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(Approved by AICTE, New Delhi, Recognised by Govt. of Karnataka and Affiliated to Visvesvaraya Technological University, Belagavi)

COURSE CONTENT AND OUTCOMES OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(Effective from Academic year 2020-21)

III Semester

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES			
Course Code:	**21MAT31**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

CLO 1. To have an insight into solving ordinary differential equations by using Laplace transform techniques
CLO 2. Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.
CLO 3. To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the z-transform method.
CLO 4. To develop the proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Laplace transforms of derivatives, solution of differential equations.

Self-study: Solution of simultaneous first-order differential equations.

Teaching-Learning Process	Chalk and talk method /

Module-2

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.

Self-study: Convergence of series by D'Alembert's Ratio test and, Cauchy's root test

Teaching-Learning Process	Chalk and talk method / Powerpoint Presentation

Module-3	
Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems. Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations. **Self-Study:** Initial value and final value theorems, problems.	
Teaching-Learning Process	Chalk and talk method / Powerpoint Presentation
Module-4	
Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems. **Self-Study:** Solution of Poisson equations using standard five-point formula.	
Teaching-Learning Process	Chalk and talk method / Powerpoint Presentation
Module-5	
Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae). Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems. **Self- Study:** Hanging chain problem	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course Outcomes (Course Skill Set)

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

CO 1. To solve ordinary differential equations using Laplace transform.

CO 2. Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.

CO 3. To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations

CO 4. To solve mathematical models represented by initial or boundary value problems involving partial differential equations

CO 5. Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

DATA STRUCTURES AND APPLICATIONS			
Course Code:	**21CS32**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03

Course Objectives:

CLO 1. Explain the fundamentals of data structures and their applications essential for implementing solutions to problems.
CLO 2. Illustrate representation of data structures: Stack, Queues, Linked Lists, Trees and Graphs.
CLO 3. Design and Develop Solutions to problems using Arrays, Structures, Stack, Queues, Linked Lists.
CLO 4. Explore usage of Trees and Graph for application development.
CLO 5. Apply the Hashing techniques in mapping key value pairs.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Data Structures, Classifications (Primitive & Non-Primitive), Data structure operations (Traversing, inserting, deleting, searching, and sorting). Review of Arrays. Structures: Array of structures Self-Referential Structures.
Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays and Multidimensional Arrays.
Demonstration of representation of Polynomials and Sparse Matrices with arrays.

Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7, Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14 Textbook 3: Chapter 1: 1.3

Laboratory Component:

1. Design, Develop and Implement a menu driven Program in C for the following Array Operations
   a. Creating an Array of N Integer Elements
   b. Display of Array Elements with Suitable Headings
   c. Exit.
   Support the program with functions for each of the above operations.

2. Design, Develop and Implement a menu driven Program in C for the following Array operations
   a. Inserting an Element (ELEM) at a given valid Position (POS)
   b. Deleting an Element at a given valid Position POS)

c. Display of Array Elements
d. Exit.

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

Teaching-Learning Process	Problem based learning (Implementation of different programs to illustrate application of arrays and structures. https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html https://ds1-iiith.vlabs.ac.in/data-structures-1/List%20of%20experiments.html

Module-2

Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays. Different representation of expression. Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion.

Queues: Definition, Array Representation of Queues, Queue Operations, Circular Queues, Queues and Circular queues using Dynamic arrays, Dequeues, Priority Queues.

Textbook 1: Chapter 3: 3.1 -3.4, 3.6 Textbook 2: Chapter 6: 6.1 -6.4, 6.5, 6.7-6.13

Laboratory Component:

1. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)
   a. *Push* an Element on to Stack
   b. *Pop* an Element from Stack
   c. Demonstrate *Overflow* and *Underflow* situations on Stack
   d. Display the status of Stack
   e. Exit

   Support the program with appropriate functions for each of the above operations
2. Design, Develop and Implement a Program in C for the following Stack Applications
   a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^
   b. Solving Tower of Hanoi problem with n disks

Teaching-Learning Process	Active Learning, Problem based learning https://nptel.ac.in/courses/106/102/106102064/ https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html

Module-3

Linked Lists: Definition, classification of linked lists. Representation of different types of linked lists in Memory, Traversing, Insertion, Deletion, Searching, Sorting, and Concatenation Operations on Singly linked list, Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples.

Textbook 1: Chapter 4: 4.1 – 4.4, 4.5.2, 4.7, 4.8, Textbook 2: Chapter 5: 5.1 – 5.9

Laboratory Component:

1. Singly Linked List (SLL) of Integer Data
   a. Create a SLL stack of N integer.
   b. Display of SLL
   c. Linear search. Create a SLL queue of N Students Data Concatenation of two SLL of integers.
2. Design, Develop and Implement a menu driven Program in C for the following operationson Doubly Linked List (DLL) of Professor Data with the fields: ID, Name, Branch, Area of specialization

a. Create a DLL stack of N Professor's Data.
b. Create a DLL queue of N Professor's Data

Display the status of DLL and count the number of nodes in it.

Teaching-Learning Process	MOOC, Active Learning, Problem solving based on linked lists. https://nptel.ac.in/courses/106/102/106102064/ https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html

Module-4

Trees 1: Terminologies, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, and Searching operation on Binary search tree. Application of Trees-Evaluation of Expression.

Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9

Laboratory Component:

1. Given an array of elements, construct a complete binary tree from this array in level order fashion. That is, elements from left in the array will be filled in the tree level wise starting from level 0. Ex: Input :
   arr[] = {1, 2, 3, 4, 5, 6}
   Output : Root of the following tree

2. Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers
   a. Create a BST of N Integers
   b. Traverse the BST in Inorder, Preorder and Post Order

Teaching-Learning Process	Problem based learning http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html

Module-5

Trees 2: AVL tree, Red-black tree, Splay tree, B-tree.

Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Traversal methods: Breadth First Search and Depth FirstSearch.

Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

Textbook 1: Chapter 10:10.2, 10.3, 10.4, Textbook 2:7.10 – 7.12, 7.15 Chapter 11: 11.2, Textbook 1: Chapter 6 : 6.1–6.2, Chapter 8 : 8.1-8.3, Textbook 2: 8.1 – 8.3, 8.5, 8.7

Textbook 3: Chapter 15:15.1, 15.2,15.3, 15.4,15.5 and 15.7

Laboratory Component:

1. Design, Develop and implement a program in C for the following operations on Graph (G) of cities
    a. Create a Graph of N cities using Adjacency Matrix.
    b. Print all the nodes reachable from a given starting node in a diagraph using DFS/BFS method.

2. Design and develop a program in C that uses Hash Function H:K->L as H(K)=K mod m(reminder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

Teaching-Learning Process	NPTL, MOOC etc. courses on trees and graphs. http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

Course Outcomes (Course Skill Set)

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

CO 1. Identify different data structures and their applications.
CO 2. Apply stack and queues in solving problems.
CO 3. Demonstrate applications of linked list.
CO 4. Explore the applications of trees and graphs to model and solve the real-world problem.
CO 5. Make use of Hashing techniques and resolve collisions during mapping of key value pairs

ANALOG AND DIGITAL ELECTRONICS			
Course Code	**21CS33**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03

Course Learning Objectives:

CLO 1. Explain the use of photo electronics devices, 555 timer IC, Regulator ICs and uA741

CLO 2. Make use of simplifying techniques in the design of combinational circuits.

CLO 3. Illustrate combinational and sequential digital circuits

CLO 4. Demonstrate the use of flipflops and apply for registers

CLO 5. Design and test counters, Analog-to-Digital and Digital-to-Analog conversion techniques.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

BJT Biasing: Fixed bias, Collector to base Bias, voltage divider bias

Operational Amplifier Application Circuits: Peak Detector, Schmitt trigger, Active Filters, Non-Linear Amplifier, Relaxation Oscillator, Current-to-Voltage and Voltage-to-Current Converter, Regulated Power Supply Parameters, adjustable voltage regulator, D to A and A to D converter.

Textbook 1: Part A: Chapter 4 (Sections 4.2, 4.3, 4.4), Chapter 7 (Sections 7.4, 7.6 to 7.11), Chapter 8 (Sections 8.1 and 8.5), Chapter 9.

Laboratory Component:

1. Simulate BJT CE voltage divider biased voltage amplifier using any suitable circuit simulator.
2. Using ua 741 Opamp, design a 1 kHz Relaxation Oscillator with 50% duty cycle
3. Design an astable multivibrator circuit for three cases of duty cycle (50%, <50% and >50%) using NE 555 timer IC.
4. Using ua 741 opamap, design a window comparator for any given UTP and LTP.

Teaching-Learning Process	1. Demonstration of circuits using simulation. 2. Project work: Design a integrated power supply and function generator operating at audio frequency. Sine, square and triangular functions are to be generated. 3. Chalk and Board for numerical

Module-2

Karnaugh maps: minimum forms of switching functions, two and three variable Karnaugh maps, four variable Karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants, the prime implicant chart, Petricks method, simplification of incompletely specified functions, simplification using map-entered variables

Textbook 1: Part B: Chapter 5 (Sections 5.1 to 5.4) Chapter 6 (Sections 6.1 to 6.5)

Laboratory Component:

1. Given a 4-variable logic expression, simplify it using appropriate technique and inplement the same using basic gates.

Teaching-Learning Process	1. Chalk and Board for numerical 2. Laboratory Demonstration

Module-3

Combinational circuit design and simulation using gates: Review of Combinational circuit design, design of circuits with limited Gate Fan-in, Gate delays and Timing diagrams, Hazards in combinational Logic, simulation and testing of logic circuits

Multiplexers, Decoders and Programmable Logic Devices: Multiplexers, three state buffers, decoders and encoders, Programmable Logic devices.

Textbook 1: Part B: Chapter 8, Chapter 9 (Sections 9.1 to 9.6)

Laboratory Component:

1. Given a 4-variable logic expression, simplify it using appropriate technique and realize the simplified logic expression using 8:1 multiplexer IC.
2. Design and implement code converter I) Binary to Gray (II) Gray to Binary Code

Teaching-Learning Process	1. Demonstration using simulator 2. Case study: Applications of Programmable Logic device 3. Chalk and Board for numerical

Module-4

Introduction to VHDL: VHDL description of combinational circuits, VHDL Models for multiplexers, VHDL Modules.

Latches and Flip-Flops: Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3,SR Flip Flop, J K Flip Flop, T Flip Flop.

Textbook 1: Part B: Chapter 10(Sections 10.1 to 10.3), Chapter 11 (Sections 11.1 to 11.7)

Laboratory Component:

1. Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same in HDL simulator
2. Realize a J-K Master / Slave Flip-Flop using NAND gates and verify its truth table. And implement the same in HDL.

Teaching-Learning Process	1. Demonstration using simulator 2. Case study: Arithmetic and Logic unit in VHDL 3. Chalk and Board for numerical

Module-5

Registers and Counters: Registers and Register Transfers, Parallel Adder with accumulator, shift registers, design of Binary counters, counters for other sequences, counter design using SR and J K Flip Flops.

