string, return a string made of each char just before and just after every appearance of the word in the string. Ignore cases where there is no char before or after the word, and a char may be included twice if it is between two words.
If inputs are "abcXY123XYijk" and "XY", output should be "c13i".
If inputs are "XY123XY" and "XY", output should be "13".

8. **Lab Assignment No: 8**

Objective: To Understand and Implement the concept of Abstract classes and Interfaces

Q1. Create an abstract class Compartment to represent a rail coach. Provide an abstract function notice in this class. Derive FirstClass, Ladies, General, Luggage classes from the compartment class. Override the notice function in each of them to print notice suitable to the type of the compartment. Create a class TestCompartment. Write main function to do the following: Declare an array of Compartment of size 10. Create a compartment of a type as decided by a randomly generated integer in the range 1 to 4. Check the polymorphic behavior of the notice method.

Q2.Write a program in java which implement interface Student which has two methods Display_Grade and Attendance for PG_Students and UG_Students (PG_Students and UG_Students are two different classes for Post Graduate and Under Graduate Students respectively).

9. **Lab Assignment No: 9**

Objective: To Understand and Implement Exception handling in java

Q1. Write a program in Java to display name and roll number of students. Initialize respective array variables for 10 students. Handle ArrayIndexOutOfBoundsException, so that any such problem does not cause illegal termination of program.

Q2. Write a program to accept name and age of a person from the command prompt(passed as arguments when you execute the class) and ensure that the age entered is >=18 and < 60. Display proper error messages. The program must exit gracefully after displaying the error message in case the arguments passed are not proper. (Hint : Create a user defined exception class for handling errors.)

10. **Lab Assignment No: 10**

Objective: To Understand and Implement File Handling and multithreading in java

Q1. Write a program to count the number of times a character appears in the Fileand also copy from one file to another. (Case insensitive... 'a' and 'A' are considered to be the same)

Q2. 1. Create class of SalesPersons as a thread that will display fives sales persons name. 2. Create a class as Days as other Thread that has array of seven days.
3. Call the instance of SalesPersons in Days and start both the threads 4. suspendSalesPersons on Sunday and resume on wednesday Note: use suspend, resume methods from thread

Q3. Create two threads, one thread to display all even numbers between 1 & 20, another to display odd numbers between 1 & 20. Note: Display all even numbers followed by odd numbers Hint: use join

11. **Lab Assignment No: 11**

Objective: To Understand and Implement Applets, AWT and Swings

Q1. Program to create a calculator with the help of AWT packages in Java.

Q2. Program to create a unit converter using Swings in Java.

Q3. APPLETS

a) Working with Frames and various controls.
b) Working with Dialogs and Menus.
c) Working with Panel and Layout.
d) Incorporating Graphics.
e) Working with colors and fonts

Text Books

1. Krishna P. R., Object Oriented Programming through JAVA, 1st Edition, Universities Press, 2008.
2. Patrick Naghton& H. Schildt – The Complete Reference Java 2, Tata McGraw Hill Publication, New Delhi.
3. Dietel,Dietel - Java How to program , 7th edition; Pearson Education , New Delhi.

Reference Books

1. C. Horstmann,G. Cornell - Core Java 2 Vol I & Vol II ; Pearson Education , New Delhi.
2. Balagurusamy -Programming in Java, 2nd Edition; Tata McGraw Hill Publication; New Delhi.

SEMESTER IV COURSE INFORMATION SHEET

COURSE INFORMATION SHEET
Course Code: AI201
Course Title: Probability and Statistical Analysis
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class Schedule Per Week: 3
Class: B. Tech
Semester / Level: IV/2
Branch: AIML

Course Objectives

This course enables the students to:

1.	Apply descriptive and inferential statistical techniques to summarize, visualize, and interpret data effectively.
2.	Explain the basic principles of probability theory, including conditional probability, bayes theorem, probability distributions and random variables.
3.	Compute probabilities using discrete and continuous probability distributions of random variables, including Binomial, Poisson, Uniform, Exponential and Normal distributions.
4.	Utilize probabilistic models and statistical methods to solve problems in fields such as engineering, business and other areas.
5.	Formulate and test statistical hypotheses using confidence intervals, p-values, and various statistical tests.

Course Outcomes:

After the completion of this course, students will be able to:

1.	Describe and summarize large real-life datasets.
2.	Compute the probability of complex events.
3.	Describe the characteristic properties of different types of random variables.
4.	Estimate distribution parameters for real life samples.
5.	Perform hypothesis testing on datasets and interpret the results.

SYLLABUS

Module 1: Descriptive Statistics	**[8 Lectures]**

Introduction, Describing Datasets, Summarizing Datasets, Chebyshev's Inequality, Normal Datasets, Paired Datasets and Correlation coefficient, Lorenz Curve and Gini Index.

Module 2: Elements of Probability	**[8 Lectures]**
Basic concepts, Conditional Probability, Baye's formula, Independent Events, Random variables, Types of Random variables, jointly distributed random variables, Expectation and its properties, Variance and Covariance	

Module 3: Special Random Variables	**[8 Lectures]**
The Bernoulli and binomial random variable, The Poisson random variable, The uniform random variable, The normal random variable, Exponential Random variables, The gamma distribution, The Chi-square, t-distribution, and F-distribution.	

Module 4: Parameter Estimation	**[8 Lectures]**
Maximum Likelihood Estimators, Interval Estimates, Estimating the difference in means of two normal distributions.	

Module 5: Hypothesis Testing	**[8 Lectures]**
Significance Levels, Tests about mean of a normal population, Testing the equality of means of two normal populations. Tests concerning the variance of a normal population.	

Textbooks:

1. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Academic Press, 2021

Reference Books:

1. Rohatagi V. K., Saleh A. K., An Introduction to Probability and Statistics, 3rd Edition, Wiley, 2015

Course Outcomes (COs) Attainment Assessment Tools and Evaluation Procedure:

Direct Assessment Tool	**% Contribution During Co – Assessment**
Mid Semester Examination	25
End Semester Examination	50
Quiz 1 + Quiz 2	10+10
Assignment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**

Mid Semester Examination	√	√	√		
End Semester Examination	√	√	√	√	√
Quiz 1 + Quiz 2	√	√	√	√	
Assignment				√	

Indirect Assessment:

1. Student Feedback on Course Outcomes (COs)
2. Student feedback on faculty

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	High	High	Low	High	Medium	Low	Low	Low	Medium	Medium	High	Medium	Low	High	Low
CO2	High	High	High	High	Medium	Low	Low	Low	Medium	Medium	Medium	Low	High	High	Low
CO3	Medium	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	High	High	Low
CO4	Medium	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
CO5	Medium	Low	High	Low	Low	Low	Low	Low	Low	High	Low	Low	High	High	Low

COURSE INFORMATION SHEET

Course code: AI203
Course title: Mathematics for Data Science
Pre-requisite(s): Maths-I. Maths-II
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: IV
Branch: CSE/IT/AIML

Course Objectives

This course enables the students to:

1.	Represent real-world problems using graph theory and apply adjacency matrices, eigenvalues, and eigenvectors for analysis.
2.	Model probabilistic state transitions using Markov Chains and Hidden Markov Models for sequential decision-making.
3.	Apply Singular Value Decomposition (SVD) and Principal Component Analysis (PCA) for feature extraction and dimensionality reduction.
4	Implement interpolation techniques such as Lagrange interpolation, Newton's divided difference, and regression methods for data approximation.
5.	Utilize optimization techniques like Maximum Likelihood Estimation (MLE) and Gradient Des to enhance machine learning models.

Course Outcomes:

After the completion of the course students will be able to:

1.	Formulate practical problems as graphs and use graph theoretic methods on them.
2.	Model transfer of information and state using Markov chains.
3.	Reduce the dimensionality of large datasets and understand the challenges in doing so.
4.	Interpolate missing data both for linear and non linear cases over multiple dimensions.
5.	Apply concepts of optimization to machine learning problems

SYLLABUS

Module 1: Graph Theory	**Lectures: 8**

Basic concepts and terminology, Adjacency matrix – representation and uses, Eigen values and Eigen vectors – importance and applications

Module 2: Stochastic Processes	**Lectures: 8**
Markov chain basics, Hidden Markov models, - the Likelihood problem, the decoding problem, the Learning problem.	

Module 3: SVD & PCA	**Lectures: 8**
Vector and inner product spaces. Singular values, Singular Value Decomposition, Compression of data using PCA, relation of PCA with co-variance and correlation, Linear Discriminant Analysis	

Module 4: Interpolation	**Lectures: 8**
Lagrange interpolation, Orthogonal family of polynomials, Newton divided difference methods – use of Vandermonde matrix, Chebyshev interpolation, Hermite regression, Least square regression	

Module 5: Optimization and Learning Techniques	**Lectures: 8**
Basic probability theory, Introduction to matrix calculus – Matrix differentiation, Matrix integration, Maximum Likelihood Estimation, Gradient Descent,	

Textbook:

1) Arangala C., "Linear Algebra with Machine Learning and Data", CRC Press, 1st Edition, 2023

Reference Books:

1) Carter N. "Data Science for Mathematicians", CRC Press, 1st Edition, 2021
2) Strang G. "Introduction to Linear Algebra", 5th Edition, Cambridge Press, 2016

Course Outcomes (COs) Attainment Assessment Tools andEvaluation Procedure:

Direct Assessment Tool	**% Contribution During Co – Assessment**
Mid Semester Examination	25
End Semester Examination	50
Quiz 1 + Quiz 2	10+10
Assignment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Mid Semester Examination	√	√	√		
End Semester Examination	√	√	√	√	√
Quiz 1 + Quiz 2	√	√	√	√	
Assignment				√	

Indirect Assessment:

1. Student Feedback on Course Outcomes (COs)
2. Student feedback on faculty

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	High	High	Medium	Medium	High	Low						High	High	Medium	
CO2	High	High	Medium	High	High	Low						High	High	Medium	
CO3	High	High	High	High	High	Low						High	High	High	
CO4	High	High	High	High	High	Low						High	High	High	
CO5	High	High	High	High	High	Low						High	High	High	

COURSE INFORMATION SHEET
Course code: CS241
Course title: Design and Analysis of Algorithm
Pre-requisite(s): Algorithms Lab
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: II/2
Branch: CSE/AIML
Name of Teacher:

Course Objectives

This course enables the students to:

1.	Analyze the performance of recursive and nor-recursive algorithms.
2.	Understand various algorithm design techniques.
3.	Use different paradigms of problem solving.
4.	Find efficient ways to solve a given problem.
5.	Compare various algorithms of a given problem.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the concepts and mathematical foundation for analysis of algorithms.
CO2	Apply different standard algorithm design techniques, namely, divide & conquer, greedy, dynamic programming, backtracking and branch & bound.
CO3	Become adept at applying standard algorithms for fundamental problems in Computer Science.
CO4	Design algorithms for a given problem using standard algorithm design techniques.
CO5	Analyze and compare the efficiency of various algorithms of a given problem.

SYLLABUS

Module 1: Algorithm & Complexity **[8 Lectures]**
Introduction, Algorithm Complexity and various cases using Insertion Sort, Asymptotic Notations, Time complexity of Recursive Algorithm, Solving Recurrences using Iterative, Recursion Tree and Master Theorem.

Module 2: Divide & Conquer **[8 Lectures]**
Discussion of basic approach using Binary Search, Merge Sort , Quick Sort , Selection in Expected linear time, Maximum Subarray , Matrix Multiplication , Introduction of Transform and Conquer and AVL Tree .

Module 3: Dynamic Programming **[8 Lectures]**
Introduction and Approach, Rod Cutting, LCS, Optimal BST, Transitive closure and All-pair Shortest Path, Travelling Salesperson Problem.

Module 4: Greedy & Other Design Approaches **[8 Lectures]**
Introduction to greedy using fractional knapsack, Huffman Code, Minimum Spanning Tree – Prim and Kruskal, Single Source Shortest Path Dijkstra's and Bellman-Ford, Introduction to Backtracking using N-Queens problem, Introduction to Branch and Bound using Assignment Problem or TSP.

Module 5: NP Completeness and Other Advanced Topics **[8 Lectures]**
Non-deterministic algorithms – searching and sorting, Class P and NP, Decision and Optimization problem, Reduction and NPC and NPH, NP Completeness proof for: SAT, Max-Clique, Vertex Cover, Introduction to Randomized Algorithms, Introduction to Approximation Algorithms.