Textbook 1: Part B: Chapter 12 (Sections 12.1 to 12.5)	
Laboratory Component: 1. Design and implement a mod-n (n<8) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working. 2. Design and implement an asynchronous counter using decade counter IC to count up from 0 to n (n<=9) and demonstrate on 7-segment display (using IC-7447)	
Teaching-Learning Process	1. Demonstration using simulator 2. Project Work: Designing any counter, use LED / Seven-segment display to display the output 3. Chalk and Board for numerical
Course outcome (Course Skill Set) At the end of the course the student will be able to: CO 1. Design and analyze application of analog circuits using photo devices, timer IC, power supply and regulator IC and op-amp. CO 2. Explain the basic principles of A/D and D/A conversion circuits and develop the same. CO 3. Simplify digital circuits using Karnaugh Map, and Quine-McClusky Methods CO 4. Explain Gates and flip flops and make us in designing different data processing circuits, registers and counters and compare the types. CO 5. Develop simple HDL programs	

III Semester

COMPUTER ORGANIZATION AND ARCHITECTURE			
Course Code	**21CS34**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand the organization and architecture of computer systems, their structure and operation
CLO 2. Illustrate the concept of machine instructions and programs
CLO 3. Demonstrate different ways of communicating with I/O devices
CLO 4. Describe different types memory devices and their functions
CLO 5. Explain arithmetic and logical operations with different data types
CLO 6. Demonstrate processing unit with parallel processing and pipeline architecture

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

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2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.

Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes

Textbook 1: Chapter1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter2 – 2.2 to 2.5

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits

Textbook 1: Chapter4 – 4.1, 4.2, 4.4, 4.5, 4.6

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Virtual memories

Textbook 1: Chapter 5 – 5.1 to 5.4, 5.5 (5.5.1, 5.5.2)

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4	
Arithmetic: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers **Basic Processing Unit:** Fundamental Concepts, Execution of a Complete Instruction, Hardwired control, Microprogrammed control **Textbook 1: Chapter2-2.1, Chapter6 – 6.1 to 6.3** **Textbook 1: Chapter7 – 7.1, 7.2,7.4, 7.5**	
Teaching-Learning Process	Chalk& board, Problem based learning
Module-5	
Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing, Array Processors **Textbook 2: Chapter 9 – 9.1, 9.2, 9.3, 9.4, 9.6, 9.7**	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes At the end of the course the student will be able to: CO 1. Explain the organization and architecture of computer systems with machine instructions and programs CO 2. Analyze the input/output devices communicating with computer system CO 3. Demonstrate the functions of different types of memory devices CO 4. Apply different data types on simple arithmetic and logical unit CO 5. Analyze the functions of basic processing unit, Parallel processing and pipelining	

III Semester

OBJECT ORIENTED PROGRAMMING WITH JAVA LABORATORY			
Course Code	**21CSL35**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	1	Exam Hours	03

Course Objectives:

CLO 1. Demonstrate the use of Eclipse/Netbeans IDE to create Java Applications.
CLO 2. Using java programming to develop programs for solving real-world problems.
CLO 3. Reinforce the understanding of basic object-oriented programming concepts.

	Note: two hours tutorial is suggested for each laboratory sessions.
	Prerequisite
	• Students should be familiarized about java installation and setting the java environment. • Usage of IDEs like Eclipse/Netbeans should be introduced.
Sl. No.	***PART A – List of problems for which student should develop program and execute in the Laboratory***
1	Aim: Introduce the java fundamentals, data types, operators in java Program: Write a java program that prints all real solutions to the quadratic equation ax2+bx+c=0. Read in a, b, c and use the quadratic formula.
2	Aim: Demonstrating creation of java classes, objects, constructors, declaration and initialization of variables. Program: Create a Java class called **Student** with the following details as variables within it. USN Name Branch Phone Write a Java program to create n Student objects and print the USN, Name, Branch, and Phone of these objects with suitable headings.
3	Aim: Discuss the various Decision-making statements, loop constructs in java Program: A. Write a program to check prime number B.Write a program for Arithmetic calculator using switch case menu
4	Aim: Demonstrate the core object-oriented concept of Inheritance, polymorphism Design a super class called **Staff** with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a Java program to read and display at least 3 staff objects of all three categories.
5	Aim: Introduce concepts of method overloading, constructor overloading, overriding. Program: Write a java program demonstrating Method overloading and Constructor overloading.
6	Aim: Introduce the concept of Abstraction, packages. Program: Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.
7	Aim: Introduction to abstract classes, abstract methods, and Interface in java

	Program: Write a program to generate the resume. Create 2 Java classes Teacher (data: personal information, qualification, experience, achievements) and Student (data: personal information, result, discipline) which implements the java interface Resume with the method biodata().
8	Aim: Demonstrate creation of threads using Thread class and Runnable interface, multi-threaded programming. Program: Write a Java program that implements a **multi-thread** application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number and prints; third thread will print the value of cube of the number.
9	Aim: Introduce java Collections. Program: Write a program to perform string operations using ArrayList. Write functions for the following a. Append - add at end b. Insert – add at particular index c. Search d. List all string starts with given letter.
10	Aim: Exception handling in java, introduction to throwable class, throw, throws, finally. Program: Write a Java program to read two integers a and b. **Compute** a/b and print, when b is not zero. Raise an exception when b is equal to zero.
11	Aim: Introduce File operations in java. Program: Write a java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes
12	Aim: Introduce java Applet, awt, swings. Programs: Develop an applet that displays a simple message in center of the screen. Develop a simple calculator using Swings.
	PART B – Practical Based Learning
01	A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the program for the given problem with appropriate outputs.

Course Outcome (Course Skill Set)
At the end of the course the student will be able to:

CO 1. Use Eclipse/NetBeans IDE to design, develop, debug Java Projects.
CO 2. Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP.
CO 3. Demonstrate the ability to design and develop java programs, analyze, and interpret object-oriented data and document results.
CO 4. Apply the concepts of multiprogramming, exception/event handling, abstraction to develop robust programs.
CO 5. Develop user friendly applications using File I/O and GUI concepts.

PROGRAMMING IN C++			
Course Code	**21CS382**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12	Total Marks	100
Credits	01	Exam Hours	01

Course Objectives:

CLO 1. Understanding about object oriented programming and Gain knowledge about the capability to store information together in an object.
CLO 2. Understand the capability of a class to rely upon another class and functions.
CLO 3. Understand about constructors which are special type of functions.
CLO 4. Create and process data in files using file I/O functions
CLO 5. Use the generic programming features of C++ including Exception handling.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Object Oriented Programming: Computer programming background- C++ overview- First C++ Program -Basic C++ syntax, Object Oriented Programming: What is an object, Classes, methods and messages, abstraction and encapsulation, inheritance, abstract classes, polymorphism.

Textbook 1: Chapter 1(1.1 to 1.8)

Teaching-Learning Process	Chalk and board, Active Learning, practical based learning

Module-2

Functions in C++: Tokens – Keywords – Identifiers and constants – Operators in C++ – Scope resolution operator – Expressions and their types – Special assignment expressions – Function prototyping – Call by reference – Return by reference – Inline functions -Default arguments – Function overloading.

Textbook 2: Chapter 3(3.2,3.3,3.4,3.13,3.14,3.19, 3.20) , chapter 4(4.3,4.4,4.5,4.6,4.7,4.9) .

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration, presentation, problem solving

Module-3

Inheritance & Polymorphism: Derived class Constructors, destructors-Types of Inheritance- Defining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance.

Textbook 2: Chapter 6 (6.2,6.11) chapter 8 (8.1 to,8.8)

Teaching-Learning Process	Chalk and board, Demonstration, problem solving
Module-4	
I/O Streams: C++ Class Hierarchy- File Stream-Text File Handling- Binary File Handling during file operations. **Textbook 1: Chapter 12(12.5) , Chapter 13 (13.6,13.7)**	
Teaching-Learning Process	Chalk and board, Practical based learning, practical's
Module-5	
Exception Handling: Introduction to Exception - Benefits of Exception handling- Try and catch block- Throw statement- Pre-defined exceptions in C++ . **Textbook 2: Chapter 13 (13.2 to13.6)**	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes (Course Skill Set): At the end of the course the student will be able to: CO 1. Able to understand and design the solution to a problem using object-oriented programming concepts. CO 2. Able to reuse the code with extensible Class types, User-defined operators and function Overloading. CO 3. Achieve code reusability and extensibility by means of Inheritance and Polymorphism CO 4. Identify and explore the Performance analysis of I/O Streams. CO 5. Implement the features of C++ including templates, exceptions and file handling for providing programmed solutions to complex problems.	

DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	**21CS42**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03

Course Learning Objectives:

CLO 1. Explain the methods of analysing the algorithms and to analyze performance of algorithms.
CLO 2. State algorithm's efficiencies using asymptotic notations.
CLO 3. Solve problems using algorithm design methods such as the brute force method, greedy method, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking and branch and bound.
CLO 4. Choose the appropriate data structure and algorithm design method for a specified application.
CLO 5. Introduce P and NP classes.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: What is an Algorithm? It's Properties. Algorithm Specification-using natural language, using Pseudo code convention, Fundamentals of Algorithmic Problem solving, Analysis Framework-Time efficiency and space efficiency, Worst-case, Best-case and Average case efficiency.

Performance Analysis: Estimating Space complexity and Time complexity of algorithms.

Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation ( ) with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples.

Brute force design technique: Selection sort, sequential search, string matching algorithm with complexity Analysis.

Textbook 1: Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2)

Textbook 2: Chapter 1(section 1.1,1.2,1.3)

Laboratory Component:

1. Sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the brute force method works along with its time complexity analysis: worst case, average case and best case.

Teaching-Learning Process	1. Problem based Learning. 2. Chalk & board, Active Learning. 3. Laboratory Demonstration.

Module-2

Divide and Conquer: General method, Recurrence equation for divide and conquer, solving it using Master's theorem. , Divide and Conquer algorithms and complexity Analysis of Finding the maximum & minimum, Binary search, Merge sort, Quick sort.

Decrease and Conquer Approach: Introduction, Insertion sort, Graph searching algorithms, Topological Sorting. It's efficiency analysis.

Textbook 2: Chapter 3(Sections 3.1,3.3,3.4,3.5,3.6)

Textbook 1: Chapter 4 (Sections 4.1,4.2,4.3), Chapter 5(Section 5.1,5.2,5.3)

Laboratory Component:

1. Sort a given set of n integer elements using Quick Sort method and compute its time

   complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.

2. Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.

Teaching-Learning Process	1. Chalk & board, Active Learning, MOOC, Problem based Learning. 2. Laboratory Demonstration.

Module-3

Greedy Method: General method, Coin Change Problem, Knapsack Problem, solving Job sequencing with deadlines Problems.

Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm with performance analysis.

Single source shortest paths: Dijkstra's Algorithm.

Optimal Tree problem: Huffman Trees and Codes.

Transform and Conquer Approach: Introduction, Heaps and Heap Sort.

Textbook 2: Chapter 4(Sections 4.1,4.3,4.5)

Textbook 1: Chapter 9(Section 9.1,9.2,9.3,9.4), Chapter 6(section 6.4)

Laboratory Component:

Write & Execute C++/Java Program

1. To solve Knapsack problem using Greedy method.
2. To find shortest paths to other vertices from a given vertex in a weighted connected graph, using Dijkstra's algorithm.
3. To find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
4. To find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.

Teaching-Learning Process	1. Chalk & board, Active Learning, MOOC, Problem based Learning. 2. Laboratory Demonstration.

Module-4

Dynamic Programming: General method with Examples, Multistage Graphs.

Transitive Closure: Warshall's Algorithm. **All Pairs Shortest Paths**: Floyd's Algorithm,

Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem.

Space-Time Tradeoffs: Introduction, Sorting by Counting, Input Enhancement in String Matching-Harspool's algorithm.

Textbook 2: Chapter 5 (Sections 5.1,5.2,5.4,5.9)

Textbook 1: Chapter 8(Sections 8.2,8.4), Chapter 7 (Sections 7.1,7.2)

Laboratory Component:

Write C++/ Java programs to

1. Solve All-Pairs Shortest Paths problem using Floyd's algorithm.
2. Solve Travelling Sales Person problem using Dynamic programming.
3. Solve 0/1 Knapsack problem using Dynamic Programming method.

Teaching-Learning Process	1. Chalk & board, Active Learning, MOOC, Problem based Learning. 2. Laboratory Demonstration.

Module-5

Backtracking: General method, solution using back tracking to N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles Problems.

Branch and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem

NP-Complete and NP-Hard problems: Basic concepts, non- deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes.

Textbook 1: Chapter 12 (Sections 12.1,12.2) Chapter 11(11.3)

Textbook 2: Chapter 7 (Sections 7.1,7.2,7.3,7.4,7.5) Chapter 11 (Section 11.1)

Laboratory Component:

1. Design and implement C++/Java Program to find a subset of a given set S = {Sl, S2,…, Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S = {1, 2, 5, 6, 8} and d= 9, there are two solutions {1, 2, 6} and {1, 8}. Display a suitable message, if the given problem instance doesn't have a solution.

2. Design and implement C++/Java Program to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

Teaching-Learning Process	1. Chalk & board, Active Learning, MOOC, Problem based learning. 2. Laboratory Demonstration.

Course outcome (Course Skill Set)

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

CO 1. Analyze the performance of the algorithms, state the efficiency using asymptotic notations and analyze mathematically the complexity of the algorithm.

CO 2. Apply divide and conquer approaches and decrease and conquer approaches in solving the problems analyze the same

CO 3. Apply the appropriate algorithmic design technique like greedy method, transform and conquer approaches and compare the efficiency of algorithms to solve the given problem.

CO 4. Apply and analyze dynamic programming approaches to solve some problems. and improve an algorithm time efficiency by sacrificing space.

CO 5. Apply and analyze backtracking, branch and bound methods and to describe P, NP and NP-Complete problems.

IV Semester

MICROCONTROLLER AND EMBEDDED SYSTEMS			
Course Code	**21CS43**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03

Course Learning Objectives:

CLO 1: Understand the fundamentals of ARM-based systems, including programming modules with registers and the CPSR.

CLO 2: Use the various instructions to program the ARM controller.

CLO 3: Program various embedded components using the embedded C program.

CLO 4: Identify various components, their purpose, and their application to the embedded system's applicability.

CLO 5: Understand the embedded system's real-time operating system and its application in IoT.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to develop the outcomes.
2. Show video/animation films to explain the functioning of various concepts.
3. Encourage collaborative (group learning) learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
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6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world, and when that's possible, it helps improve the students' understanding.

Module-1

Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions

Textbook 1: Chapter 1 - 1.1 to 1.4, Chapter 2 - 2.1 to 2.5

Laboratory Component:

1. Using Keil software, observe the various registers, dump, CPSR, with a simple ALP programme.

Teaching-Learning Process	1. Demonstration of registers, memory access, and CPSR in a programme module. 2. For concepts, numerical, and discussion, use chalk and a whiteboard, as well as a PowerPoint presentation.

Module-2

Introduction to the ARM Instruction Set: Data Processing Instructions , Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants

C Compilers and Optimization : Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing,

Textbook 1: Chapter 3: Sections 3.1 to 3.6 (Excluding 3.5.2), Chapter 5

Laboratory Component:

2. Write a program to find the sum of the first 10 integer numbers.
3. Write a program to find the factorial of a number.
4. Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM.
5. Write a program to find the square of a number (1 to 10) using a look-up table.
6. Write a program to find the largest or smallest number in an array of 32 numbers.

Teaching-Learning Process	1. Demonstration of sample code using Keil software. 2. Laboratory Demonstration

Module-3

C Compilers and Optimization : Structure Arrangement, Bit-fields, Unaligned Data and Endianness, Division, Floating Point, Inline Functions and Inline Assembly, Portability Issues.

ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs

Textbook 1: Chapter-5,6

Laboratory Component:

1. Write a program to arrange a series of 32 bit numbers in ascending/descending order.
2. Write a program to count the number of ones and zeros in two consecutive memory locations.
3. Display "Hello World" message using Internal UART.

Teaching-Learning Process	1. Demonstration of sample code using Keil software. 2. Chalk and Board for numerical

Module-4

Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems.

Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.

Textbook 2: Chapter 1 (Sections 1.2 to 1.6), Chapter 2 (Sections 2.1 to 2.6)

Laboratory Component:

1. Interface and Control a DC Motor.
2. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
3. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
4. Interface a DAC and generate Triangular and Square waveforms.
5. Interface a 4x4 keyboard and display the key code on an LCD.
6. Demonstrate the use of an external interrupt to toggle an LED On/Off.
7. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

Teaching-Learning Process	1. Demonstration of sample code for various embedded components using keil. 2. Chalk and Board for numerical and discussion

Module-5

RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan. **Textbook 2: Chapter-10 (Sections 10.1, 10.2, 10.3, 10.4 , 10.7, 10.8.1.1, 10.8.1.2, 10.8.2.2, 10.10 only), Chapter 12, Chapter-13 (block diagram before 13.1, 13.3, 13.4, 13.5, 13.6 only)**
Laboratory Component: 1. Demonstration of IoT applications by using Arduino and Raspberry Pi

Teaching-Learning Process	1. Chalk and Board for numerical and discussion 2. Significance of real time operating system[RTOS] using raspberry pi

Course outcome (Course Skill Set)

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

CO 1. Explain C-Compilers and optimization

CO 2. Describe the ARM microcontroller's architectural features and program module.

CO 3. Apply the knowledge gained from programming on ARM to different applications.

CO 4. Program the basic hardware components and their application selection method.

CO 5. Demonstrate the need for a real-time operating system for embedded system applications.

IV Semester

OPERATING SYSTEMS			
Course Code:	**21CS44**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

CLO 1. Demonstrate the need for OS and different types of OS
CLO 2. Apply suitable techniques for management of different resources
CLO 3. Use processor, memory, storage and file system commands
CLO 4. Realize the different concepts of OS in platform of usage through case studies

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

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6. IntroduceTopics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.

Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot.

Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication

Textbook 1: Chapter - 1,2,3

Teaching-Learning Process	Active learning and problem solving 1. https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O 2. https://www.youtube.com/watch?v=a2B69vCtjOU&list=PL3-wYxbt4yCjpcfUDz-TgD_ainZ2K3MUZ&index=2

Module-2

<table>
<tr><td colspan="2">Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling; Thread scheduling.

Process Synchronization: Synchronization: The critical section problem; Peterson’s solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.

Textbook 1: Chapter - 4,5</td></tr>
<tr><td>Teaching-Learning Process</td><td>Active Learning and problem solving
1. https://www.youtube.com/watch?v=HW2Wcx-ktsc
2. https://www.youtube.com/watch?v=9YRxhlvt9Zo</td></tr>
<tr><td colspan="2">Module-3</td></tr>
<tr><td colspan="2">Deadlocks: Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

Textbook 1: Chapter - 7,8</td></tr>
<tr><td>Teaching-Learning Process</td><td>Active Learning, Problem solving based on deadlock with animation
1. https://www.youtube.com/watch?v=MYgmmJJfdBg
2. https://www.youtube.com/watch?v=Y14b7_T3AEw&list=PLEJxKK7AcSEGPOCFtQTJhOElU44J_JAun&index=30</td></tr>
<tr><td colspan="2">Module-4</td></tr>
<tr><td colspan="2">Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

File System, Implementation of File System: File system: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.

Textbook 1: Chapter - 9,10,11</td></tr>
<tr><td>Teaching-Learning Process</td><td>Active learning about memory management and File system
1. https://www.youtube.com/watch?v=pJ6qrCB8pDw&list=PLIY8eNdw5tW-BxRY0yK3fYTYVqytw8qhp
2. https://www.youtube.com/watch?v=-orfFhvNBzY</td></tr>
<tr><td colspan="2">Module-5</td></tr>
<tr><td colspan="2">Secondary Storage Structures, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems.

Case Study: The Linux Operating System: Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication.

Textbook 1: Chapter - 2,21</td></tr>
<tr><td>Teaching-Learning Process</td><td>Active learning about case studies
1. https://www.youtube.com/watch?v=TTBkc5eiju4
2. https://www.youtube.com/watch?v=8hkvMRGTzCM&list=PLEAYkSg4uSQ2PAch478muxnoeTNz_QeUJ&index=36
3. https://www.youtube.com/watch?v=mX1FEur4VCw</td></tr>
<tr><td colspan="2"></td></tr>
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Course Outcomes (Course Skill Set)

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

CO 1. Identify the structure of an operating system and its scheduling mechanism.
CO 2. Demonstrate the allocation of resources for a process using scheduling algorithm.
CO 3. Identify root causes of deadlock and provide the solution for deadlock elimination
CO 4. Explore about the storage structures and learn about the Linux Operating system.
CO 5. Analyze Storage Structures and Implement Customized Case study

IV Semester

UNIX SHELL PROGRAMMING			
Course Code	**21CS482**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12	Total Marks	100
Credits	01	Exam Hours	01

Course Objectives:

CLO 1. To help the students to understand effective use of Unix concepts, commands and terminology.
CLO 2. Identify, access, and evaluate UNIX file system.
CLO 3. Understand UNIX command syntax and semantics.
CLO 4. Ability to read and understand specifications, scripts and programs.
CLO 5. Analyze Facility with UNIX Process.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction of UNIX - Introduction, History, Architecture, Experience the Unix environment, Basic commands ls, cat, cal, date, calendar, who, printf, tty, sty, uname, passwd, echo, tput, and bc.

Textbook 1: Chapter 1(1.1 to 1.4) , Chapter 2- 2.1

Teaching-Learning Process	Chalk and board, Active Learning, practical based learning

Module-2

UNIX File System- The file, what's in a filename? The parent-child relationship, pwd, the Home directory, absolute pathnames, using absolute pathnames for a command, cd, mkdir, rmdir, Relative pathnames, The UNIX file system.

Textbook 1: Chapter 4

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration, presentation, problem solving

Module-3

Basic File Attributes - Is – l, the –d option, File Permissions, chmod, Security and File Permission, users and groups, security level, changing permission, user masks, changing ownership and group, File Attributes, More file attributes: hard link, symbolic link, umask, find.

Textbook 1: Chapter 6

Teaching-Learning Process	Chalk and board, Demonstration, problem solving

Module-4

Introduction to the Shell Scripting - Introduction to Shell Scripting, Shell Scripts, read, Command Line Arguments, Exit Status of a Command, The Logical Operators && and ||, exit, if, and case conditions, expr, sleep and wait, while, until, for, $, @, redirection. The here document, set, trap, Sample Validation and Data Entry Scripts. **Textbook 1: Chapter 11,12,14**	
Teaching-Learning Process	Chalk and board, Practical based learning, practical's
Module-5	
Introduction to UNIX System process: Mechanism of process creation. Parent and child process. The ps command with its options. Executing a command at a specified point of time: at command. Executing a command periodically: cron command and the crontab file.. Signals. **Textbook 1: Chapter 9,19**	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes (Course Skill Set): At the end of the course the student will be able to: CO 1. Know the basics of Unix concepts and commands. CO 2. Evaluate the UNIX file system. CO 3. Apply Changes in file system. CO 4. Understand scripts and programs. CO 5. Analyze Facility with UNIX system process	

IV Semester

AUTOMATA THEORY AND COMPILER DESIGN			
Course Code	**21CS51**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Introduce the fundamental concepts of Automata Theory, Formal Languages and compiler design
CLO 2. Principles Demonstrate Application of Automata Theory and Formal Languages in the field of compiler design
CLO 3. Develop understanding of computation through Push Down Automata and Turing Machines
CLO 4. Introduce activities carried out in different phases of Phases compiler
CLO 5. Identify the undecidability problems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different approaches and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion, Minimization of DFA

Introduction to Compiler Design: Language Processors, Phases of Compilers

Textbook 1: Chapter1 – 1.5, Chapter2 – 2.2,2.3,2.5 Chapter4 –4.4
Textbook 2: Chapter1 – 1.1 and 1.2

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Proving Languages Not to Be Regular

Lexical Analysis Phase of compiler Design: Role of Lexical Analyzer, Input Buffering , Specification of Token, Recognition of Token.