Text Books:

1. Cormen Thomas H. et al., Introduction to Algorithms. 3rd Edition, PHI Learning, latest edition.

Reference Books:

1 Horowitz E., Sahani, Fundamentals of Computer Algorithms, Galgotia Publication Pvt. Ltd.
2 Dave and Dave, Design and Analysis of Algorithms, 2nd Edition, Pearson.
3 Goodrich, Tamassia. Algorithm Design. Wiley.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	Medium	Medium	High	Medium	Low	Low	Low	Low	Low	Medium	Low	Medium	High	High	Medium
CO2	Medium	Medium	High	Medium	Low	Low	Low	Low	Low	Medium	Low	Medium	High	High	Medium
CO3	Medium	Medium	High	Medium	Low	Low	Low	Low	Low	Medium	Medium	Medium	High	High	High
CO4	High	High	High	High	Medium	Low	Low	Low	Low	Medium	Medium	High	High	High	High
CO5	High	High	High	High	Medium	Low	Low	Low	Low	Medium	Medium	High	High	High	Medium

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course code: AI205
Course title: Introduction to AI
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:1 P:0
Class schedule per week: 4
Class: B. Tech
Semester / Level: IV/ II
Branch: CSE/IT/AIML

Course Objectives

This course enables the students to:

1.	Familiarize with knowledge representation concepts.
2.	Understand problem formulation and choice of informed and uninformed search.
3.	Understand Classical and Heuristic methods and solve game problems.
4.	Learn reinforcement learning.
5.	Learn how to solve real life probabilistic problems

Course Outcomes

After the completion of this course, students will be able to:

CO1	Formulate propositional logic for real life problems and present formal proofs for standard problems.
CO2	Solve problems using First Order Predicate Logic and work with automatic Theorem Provers.
CO3	Perform Search using Classical and Heuristic methods and solve game problems.
CO4	Design entropy-based solutions for real life probabilistic problems.
CO5	Understand the basics of reinforcement systems and their operating principals.

SYLLABUS

Module 1: Introduction and Propositional Logic	Lectures: 8
What Is Artificial Intelligence? Agents, Knowledge-Based Systems, Propositional Logic – Syntax, Semantics, Proof Systems, Resolution, Horn Clauses, Computability and Complexity	

Module 2: First Order Predicate Logic	Lectures: 8
Syntax, Semantics, Quantifiers and Normal Forms, Proof Calculi, Resolution, Automated Theorem Provers, Applications and Limitations	

Module 3: Search Games and Problem Solving	Lectures: 8
Introduction, Uninformed Search, Heuristic Search, Games with Opponents, Heuristic Evaluation functions	

Module 4: Reasoning with Uncertainity	Lectures: 8
Computing with Probabilities, The principal of Maximum Entropy, Reasoning with Bayesian Networks	

Module 5: An Introduction to Reinforcement Learning	Lectures: 8
Definitions, Uninformed combinatorial search, Value iteration and Dynamic Programming, Q-Learning, Exploration and Exploitation, Approximation, Generalization and Convergence, the Curse of Dimensionality	

Textbook:

1) Ertel W.., "Introduction to Artificial Intelligence", UTiCS Springer, 2nd Edition, 2017
2) Akerkar R. "Introduction to Artificial Intelligence", 2nd Edition, PHI Press, 2014

Reference Books:

1) Russell S., Norvig P. "Artificial Intelligence: A Modern Approach", Pearson Publications, 4tht Edition, 2022
2) Akerkar R. "Introduction to Artificial Intelligence", 2nd Edition, PHI Press, 2014

Mapping Course Outcomes onto Program Outcomes

CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	High	Medium	Medium	Medium	Medium	High	Low	Low	Medium	Medium	No	Low	High	Medium	Medium
CO2	High	High	High	High	High	High	Low	Low	Medium	Medium	No	Low	High	High	Medium
CO3	High	High	High	High	High	Low	Low	Low	Medium	Medium	No	Medium	High	High	High
CO4	High	High	High	High	High	Low	Low	Low	Medium	Medium	No	Medium	High	High	High
CO5	High	Medium	Medium	High	High	Medium	Low	Low	Medium	Medium	No	Low	Medium	Medium	Medium

SEMESTER IV LABORATORIES

Course Code: AI 202
Course Title: IT/ Systems Workshop (LEX, YACC)
Pre-requisite(s) : CS102 : PPS Lab & CS232 : Data Structures Lab
Co- requisite(s) : CS 240 (Shell and Kernel Programming Lab)
Credits: L: 0 T: 0 P: 2
Class schedule per week: 2
Class : B. Tech
Semester / Level: IV/II
Branch: AIML

Course Objectives:

This course enables the students to

1.	Learn the formalism of regular expression (regex) to represent patterns of interest (tokens) required in various applications.
2.	Learn how to convert a regex automatically into a deterministic finite automaton using the tool, Lex.
3.	Acquire skills in writing context free grammar (CFG) to capture the syntactic structure of objects of interest.
4.	Learn how to automatically generate a syntax analyser (parser) from a context free grammar using the software tool, YACC.
5.	Given a pattern recognition problem, identify the pattern features that can be specified by regular expressions and other features that can be captured by a context free grammar. Use tools to generate a software for solving the problem and test its validity.

Course Outcomes:

After the completion of this course, students will be able to

1.	Write regular expressions for various strings of interest, such as, name, number in a given base, real number, date, keywords, etc.
2.	Write regex for a pattern in the notation of Lex, attach actions in C language, and use the definition sections of Lex to generate a C program that becomes the pattern recognizer.
3.	Given a set of strings with a desired structure, write a context free grammar (CFG), first in a formal notation, then in the notation of YACC; generate a syntax analyser.
4.	Communicate between the pattern recognizer generated by lex and the syntax analyser generated by yacc in order to create a software that recognizes strings belonging to a context free language. Acquire skills to interpret the outputs generated by Lex and YACC.
5.	Add semantic actions to the CFG rules of YACC to perform analysis of the input string and/or undertake transformations as appropriate to the problem statement

SYLLABUS

1. Experimentation with the use of a production quality open source compiler, such as gcc (gnu C Compiler), to get insight about its working. Familiarity with the internal dumps provided by the compiler. Review of useful shell commands, working with an editor, such as vi, and working knowledge of Linux operating system.

2. Introduce the basic theoretical concepts related to regular expressions (regexes), such as finite alphabet, strings over the alphabet, and languages. Definition of regular expression (regex), regex operators and their properties, language denoted by a regex.

3. Introduction to Lexical analyser generator tool, lex. Structure of a lex script. Write regex in Lex notation and conduct experiments with lex to convert regular expressions to a minimal deterministic finite automation (DFA which is also a pattern recognizer). Test the performance of the recognizer over different input strings, few belonging to the language and few not in the language of regex.

4. Introduce the basic theoretical concepts related to a context free grammar (CFG) and LALR(1) parsing, such as terminals, non-terminals, production rules, derivations, parse tree, language corresponding to CFG, LR(0) item, parser actions - shift, reduce, accept and error, LALR(1) parsing table and LALR(1) automaton. Write grammars for objects with simple structure.

5. Introduction to parser generator tool, YACC (Yet Another Compiler Compiler). Structure of an yacc script. Write a CFG in yacc notation, conduct experiments with yacc to generate a parser from the given CFG. Understand and interpret the generator parser. Test the performance of the parser over different input strings, few belonging to the language of the grammar and few strings which are not.

6. Given an application, use Lex and yacc to generate a software that recognize objects with the desired structure and produce output after performing appropriate transformations as required in the application.

Text Books:

1. Lex and Yacc, John R. Levine, Tony Mason, Doug Brown [1992], O'Reilly & Associates, 2nd Edition, (ebook available)

References :

1. Lex and Yacc Tutorial, Tom Niemann, epaperpress.com
2. Johnson, Stephen C. [1975]. Yacc: Yet Another Compiler Compiler. Computing Science Technical Report No. 32, Bell Laboratories, Murray hill, New Jersey. A PDF version is available at e Paper Press.
3. Lesk, M. E. and E. Schmidt [1975]. Lex – A Lexical Analyzer Generator. Computing Science Technical Report No. 39, Bell Laboratories, Murray Hill, New Jersey. A PDF version is available e-Paper Press.

Mapping Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	High	Medium	High	Medium	High	Low	Low	Low	High	High	Medium	Medium	Medium	High	Medium
CO2	High	High	High	High	High	Low	Low	Low	High	High	Medium	High	High	High	Medium
CO3	High	High	High	High	High	Low	Low	Low	High	High	Medium	High	High	High	Medium
CO4	High	High	High	High	High	Low	Low	Medium	High	High	Medium	High	High	High	Medium
CO5	High	High	High	High	High	Medium	Low	Medium	High	High	Medium	High	High	High	High

COURSE INFORMATION SHEET
Course code: AI204
Course title: Mathematics for Data Science Lab.
Pre-requisite(s):
Co- requisite(s): Mathematics for Data Science
Credits: L: T: P: 3
Class schedule per week: 3
Class: B. Tech
Semester / Level: IVth
Branch: AI/ML

Course Outcomes

After the completion of this course, students will be:

1.	Able to convert real life problems into graphs.
2.	Able to solve simple system of equations
3.	Fit straight lines and curves to datasets
4.	Compute eigen values for matrices and factorize large matrices.
5.	Detect optimum points for fitness functions.

SYLLABUS

Module 1: Graph Algorithms **[8 Lectures]**
Representation of graphs using adjacency matrix, Traversal of Graphs, Shortest path algorithms, Detecting spanning trees

Module 2: System of Equations **[8 Lectures]**
Representing system of equations, Gauss Elimination methods, LU Decomposition, Matrix inversion.

Module 3: Interpolation and Curve Fitting **[8 Lectures]**
Fitting straight lines, Polynomial Interpolation, Interpolation with Cubic spline.

Module 4: Matrix Methods **[8 Lectures]**
Reduction using PCA, Matrix Factorization, Computing Eigen values and vectors.

Module 5: Optimization and Statistics **[8 Lectures]**
Finding maxima and minima using Hill climbing techniques, Gradient descent. Generating data for standard distributions.

SEMESTER V COURSE INFORMATION SHEET

COURSE INFORMATION SHEET
Course Code: IT333
Course Title: Data Communication & Computer Networks (DCCN)
Pre-requisite(s): Operating System, Digital System Design
Co-requisite(s):
Credits: L:3 T:1 P:0
Class Schedule per week: 4
Class: B.Tech.
Semester/Level: V
Branch: CS/AIML

Course Objectives:

This course enables the students to:

1.	Study the basic communication model, types of networks, applications and layered protocol architecture.
2.	Understand characteristics of transmission media, types of impairments, error detection and correction methods.
3.	Understand digital & analog transmission systems, multiplexing, digital encoding and modulation techniques.
4.	Understand basics of local area networking, error and flow control mechanisms and shared channel access mechanisms.
5.	Understand internetworking concepts, IP addressing & routing techniques, and transport protocols.

Course Outcomes

After successful completion of this course, students will be able to:

1.	Comprehend communication protocol architecture, identify network types and map functions to real-life applications.
2.	Examine signal impairments, determine channel capacity, analyze transmission characteristics of different mediums.
3.	Simulate analog and digital signaling methods, multiplexing & encoding techniques and compare efficiency.
4.	Analyze local area networking implementations, present error and flow control solutions.
5.	Experiment with internetworking protocols, analyze and compare their functions and evaluate efficiency.

SYLLABUS

Module I
Basics of Data Communications and Networking: Overview: Communication Model, Types of Networks, Internet, Protocol Architecture Standards, TCP/IP Architecture, Internet Applications.

Module II
Data Transmission: Analog and Digital Transmission System, Transmission Impairments, Channel Capacity, Guided Transmission Mediums, Wireless Transmission and Propagation.
Signal encoding: Digital Signaling and Analog Signaling, Encoding Techniques, Modulation Techniques.

Module III
Multiplexing: Frequency Division Multiplexing and Synchronous Time Division Multiplexing
Error Handling: Types of Errors, Error Detection and Correction Mechanisms.
Data Link Control Protocols: Data Link Error and Flow Control, HDLC Protocol.

Module IV
Local Area Networking: Topologies, Protocol Architecture, Virtual LANs, Multiple Channel Access Mechanisms, Traditional and High-Speed Ethernet, Wireless LANs, IEEE 802.11 Overview.

Module V
Internetworking: Internetworking Principles, Circuit Switching and Packet Switching, Internet Protocol, DHCP Protocol, Transport Protocols, Routing in Packet Switched Networks, Quality of Service Parameters, Integrated Services, Differentiated Services, MPLS.