Textbook 1: Chapter3 – 3.1, 3.2, Chapter4- 4.1 **Textbook 2: Chapter3- 3.1 to 3.4**	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-3	
Context Free Grammars: Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion, Left Factoring. **Syntax Analysis Phase of Compilers: part-1:** Role of Parser , Top-Down Parsing **Textbook 1: Chapter 5 – 5.1.1 to 5.1.6, 5.2 (5.2.1, 5.2.2), 5.4** **Textbook 2: Chapter 4 – 4.1, 4.2, 4.3 (4.3.2 to 4.3.4) ,4.4**	
Teaching-Learning Process	**Chalk and board, Problem based learning, Demonstration**
Module-4	
Push Down Automata: Definition of the Pushdown Automata, The Languages of a PDA. **Syntax Analysis Phase of Compilers: Part-2:** Bottom-up Parsing, Introduction to LR Parsing: SLR, More Powerful LR parsers **Textbook1: Chapter 6 – 6.1, 6.2** **Textbook2: Chapter 4 – 4.5, 4.6, 4.7 (Up to 4.7.4)**	
Teaching-Learning Process	Chalk & board, Problem based learning
Module-5	
Introduction to Turing Machine: Problems that Computers Cannot Solve, The Turing machine, problems, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine **Undecidability :** A language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE. **Other Phases of Compilers: Syntax Directed Translation**- Syntax-Directed Definitions, Evaluation Orders for SDD's. **Intermediate-Code Generation**- Variants of Syntax Trees, Three-Address Code. **Code Generation**- Issues in the Design of a Code Generator **Textbook1: Chapter 8 – 8.1, 8.2,8.3,8.4 Chapter 9 – 9.1,9.2** **Textbook2: Chapter 5 – 5.1, 5.2, Chapter 6- 6.1,6.2 Chapter 8- 8.1**	
Teaching-Learning Process	**Chalk and board, MOOC**

Course Outcomes

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

CO 1. Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation

CO 2. Design and develop lexical analyzers, parsers and code generators

CO 3. Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.

CO 4. Acquire fundamental understanding of the structure of a Compiler and Apply concepts automata theory and Theory of Computation to design Compilers

CO 5. Design computations models for problems in Automata theory and adaptation of such model in the field of compilers

V Semester

COMPUTER NETWORKS			
Course Code:	21CS52	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40T + 20P	Total Marks	100
Credits	04	Exam Hours	03

Course Objectives:

CLO 1. Fundamentals of data communication networks.
CLO 2. Software and hardware interfaces
CLO 3. Application of various physical components and protocols
CLO 4. Communication challenges and remedies in the networks.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to networks: Network hardware, Network software, Reference models,

Physical Layer: Guided transmission media, Wireless transmission

Textbook 1: Ch.1.2 to 1.4, Ch.2.2 to 2.3

Laboratory Component:

1. Implement Three nodes point – to – point network with duplex links between them for different topologies. 1Set the queue size, vary the bandwidth, and find the number of packets dropped for various iterations.

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-2

The Data link layer: Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols.

The medium access control sublayer: The channel allocation problem, Multiple access protocols.

Textbook 1: Ch.3.1 to 3.4, Ch.4.1 and 4.2

Laboratory Component:

1. Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the throughput with respect to transmission of packets

2. Write a program for error detecting code using CRC-CCITT (16- bits).	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-3	
The Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, QoS. **Textbook 1: Ch 5.1 to 5.4**	
Laboratory Component: 1. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion in the network. 2. Write a program to find the shortest path between vertices using bellman-ford algorithm.	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
The Transport Layer: The Transport Service, Elements of transport protocols, Congestion control, The internet transport protocols. **Textbook 1: Ch 6.1 to 6.4 and 6.5.1 to 6.5.7**	
Laboratory Component: 1. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination. 2. Write a program for congestion control using leaky bucket algorithm.	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-5	
Application Layer: Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service. **Textbook 2: Ch 2.1 to 2.4**	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Course Outcomes (Course Skill Set) At the end of the course the student will be able to: CO 1. Learn the basic needs of communication system. CO 2. Interpret the communication challenges and its solution. CO 3. Identify and organize the communication system network components CO 4. Design communication networks for user requirements.	

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IV Semester

DATABASE MANAGEMENT SYSTEMS			
Course Code	21CS53	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Provide a strong foundation in database concepts, technology, and practice.
CLO 2. Practice SQL programming through a variety of database problems.
CLO 3. Demonstrate the use of concurrency and transactions in database
CLO 4. Design and build database applications for real world problems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.

Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema
architecture and data independence, database languages, and interfaces, The Database System environment.

Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples

Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.

Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.

Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

Textbook 1:, Ch 5.1 to 5.3, 8.1 to 8.5, 9.1;

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

SQL: SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.

Advances Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.
Database

Application Development: Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop.

Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.

Normalization Algorithms: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and
Normal Forms

Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6

Teaching-Learning Process	Chalk& board, Problem based learning

Module-5

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.
Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.
Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;

Course Outcomes

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

CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS

CO 2. Use Structured Query Language (SQL) for database manipulation and also demonstrate the basic of query evaluation.

CO 3. Design and build simple database systems and *relate* the concept of transaction, concurrency control and recovery in database

CO 4. Develop application to interact with databases, relational algebra expression. CO 5. Develop applications using tuple and domain relation expression from queries.

PRINCIPLES OF ARTIFICIAL INTELLIGENCE			
Course Code	21AI54	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Gain a historical perspective of AI and its foundations
CLO 2. Become familiar with basic principles of AI toward problem solving
CLO 3. Get to know approaches of inference, perception, Uncertain Knowledge and Reasoning

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: What is AI? Foundations and History of AI

Intelligent Agents: Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.

Text book 1: Chapter 1- 1.1, 1.2, 1.3 Chapter 2- 2.1, 2.2, 2.3, 2.4

Teaching-Learning Process	Chalk and board, Active Learning.

Module-2

Problem-solving: Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search;

Text book 1: Chapter 3- 3.1, 3.2, 3.3, 3.4

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Informed Search Strategies: Heuristic functions, Greedy best first search, A*search. Heuristic Functions

Logical Agents: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic

Text book 1: Chapter 4 – 4.1, 4.2 Chapter 7- 7.1, 7.2, 7.3, 7.4, 7.5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

First Order Logic: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic.

Inference in First Order Logic : Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution

Text book 1: Chapter 8- 8.1, 8.2, 8.3 Chapter 9- 9.1, 9.2, 9.3, 9.4, 9.5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-5

Uncertain Knowledge and Reasoning: Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye's Rule and its use. Wumpus World Revisited

Text Book 1: Chapter 13-13.1, 13.2, 13.3, 13.4, 13.5, 13.6

Teaching-Learning Process	Chalk and board, Active Learning.

Course Outcomes

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

CO 1. Apply knowledge of agent architecture, searching and reasoning techniques for different applications.
CO 2. Analyse Searching and Inferencing Techniques.
CO 3. Develop knowledge base sentences using propositional logic and first order logic
CO 4. Demonstrating agents, searching and inferencing
CO 5. Illustrate the application of probability in uncertain reasoning.

V Semester

C# AND .NET FRAMEWORK			
Course Code:	**21CS582**	CIE Marks	50
Teaching Hours/Week	1:0:0:0	SEE Marks	50
Total No. of Hours	12	Total Marks	100
Credits	01	Exam Hours	01

Course Objectives:

CLO 1. Understand the basics of C# and .NET
CLO 2. Learn the variables and constants of C#
CLO 3. Know the object-oriented aspects and applications.
CLO 4. Learn the basic structure of .NET framework.
CLO 5. Learn to create a simple project of .NET Core

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Introduction to C# **Part-I:** Understanding C#, .NET, overview of C#, Variables, Data Types, Operators, Expressions, Branching, Looping, Methods, implicit and explicit casting.	
Teaching-Learning Process	Active learning
Module-2	
Part-II: Constants, Arrays, Array Class, Array List, String, String Builder, Structure, Enumerations, boxing and unboxing.	
Teaching-Learning Process	Active learning
Module-3	
Object Oriented Concepts-I: Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism.	
Teaching-Learning Process	Active learning
Module-4	
Object Oriented Concepts-II:	

Sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.	
Teaching-Learning Process	Active learning
Module-5	
Introduction to .NET FRAMEWORK: Assemblies, Versoning, Attributes, reflection, viewing meta data, remoting, security in .NET, Environment Setup of .NET Core and create a small project.	
Teaching-Learning Process	Active learning
Course Outcomes (Course Skill Set) At the end of the course the student will be able to: CO 1. Able to explain how C# fits into the .NET platform. CO 2. Describe the utilization of variables and constants of C# CO 3. Use the implementation of object-oriented aspects in applications. CO 4. Analyze and Set up Environment of .NET Core. CO 5. Evaluate and create a simple project application.	

VI Semester

SOFTWARE ENGINEERING & PROJECT MANAGEMENT			
Course Code	**21CS61**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers.

CLO 2. Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.

CLO 3. Infer the fundamentals of object oriented concepts, differentiate system models, use UML diagrams and apply design patterns.

CLO 4. Explain the role of DevOps in Agile Implementation.

CLO 5. Discuss various types of software testing practices and software evolution processes.

CLO 6. Recognize the importance Project Management with its methods and methodologies.

CLO 7. Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: The evolving role of software, Software, The changing nature of software, Software engineering, A Process Framework, Process Patterns, Process Assessment, Personal and Team Process Models, Process Technology, Product and Process.

Textbook 1: Chapter 1: 1.1 to 1.3

Process Models: Prescriptive models, Waterfall model, Incremental process models, Evolutionary process models, Specialized process models.

Textbook 1: Chapter 2: 2.1, 2.2, 2.4 to 2.7

Requirements Engineering: Requirements Engineering Task, Initiating the Requirements Engineering process, Eliciting Requirements, Developing use cases, Building the analysis model, Negotiating Requirements, Validating Requirements, Software Requirement Document **(Sec 4.2)**

Textbook 1: Chapter 3: 3.1 to 3.6, Textbook 5: Chapter 4: 4.2

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Introduction, Modelling Concepts and Class Modelling: What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling, abstraction, The Three models. Class Modelling: Object and Class Concept, Link and associations concepts, Generalization and Inheritance, A sample class model, Navigation of class models, Introduction to RUP**(Textbook: 5 Sec 2.4)** and UML diagrams

Textbook 2: Chapter 1,2,3

Building the Analysis Models: Requirement Analysis, Analysis Model Approaches, Data modeling Concepts, Object Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, class Based Modeling, Creating a Behavioral Model.

Textbook 1: Chapter 8: 8.1 to 8.8

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Software Testing: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object -Oriented Software, Validation Testing, System Testing, The Art of Debugging.

Textbook 1: Chapter 13: 13.1 to 13.7

Agile Methodology & DevOps: Before Agile – Waterfall, Agile Development,

Self-Learning Section:
What is DevOps?, DevOps Importance and Benefits, DevOps Principles and Practices, 7 C's of DevOps Lifecycle for Business Agility, DevOps and Continuous Testing, How to Choose Right DevOps Tools?, Challenges with DevOps Implementation.

Textbook 4: Chapter 2: 2.1 to 2.9

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-4

Introduction to Project Management:
Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.

Textbook 3: Chapter 1: 1.1 to 1.17

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-5

Activity Planning:
Objectives of Activity Planning, When to Plan, Project Schedules, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass– Backward Pass, Identifying critical path, Activity Float, Shortening Project Duration, Activity on Arrow Networks.

Textbook 3: Chapter 6: 6.1 to 6.16

Software Quality:
Introduction, The place of software quality in project planning, Importance of software quality, software quality models, ISO 9126, quality management systems, process capability models, techniques to enhance software quality, quality plans.

Textbook 3: Chapter 13: (13.1 to 13.6 , 13.9, 13.11, 13.14),

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Course Outcomes

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

CO 1. Understand the activities involved in software engineering and analyze the role of various process models

CO 2. Explain the basics of object-oriented concepts and build a suitable class model using modelling techniques

CO 3. Describe various software testing methods and to understand the importance of agile methodology and DevOps

CO 4. Illustrate the role of project planning and quality management in software development

CO 5. Understand the importance of activity planning and different planning models

VI Semester

DATA SCIENCE AND ITS APPLICATIONS			
Course Code	21AD62	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03

Course Learning Objectives:

CLO 1.Demonstrate the proficiency with statistical analysis of data to derive insight from results and interpret the data findings visually

CLO 2.Utilize the

CLO 3. skills in data management by obtaining, cleaning and transforming the data.

CLO 4.Make use of machine learning models to solve the business-related challenges

CLO 5. Experiment with decision trees, neural network layers and data partition.

CLO 6. Demonstrate how social clustering shape individuals and groups in contemporary society.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1: Introduction

What is Data Science? Visualizing Data, matplotlib, Bar Charts, Line Charts, Scatterplots, **Linear Algebra,** Vectors, Matrices, **Statistics,** Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation, **Probability,** Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem.

Chapters 1, 3, 4, 5 and 6

Laboratory Component:

1. Installation of Python/R language, Visual Studio code editors can be demonstrated along with Kaggle data set usage.
2. Write programs in Python/R and Execute them in either Visual Studio Code or PyCharm Community Edition or any other suitable environment.
3. A study was conducted to understand the effect of number of hours the students spent studying on their performance in the final exams. Write a code to plot line chart with number of hours spent studying on x-axis and score in final exam on y-axis. Use a red '*' as the point character, label the axes and give the plot a title.

Number of hrs spent studying (x)	10	9	2	15	10	16	11	16
Score in the final exam (0 – 100) (y)	95	80	10	50	45	98	38	93

4. For the given dataset mtcars.csv (www.kaggle.com/ruiromanini/mtcars), plot a histogram to check the frequency distribution of the variable 'mpg' (Miles per gallon)

Teaching-Learning Process	1. Demonstration of different charts 2. PPT Presentation for Theorems and different distributions 3. Live coding and execution for visualization with simple examples

Module-2: Hypothesis and Inference

Statistical Hypothesis Testing, Example: Flipping a Coin, p-Values, Confidence Intervals, p-Hacking, Example: Running an A/B Test, Bayesian Inference, **Gradient Descent,** The Idea Behind Gradient Descent Estimating the Gradient, Using the Gradient, Choosing the Right Step Size, Using Gradient Descent to Fit Models, Minibatch and Stochastic Gradient Descent, **Getting Data,** stdin and stdout, Reading Files, Scraping the Web, Using APIs, Example: Using the Twitter APIs, **Working with Data,** Exploring Your Data, Using NamedTuples, Dataclasses, Cleaning and Munging, Manipulating Data, Rescaling, An Aside: tqdm, Dimensionality Reduction.

Chapters 7, 8, 9 and 10

Laboratory Component:

1. Consider the books dataset BL-Flickr-Images-Book.csv from Kaggle (https://www.kaggle.com/adeyoyintemidayo/publication-of-books) which contains information about books. Write a program to demonstrate the following.

- Import the data into a DataFrame
- Find and drop the columns which are irrelevant for the book information.
- Change the Index of the DataFrame
- Tidy up fields in the data such as date of publication with the help of simple regular expression.
- Combine str methods with NumPy to clean columns

Teaching-Learning Process	1. Demonstration of Hypothesis test. 2. PPT Presentation to explore and manipulate data. 3. Live coding of concepts with simple examples 4. Case Study: Extraction of data from Books dataset

Module-3: Machine Learning

Modeling, What Is Machine Learning?, Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, **k-Nearest Neighbors,** The Model, Example: The Iris Dataset, The Curse of Dimensionality, **Naive Bayes,** A Really Dumb Spam Filter, A More Sophisticated Spam Filter, Implementation, Testing Our Model, Using Our Model, **Simple Linear Regression,** The Model, Using

Gradient Descent, Maximum Likelihood Estimation, **Multiple Regression,** The Model, Further Assumptions of the Least Squares Model, Fitting the Model, Interpreting the Model, Goodness of Fit, Digression: The Bootstrap, Standard Errors of Regression Coefficients, Regularization, **Logistic Regression,** The Problem, The Logistic Function, Applying the Model, Goodness of Fit, Support Vector Machines.

Chapters 11, 12, 13, 14, 15 and 16

Laboratory Component:

1. Train a regularized logistic regression classifier on the iris dataset (https://archive.ics.uci.edu/ml/machine-learning-databases/iris/ or the inbuilt iris dataset) using sklearn. Train the model with the following hyper parameter C = 1e4 and report the best classification accuracy.
2. Train an SVM classifier on the iris dataset using sklearn. Try different kernels and the associated hyper parameters. Train model with the following set of hyper parameters RBF-kernel, gamma=0.5, one-vs-rest classifier, no-feature-normalization. Also try C=0.01,1,10C=0.01,1,10. For the above set of hyper parameters, find the best classification accuracy along with total number of support vectors on the test data

Teaching-Learning Process	1. Demonstration of Models 2. PPT Presentation for techniques 3. Live coding of all concepts with simple examples

Module-4: Decision Trees

What Is a Decision Tree?, Entropy, The Entropy of a Partition, Creating a Decision Tree, Putting It All Together, Random Forests, **Neural Networks,** Perceptrons, Feed-Forward Neural Networks, Backpropagation, Example: Fizz Buzz, **Deep Learning,** The Tensor, The Layer Abstraction, The Linear Layer, Neural Networks as a Sequence of Layers, Loss and Optimization, Example: XOR Revisited, Other Activation Functions, Example: Fizz Buzz Revisited, Softmaxes and Cross-Entropy, Dropout, Example: MNIST, Saving and Loading Models, **Clustering,** The Idea, The Model, Example: Meetups, Choosing k, Example: Clustering Colors, Bottom-Up Hierarchical Clustering

Chapters 17, 18, 19 and 20

Laboratory Component:

1. Consider the following dataset. Write a program to demonstrate the working of the decision tree based ID3 algorithm.

Price	Maintenance	Capacity	Airbag	Profitable
Low	Low	2	No	Yes
Low	Med	4	Yes	Yes
Low	Low	4	No	Yes
Low	Med	4	No	No
Low	High	4	No	No
Med	Med	4	No	No
Med	Med	4	Yes	Yes
Med	High	2	Yes	No
Med	High	5	No	Yes
High	Med	4	Yes	Yes
high	Med	2	Yes	Yes
High	High	2	Yes	No
high	High	5	yes	Yes

2. Consider the dataset spiral.txt (https://bit.ly/2Lm75Ly). The first two columns in the dataset corresponds to the co-ordinates of each data point. The third column corresponds to the actual cluster label. Compute the rand index for the following methods:

- K – means Clustering
- Single – link Hierarchical Clustering
- Complete link hierarchical clustering.
- Also visualize the dataset and which algorithm will be able to recover the true clusters.

Teaching-Learning Process	1. Demonstration using Python/ R Language 2. PPT Presentation for decision tree, Neural Network, Deep learning and clustering 3. Live coding for the concepts with simple examples 4. Project Work: Algorithm implementation

Module-5: Natural Language Processing

Word Clouds, n-Gram Language Models, Grammars, An Aside: Gibbs Sampling, Topic Modeling, Word Vectors, Recurrent Neural Networks, Example: Using a Character-Level RNN, **Network Analysis,** Betweenness Centrality, Eigenvector Centrality, Directed Graphs and PageRank, **Recommender Systems,** Manual Curation, Recommending What's Popular, User-Based Collaborative Filtering, Item-Based Collaborative Filtering, Matrix Factorization.

Chapters 21, 22 and 23

Laboratory Component:

Mini Project – Simple web scrapping in social media

Teaching-Learning Process	1. Demonstration of models 2. PPT Presentation for network analysis and Recommender systems 3. Live coding with simple examples

Course outcome (Course Skill Set)

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

CO 1. Identify and demonstrate data using visualization tools.

CO 2. Make use of Statistical hypothesis tests to choose the properties of data, curate and manipulate data.

CO 3. Utilize the skills of machine learning algorithms and techniques and develop models.

CO 4. Demonstrate the construction of decision tree and data partition using clustering.

CO 5. Experiment with social network analysis and make use of natural language processing skills to develop data driven applications.

VI Semester

MACHINE LEARNING			
Course Code	21AI63	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Define machine learning and understand the basic theory underlying machine learning.
CLO 2. Differentiate supervised, unsupervised and reinforcement learning
CLO 3. Understand the basic concepts of learning and decision trees.
CLO 4. Understand Bayesian techniques for problems appear in machine learning
CLO 5. Perform statistical analysis of machine learning techniques.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction:
Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML

Concept learning and Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm –Remarks on VS- Inductive bias.

Text book 2: Chapter 1, Text book 1:Chapter 1 and 2

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

End to end Machine learning Project: Working with real data, Look at the big picture, Get the data, Discover and visualize the data, Prepare the data, select and train the model, Fine tune your model.

Classification : MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi label classification, multi output classification

Text book 2: Chapter 2, Chapter 3

Teaching-Learning Process	Chalk and board, Active Learning

<table>
<tr><th colspan="2">Module-3</th></tr>
<tr><td colspan="2">Training Models: Linear regression, gradient descent, polynomial regression, learning curves, regularized linear models, logistic regression

Support Vector Machine: linear, Nonlinear , SVM regression and under the hood

Text book 2: Chapter 4, Chapter 5</td></tr>
<tr><td>Teaching-Learning Process</td><td>Chalk and board, Problem based learning, Demonstration</td></tr>
<tr><th colspan="2">Module-4</th></tr>
<tr><td colspan="2">Decision Trees Training and Visualizing DT, making prediction, estimating class, the CART training, computational complexity, GINI impurity, Entropy, regularization Hyper parameters, Regression, instability

Ensemble learning and Random Forest: Voting classifiers, Bagging and pasting, Random patches, Random forests, Boosting, stacking

Text book 2: Chapter 6, Chapter 7</td></tr>
<tr><td>Teaching-Learning Process</td><td>Chalk& board, Problem based learning</td></tr>
<tr><th colspan="2">Module-5</th></tr>
<tr><td colspan="2">Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– example-Bayesian Belief Network – EM Algorithm

Text book 1: Chapter 6</td></tr>
<tr><td>Teaching-Learning Process</td><td>Chalk and board, MOOC</td></tr>
<tr><td colspan="2">Course Outcomes
At the end of the course the student will be able to:
CO 1. Understand the concept of Machine Learning and Concept Learning.
CO 2. Apply the concept of ML and various classification methods in a project.
CO 3. Analyse various training models in ML and the SVM algorithm to be implemented.
CO 4. Apply the ML concept in a decision tree structure and implementation of Ensemble learning and Random Forest.
CO 5. Apply Bayes techniques and explore more about the classification in ML.</td></tr>
</table>

VI Semester

BUSINESS INTELLIGENCE			
Course Code	21AI641	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

CLO 1. Explain the Decision Support systems and Business Intelligence framework.
CLO 2. Illustrate the significance of computerized Decision Support, and understand the mathematical modeling behind decision support.
CLO 3. Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.
CLO 4. Explore knowledge management; explain its activities, approaches and its implementation.
CLO 5. Describe the Expert systems , areas suitable for application of experts system

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Decision Support and Business Intelligence: Opening Vignette, Changing Business Environments and Computerized Decision Support, Managerial Decision Making, Computerized Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A framework for Business Intelligence (BI), A Work System View of Decision Support.