Textbook:

1. Stallings W., Data and Computer Communications, 10th Edition, Pearson Education, PHI, New Delhi, 2017.

Reference Book:

1. Forouzan B. A., Data Communications and Networking, 6th Edition, TMH, New Delhi, 2022.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	High	High	High	High	Medium	Low	No	Low	Low	Medium	Medium	High	High	Medium	Medium
CO2	High	High	High	Medium	Medium	Low	Low	No	Low	Medium	Low	High	High	High	High
CO3	High	High	High	High	Medium	Medium	Low	Low	Low	Medium	Low	High	High	High	High
CO4	High	High	High	High	High	Medium	Medium	Low	Medium	High	Medium	High	High	High	High
CO5	High	High	High	High	High	Medium	Medium	Low	Medium	High	Medium	High	High	High	High

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course code: CS361

Course title: Database Management System (DBMS)

Pre-requisite(s): Data Structures

Co- requisite(s):

Credits: L: 3 T: 0 P: 0

Class schedule per week: 3

Class: B. Tech

Semester / Level: III

Branch: CSE/AIML

Name of Teacher:

Course Objectives

This course enables the students to:

1.	Understand the fundamental concepts, historical perspectives, current trends, structures, operations and functions of different components of databases.
.	Recognize the importance of database analysis and design in the implementation of any database application.
3.	Describe the role of transaction processing in a database system.
4.	Understand various concurrency control mechanisms for a database system.
5.	Describe the roles of recovery and security in a database system.

Course Outcomes

After the completion of this course, students are expected to:

CO1	Analyze data organization requirements and their inter relationships.
CO2	Illustrate the features of data models and their application for storing data.
CO3	Design queries to maintain and retrieve useful information from the databases created.
CO4	Analyze the physical database design with respect to their expected performance using normalization and query processing.
CO5	Examine the best practices according to concepts of indexing, transaction control and concurrency maintenance

SYLLABUS

Module 1: **[8Lectures]**
Database Design and Entity - Relational Model
Purpose of Database System; View of Data, Database Languages, Transaction Management, Database architecture, Database Users and Administrator, Types of database System, Overview of design process, E-R model, Constraints, E–R Diagram, E-R Diagram issues, Weak Entity Sets, Extended E – R Features, Reduction to E–R Schemas.

Module 2: **[8Lectures]**
Relational Model
Structure of Relational Database, Codd's Rules, Fundamental Relational Algebra Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations, Data definition, Basic structure of SQL queries, Set Operations, Aggregate Functions, Null Values, Nested Sub Queries, complex queries, views, modification of database, Joined relations, SQL data types & schemas, Integrity constraints, authorization, Embedded SQL, Triggers.

Module 3: **[8Lectures]**
Relational Database Design
Functional dependency, Decomposition, Normalization, First normal form, Second normal form, Third normal form, BCNF, Multivalued dependencies and Fourth normal form, Join dependencies and Fifth normal form, DKNF.

Module 4: **[8Lectures]**
Indexing & Hashing
Ordered Indices, B+ Tree index files, B-Tree index files, Multiple key access Static hashing, Dynamic Hashing, Comparison of ordered indexing and hashing, Index definition in SQL.
Query Processing, Measure of Query Cost, Selection Operation, Evaluation of Expressions.

Module 5: **[8Lectures]**
Transaction & Concurrency Control
Transaction Concepts & ACID Properties, Transaction States, Implementation of Atomicity & Durability, Concurrent Executions, Serializability& Its Testing, Recoverability, Lock-Based protocols, Validation based protocol, Multiple Granularity, Multiversion Schemes, Deadlock Handling.

Text Books:

1. Silberschatz A. et.al, Database System Concepts, 6th Edition, Tata Mc-Graw Hill, New Delhi, 2011. (T1)

Reference Books:

1. Elmasri R., Fundamentals of Database Systems, 7thEdition, Pearson Education, New Delhi, 2016. (R1).
2. Ullman Jeffrey D et.al., A First course in Database Systems, 3rd Edition, Pearson Education, New Delhi- 2014.(R2)

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50
Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher’s Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect assessment –

1. Student feedback on course outcome
2. Student feedback on faculty

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	Medium	Low	Medium	Medium	High	High	Medium	Low	Low	Low	Low	Medium	High	Medium	Medium
CO2	High	Low	Medium	Medium	High	High	Medium	Low	Low	Low	Low	Medium	High	Medium	Medium
CO3	High	Low	High	High	High	High	Medium	Low	Low	Medium	Low	Medium	High	Medium	High
CO4	High	Low	High	High	High	High	Medium	Low	Low	Medium	Medium	High	High	Medium	High
CO5	Medium	Low	High	High	High	High	Medium	Low	Low	Low	Medium	High	High	Medium	High

Mapping Between Course outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

COURSE INFORMATION SHEET
Course code: AI301
Course title: Supervised Learning
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: V/ III
Branch: AIML

Course Objectives

This course enables the students to:

1.	Familiarize with the core concepts of supervised learning.
2.	Understand the working of a simple neural network with backpropagation.
3.	Understand the technique of SVMs and decide the proper kernel for a task.
4.	Learn about tree based classifiers and demonstrate the splitting criteria.
5.	Learn how Ensemble works.

Course Outcomes:

After completion of the course students will be able to:

1.	Demonstrate with examples the core concepts of supervised learning.
2.	Articulate the working of a simple neural network with backpropagation.
3.	Perform classification using SVMs and decide the proper kernel for a task.
4.	Build tree based classifiers and demonstrate the splitting criteria.
5.	Demonstrate how Ensemble learning helps improve classifier performance

SYLLABUS

Module 1: Preliminaries	**Lectures: 8**
Terminology, Regression, Classification, Weight Space, Curse of dimensionality, Overfitting, Training, testing and Validation Sets, Confusion Matrix, Accuracy Metrics, ROC Curve, Unbalanced datasets, Precision, Probability, Naïve Bayes' classification, Basic Statistics – Average, Variance and Covariance, Gaussian.	

Module 2: Neural Networks, Linear Separability and Multi-Layer Perceptron	**Lectures: 12**
Hebb's rule, McCullogh and Pitts Neurons, Limitations of the basic neurons, the Perceptron, the concept of Linear Separability, Linear Regression, The concept of Bias, Backpropagation and its working, Practical aspects of learning – Amount of training data, number of hidden layers, when to stop learning, Deriving the back propagation algorithm	

Module 3: Support Vector Machines	**Lectures: 8**
The concept of optimal separation, Kernels and choosing the right kernel, The SVM algorithm, Extending SVM for multi class classification, SYM regression	

Module 4: Learning with Trees	**Lectures: 8**
Using decision trees, Constructing decision trees, Entropy, ID3, Dealing with continuous variables, Computational complexity, Gini Index and CART	

Module 5: Ensemble Learning	**Lectures: 4**
Concepts, Bagging, Boosting, Random Forest, Different ways to combine classifiers	

Textbook:

1 Marsland S., "Machine Learning: An Algorithmic Perspective", CRC Press, 2nd Edition, 2015

Reference Books:

1) Han J., Kamber M., Pei J., "Data Mining: Concepts and Techniques", Moran Kaufman, 3rd Edition, 2012
2) Zaki M. J., Meira W., "Data Mining and Analysis: Foundations and Algorithms", 2nd Edition, Cambridge University Press, 2020

Mapping CourseOutcomesonto ProgramOutcomes

CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	High	Medium	Medium	Medium	Medium	High	Low	Low	Medium	Medium	No	Low	High	Medium	Medium
CO2	High	High	High	High	High	High	Low	Low	Medium	Medium	No	Low	High	High	Medium
CO3	High	High	High	High	High	High	Low	Low	Medium	Medium	No	Low	High	High	High
CO4	High	High	High	High	High	High	Low	Low	Medium	Medium	No	Low	High	High	High
CO5	High	High	High	High	High	High	Low	Low	Medium	Medium	No	Low	High	High	High

COURSE INFORMATION SHEET
Course code: IT337
Course title: Software Engineering
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: III
Branch: CSE/AIML

Course Objectives

This course enables the students to:

1.	Students are effective team members, aware of cultural diversity, who conduct themselves ethically and professionally
2.	Students use effective communication skills and technical skills to assure production of quality software, on time and within budget.
3.	Students build upon and adapt knowledge of science, mathematics, and engineering to take on more expansive tasks.
4.	Able to increase level of self-reliance, technical expertise, and leadership.

Course Outcomes

After the completion of this course, students will be:

1.	Explain the software engineering principles and techniques
2.	Analyse and evaluate the requirements of a given problem statement/case study
3.	Apply Design Concepts to create suitable Solutions of a given problem statement
4.	Apply Testing strategies to improve the quality of the software
5.	Solve problems related to Estimation and Quality

SYLLABUS

Module I	**(8Lectures)**
Introduction	
Some Definitions, FAQs about software engineering, the evolving role of software, Software process models, Waterfall model, the prototyping model, spiral model, RAD and Incremental model, Management activities, Project planning and Project Scheduling.	

Module II	**(8Lectures)**
Software Requirements	
Functional and non-functional requirements, User requirements, System requirements, the software requirements document. IEEE standard of SRS, Quality of good SRS.	
Requirement Engineering Process: Feasibility study, Requirements elicitation and analysis, Requirements validation, Requirement management.	

Module III	**(8Lectures)**
Design Engineering	
Design Process and Design Quality, Design Concepts, Design Models, Object oriented Design, UML: Class diagram, Sequence diagram, Collaboration diagram.	

Module IV	**(8Lectures)**
Verification and Validation	
Verification and Validation Planning, S/W inspection, static analysis.	
Software Testing	
Testing functions, Test care design, White Box testing, Black box testing, Unit testing, Integration Testing, System testing, Reliability.	

Module V	**(8Lectures)**
Process metrics, Software Measurement, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Quality assurance and standards, Quality planning, Quality control, **S**/W Maintenance in detail.	

Text Book:

1. Sommerville, Software Engineering, 7th Edition, Pearson Education Publication. (T1)

Reference Books:

1 Pressman R. S.,Software Engineering: A Practiioners Approach, 5th Edition., TMA, New Delhi.(R1)
2 Mall Rajib, Fundamental of Software Engineering, 4th Edition, PHI Learning Private Limited.(R2)
3 Peters J. F. &Pedrycz W., Software Engineering, John Wiley & Sons, Inc. 2000.(R3)
4 Behforooz A. & Hudson F.J., Software Engineering Fundamentals, Oxford Univ. Press, New York, 2000.(R4)

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	High	High	High	Low	Low	Medium	Low	Medium	High	High	Low	Low	Low	High	Medium
2	Medium	High	Low	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Low	Low	Medium	High
3	Medium	High	High	High	High	Low	Low	Low	Medium	High	Low	Medium	Medium	High	High
4	High	Low	Medium	Low	Medium	Low	Medium	Medium	Low	Low	Low	Medium	Medium	High	Medium
5	Medium	Medium	Low	Medium	High	Low	Low	Low	Low	High	Medium	High	Low	Medium	High

SEMESTER V LABORATORIES

COURSE INFORMATION SHEET
Course code: AI302
Course title: Supervised Learning Lab
Pre-requisite(s):
Co- requisite(s): Supervised Learning
Credits: L: T: P: 3
Class schedule per week: 3
Class: BTech
Semester / Level: IV/III
Branch: AI/ML

Course Outcomes

After the completion of this course, students will be able to:

1.	Preprocess data to improve classifier performance
2.	Implement basic classification algorithms and measure their efficacy.
3.	Implement simple tree based classifiers.
4.	Implement binary classifiers with a single hidden layer.
5.	Implement ensemble learning methods.

SYLLABUS

Module 1: Preprocessing **[8 Lectures]**
Implementation of algorithms for Normalizing data, Discretizing numeric features using thresholding and entropy, Measure correlation, Denoising data, Imputation of missing data, sample data sets.

Module 2: Basic Algorithms **[8 Lectures]**
Implementing Linear Regression using formula and iterative methods, Naïve Bayes classification, K-NN, Computing and visualizing performance metrics.

Module 3: Implementing Tree based classifiers **[8 Lectures]**
Computing entropy of features and datasets, Implementing basic tree classifiers,

Module 4: Implementing Neural Network **[8 Lectures]**
Computing loss function for binary classification, implementing back propagation for neural network using a single hidden layer. Performing multiclass classification using OvA.

Module 5: Ensemble Learning **[8 Lectures]**
Implementing a vote based classifier, Implementing a random forest. Estimating classifier improvement

SEMESTER VI COURSE INFORMATION SHEET

COURSE INFORMATION SHEET
Course code: AI303
Course title: Unsupervised Learning
Pre-requisite(s):
Co- requisite(s): Unsupervised Learning Lab
Credits: L:3 T:0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: VI/ III
Branch: AI/ML

Course Objectives

This course enables the students to:

1.	Understand the different attribute types for correctly capturing the clusters.
2.	Correctly apply agglomerative clustering techniques.
3.	Apply and interpret results from partitional clustering methods.
4.	Understand the use of Density based clustering methods.
5.	Understand how to evaluate clustering results using a variety of metrics.

Course Outcomes

After the completion of this course, students will be able to:

1.	Demonstrate the basic concepts of clustering.
2.	Build trees to create clusters and define different distance measures.
3.	Perform iterative clustering.
4.	Decide when to perform density-based clustering.
5.	Estimate the estimate the performance of a clustering algorithm.

SYLLABUS

Module 1: Introduction to Clustering **[8 Lectures]**
Introduction to Cluster Analysis, Capturing clusters, Need for visualizing data, Proximity matrix, Dendrograms

Module 2: Hierarchical Clustering **[8 Lectures]**
Single link vs Complete-link clustering, Agglomerative vs Divisive Clustering, Ward's Method, Probabilistic Hierarchical Clustering

Module 3: Partition based Clustering **[8 Lectures]**
Iterative Partition Cluster Method, The Initial Partition, K-Means Algorithm, K-Medoids Algorithm (PAM)

Module 4: Density based Clustering **[8 Lectures]**
Introduction, Algorithms for clustering categorical data – ROCK, Defining Density for clustering, DBSCAN.

Module 5: Estimating Cluster Validity **[8 Lectures]**
Internal, External and Relative validation. Purity, Maximum Matching, F-Measure, Entropy based measures. Pairwise measures including Jaccard Coefficient. Internal measures including BetaCV Measure, Dunn Index, Davies Bouldin index, Silhouette Coefficient. Relative measures including Calinski Harabasz index.

Text books:

1. King R., S., "Cluster Analysis and Data Mining: An Introduction", Mercury Learning and Information, 1st Edition, 2015.

Reference books:

2. Mohammed J. Zaki and Wagner Meira, Jr, "Data Mining and Machine Learning: Fundamental Concepts and Algorithms" , 2nd Edition, Cambridge University Press, March 2020
3. Han J., Kamber M., "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kauffman Press, 2019.

Mapping CourseOutcomesonto ProgramOutcomes

CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO 1	PSO2	PSO 3
CO1	High	Medium	Medium	Medium	Medium	High	Low	Medium	Medium	Medium	No	Medium	High	Medium	Medium
CO2	High	High	High	High	High	High	Low	Medium	Medium	Medium	No	Medium	High	High	High
CO3	High	High	High	High	High	High	Low	Medium	Medium	Medium	No	Medium	High	High	High
CO4	High	High	High	High	High	High	Low	Medium	Medium	Medium	No	Medium	High	High	High
CO5	High	High	High	High	High	High	Low	Medium	Medium	Medium	No	Medium	High	High	High

COURSE INFORMATION SHEET
Course code: AI305
Course title: Deep Learning
Pre-requisite(s): Mathematics for Data Science
Co- requisite(s): Deep Learning Lab
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Branch: AI/ML

Course Outcomes

After the completion of this course, students will be:

1.	Understand the shortcomings shallow networks and advantages offered by deep learning networks
2.	Represent deep networks mathematically and express their working in pure mathematical terms.
3.	Should be able to compute gradients, express loss functions and demonstrate back propagation for simple networks
4.	Should be able to quantifiably measure the performance of deep learning networks and suggest methods to improve network performance.
5.	Have a preliminary knowledge of CNNs and RNNs.

SYLLABUS

Module 1: Introduction **[8 Lectures]**
Introducing Learning models, Understanding Linear Regression, Overview of supervised learning, Shallow neural networks, Understanding the Universal Approximation Theorem, Multivariate inputs and outputs,

Module 2: Deep Neural Networks **[8 Lectures]**
Composition of neural networks, Forming deep neural networks, Mathematical notation to represent deep neural networks, Constructing loss functions, Multiple outputs and cross entropy loss.

Module 3: Fitting models **[8 Lectures]**
Gradient descent, Stochastic Gradient descent, Momentum, Adam, Training hyperparameters, Computing derivatives, Back propogation, Parameter Initialization

Module 4: Measuring Performance & regularization **[8 Lectures]**
Training a simple model, Sources of errors, Reducing error, Double descent, Choosing hyperparameters, Explicit regularization, Implicit regularization, Heuristics to improve performance

Module 5: Types of networks (to be kept necessarily simple) **[8 Lectures]**
Basics of Convolutional Neural Networks, Understanding concepts of downsampling and upsampling, Basics of recurrent neural networks, Concepts of vanishing and exploding gradients.

Text Books:

1. Prince, S., J., D., Understanding Deep Learning, MIT Press, 1st Edition, 2024

Reference Books:

1. Bishop C., Bishop H., Deep Learning: Foundations and Concepts, Springer, 1st Edition, 2024
2. Dawani, J., Hands on Mathematics for Deep Learning, Packt Publishing, 1st Edition, 2020

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure Direct Assessment

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	**% Distribution**
Mid semester examination	25
Two quizzes	20(2X10)
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course outcomes onto Program Outcomes

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes(PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	High	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Low	Medium	Medium	Medium	Low	Low
CO2	Medium	Medium	Medium	Low	Low	Medium	Low	Medium	Medium	Medium	Low	Medium	Low	Low	Medium
CO3	High	High	Low	High	High	High	Medium	Low	Low	Low	Medium	Low	Low	Low	Medium
CO4	Medium	Low	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low
CO5	High	Medium	Low	Medium	High	Low	Low	Low	Low	Medium	Low	Low	Low	Medium	Medium

Mapping Between Course Outcomes and Course Delivery Methods

Course Outcomes	**Course Delivery Method**
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

COURSE INFORMATION SHEET
Course code: AI307
Course title: Modern Artificial Intelligence
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: VI/III
Branch: CSE/IT/AIML

Course Objectives

This course enables the students:

1	To understand Artificial intelligence, task of AI, history of AI, concept of agent, understand different types of environment, application of AI
2	To understand the idea of search based problem solving, state space search, heuristic search, hill climbing, simulated annealing, search in complex environment
3	To understand how an agent can store and use knowledge to reason and make decision, basic principles of propositional logic, how to translate propositional into predicate logic, first order logic
4	To build intelligent system that can make decision in presence of uncertainty, understand Bayesian network, Probabilistic reasoning and Belief networks
5	To understand the fundamental concept of Machine learning, Neural networks and Deep learning

Course Outcomes

After the completion of this course, students will be able to:

1	Determine problems that are amenable to AI-based solutions
2	Able to state and apply major algorithms, methods, and theoretical results in the field of artificial intelligence, Illustrate uninformed and informed search techniques for problem solving in intelligent systems.
3	Able to understand and use different knowledge representation techniques enabling reasoning and inference in artificial intelligence-based systems
4	Able to formulate , solve planning problems, planning types, reason in environment, understand Bayesian Inference, and Probabilistic reasoning,
5	Ability to implements machine learning algorithms, train and evaluate models, implement different activation functions and optimization techniques.

SYLLABUS

Module 1: Preliminaries	Lectures: 6
What is Artificial Intelligence (AI)? Evolution of AI, Intelligent Agents, Concept of rationality, Nature of environments, Structure of agents, Applications of AI	

Module 2: Automated Problem Solving	Lectures: 8
Search based problem solving, State space search, Heuristic search, Game tree search, Local search, Search in complex environments	

Module 3: Knowledge Representation and Reasoning	Lectures: 10
Knowledge based agents, propositional logic, propositional logic to predicate logic, propositional logic-based agents, First order predicate logic, Knowledge representation in First Order Logic, Forward chaining, Backward chaining, Inference by resolution refutation	

Module 4: Planning and Probabilistic Reasoning	Lectures: 8
Planning in AI, Components of a planning problem, Types of planning in AI, Reasoning under uncertainty, Bayesian Inference, Probabilistic reasoning, Belief networks	

Module 5: Learning	Lectures: 8
Machine learning fundamentals, Forms of learning, learning decision trees, neural networks-based learning, Deep learning fundamentals	

Textbook:

1. Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.

Reference Books:

1) Deepak Khemani, A First Course in Artificial Intelligence, Mc Graw Hill, First Edition, 2013.
2) Sridhar and Vijayalakshmi, Machine Learning, Oxford University Press, First Edition, 2021

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure Direct Assessment

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	**% Distribution**
Mid semester examination	25
Two quizzes	20(2X10)
Teacher’s Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes(PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	High	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Low	Medium	Medium	Medium	Low	Low
CO2	Medium	Medium	Medium	Low	Low	Medium	Low	Medium	Medium	Medium	Low	Medium	Low	Low	Medium
CO3	High	High	Low	High	High	High	Medium	Low	Low	Low	Medium	Low	Low	Low	Medium
CO4	Medium	Low	Medium	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Medium	Low
CO5	High	Medium	Low	Medium	High	Low	Low	Low	Low	Medium	Low	Low	Low	Medium	Medium

Mapping Between Course Outcomes and Course Delivery Methods

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

SEMESTER VI LABORATORIES

COURSE INFORMATION SHEET
Course code: AI304
Course title: Unsupervised Learning Lab.
Pre-requisite(s):
Co- requisite(s): Unsupervised Learning
Credits: L: T: P: 3
Class schedule per week: 3
Class: B. Tech
Semester / Level: IV
Branch: AI/ML

Course Outcomes

After the completion of this course, students will be able to:

1.	Preprocess data to improve clustering performance
2.	Implement basic clustering algorithms and measure their efficacy.
3.	Implement simple tree based clustering.
4.	Implement density based clustering algorithms
5.	Implement advanced and non traditional clustering algorithms.

SYLLABUS

Module 1: Preprocessing **[8 Lectures]**
Experiments to denoise, standardize and perform other data wrangling tasks e.g. discretization. Compute distance between vectors using Euclidean, Chessboard, Manhattan and Minkowski's distance measures. Measure the entropy of a dataset. Vectorize distance computations

Module 2: Partitional Clustering **[8 Lectures]**
Perform Partitional clustering of a dataset using K-Means algorithms. Visualize the clusters in two and three dimensions. Calculate the entropy of the clustered dataset while varying k. Perform bisecting k-means. Implement medoid based clustering.

Module 3: Tree based classifiers **[8 Lectures]**
Implement an agglomerative clustering algorithm e.g. AGNES. Implement different measures to calculate the distance between clusters e.g. mean distance, nearest neighbour distance, farthest neighbour distance. Compare the results with partitional clusters for same number of clusters.

Module 4: Density based clustering **[8 Lectures]**
Implement density-based clustering using DBSCAN. Test the performance of the algorithm using non symmetric tor datasets. Measure the goodness of the clusters using standard methods like Silhouette coefficient, Ward's formula, Dunne's method etc.

Module 5: Advanced clustering **[8 Lectures]**
Cluster datasets using fuzzy clustering, GMM and evolutionary approaches like GA

SEMESTER VII COURSE INFORMATION SHEET

COURSE INFORMATION SHEET
Course code: AI401
Course title: Reinforcement Learning
Pre-requisite(s):
Co- requisite(s): Machine Learning Basics
Credits: L: 2 T:0 P:0
Class schedule per week: 2
Class: BTech
Semester / Level: VII/ IV
Branch: AI/ML

Course Outcomes

After the completion of this course, students will be able to:

1.	Explain basic mathematical concepts of Reinforcement learning
2.	Solve real world problems using Bellman Optimality equations.
3.	Implement Monte Carlo Methos
4.	Implement TD learning
5.	Solve problems related to Policy Gradient methods.

SYLLABUS

Module 1: Basic Concepts **[8 Lectures]**
A grid world example , State and action, State transition , Policy, Reward, Trajectories, returns, and episodes,Markov decision processes, Summary
State Values and Bellman Equation ,Motivating example1:Why are returns important? .Motivating example2:How to calculate returns? State values , Bellman equation Examples for illustrating the Bellman equation, Matrix-vector form of the Bellman equation, Solving state values from the Bellman equation ,From state value to action value , Summary

Module 2: Optimal State Values and Bellman Optimality Equation **[8 Lectures]**
Motivating example: How to improve policies? Optimal state values and optimal policies, Bellman optimality equation, Solving an optimal policy from the BOE, Factors that influence optimal policies, Summary Value iteration, Policy iteration ,Truncated policy iteration, Summary

Module 3: Monte Carlo Methods: **[8 Lectures]**
Motivating example: Mean estimation, MC Basic, MC Exploring Starts, MC-Greedy:Learning without exploring starts, Exploration and exploitation of-greedy policies ,Summary
Stochastic Approximation: Motivatinge Example: Mean estimation, Robbins-Monro algorithm, Dvoretzkys convergence theorem , Stochastic gradient descent, Summary

Module 4: Temporal Difference Learning **[8 Lectures]**
TD learning of state values, TD learning of action values: Sarsa, TD learning of action values: n-step Sarsa, TD learning of optimal action values: Q-learning, A unified viewpoint, Summary .

Value Function Methods :Value representation: From table to function,TD learning of state values based on function approximation, TD learning of action values based on function approximation, Deep Q-learning, Summary.