Text Book 1: Chapter 1

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-2

Computerized Decision Support: Decision Making, Models, Phases of the Decision-Making Process, The Intelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions Are Supported.

Modeling and Analysis: Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Management Support Systems, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking. **Text Book 1: Chapter 2**	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-3	
Data Warehousing: Data Warehousing Definitions and Concepts, Data Warehousing Process Overview, Data Warehousing Architectures, Data Integration and the Extraction, Transformation, and Load (ETL) Processes. **Text Book 1:** Chapter 5	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-4	
Knowledge Management: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation. **Text Book 1: Chapter 11**	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-5	
Expert Systems: Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Problem Areas Suitable for Expert Systems, Development of Expert Systems, Benefits, Limitations, and Critical Success Factors of Expert Systems. **Text Book 1: Chapter 12**	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Course outcome (Course Skill Set)

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

CO 1. Apply the basics of data and business to understand Decision Support systems and Business Intelligence framework.

CO 2. Describe the significance of Computerized Decision Support, apply the basics of mathematics to Understand the mathematical modeling behind decision support.

CO 3. Explain Data warehousing, its architecture and Extraction, Transformation, and Load (ETL) Processes.

CO 4. Analyze the importance of knowledge management and explain its activities, approaches and Its implementation

CO 5. Describe the Expert systems and analyze its development, discuss areas suitable for application of experts system.

VI Semester

ADVANCED JAVA PROGRAMMING			
Course Code	21CS642	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understanding the fundamental concepts of Enumerations and Annotations
CLO 2. Apply the concepts of Generic classes in Java programs
CLO 3. Demonstrate the fundamental concepts of String operations
CLO 4. Design and develop web applications using Java servlets and JSP
CLO 5. Apply database interaction through Java database Connectivity

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same program
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Enumerations, Autoboxing and Annotations:
Enumerations, Ednumeration fundamentals, the values() and valueOf() methods, Java enumerations are class types, enumerations inherits Enum, example, type wrappers, Autoboxing, Autoboxing methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of warning

Annotations, Annotation basics, specifying retention policy, obtaining annotations at run time by use of reflection, Annotated element interface, Using default values, Marker Annotations, Single member annotations, Built in annotations

Textbook 1: Chapter12

Teaching-Learning Process	Chalk and board, Online demonstration, Problem based learning

Module-2

Generics: What are Generics, A Simple Generics Example, A Generic Class with Two Type Parameters, The General Form of a Generic Class, Bounded Types, Using Wildcard Arguments, Bounded Wildcards, Creating a Generic Method, Generic Interfaces, Raw types and Legacy code, Generic Class Hierarchies, Erasure, Ambiguity errors, Some Generic Restrictions

Textbook 1: Chapter 14

Teaching-Learning Process	Chalk and board, Online Demonstration

Module-3

String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf(), Changing the case of characters within a String, String Buffer, String Builder **Textbook 1: Chapter 15**	
Teaching-Learning Process	Chalk and board, Online Demonstration
Module-4	
Background; The life cycle of a servlet; A simple servlet; the servlet API; The javax.servlet package Reading servlet parameter; the javax.servlet.http package; Handling HTTP Requests and Responses; using Cookies; Session Tracking, Java Server Pages (JSP); JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions, Cookies, Session Objects **Textbook 1: Chapter 31** **Textbook 2: Chapter 11**	
Teaching-Learning Process	Chalk and board, Online Demonstration
Module-5	
The concept of JDBC; JDBC Driver Types; JDBC packages; A brief overview of the JDBC Process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data Types; Exceptions. **Textbook 2: Chapter 6**	
Teaching-Learning Process	Chalk and board, Online Demonstration
Course Outcomes At the end of the course the student will be able to: CO 1. Understanding the fundamental concepts of Enumerations and Annotations CO 2. Apply the concepts of Generic classes in Java programs CO 3. Demonstrate the concepts of String operations in Java CO 4. Develop web based applications using Java servlets and JSP CO 5. Illustrate database interaction and transaction processing in Java	

VI Semester

NATURAL LANGUAGE PROCESSING			
Course Code	21AI643	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Analyse the natural language text.
CLO 2. Define the importance of natural language.
CLO 3. Understand the concepts Text mining.
CLO 4. Illustrate information retrieval techniques.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same program
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Overview and language modeling: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

Textbook 1: Ch. 1,2

Teaching-Learning Process	Chalk and board, Online demonstration, Problem based learning

Module-2

Word level and syntactic analysis: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

Textbook 1: Ch. 3,4

Teaching-Learning Process	Chalk and board, Online Demonstration

Module-3

Extracting Relations from Text: From Word Sequences to Dependency Paths:
Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation.

Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.

A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience. **Textbook 2: Ch. 3,4,5**	
Teaching-Learning Process	Chalk and board, Online Demonstration
Module-4	
Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, **Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures:** Introduction, Cohesion, Coh-Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. **Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling:** Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. **Evolving Explanatory Novel Patterns for Semantically-Based Text Mining:** Related Work, A Semantically Guided Model for Effective Text Mining. **Textbook 2: Ch. 6,7,8,9**	
Teaching-Learning Process	Chalk and board, Online Demonstration
Module-5	
INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora. **Textbook 1: Ch. 9,12**	
Teaching-Learning Process	Chalk and board, Online Demonstration
Course Outcomes At the end of the course the student will be able to: CO 1. Analyse the natural language text. CO 2. Define the importance of natural language. CO 3. Understand the concepts Text mining. CO 4. Illustrate information retrieval techniques.	

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VI Semester

DATA SECURITY AND PRIVACY			
Course Code	21AD644	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Identify standard algorithms used to provide confidentiality, integrity and authenticity for data.
CLO 2. Distinguish key distribution and management schemes.
CLO 3. Deploy encryption techniques to secure data in transit across data networks
CLO 4. Implement security applications in the field of Information technology
CLO 5. Demonstrate data privacy

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1: Classical Encryption Techniques

Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono-alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad.

Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm.

Text Book1: Chapter 3, Chapter 4

Teaching-Learning Process	1. PPT – Cryptographic techniques 2. Demonstration of structure of Block ciphers, encryption standards 3. Chalk and Board 4. Problem solving

Module-2: Public-Key Cryptography and RSA

Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA.

Other Public-Key Cryptosystems: Diffiehellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on a asymmetric cipher

Text Book 1: Chapter 9

Teaching-Learning Process	1. PPT – Cryptographic algorithms 2. Demonstration of key exchange protocols

Module-3: Key Management and Distribution

Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, Public Key infrastructure

Text Book 1: Chapter 14

Teaching-Learning Process	1. PPT – Cryptographic algorithms 2. Demonstration of key distribution scenario

Module-4: An Introduction to privacy preserving data mining

Privacy-Preserving Data Mining Algorithms, The Randomization Method, Group Based Anonymization.

Text Book 2: Chapter 2

Teaching-Learning Process	1. PPT – Privacy Preserving Algorithms 2. Demonstration of Randomization method

Module-5: Distributed Privacy

Distributed Privacy-Preserving Data Mining, Privacy-Preservation of Application Results, Limitations of Privacy: The Curse of Dimensionality, Applications of Privacy-Preserving Data Mining

Text Book 2: Chapter 2

Teaching-Learning Process	3. PPT – On Privacy preservation applications 4. Demonstration of dimensionality curse in data mining

Course Outcomes

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

CO 1. Identify the vulnerabilities in any computing system and hence to choose security solution.
CO 2. Plan to resolve the identified security issues.
CO 3. Analyse security mechanisms using theoretical approaches
CO 4. Recognize the importance of data privacy, limitations and applications
CO 5. Organize the privacy preserving algorithms

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VI Semester

INTRODUCTION TO DATA STRUCTURES			
Course Code	21CS651	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Introduce elementary data structures.
CLO 2. Analyze Linear Data Structures: Stack, Queues, Lists
CLO 3. Analyze Non Linear Data Structures: Trees
CLO 4. Assess appropriate data structure during program development/Problem Solving.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.

Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction:
Introduction to arrays: one-dimensional arrays, two dimensional arrays, initializing two dimensional arrays, Multidimensional arrays.
Introduction to Pointers: Pointer concepts, accessing variables through pointers, Dynamic memory allocation, pointers applications.
Introduction to structures and unions: Declaring structures, Giving values to members, structure initialization, arrays of structures, nested structure, unions, size of structures.

Textbook 1: Ch 8.3 to 8.15,Ch 12.3 to 12.19
Textbook 2:Ch 2.1 to2.13,2.51 ,2.80 to 2.98

Teaching-Learning Process	Chalk and board, Active Learning

Module-2

Linear Data Structures-Stacks and queues:
Introduction, Stack representation in Memory, Stack Operations, Stack Implementation, Applications of Stack. Introduction, Queues-Basic concept, Logical representation of Queues, Queue Operations and its types, Queue Implementation, Applications of Queue.

Textbook 2: Ch 6.1 to 6.14 ,Ch 8.1,8.2

Teaching-Learning Process	Chalk and board, Active Learning, Problem Based Learning

Module-3

Linear Data Structures-Linked List:
Introduction, Linked list Basic concept, Logical representation of Linked list, Self-Referential structure, Singly-linked List Operations and Implementation, Circular Linked List, applications of Linked list.

Textbook 1: Ch 15.1 ,15.3,15.4,15.8 **Textbook 2: Ch 9.2.9.5**	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
Module-4	
Non Linear Data Structures – Trees Introduction, Basic concept, Binary Tree and its types, Binary Tree Representation, Binary Tree Traversal, Binary Search tree, Expression Trees. **Textbook1: Ch 16.1,16.2** **Textbook2:Ch 10.1,10.2,10.4,10.6.3**	
Teaching-Learning Process	Chalk& board, Active Learning, Problem based learning
Module-5	
Sorting and Searching Sorting: Introduction, Bubble sort, Selection sort, Insertion sort Searching: Introduction, Linear search, Binary search. **Textbook1: Ch 17.1,17.2.2, 17.2.4, 17.3.1,17.3.2** **Textbook2: Ch 11.1.,11.2,11.3,11.7,11.10.1,11.10.2**	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
Course Outcomes At the end of the course the student will be able to: CO 1. Express the fundamentals of static and dynamic data structure. CO 2. Summarize the various types of data structure with their operations. CO 3. Interpret various searching and sorting techniques. CO 4. Choose appropriate data structure in problem solving. CO 5. Develop all data structures in a high level language for problem solving.	

VI Semester

INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS			
Course Code	21CS652	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand the basic concepts and the applications of database systems.
CLO 2. Understand the relational database design principles.
CLO 3. Master the basics of SQL and construct queries using SQL.
CLO 4. Familiar with the basic issues of transaction processing and concurrency control.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain the functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.

Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema
architecture and data independence, database languages, and interfaces, The Database System environment.

Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams,Examples

Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Relational Model: Relational Model Concepts, Relational Model Constraints and relationaldatabase schemas, Update operations, transactions, and dealing with constraint violations.

Relational Algebra: Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison**.** Examples of Queries in relational algebra.

Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

Textbook 1:,ch5.1 to 5.3, 8.1 to 8.5, 9.1;

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

SQL:SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.

Advances Queries: More complex SQL retrieval queries, Specifying constraints asassertions and action triggers, Views in SQL, Schema change statements in SQL.Database

Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.

Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6

Teaching-Learning Process	Chalk& board, Problem based learning

Module-5

Transaction management and Concurrency –Control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.

Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;

Teaching-Learning Process	Chalk and board, MOOC

Course Outcomes

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

CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS

CO 2. Use Structured Query Language (SQL) for database manipulation.

CO 3. Design and build simple database systems

CO 4. Develop application to interact with databases.

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VI Semester

INTRODUCTION TO CYBER SECURITY			
Course Code	21CS653	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. To familiarize cybercrime terminologies and ACTs
CLO 2. Understanding cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention
CLO 3. Understand the motive and causes for cybercrime, cybercriminals, and investigators
CLO 4. Understanding criminal case and evidence, detection standing criminal case and evidence.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Cybercrime:

Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes,

Cybercrime: The Legal Perspectives,

Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000.

Textbook1:Ch1 (1.1 to 1.8).

Teaching-Learning Process	Chalk and board, Active Learning

Module-2

Cyber offenses:
How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cybercafe and Cybercrimes.

Botnets: The Fuel for Cybercrime, Attack Vector

Textbook1: Ch2 (2.1 to 2.7).

Teaching-Learning Process	Chalk and board, Active Learning

Module-3

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors,

Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks. **Textbook1: Ch4 (4.1 to 4.9, 4.12).**	
Teaching-Learning Process	Chalk and board, Case studies
Module-4	
Understanding the people on the scene: Introduction, understanding cyber criminals, understanding cyber victims, understanding cyber investigators. **The Computer Investigation process:** investigating computer crime. **Understanding Cybercrime Prevention:** Understanding Network Security Concepts, Understanding Basic Cryptography Concepts, Making the Most of Hardware and Software Security **Textbook 2:Ch3,Ch 4, Ch 7.**	
Teaching-Learning Process	Chalk& board, Case studies
Module-5	
Cybercrime Detection Techniques: Security Auditing and Log Firewall Logs, Reports, Alarms, and Alerts, Commercial Intrusion Detection Systems, Understanding E-Mail Headers Tracing a Domain Name or IP Address. **Collecting and preserving digital Evidence:** Introduction, understanding the role of evidence in a criminal case, collecting digital evidence, preserving digital evidence, recovering digital evidence, documenting evidence. **TextBook 2:Ch 9, Ch 10.**	
Teaching-Learning Process	Chalk and board, Case studies
Course Outcomes At the end of the course the student will be able to: CO 1. Describe the cyber crime terminologies CO 2. Analyze cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention CO 3. Analyze the motive and causes for cybercrime, cybercriminals, and investigators CO 4. Apply the methods for understanding criminal case and evidence, detection standing criminal case and evidence.	

VI Semester

PROGRAMMING IN JAVA			
Course Code	21CS654	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Learn fundamental features of object oriented language and JAVA.
CLO 2. To create, debug and run simple Java programs.
CLO 3. Learn object oriented concepts using programming examples.
CLO 4. Study the concepts of importing of packages and exception handling mechanism.
CLO 5. Discuss the String Handling examples with Object Oriented concepts.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries.

Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings

Textbook 1:Ch 2,Ch 3.

Teaching-Learning Process	Chalk and board, Problem based learning.

Module-2

Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses,

Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements.

Textbook 1:Ch 4,Ch 5.

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class.

A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited. **Inheritance:** Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding. **Textbook 1: Ch 6, Ch 7.1-7.9,Ch 8.1-8.5**

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4
Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces. **Exception Handling**: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions **Textbook 1: Ch 9,Ch 10.**

Teaching-Learning Process	Chalk& board, Problem based learning, Demonstration

Module-5
Enumerations :Enumerations, Type Wrappers. **String Handling:** The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String , Additional String Methods, StringBuffer, StringBuilder. **Textbook 1: Ch 12.1,12.2,Ch 15.**

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Course Outcomes

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

CO 1. Develop JAVA programs using OOP principles and proper program structuring.
CO 2. Develop JAVA program using packages, inheritance and interface.
CO 3. Develop JAVA programs to implement error handling techniques using exception handling
CO 4. Demonstrate string handling concepts using JAVA.

VI Semester

DATA VISUALIZATION			
Course Code	21AD71	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand and use various plot types with Python
CLO 2. Explore and work with different plotting libraries
CLO 3. Create effective visualizations
CLO 4. Implement exemplary applications related to Network Programming and Web Service
CLO 5. Exhibit the awareness of the importance and limitation of the exploratory data analysis paradigm

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.

Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1: Data Visualization and Data Exploration

Introduction: Data Visualization, Importance of Data Visualization, Data Wrangling, Tools and Libraries for Visualization

Overview of Statistics: Measures of Central Tendency, Measures of Dispersion, Correlation, Types od Data, Summary Statistics

Numpy: Numpy Operations - Indexing, Slicing, Splitting, Iterating, Filtering, Sorting, Combining, and Reshaping

Pandas: Advantages of pandas over numpy, Disadvantages of pandas, Pandas operation - Indexing, Slicing, Iterating, Filtering, Sorting and Reshaping using Pandas

Text Book 1: Chapter 1

Teaching-Learning Process	5. PPT – Visualization tools 6. Demonstration of operations on data

Module-2: Plots

Comparison Plots: Line Chart, Bar Chart and Radar Chart; **Relation Plots:** Scatter Plot, Bubble Plot , Correlogram and Heatmap; **Composition Plots:** Pie Chart, Stacked Bar Chart, Stacked Area Chart, Venn

Diagram; **Distribution Plots:** Histogram, Density Plot, Box Plot, Violin Plot; **Geo Plots:** Dot Map, Choropleth Map, Connection Map; What Makes a Good Visualization?

A Deep Dive into Matplotlib
Introduction, Overview of Plots in Matplotlib, **Pyplot Basics:** Creating Figures, Closing Figures, Format Strings, Plotting, Plotting Using pandas DataFrames, Displaying Figures**,** Saving Figures; **Basic Text and Legend**

Functions: Labels, Titles, Text, Annotations, Legends**; Basic Plots:**Bar Chart, Pie Chart, Stacked Bar Chart, Stacked Area Chart, Histogram, Box Plot, Scatter Plot, Bubble Plot; **Layouts:** Subplots, Tight Layout, Radar Charts, GridSpec; **Images:** Basic Image Operations, Writing Mathematical Expressions

Text Book 1: Chapter 2, Chapter 3

Teaching-Learning Process	3. PPT - Visualization techniques 4. Demonstration of operations on plots using Matplotlib

Module-3: Simplifying Visualizations using Seaborn

Introduction, Advantages of Seaborn **Controlling Figure Aesthetics:** Seaborn Figure Styles, Removing Axes Spines, Contexts; **Color Palettes:** Categorical Color Palettes, Sequential Color Palettes, Diverging Color Palettes; **Interesting Plots in Seaborn:** Bar Plots, Kernel Density Estimation, Plotting Bivariate Distributions, Visualizing Pairwise Relationships, Violin Plots;

Text Book 1: Chapter 4

Teaching-Learning Process	1. PPT - Visualization techniques 2. Demonstration of operations on plots using Seaborn

Module-4: Plotting Geospatial Data

Introduction, Geoplotlib, The Design Principles of Geoplotlib, Geospatial Visualizations, Tile Providers, Custom Layers, Introduction to Folium

Visualizing Data: Building a Google map from geocoded data, Visualizing networks and interconnection and Visualizing mail data

Making Things Interactive with Bokeh
Introduction, Bokeh, Concepts of Bokeh, Interfaces in Bokeh, Output, Bokeh Server, Presentation, Integrating, Adding Widgets

Text Book 1: Chapter5, Chapter 6

Teaching-Learning Process	5. PPT - Visualization techniques 6. Demonstration of operations using Geoplotlib

Module-5: Networked Programs

HyperText Transfer Protocol – HTTP, The World's Simplest Web Browser, Retrieving an image over HTTP, Retrieving web pages with urllib, Parsing HTML and scraping the web, Parsing HTML using regular expressions, Parsing HTML using BeautifulSoup, Reading binary files using urllib

Using Web Services
eXtensibleMarkup Language – XML, Parsing XML, Looping through nodes, JavaScript Object Notation – JSON, Parsing JSON

Text Book 2: Chapters 12 and Chapter 13

Teaching-Learning Process	7. PPT – On web services, browsers, HTTP, HTML 8. Demonstration of parsing and looping - XML,JSON

Course Outcomes

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

CO 1. Demonstrate the data visualization techniques.
CO 2. Analyze data represented in the form of graphs & charts
CO 3. Experiment with different visualization tools
CO 4. Identify geospatial data and interconnection of data.
CO 5. Make use of the web for data extraction

VII Semester

CLOUD COMPUTING			
Course Code	21CS72	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:0:0:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	02	Exam Hours	03

Course Learning Objectives:

CLO 1. Introduce the rationale behind the cloud computing revolution and the business drivers
CLO 2. Introduce various models of cloud computing
CLO 3. Introduction on how to design cloud native applications, the necessary tools and the design tradeoffs.
CLO 4. Realize the importance of Cloud Virtualization, Abstraction`s and Enabling Technologies and cloud security

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction:
Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka

Textbook 1: Chapter 1: 1.1,1.2 and 1.3

Teaching-Learning Process	Chalk and board, Active Learning

Module-2

Virtualization: Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples

Textbook 1 : Chapter 3: 3.1 to 3.6

Teaching-Learning Process	Chalk and board, Active Learning

Module-3

Cloud Computing Architecture: Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges

Textbook 1: Chapter 4: 4.1 to 4.5

Teaching-Learning Process	Chalk and board, Demonstration

Module-4

Cloud Security: Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security, Security Risks posed by shared images and management OS.

Textbook 2: Chapter 9: 9.1 to 9.6, 9.8, 9.9

Teaching-Learning Process	Chalk and board

Module-5

Cloud Platforms in Industry
Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.

Textbook 1: Chapter 9: 9.1 to 9.2

Cloud Applications:
Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.

Textbook 1: Chapter 10: 10.1 to 10.2

Teaching-Learning Process	Chalk and board

Course outcome (Course Skill Set)

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

CO 1. Understand and analyze various cloud computing platforms and service provider.
CO 2. Illustrate various virtualization concepts.
CO 3. Identify the architecture, infrastructure and delivery models of cloud computing.
CO 4. Understand the Security aspects of CLOUD.
CO 5. Define platforms for development of cloud applications

VII Semester

SOCIAL NETWORK ANALYSIS			
Course Code	21AI731	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand Semantic Web for social network analysis.
CLO 2. Learn the Representation, Modelling and Aggregating social network data.
CLO 3. Learn the basic algorithms and techniques for detection and decentralization of social network.
CLO 4. Study Human behaviour in social networks and its management.
CLO 5. Visual representation of social network data in different applications.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web.

Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis.

Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks.