Module 5: Policy Gradient Methods [8 Lectures]

Policy representation: From table to function, Metrics for de fining optimal policies, Gradients of the metrics, Monte Carlo policy gradient(REINFORCE) . Actor-Critic Methods: The simplest actor-critic algorithm(QAC),Advantage actor-critic(A2C) Off-policy actor-critic, Deterministic actor-critic, Summary.

PROGRAM ELECTIVES

COURSE INFORMATION SHEET
Course code: CS331
Course title: Formal language and Automata Theory
Pre-requisite(s): Discrete Mathematics
Co- requisite(s): NIL
Credits: L:3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: II
Branch: CSE/AIML

Course Objectives

This course enables the students to:

1.	Define a system and recognize the behavior of a system.
2.	Design finite state machines and the equivalent regular expressions.
3.	Construct pushdown automata and the equivalent context free grammars
4.	Design Turing machines and Post machines
5.	Learn about the issues in finite representations for languages and machines, as well as gain a more formal understanding of algorithms and procedures.

Course Outcomes

After the completion of this course, students will be able to:

1.	Relate formal languages and mathematical models of computation
2.	Analyze different types of languages and the corresponding machines
3.	Analyze the Pushdown machine and its role in compiler construction
4.	Find the capability of real computers and learn examples of unsolvable problems.
5.	Analyze classes of P, NP, NP-C and NP-Hard problems

SYLLABUS

Module 1	**Lectures: 10**
Introduction to Automata: (mathematical model of digital devices, including real computer), State Transition Graph, Finite Automaton (FA) and its types, Deterministic Finite Automaton (DFA), Non-deterministic Finite Automaton (NDFA), Complement, Union, Intersection of FA's , Conversion Strategy from NDFA to DFA , Minimization of FA, Finite Automaton with Output, Applications of FA.	

Module 2	**Lectures: 6**
Regular Expressions(RE): Introduction , R.E.'s and basic operations, Algebraic laws on Regular Expression, Finite and Infinite Languages, Equivalence of finite Automaton and regular expressions, Constructing NDFA from Regular Expression , Pumping Lemma for Regular Language, Closure properties of Regular Languages, Non-regular languages,Applications, Regular Expressions.	

Module 3	**Lectures: 8**
Grammar: Introduction, Formal Definition of Grammar, The Chomsky Hierarchy of Grammar, Designing Regular grammar from DFA, Context Free Grammar, Closure properties of Context Free Languages, , CFG and Normal form: Chomsky Normal Form, Greibach Normal Form, Non- Context Free Language, Applications of CFGs.	

Module 4	**Lectures: 8**
Push Down Automation (PDA): Introduction, Definition of PDA, Types of Pushdown Automata (DPDA and NPDA), Converting CFG to PDA, Derivation (Parsing), Parsing Techniques, Ambiguous and Unambiguous Grammar, Demerits of Ambiguous Grammar.	

Module 5:	**Lectures: 8**
Turing Machine(TM): Single Tape TM, Variations of TM, Halting Problem, Turing Machine and Languages, Enumerable Languages, Decidable, Recognizable and Undecidable languages, Solvable and Unsolvable problems, Post Correspondence Problems(PCP), Classes of Problems: P, NP, NP-C and NP-Hard.	

Textbook:

1. Hopcroft J.E., Motwani R. and Ullman J.D, Introduction to Automata Theory, Languages and Computations, Second Edition, Pearson Education, 2008. (T1).

Reference Books:

1) Mishra K.L.P. andChandrasekaran N. , Theory of Computer Science: Automata, Languages and Computation, 3rd Edition, PHI.(R1)

2)Martin John C., Introduction to Languages and the Theory of Computation, 3rd Edition, TataMcGraw Hill Publishing Company, New Delhi, 2007. (R2)

3)Lewis Harry R. and Papadimitriou Christos H., Elements of the theory of Computation, 2nd Edition, Prentice-Hall of India Pvt. Ltd. (R3)

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure Direct Assessment

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	**% Distribution**
Mid semester examination	25
Two quizzes	20(2X10)
Teacher's Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course outcomes onto Program Outcomes

Course Outcome	Program Outcomes												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	High	Medium	High	High	Low	Medium	Low	Low	Medium	Low	Low	Low	High	High	Medium
2	High	High	Low	High	Low	Medium	Medium	Low	Low	Low	Medium	Low	Medium	Medium	Low
3	High	High	High	High	High	Low	Low	Low	Medium	Medium	Low	Medium	Medium	High	Low
4	High	Low	Medium	Low	Medium	Low	Medium	Medium	Low	Low	Low	Medium	Medium	High	Low
5	Medium	Medium	Low	Medium	High	Low	Low	Low	Low	High	Medium	High	Medium	Medium	Low

Mapping Between Course Outcomes and Course Delivery Methods

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7

COURSE INFORMATION SHEET
Course code: CS362
Course title: Operating System
Pre-requisite(s): Data Structure, Computer System Architecture, Basic Course on Computer Programming
Co- requisite(s): None
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: BTech
Semester / Level: V
Branch: CSE/AIML

Course Objectives

The course enables the students to:

1.	Present the main components of OS and their working
2.	Introduce the concepts of process and thread and their scheduling policies
3.	Handling synchronization of concurrent processes and deadlocks
4.	Analyze the different techniques for managing memory, I/O, disk and files
5.	Design the components of operating system

Course Outcomes

After the completion of the course student will be able to:

1.	Describe the main components of OS and their working
2.	Explain the concepts of process and thread and their scheduling policies
3.	Solve synchronization and deadlock issues
4.	Compare the different techniques for managing memory, I/O, disk and files
5.	Design components of operating system

SYLLABUS

Module I	**[8Lectures]**
Operating system Overview	
Operating system Objective and Functions, Evolution of Operating System, Major Advances in OS Components, Characteristics of Modern Operating Systems	
Process Description and Control	
Process Concept, Process States, Process Description, Process Control, Threads, Types of Threads, Multicore and Multithreading	

Module II	**[8Lectures]**
Scheduling	
Type of scheduling, Uniprocessor Scheduling, Multiprocessor Scheduling	

Module III	**[8Lectures]**
Concurrency Mutual Exclusion and Synchronization	
Principle of Concurrency, Mutual Exclusion, Hardware Support, Semaphores, Monitors, Message Passing, Readers/Writers Problem	
Deadlock and Starvation Principle of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher Problem	

Module IV	**[8Lectures]**
Memory Management	
Memory Management Requirements, Memory Partitioning, Paging, Segmentation	
Virtual Memory	
Hardware and Control Structures, Operating System Policies for Virtual Memory	

Module V	**[8Lectures]**
I/O Management and Disk Scheduling	
I/O device, Organization of the I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling, RAID, Disk Cache	
File Management	
Overview, File Organization and Access, File Directories, File Sharing, Record Blocking, File Allocation and Free Space Management	

Text Book:

1. StallingsW., Operating systems - Internals and Design Principles, , 8th Edition, Pearson, 2014.

Reference Books:

1. SilberchatzAbraham, Galvin Peter B.,Gagne Greg, Operating System Principles, 9th Edition, Wiley Student Edition, 2013.
2. Tanenbaum Andrew S., Modern Operating Systems, 4th Edition, Pearson, 2014.
3. Dhamdhere D. M. ,Operating Systems A concept - based Approach, 3rd Edition, McGrawHill Education, 2017.

4. Stuart B. L., Principles of Operating Systems, 1st Edition, 2008, Cengage learning, India Edition.
5. Godbole A. S., Operating Systems, 3rd Edition, McGrawHill Education, 2017.

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Low	Low	Low	Medium	Medium	Medium	Low
CO2	Medium	Medium	Medium	Medium	Low	Low	Medium	Low	Low	Low	Low	Medium	Medium	Medium	Low
CO3	Medium	Medium	High	Medium	Medium	Medium	Medium	Medium	Low	Medium	Low	High	High	Medium	Medium
CO4	High	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	High	High	High
CO5	High	Medium	Medium	Medium	Medium	High	Low	Low	Low	Low	Low	Low	High	High	Low

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET
Course code: IT337
Course title: Software Engineering
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: III
Branch: CSE/AIML

Course Objectives

This course enables the students to:

1.	Be effective team members, aware of cultural diversity, who conduct themselves ethically and professionally
2.	Use effective communication skills and technical skills to assure production of quality software, on time and within budget.
3.	Build upon and adapt knowledge of science, mathematics, and engineering to take on more expansive tasks.
4.	Able to increase level of self-reliance, technical expertise, and leadership.

Course Outcomes

After the completion of this course, students will be:

1.	Explain the software engineering principles and techniques
2.	Analyse and evaluate the requirements of a given problem statement/case study
3.	Apply Design Concepts to create suitable Solutions of a given problem statement
4.	Apply Testing strategies to improve the quality of the software
5.	Solve problems related to Estimation and Quality

SYLLABUS

Module I	**[8Lectures]**
Introduction	
Some Definitions, FAQs about software engineering, the evolving role of software, Software process models, Waterfall model, the prototyping model, spiral model, RAD and Incremental model, Management activities, Project planning and Project Scheduling.	

Module II	**[8Lectures]**
Software Requirements	
Functional and non-functional requirements, User requirements, System requirements, the software requirements document. IEEE standard of SRS, Quality of good SRS.	
Requirement Engineering Process: Feasibility study, Requirements elicitation and analysis, Requirements validation, Requirement management.	

Module III	**[8Lectures]**
Design Engineering	
Design Process and Design Quality, Design Concepts, Design Models, Object oriented Design, UML: Class diagram, Sequence diagram, Collaboration diagram.	

Module IV	**[8Lectures]**
Verification and Validation	
Verification and Validation Planning, S/W inspection, static analysis.	
Software Testing	
Testing functions, Test care design, White Box testing, Black box testing, Unit testing, Integration Testing, System testing, Reliability.	

Module V	**[8Lectures]**
Process metrics, Software Measurement, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Quality assurance and standards, Quality planning, Quality control, **S**/W Maintenance in detail.	

Text Book:

1. Sommerville, Software Engineering, 7th Edition, Pearson Education Publication. (T1)

Reference Books:

1. Pressman R. S.,Software Engineering: A Practiioners Approach, 5th Edition., TMA, New Delhi.(R1)
2. Mall Rajib, Fundamental of Software Engineering, 4th Edition, PHI Learning Private Limited.(R2)
3. Peters J. F. &Pedrycz W., Software Engineering, John Wiley & Sons, Inc. 2000.(R3)
4. Behforooz A. & Hudson F.J., Software Engineering Fundamentals, Oxford Univ. Press, New York, 2000.(R4)

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher’s Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes											Program Specific Outcomes (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	High	High	High	Low	Low	Medium	Low	Medium	High	High	Low	Low	Low	High	Medium
2	Medium	High	Low	Medium	Medium	Medium	Medium	Medium	Medium	High	Medium	Low	Low	Medium	High
3	Medium	High	High	High	High	Low	Low	Low	Medium	High	Low	Medium	Medium	High	High
4	High	Low	Medium	Low	Medium	Low	Medium	Medium	Low	Low	Low	Medium	Medium	High	Medium
5	Medium	Medium	Low	Medium	High	Low	Low	Low	Low	High	Medium	High	Low	Medium	High

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET
Course code: IT331
Course title: Image Processing
Pre-requisite(s): Discrete Mathematics, Data Structures
Co- requisite(s):
Credits: L: 3 T:0 P: 0
Class schedule per week: 3
Class: B. Tech
Branch: CSE/IT/AIML

Course Outcomes

After the completion of this course, students will be:

1.	Understand the concept of image formation, digitization, and role human visual system plays in perception of image data and spatial filtering techniques for enhancing the appearance of an image.
2.	Acquire an appreciation for various frequency-based filtering techniques for enhancing the appearance of an image, duly applying them in different applications.
3.	Discern the difference between noise models, gain an insight into assessing the degradation function and realize different spatial and frequency-based filtering techniques for reduction and removal of noise.
4.	Synthesize a solution to image compression using the concept of information theory and lossless and lossy compression techniques.
5.	Design and create practical solutions using morphological and image segmentation operators for common image processing problems and assess the results.

SYLLABUS

Module I	**[8 Lectures]**
Introduction to Digital Image Processing, Elements of Visual Perception, Image Sensing & Acquisition, Sampling and Quantization, Basic Relationships between Pixels, Intensity Transformations, Histogram Processing, Spatial Convolution & Correlation, Smoothing Spatial Filters, Sharpening Spatial Filters.	

Module II	**[8 Lectures]**
Introduction to the Fourier Transform, Discrete Fourier Transform, Properties of the Two-Dimensional Fourier Transform, Image Smoothing using Frequency Domain filters, Image Sharpening using Frequency Domain filters, Selective Filtering, Basics of Fast Fourier Transform, Basics of: Walsh- Hadamard Transform; K-L Transform; Discrete Cosine Transform.	

Module III	**[8 Lctures]**
Model of Image Degradation/Restoration Process, Noise Probability Density Functions, Restoration in presence of Noise only, Periodic Noise Reduction using Frequency Domain filtering, Circulant Matrices, Block Circulant Matrices, Unconstrained Restoration, Constrained Restoration, Basics of Inverse Filtering	

Module IV	**[8 Lectures]**
Image Compression Fundamentals – Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria, Image Compression Models– Source Encoder and Decoder, Channel Encoder and Decoder, Elements of Information Theory, Error-Free Compression – Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression – Lossy Predictive Coding, Transform Coding. Color Fundamentals, Color Models, Basics of Full Colour Image Processing	

Module V	**[8 Lectures]**
Morphological Image Processing-Preliminaries, Dilation and Erosion, Opening and Closing, Hit-or-Miss Transformation, Boundary Extraction, Hole Filling, Connected Components, Convex Hull, Thinning, Thickening, Skeletons, Pruning Image Segmentation- Fundamentals,Point, Line and Edge Detection, Thresholding, Region Based Segmentation, Segmentation based on colour.	

Text books:

1. Rafael. C. Gonzalez & Richard E. Woods- Digital Image Processing, 3/e Pearson Education, New Delhi - 2009

Reference books:

1. W.K.Pratt-Digital Image Processing, 4/e, John Wiley & sons, Inc. 2006.
2. M. Sonka et al. Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition, 2007.
3. Jayaraman, Digital Image Processing, Tata McGraw-Hill Education, 2011

COURSE INFORMATION SHEET
Course code: AI309
Course title: Evolutionary Computing
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:1 P:0
Class schedule per week: 4
Class: B. Tech
Semester / Level: III
Branch: CSE/IT

Course Outcomes:

After completion of the course students shall be able to:

1.	Understand what kind of problems can be solved using EAs.
2.	Use the common EA operators and appreciate their need.
3.	Solve real life problems using EAs
4.	Compare the performance of EAs with traditional algorithms.
5.	Perform multiobjective optimizations with constraints using EAs.

Module 1: Preliminaries	**Lectures: 6**
Module 1: Introduction to Evolutionary Computation Introduction, Problems that can be solved, Understanding the challenges of NP problems, Inspiration from biology, Advantages of evolutionary computing.	

Module 2: Basic Model (8L)	**Lectures: 6**
What is an evolutionary algorithm? Components of evolutionary algorithms, The operation of an evolutionary algorithm, Natural versus artificial evolution. Iterating through application problems.	

Module 3: Operators in Evolutionary Computations	**Lectures: 12**
Representation – Binary, Integer, Floating point, Permutation representations, Selection, Population Management, Mutation, Recombination, Elitism, Nicheism	

Module 4: Common Evolutionary algorithms	**Lectures: 8**
Problem solving with Hill climbing, Tabu Search, Simulated Annealing, Genetic Algorithms, Particle Swarm optimization.	

Module 5: Advanced Topics	**Lectures: 8**
Performance measures, Peak vs Average performance, Multiobjective problem solving, Constraint handling.	

Textbook:

1. Eiben A. E., Smith J. E., Introduction to Evolutionary Computing, 2nd Edition, Springer Publications, 2015.

Reference Books:

1. A. P. Engelbrecht, Computational Intelligence, Wiley, USA, 2007
2. Genetic Algorithms in Search, Optimization and machine Learning, D. E. Goldberg, Addition -Wisley Companay Inc, 1989
3. S.N. Sivanandam, S.N. Deepa, "Introduction to Genetic Algorithms", Springer Berlin, Heidelberg, New York,2008

COURSE INFORMATION SHEET
Course Code: IT353
Course Title: Blockchain Technology
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:3 T:0 P:0
Class schedule per week: 3
Class: B.Tech
Semester / Level: PE
Branch: CSE/IT/AIML

Course Objectives

This course enables the students to:

1.	Provide an overview of the different blockchain technologies.
2.	Provide the knowledge on the need of blockchain and its applicability in real world problem.
3.	Provide the knowledge of cryptocurrency design and its security against scam ,fraud, hacking.
4.	Provide the ability to design and implement new ways of using blockchain for applications other than cryptocurrency.
5.	Be able to apply the knowledge gained through the course in actual blockchain development or blockchain contract developer

Course Outcomes

After the completion of this course, students will be able to:

1.	Learn and explain the difference between centralized, decentralized network and blockchain.
2.	Explain fundamental concepts of blockchain using hashes and consensus.
3.	Understand the concept of mining in blockchains.
4.	Understand the working of Bitcoin and its security.
5.	Know about the different platforms for implementing blockchain and its varied application.

SYLLABUS

Module I
Introduction to Blockchain Technology
Introduction to Blockchain, Trusted Third party for transactions, Difference between centralized, decentralized and distributed peer to peer networks, Types of Blockchain (Permission Blockchain vs. Permissionless Blockchain), History of Bitcoins.

Module II
Fundamental concepts of Blockchain
Concepts of Block, Transactions, Hashes, Consensus. Hashes: Hash cryptography, Encryption vs. hashing, Transactions: Recording transactions, Digital Signature, Verifying and confirming transactions, Blocks and blockchain: Hash pointers, Blocks, Consensus building. Distributed consensus, Byzantine generals problem, Consensus mechanism: POW, POS, POB, POA, etc. Blockchain Architecture, Markle Root Tree.

Module III
Mining and simulating blockchain
Mining and simulating blockchain: Game theory behind competitive mining. Incentives: mining and transaction fees, Energy expended in mining.

Module IV
Bitcoin ad Security
Bitcoin: Bitcoin creation, exchanges. Wallets, security. Protecting blockchain from attackers. Forks – soft and hard, Blockchain security, Key Management in Bitcoin, Case studies.

Module V
Platforms and Applications
Introduction to Blockchain platform: Ethereum, Hyperledger, IOTA, EOS, Multichain, SOLIDITY, Designing a new blockchain, Distributed Application (DAPP).
Applications: E-Governance, Elections, File sharing, Micropayments
Challenges and Research Issues in blockchain

Text Book:

1. Bitcoin and Cryptocurrency technologies: a comprehensive introduction. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Princeton University Press, First edition,2016
2. Blockchain Applications: A Hands-On Approach. Arshdeep Bahga, Vijay Madisetti. VPT Publisher. First edition,2018.
3. Blockchain: Step – by – Step Guide to Understand by Paul Laurence, Createspace Independent Pub.

Reference Book:

1. Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners by Chris Dannen, Apress
2. Blockchain: The comprehensive beginner's guide by Frank Walrtin

Web References:

1. https://bitcoin.org/bitcoin.pdf
2. https://blockchain.mit.edu/how-blockchain-works

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2*10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Mini Project
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	High	High	Medium	Medium	High	Low	Medium	Low	Medium	Medium	High	Medium	High	Medium	Low
CO2	High	High	High	Medium	Medium	Low	Low	Low	Low	Medium	Medium	Medium	High	High	Medium
CO3	High	High	High	High	Medium	Low	Low	Low	Low	Low	Low	Low	High	High	Medium
CO4	High	Medium	Medium	Medium	Low	Low	Low	Low	Medium	Medium	High	Medium	Medium	Medium	Low
CO5	High	High	High	High	Medium	Medium	Low	Low	Medium	Medium	Medium	Medium	High	High	High

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6, CD7
CO4	CD1, CD3, CD6
CO5	CD1, CD2, CD3, CD4, CD5, CD6, CD7

COURSE INFORMATION SHEET
Course code: AI311
Course title: Network Analysis
Pre-requisite(s): MA 205, CS241
Co- requisite(s): Network Analysis
Credits: L:3 T:0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: V/III
Branch: AI/ML

Course Outcomes

After the completion of this course, students will be able to:

1.	Associate groups of data with type of network
2.	Ascertain mathematical properties of networks
3.	Implement simple visualisation and traversal algorithms for networks
4.	Categorize a network as a real world network.
5.	Decide whether a network is a random network.

SYLLABUS

Module 1: Introduction **[8 Lectures]**
Types of networks – Technological, Information, Social, Biological, Mathematics of networks – Representations, Weighted, Directed, Bipartite, Multilayer and Dynamic, Trees, Planar, Degree, Walks and Paths, Components, Independent paths, connectivity and cut sets, graph Laplacian

Module 2: Measures and Metrics **[8 Lectures]**
Centrality, Groups of nodes, Transitivity and clustering coefficient, Reciprocity, Signed edges and structural balance, Similarity, Homophily and assorative mixing.

Module 3: Algorithms for networks **[8 Lectures]**
Storing Network data, Algorithms for basic network quantities, Shortest path and breadth first search, Shortest paths in networks with varying edge lengths, Maximum flow and minimum cuts.

Module 4: Structure of Real world Networks **[8 Lectures]**
Components, components and small world effects, degree distribution, Power law and scale free networks, Distribution of other centrality measures, Clustering coefficients.

Module 5: Random Graphs **[8 Lectures]**
Random Graphs, Mean number of edges and mean degree, Degree distribution and clustering coefficient, Giant component, Small components, Path lengths

COURSE INFORMATION SHEET
Course code: AI 313
Course title: Classical Optimization Techniques
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: III
Branch: CSE/IT/AIML

Course Outcomes:

After completion of the course, students shall be able to:

1.	Apply problem solving techniques through OR approaches.
2.	Construct the operational models for the real-world applications using Linear Programming methods .
3.	Analyse the optimal solution for the given problem by applying Integer Programming and Advanced LP solution Techniques.
4.	Solve Assignment and Transportation Problems using classical techniques.
5.	Model problems using Non-Linear Programming and evaluate the suitability of the available techniques for the problem at hand.

Module 1: Introduction to Operations Research	**Lectures: 6**
Operations Research (OR)An overview, Organ and Development of OR, Nature and Features of OR Modelling in OR, General Solution Methods for OR models, Scientific method in OR, Methodology of OR, Application, Opportunities and Shortcomings of OR.	
Module 2: Linear Programming	**Lectures: 10**
Introduction, Mathematical Formulation of the Problem, Graphical Solution Method, Some Exceptional Cases, General LPP, Canonical and Standard forms of LPP, Simplex Method: Introduction, Fundamental properties of solutions, the Computational Procedure, Use of Artificial variables, two-phase method, Big M method. Duality in linear programming, formulation of dual linear programming and examples.	
Module 3: Integer Programming and Advance LPP techniques	**Lectures: 8**
Introduction, Gomory’s Method, Fractional Cut Method, Integer & Mixed Integer Problem , Branch and Bound Technique , Revised Simplex Method, Bounded Variable, Parametric LPP, Karmakar Algorithm.	
Module 4: Transportation and Assignment Problems:	**Lectures: 8**
Mathematical model of transportation problem, methods of finding initial solution (Northwest corner rule, Least cost method, Vogel’s approximation method), test for optimality in TP using MODI Method. Mathematical model of Assignment problem, Hungarian method for solving Assignment problem.	
Module 5: Other Optimization modelling and Applications	**Lectures: 8**
Nonlinear Programming : Sample Applications , Graphical Illustrations of Nonlinear Programming, One-Variable and Multi-variable Unconstrained Optimization, The Karush-Kuhn-Tucker(KKT) Conditions. **Forecasting** : Forecasting Models, Judgemental Forecasting methods, Time Series Forecasting Methods.	

Textbook:

1. Hiller S. & Lieberman G.J. “Introduction to Operations Research”, 11th Edition, McGraw Hill, August 2021.

Reference Books:

1) Taha H.A. “Operations Research: An Introduction”, 10th Edition, Pearson August 2019.
2) Pai Pradeep Prabhakar “Operations Research”, 1st Edition, Oxford University Press 2012.

COURSE INFORMATION SHEET
Course code: AI315
Course Title: Advanced Algorithms
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:1 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: VI
Branch: AI/ML

Course Outcomes:

After completion of the course, students shall be able to:

1)	Understand the concepts, properties, and analyse the operation of advanced Trees and can be able to solve real-world problems, such as database indexing and file systems.
2)	Able to apply these advanced algorithmic techniques to solve complex mathematical and computational problems.
3)	Able to understand advanced topics in combinatorial optimization and approximation algorithms.
4)	Able to solve efficiently diverse computational challenges.
5)	Able to analyse and design efficient and incentive-compatible solutions for various computational and strategic problems

SYLLABUS

Module 1: Advanced Data Structures and Analysis	**Lectures: 8**
Advanced Trees: B-trees, Red-Black Trees, Augmented Trees. Persistent Data Structures: Persistent Trees, Persistent Hashing. Van Emde Boas Trees: Overview and Operations. Amortized Analysis: Potential Method, Aggregate Analysis.	
Module 2: Advanced Divide and Conquer Algorithms	**Lectures: 8**
Strassen's Matrix Multiplication. Fast Fourier Transform: Cooley-Tukey Algorithm, Applications. Integer Multiplication: Karatsuba Algorithm, Toom-Cook Algorithm.	
Module 3: Advanced Greedy and Approximation Algorithms	**Lectures: 8**
Matroid Theory: Matroid Intersection, Greedy Algorithm with Matroids. Submodular Functions: Maximization and Minimization, Greedy Algorithms. PTAS and FPTAS: Polynomial-Time Approximation Schemes, Fully Polynomial-Time Approximation Schemes.	
Module 4: Advanced Dynamic Programming	**Lectures: 8**
Convex Hull Optimization: Line Container, Li-Chao Tree. Advanced Longest Common Subsequence: Space-Optimized, Rectangular LCS. All Pairs Shortest Paths: Floyd-Warshall Algorithm with Path Reconstruction. Range Queries and Updates: Segment Trees, Fenwick Trees, Lazy Propagation.	
Module 5: Advanced Randomized Algorithms & Game Theory	**Lectures: 8**
Randomized Algorithms for Linear Algebra: Randomized LU Decomposition, Randomized SVD. Randomized Online Algorithms: Ski Rental, Online Bin Packing. Randomized Parallel Algorithms: Randomized Parallel Sorting, PRAM Algorithms. **Game Theory**: Mechanism Design: Vickrey-Clarke-Groves Mechanisms, Incentive Compatibility. Algorithmic Aspects of Game Theory: Nash Equilibria, Price of Anarchy.	

Textbook:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.

Reference Books:

1. Donald E. Knuth, "The Art of Computer Programming, Volume 2: Seminumerical Algorithms", 3rd Edition, Pearson, 2005
2. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Reprint Edition, Cambridge University Press, 2000.

COURSE INFORMATION SHEET
Course code: IT451
Course title: Introduction to Distributed Systems
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Branch: CSE/IT/AIML

Course Outcomes

After the completion of this course, students will be able to:

1.	Define distributed systems and their architecture.
2.	outline peer to peer services and distributed file systems
3.	Elaborate on concepts of process and resource management
4.	Analyze the requirements for designing and supporting distributed systems
5.	Discuss and design the working of distributed systems

Module I: Introduction **[8 Lectures]**
Introduction to "Large-Scale"distributed systems, Consequences of "large-scale" Some large-scale distributed systems, Architectures of large scale distributed systems.

Module II: Design principles of Distributed system **[8 Lectures]**
Introduction to peer-to-peer systems, The peer-to-peer paradigms, Services on structured overlays, Building trust in P2P systems.

Module III: Communication in Distributed system **[8 Lectures]**
System Model – Inter Process Communication – the API for internet protocols – External data representation and Multicast communication. Peer to Peer Services: Peer-to-peer Systems - Introduction - Napster and its legacy - Peer-to-peer - Middleware – Routing overlays. File System: Features-File model -File accessing models- File sharing semantics
Naming: Identifiers, Addresses, Name Resolution - Name Space Implementation - Name Caches - LDAP.

Module IV: Remote Method Invocation and Objects **[8 Lectures]**
Remote Invocation - Introduction - Request-reply protocols - Remote procedure call - Remote method invocation. **Case study:** Java RMI – Group communication - Publish-subscribe systems - Message queues - Shared memory approaches -Distributed objects - Case study: Enterprise Java Beans -from objects to components.

Module V: Process Management **[8 Lectures]**
Process Migration: Features, Mechanism - Threads: Models, Issues, Implementation.
Resource Management: Introduction- Features of Scheduling Algorithms -Task Assignment Approach - Load Balancing Approach - Load Sharing Approach.

Text Books:

1. Coulouris G., Dollimore J., and Kindberg T., “Distributed Systems Concepts and Design”, 5th Edition, Pearson Education, 2012
2. Distributed Systems: Design and Algorithms, Editors(s):Serge Haddad, Fabrice Kordon, Laurent Pautet Laure Petrucci, Wiley online Library

Reference Books:

1. A. S. Tanenbaum, M. Van Steen, “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007
2. P. K. Sinha, “Distributed Systems: Concepts and Design”, Prentice Hall, 2007.

COURSE INFORMATION SHEET
Course code: IT445
Course title: Internet of Things (IoT)
Pre-requisite(s): IT201 Basics of Intelligent Computing
Co-requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: IV
Branch: CSE/IT/AIML

Course Objectives

This course enables the students to:

1.	Understand the basic concept and the Iot Paradigm
2.	Know the state of art architecture for IoT applications
3.	Learn the available protocols used for IoT
4.	Design basic IoT Applications.
5.	Evaluate optimal IoT applications.

Course Outcomes

After the completion of this course, students will be able to:

1.	Identify the IoT Components and its capabilities
2.	Explain the architectural view of IoT under real world constraints
3.	Analyse the different Network and link layer protocols
4.	Evaluate and choose among the transport layer protocols
5.	Design an IoT application

SYLLABUS

Module I
Introduction to IoT **[8Lectures]**
The definition of the Internet of Things, main assumptions and perspectives. Platform for IoT devices Device architectures. Conventional and renewable power sources for resource-constrained devices. Operating systems for resource-constrained devices.

Module II **[8Lectures]**
Architecture of IoT
Node structure: Sensing, Processing, Communication, Powering IOT networking: Topologies, Layer/Stack architecture, The data link layer for IoT- Wireless communication technologies. Wire communication technologies. Manet Networks.

Module III	[8Lectures]
Communication Technologies	
Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Discuss data rate, range, power, computations/bandwidth, QoS, Service oriented protocols (COAP). Communication protocols based on the exchange of messages (MQTT). Service discovery protocols.	

Module IV	[8Lectures]
M2M and IoT Technology Fundamentals	
Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.	

Module V	[8Lecture]
The data processing for IoT	
Organization of data processing for the Internet of things. Cloud computing. Fog computing. Application case studies: Smart Grid. Home Automation. Smart City.	

Text books:

1. Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.(T1)
2. Raj Pethuru and Raman Anupama C., The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.(T2)

Reference books:

1. Vermesan Dr. Ovidiu, Friess Dr. Peter, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers.(R1)
2. Holler Jan, TsiatsisVlasios, Mulligan Catherine, Avesand Stefan, Karnouskos Stamatis, Boyle David, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.(R2)

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

<u>Direct Assessment</u>

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5

Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	Medium	High	High	Medium	High	Low	Medium	Low	Medium	Low	Low	Medium	Medium	Medium	Medium
CO2	Medium	High	High	High	Medium	Medium	Low	Low	Low	Low	Low	Medium	Medium	High	Medium
CO3	Medium	High	Medium	Medium	Medium	Low	Low	Low	Low	Low	Low	Medium	High	Medium	Medium
CO4	Medium	Medium	Medium	High	Medium	Medium	Low	Low	Low	Low	Low	High	Medium	Medium	Medium
CO5	Medium	High	High	High	Medium	Low	Low	Medium	Low	Low	Low	High	High	Medium	Medium

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET
Course code: AI425
Course title: Computer Vision
Pre-requisite(s): Computer Graphics
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: IV
Branch: AIML

Course Objectives

This course enables the students to:

1.	Learn with both theoretical and practical aspects of computing with Vision.
2.	Acquire the foundation of Vision formation, measurement, and analysis.
3.	Understand the geometric relationships between 2D images and the 3D world.
4.	Grasp the principles of geometry and physics of imaging

Course Outcomes

After the completion of this course, students will be able to:

1.	Developed the practical skills necessary to build computer vision model.
2.	Gain exposure to object and scene recognition and categorization from images.
3.	Develop algorithm for classification and clustering.
4.	Illustrate the techniques of feature extraction and analysis.
5.	Apply in different computer vision engineering applications

SYLLABUS

Module I	**[8Lectures]**
Overview of Computer imaging systems, lenses, Image formation and Model, Geometric Camera Models, Geometric Camera Calibration, Measuring Light: Light in Space, Light in Surface, Case Study.	

Module II	**[8Lectures]**
Early Vision: Linear Filters, Spatial, Frequency and Fourier Transform, Sampling and Aliasing, Filters as Templates, Normalized Correlation and Finding patterns, Scale and Image Pyramids, Edge detection, Noise, Estimating Derivatives, Detecting Edges.	

Module III	**[8Lectures]**
Multiple Images: Geometry of Multiple Views, Stereopsis, Affine Structure from Motion, Projective structure from Motion, Segmentation by clustering, Segmentation by fitting a model, segmentation and fitting using probabilistic methods.	

Module IV	[8Lectures]
Model Based Vision: Initial Assumptions, Hypotheses, Verification, Application, Smooth Surfaces and their Outlines: Differential Geometry, Contour Geometry, Aspect Graphs: Visual Events, Computing the Aspect Graph, Range Data: Sensors, Data Segmentation, Image Registration and Model acquisition, Object Recognition.	

Module V	[8Lectures]
Probabilistic and Inferential Methods: classifiers, feature selection, Neural Networks, SVM, Recognition by relations between templates: Finding objects by voting, HMM, Application, Geometric Templates from Spatial Relations: Relations between Object and Image, Primitives, Object Recognition, Application of finding in Digital Libraries, Application Image based Rendering	

Textbook:

1. Forsyth ,D .A .,Ponce ,J ”Computer Vision A Modern Approach,” Second Edison, Pearson Education,2015.

Reference Books:

1. Szeliski , R.,” Computer Vision: Algorithms and Applications,”Springer,2011.
2. Goodfellow, Bengio, and Courville,”Deep Learning,” First Edison.MIT Press,2016.
3. Fisher,R.B.,Breckon,T. P. , Dawson-Howe,K,Fitzgibbon,A , Robertson,C., Trucco,E. , Williams,C. K. I., “Dictionary of Computer Vision and Image Processing,” Second Edison,Wiley,2014.

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	High	Medium	High	Low	Low	Medium	No	No	Low	Low	Medium	Low	Low	High	Medium
2	Medium	High	High	Low	Low	Low	No	No	Low	Low	Low	Medium	Low	High	Low
3	Medium	High	Medium	High	High	Low	No	No	Low	Low	Low	High	Medium	High	High
4	High	Low	Low	Low	Medium	Low	No	No	Low	Low	Low	Medium	Low	High	Low
5	Medium	Medium	Low	Medium	High	Low	No	No	Low	High	Low	High	Low	Medium	High

COURSE INFORMATION SHEET
Course code: IT347
Course title: Cloud Computing
Pre-requisites: IT201 Basics of Intelligent Computing
Co- requisite(s): NIL
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: III
Branch: CSE/IT/AIML

Course Objectives

This course enables the students to:

1.	Understand the elements of distributed computing and core aspects of cloud Computing.
2.	Understand the concepts and aspects of virtualization and application of virtualization technologies in cloud computing environment
3.	Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS and gain comprehensive knowledge of different types of clouds.
4.	Be familiar with application development and deployment using services of different cloud computing technologies provider: Google app Engine, Amazon Web Services (AWS) and Microsoft Azure.
5.	Understanding the key security, compliance, and confidentiality challenges in cloud computing.

Course Outcomes:

After the completion of this course, students will be able to:

1.	Recall the various aspects of cloud computing and distributed computing
2.	Understand the specifics of virtualization and cloud computing architectures.
3.	Develop and deploy cloud application using services of different cloud computing technologies provider: Google app Engine, Amazon Web Services (AWS) and Microsoft Azure.
4.	Evaluate the security and operational aspects in cloud system design, identify and deploy appropriate design choices when solving real-world cloud computing problems.
5.	Provide recommendations on cloud computing solutions for a Green enterprise.

SYLLABUS

Module I	**[8Lectures]**
Introduction: Essentials, Benefits and need for Cloud Computing - Business and IT Perspective - Cloud and Virtualization - Cloud Services Requirements - Cloud and Dynamic Infrastructure - Cloud Computing Characteristics Cloud Adoption.	

Module II	**[8Lectures]**
Principles of Parallel and Distributed Computing: Eras of computing, Parallel vs. Distributed computing, Elements of parallel computing, Elements of distributed computing, Technologies for distributed computing.	

Module III	**[8Lectures]**
Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples.	
Storage virtualization: Storage Area Networks - Network-Attached storage - Cloud Server Virtualization - Virtualized Data Centre.	

Module IV	**[8Lectures]**
Cloud computing architecture: Introduction, Cloud reference model, Types of clouds, Economics of the cloud, Open challenges.	

Module V	**[8Lectures]**
Cloud platforms in industry and Cloud applications : Amazon web services, Google app engine, Microsoft azure, Observations, Scientific applications, Scientific, Business and Consumer applications.	

Text Book:

1. Buyya Raj Kumar, Vecchiola Christian &Thamarai S. Selvi, “Mastering Cloud Computing”, McGraw Hill Publication, New Delhi, 2013.(T1)

Reference Books:

1. Velte T., Velte A. and Elsenpeter R., “Cloud Computing: A Practical Approach”, McGraw Hill, India.(R1)
2. Buyya R., Broberg J., “Cloud Computing: Principles and Paradigms”, Wiley.(R2)
3. Hwang K., Fox G. and Dongarra J., “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann, 2012.(R3)

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher’s Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	High	High	High	High	Medium	High	Medium	Medium	Low	Medium	Medium	Medium	High	High	High
CO2	High	High	High	High	High	High	Medium	Medium	Low	Medium	Medium	Medium	High	Medium	High
CO3	High	High	High	Medium	High	High	Medium	Medium	Low	Medium	Medium	Medium	High	High	High
CO4	High	High	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	High	High
CO5	High	High	High	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET
Course code: IT351
Course title: Natural Language Processing
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: BTech
Branch: CSE/IT/AIML

Course Outcomes

After the completion of this course, students will be able to:

1.	Describe the typical NLP problem, their importance & difficulty; and concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.
2.	Demonstrate understanding of the relationship between NLP and statistics& machine learning.
3.	Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis.
4.	Analyse NLP problems to decompose them into appropriate components.
5.	Evaluate a NLP system, identify shortcomings and suggest solutions for these shortcomings.

SYLLABUS

Module I: Introduction to NLP **[8 Lectures]**
Introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model; Concepts of Parts-of-speech and Formal Grammar of English.

Module II: Language Modelling **[8 Lectures]**
N-gram and Neural Language Models, Language Modelling with N-gram, Simple N-gram models, Smoothing(basic techniques), Evaluating language models;Neural Network basics, Training; Neural Language Model, Case study: application of neural language model in NLP system development.

Module III: POS Tagging **[8 Lectures]**
Parts-of-speech Tagging: basic concepts; Tagset; Early approaches: Rule based and TBL; POS tagging using HMM, POS Tagging using Maximum Entropy Model.

Module IV: Parsing Basic concepts **[8 Lectures]**
Top down and bottom up parsing, Treebank; Syntactic parsing: CKY parsing; Statistical parsing basics: Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs.

Module V: Semantics **[8 Lectures]**
Vector Semantics; Words and Vector; Measuring Similarity; Semantics with dense vectors; SVD and Latent Semantic Analysis; Embeddings from prediction: Skip-gram and CBOW; Concept of Word Sense; Introduction to WorldNet.

Text books:

1. Jurafsky Dan and Martin James H., Speech and Language Processing **(3rd ed.)**Available at: https://web.stanford.edu/~jurafsky/slp3/.

Reference books:

1. Jurafsky D. and Martin J. H., Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008
2. Goldberg Yoav, A Primer on Neural Network Models for Natural Language Processing.

COURSE INFORMATION SHEET
Course Code: AI429
Course Title: Speech Processing
Pre-requisite(s):
Co-requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class: BTech
Semester / Level: VII
Branch: AIML

Course Objectives

This course enables the students to:

1	To understand speech production and the human auditory system and different speech signal processing techniques.
2	To understand the fundamentals of speech production, its perception, and inherent features.
3	Develop an ability to evaluate the pattern comparison and design issues of speech recognition.
4	To understand the basics of LPC and its variants for various applications
5	Develop and apply speech processing technology for different real life applications.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the basics of speech production, its perception, and auditory models.
CO2	Understand the feature representation and various techniques involved in collecting the features from the speech signal in both the time and frequency domain
CO3	Analyze various components of parameter estimation and feature representations of speech signals.
CO4	Analyze the speech processing, its implementation, and properties of the speech signal.
CO5	Develop an ability to create and apply speech-processing techniques in various applications in different areas.

SYLLABUS

Module	Lectures
Module – I	**[8Lectures]**
Introduction- Human Auditory System; Speech production mechanism, Classification of speech, sounds, nature of speech signal, models of speech production, purpose of speech processing, Digital processing of speech signals. Approaches to automatic speech recognition by machine.	
Module – II	**[8Lectures]**
Speech Analysis- Time domain parameters of speech, Zero crossing, Auto correlation function, Pitch period estimation, short time Fourier analysis, Filter bank analysis, spectrographic analysis, formant extraction, pitch extraction.	
Module – III	**[8Lectures]**
Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals, Levinson-Durbin algorithm, Auto correlation method, Covariance method, LPC model of speech production, Structures	
Module – IV	**[8Lectures]**
Classification techniques- Elements of vector quantization implementation, The VQ training Set, the similarity or distance measure, Clustering the training vectors, Vector classification procedure, Comparison of vector and scalar quantizers, HMM, GMM	
Module – V	**[8Lectures]**
Application of speech processing- Speech recognition applications, Broad classes of Speech-Recognition, speaker recognition, Speech synthesis, speech coding,	

Text Books:

1. L.R. Rabiner, B. H. Juang and B. Yegnanarayana, “Fundamentals of Speech Recognition”, Pearson, Education

Reference Books:

1. L.R. Rabiner and R.E Schafer, Digital processing of speech signals, Pearson Education Inc..
2. A. M. Kondoz, “Digital Speech”, Second Edition (Wiley Students Edition), 2004.
3. W. C. Chu, “Speech Coding Algorithms: Foundation and Evolution of Standardized Coders”, Wiley Inter science, 2003.

Topics beyond syllabus/Advanced topics/Design

Teaching through Research paper

COURSE INFORMATION SHEET
Course code: IT349
Course title: Cryptography and Network Security
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: BTech
Semester / Level: III
Branch: CSE/IT/AIML

Course Objectives

This course enables the students to:

1.	To Learn Basic Concepts of Cryptography and Network Security and Apply them in various Real life Application.
2.	To understand the basic concepts of Network Security
3.	To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
4.	To understand how to deploy encryption techniques to secure data in transit across data networks
5.	To design security applications in the field of Information technology

Course Outcomes

After the completion of this course, students will be able to:

1.	Understand the basic concept of Cryptography and Network Security and their mathematical models, and to be familiar with different types of threats
2.	Learning and applying various Ciphering Techniques.
3.	Apply Symmetric and Asymmetric Cryptographic Algorithms and Standards in Networks.
4.	Examine the issues and structure of Authentication Service and Electronic Mail Security
5.	To explain and classify different malicious programs, worms and viruses, and to learn the working and design principles of Firewalls

SYLLABUS

Module I	**[8Lectures]**
Introduction to Cryptography: Computer Security concepts, The OSI Security Architecture, Security Attacks, Security Services, A model for Network Security, Classical Encryption Techniques.	

Module II	[8Lectures]
Mathematical Foundations of Cryptography: Modular Arithmetic, Euclidean Algorithm, Groups, Rings, Fields, Finite Fields of the Form GF(p), Polynomial Arithmetic, Finite Fields of the Form $GF(2^n)$, Prime Numbers, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Quadratic Congruence, Discrete Logarithms.	

Module III	[8Lectures]
Symmetric and Asymmetric Cryptography: Difference Between Symmetric and Asymmetric Cryptography, DES, Triple DES, AES, RSA Cryptosystem, Symmetric and Asymmetric Key Cryptography Together, Elgamal Cryptosystem, Elliptic Curve Cryptosystems, , Diffie-Hellman Key Exchange , Cryptographic Hash Functions, Message Authentication Codes, Digital Signature.	

Module IV	[8Lectures]
Internet Security Protocols : Basic Concepts, Security Socket Layer (SSL), Secure Hyper Text Transfer Protocol (SHTTP), Time stamping Protocol(TSP), Secure Electronic Transaction(SET), SSL Versus SET, 3-D Secure Protocol, Electronic Money, Email Security, Wireless Application Protocol(WAP) Security, Security in GSM.	

Module V	[8Lectures]
Network Security: Users, Trusts and Trusted Systems, Buffer Overflow and Malicious Software, Malicious Programs, Worms, Viruses, Intrusion Detection Systems (IDS), Firewalls: Definitions, Constructions and Working Principles.	

Text Book:

1. Forouzan B. A., Mukhopadhyay D., "Cryptography and Network Security", 3rd Edition, Mcgraw Higher Education, 2016. (T1)

Reference Books:

1. Stallings W., "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson, 2017.(R1)
2. Kahate A., "Crptography and Network Security", 3rd Edition, McGraw Hill Education, New Delhi, 2013.(R2)
3. Schneier B., "Applied Cryptogaphy: Protocols, Algorithms And Source Code In C", 2nd Edition, Wiley, 2007. (R3)

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

<u>Direct Assessment</u>

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	**% Distribution**
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher’s Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

<u>Indirect Assessment</u>

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Course Outcome	**Program Outcomes (POs)**											**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	High	High	High	High	High	High	High	Medium	Medium	Low	Medium	Medium	Medium	High	Low
CO2	High	High	High	High	High	High	High	Medium	Medium	Medium	Low	Medium	Low	Medium	High
CO3	High	Medium	High	High	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High	High
CO4	High	Medium	High	High	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Low	Medium	High
CO5	High	Medium	High	High	Low	Medium	Medium	Medium	Medium	Low	Low	Medium	Medium	Low	High

Mapping of Course Outcome onto Program Outcome

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET
Course code: IT348
Course title: Internet of Things(IoT) Lab
Pre-requisite(s): IT423 Internet of Things(IoT)
Co-requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: BTech
Semester / Level: IV
Branch: CSE/IT/AIML

Course Objectives

This course enables the students to:

1.	Understand the basic concept and the Iot Paradigm
2.	Know the state of art architecture for IoT applications
3.	Learn the available protocols used for IoT
4.	Design basic IoT Applications.
5.	Evaluate optimal IoT applications.

Course Outcomes

After the completion of this course, students will be able to:

1.	Identify the IoT Components and its capabilities
2.	Explain the architectural view of IoT under real world constraints
3.	Analyse the different Network and link layer protocols
4.	Evaluate and choose among the transport layer protocols
5.	Design an IoT application

List of Programs as Assignments:

1. **<u>Lab Assignment No: 1</u>**
   Glowing LEDs.
   Toggling LED's.
2. **<u>Lab Assignment No: 2</u>**
   Transmitting a string through UART
   Controlling LEDs blinking pattern through UART.
3. **<u>Lab Assignment No: 3</u>**
   Echo each character typed on HyperTerminal
   Digital IO configuration.
   Timer based LED Toggle.
4. **<u>Lab Assignment No: 4</u>**
   Scanning the available SSID's in the range of Wi-FI Mote.

Connect to the SSID of choice

5. **Lab Assignment No: 5**
   Demonstration of a peer to peer network topology.
   check the connectivity to any device in the same network**.**
6. **Lab Assignment No: 6**
   Send hello world to TCP server existing in the same network
   Reading of atmospheric pressure value from pressure sensor.
7. **Lab Assignment No: 7**
   I2C protocol study
   Reading Temperature and Relative Humidity value from the sensor.
   Reading Light intensity value from light sensor.
8. **Lab Assignment No: 8**
   Proximity detection with IR LED.
   Generation of alarm through Buzzer.
9. **Lab Assignment No: 9**
   Timestamp with RTC
   IO Expander.
   Relay control.
10. **Lab Assignment No: 10**
    I2C based 12-channel ADC
    EEPROM read and write
11. **Lab Assignment No: 11**
    Transmitting the measured physical value from the UbiSense Over the Air.

Text books:

1. Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.(T1)

2. Raj Pethuru and Raman Anupama C., The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.(T2)

Reference books:

1. Vermesan Dr. Ovidiu, Friess Dr. Peter, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers.(R1)

2. Holler Jan, TsiatsisVlasios, Mulligan Catherine, Avesand Stefan, Karnouskos Stamatis, Boyle David, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.(R2)

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment

Assessment Tools	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcome onto Program Outcome

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	Medium	3	4	5	6	7	8	9	10	11	1	13	14	15
CO1	Medium	High	High	Medium	High	Low	Medium	Low	Medium	Low	Low	Medium	Medium	Medium	Medium
CO2	Medium	High	High	High	Medium	Medium	Low	Low	Low	Low	Low	Medium	Medium	High	Medium
CO3	Medium	High	Medium	Medium	Medium	Low	Low	Low	Low	Low	Low	Medium	High	Medium	Medium
CO4	Medium	Medium	Medium	High	Medium	Medium	Low	Low	Low	Low	Low	High	Medium	Medium	Medium
CO5	Medium	High	High	High	Medium	Low	Low	Medium	Low	Low	Low	High	High	Medium	Medium