Text book 1: Chapter1 – 1.1, 1.3, 1.4, Chapter2 – 2.2 , 2.3, Chapter3 – 3.1 to 3.3

Teaching-Learning Process	Chalk and board, Active Learning,

Module-2

Knowledge Representation on the Semantic Web: Ontology and their role in the Semantic Web – Ontology based knowledge Representation - Ontology languages for the Semantic Web - Resource Description Framework and schema - Web Ontology Language.

Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data. **Text book 1: Chapter4 – 4.1(4.1.1), 4.2(4.2.1,4.2.2), Chapter5 – 5.1 to 5.4**	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-3	
Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection - Tools for detecting communities **Decentralized online social networks** - Introduction - Challenges for DOSN - The Case for Decentralizing OSNs - General Purpose DOSNs - Specialized Application Centric DOSNs - Social Distributed Systems - Delay-Tolerant DOSN. **Text book 2: Chapter 12 – 12.2 to 12.5, Chapter 17**	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
Understanding and predicting human behaviour for social communities: User data management - Inference and Distribution - Enabling new human experiences – The Technologies. **Managing Trust in Online Social Networks:** Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons. **Text book 2: Chapter20 - 20.2, 20.3(20.3.1), Chapter22 – 22.3, 22.5, 22.6, 22.7, 22.9, 22.10**	
Teaching-Learning Process	Chalk & board, Problem based learning, MOOC
Module-5	
Visualization of Social Networks: Social Network Analysis - Visualization - Visualizing online social networks, **Novel Visualizations and Interactions for Social Networks Exploration:** Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations. **Applications of Social Network Analysis**: Applications of Social Network Analysis - Covert networks - Community welfare - Collaboration networks - Co-Citation networks. **Text Book 2: Chapter 27 – 27.2, 27.3, 27.4, Chapter 28 – 28.5, Chapter 29 – 29.3.3, 29.3.5 to 29.3.7**	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes At the end of the course the student will be able to: CO 1. Understand the Semantic Web and Electronic sources for social network analysis. CO 2. Understand the **Representation,** Modelling and Aggregating social network data. CO 3. Analyse the human behaviour in social network. CO 4. Apply techniques for detection and decentralization of social network. CO 5. Illustrate the visual representation of social network data.	

VII Semester

DIGITAL IMAGE PROCESSING			
Course Code	21CS732	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand the fundamentals of digital image processing
CLO 2. Explain the image transform techniques used in digital image processing
CLO 3. Apply different image enhancement techniques on digital images
CLO 4. Evaluate image restoration techniques and methods used in digital imageprocessing
CLO 5. Understand the Morphological Operations and Segmentation used in digital imageprocessing

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Digital Image Fundamentals: What is Digital Image Processing? Originsof Digital Image Processing, Examples of fields that use DIP, FundamentalSteps in Digital Image Processing, Components of an Image ProcessingSystem, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships BetweenPixels, Linear and Nonlinear Operations.

Textbook 1: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, SmoothingSpatial Filters, Sharpening Spatial Filters

Frequency Domain: Preliminary Concepts, The Discrete FourierTransform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering inthe Frequency Domain, Image Smoothing and Image Sharpening UsingFrequency Domain Filters, Selective Filtering.

Textbook 1: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to 4.10

Teaching-Learning Process	1. Chalk and board, Active Learning, Demonstration 2. Laboratory Demonstration

Module-3	
Restoration: Noise models, Restoration in the Presence of Noise Onlyusing Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, InverseFiltering, Minimum Mean Square Error (Wiener) Filtering, ConstrainedLeast Squares Filtering. **Textbook 1: Chapter 5: Sections 5.2, to 5.9**	
Teaching-Learning Process	1. Chalk and board
Module-4	
Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. Wavelets: Background, Multiresolution Expansions. **Morphological Image Processing**: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms. **Text: Chapter 6: Sections 6.1 to 6.3, Chapter 7: Sections 7.1 and 7.2, Chapter 9: Sections 9.1 to 9.5**	
Teaching-Learning Process	1. Chalk& board 2. Demonstartion of Case study /Application for wavelet transfer method
Module-5	
Segmentation: Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, Principles of Thresholding. **Representation and Description:** Representation, Boundary descriptors. **Text2: Chapter 9: Sections 9.1, to 9.7 and Text 1: Chapter 11: Sections 11.1and 11.2**	
Teaching-Learning Process	1. Chalk and board, MOOC. 2. Poster making activity for various image segmentation algorithms

Course Outcomes

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

CO 1. Understand the fundamentals of Digital Image Processing.
CO 2. Apply different Image transformation techniques
CO 3. Analyze various image restoration techniques
CO 4. Understand colour image and morphological processing
CO 5. Design image analysis and segmentation techniques

VII Semester

FULLSTACK DEVELOPMENT			
Course Code	21AI733	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 T	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

CLO 1.Explain the use of learning full stack web development.
CLO 2.Make use of rapid application development in the design of responsive web pages.
CLO 3.Illustrate Models, Views and Templates with their connectivity in Django for full stack web development.
CLO 4.Demonstrate the use of state management and admin interfaces automation in Django.
CLO 5.Design and implement Django apps containing dynamic pages with SQL databases.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1: MVC based Web Designing

Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS.

Textbook 1: Chapter 1 and Chapter 3

Teaching-Learning Process	1. Demonstration using Visual Studio Code 2. PPT/Prezi Presentation for Architecture and Design Patterns 3. Live coding of all concepts with simple examples

Module-2: Django Templates and Models

Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.

Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution

Textbook 1: Chapter 4 and Chapter 5

Teaching-Learning Process	1. Demonstration using Visual Studio Code 2. PPT/Prezi Presentation for Architecture and Design Patterns 3. Live coding of all concepts with simple examples

	4. Case Study: Apply concepts learnt for an Online Ticket Booking System
Module-3: Django Admin Interfaces and Model Forms	
Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces. Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs. **Textbook 1: Chapters 6, 7 and 8**	
Teaching-Learning Process	1. Demonstration using Visual Studio Code 2. PPT/Prezi Presentation for Architecture and Design Patterns 3. Live coding of all concepts with simple examples
Module-4: Generic Views and Django State Persistence	
Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views. MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication. **Textbook 1: Chapters 9, 11 and 12**	
Teaching-Learning Process	1. Demonstration using Visual Studio Code 2. PPT/Prezi Presentation for Architecture and Design Patterns 3. Live coding of all concepts with simple examples 4. Project Work: Implement all concepts learnt for Student Admission Management.
Module-5: jQuery and AJAX Integration in Django	
Ajax Solution, Java Script, XHTMLHttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django **Textbook 2: Chapters 1, 2 and 7.**	
Teaching-Learning Process	1. Demonstration using Visual Studio Code 2. PPT/Prezi Presentation for Architecture and Design Patterns 3. Live coding of all concepts with simple examples 4. Case Study: Apply the use of AJAX and jQuery for development of EMI calculator.
Course outcome (Course Skill Set) At the end of the course the student will be able to: CO 1. Understand the working of MVT based full stack web development with Django. CO 2. Designing of Models and Forms for rapid development of web pages. CO 3. Analyze the role of Template Inheritance and Generic views for developing full stack web applications. CO 4. Apply the Django framework libraries to render nonHTML contents like CSV and PDF. CO 5. Perform jQuery based AJAX integration to Django Apps to build responsive full stack web applications,	

VII Semester

BLOCKCHAIN TECHNOLOGY			
Course Code	21CS734	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Explain the fundamentals of distributed computing and blockchain
CLO 2. Discuss the concepts in bitcoin
CLO 3. Demonstrate Ethereum platform

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Decentralization and Cryptography: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations.

Textbook 1: Chapter 1, 2

Teaching-Learning Process	Chalk and board, Active Learning – Oral presentations.

Module-2

Introduction to Cryptography & Cryptocurrencies: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency,

How Bitcoin Achieves Decentralization: Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work, Putting it all together,

Textbook 2: Chapter 1, 2

Teaching-Learning Process	Chalk and board, Demonstration

Module-3

Mechanics of Bitcoin: Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements

How to Store and Use Bitcoins: Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets **Textbook2: Chapter 3,4**	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration, MOOC
Module-4	
Bitcoin Mining: The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies, **Bitcoin and Anonymity:** Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash, **Textbook2: Chapter 5,6**	
Teaching-Learning Process	Chalk& board, Problem based learning, MOOC
Module-5	
Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. **Ethereum 101:** Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts. **Textbook 1: Chapter 10**	
Teaching-Learning Process	Chalk and board, MOOC, Practical Demonstration
Course Outcomes At the end of the course the student will be able to: CO 1. Describe the concepts of Distrbuted computing and its role in Blockchain CO 2. Describe the concepts of Cryptography and its role in Blockchain CO 3. List the benefits, drawbacks and applications of Blockchain CO 4. Appreciate the technologies involved in Bitcoin CO 5. Appreciate and demonstrate the Ethereum platform to develop blockchain application.	

VII Semester

INTERNET OF THINGS			
Course Code	21CS735	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
CLO 2. Understand the recent application domains of IoT in everyday life.
CLO 3. Understand the protocols and standards designed for IoT and the current research on it.
CLO 4. Understand the other associated technologies like cloud and fog computing in the domain of IoT.
CLO 5. Improve their knowledge about the various cutting-edge technologies in the field IoT and machine learning applications.
CLO 6. Gain insights about the current trends of machine learning and AI techniques used in IoT to orient towards the present industrial scenario.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.

Textbook 1: Chapter 4 – 4.1 to 4.5

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

Textbook 1: Chapter 5 – 5.1 to 5.9

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

Textbook 1: Chapter 6 – 6.1 to 6.5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth

Textbook 1: Chapter 7 – 7.1 to 7.16

Teaching-Learning Process	Chalk & board, Problem based learning

Module-5

IoT Communication Technologies: Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols

IoT Interoperability: Introduction, Taxonomy of interoperability, Standards, Frameworks

Textbook 1: Chapter 8 – 8.1, 6.2, 8.3, 8.4, 8.5, 8.6, .7
Textbook 1: Chapter 9 – 9.1, 9.2, 9.3

Teaching-Learning Process	Chalk and board, MOOC

Course Outcomes

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

CO 1. Understand the evolution of IoT, IoT networking components, and addressing strategies inIoT.

CO 2. Analyze various sensing devices and actuator types.CO 3. Demonstrate the processing in IoT.

CO 4. Apply different connectivity technologies.

CO 5. Understand the communication technologies , protocols and interoperability in IoT.

VII Semester

AUGMENTED REALITY			
Course Code	21AI741	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand the importance of Augmented reality
CLO 2. Understand and analyse the importance of Tracking system.
CLO 3. Compare and contrast the computer vision for Augmented reality and its applications
CLO 4. Analyse and understand Registration and camera simulation of visual coherence.
CLO 5. Acquire knowledge of Situated Visualization

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only the traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain the functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Augmented Reality
What Is Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Displays-Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model

Text book 1: Chapter 1,2

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Tracking: Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion

Text book 1: Chapter 3

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Computer Vision for Augmented Reality-Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Incremental Tracking, Simultaneous Localization and Mapping, Outdoor Tracking

Calibration and Registration-Camera Calibration, Display Calibration, Registration **Text book 1: Chapter 4,5**	
Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration
Module-4	
Visual Coherence: Registration, Photometric Registration, Common Illumination, Diminished Reality, Camera Simulation, Stylized Augmented Reality **Text book 1: Chapter 6**	
Teaching-Learning Process	Chalk& board, Problem based learning
Module-5	
Situated Visualization: Challenges, Visualization Registration, Annotations and Labeling, X-Ray Visualization, Spatial Manipulation, Information Filtering Interaction-Output Modalities, Input Modalities, Tangible Interfaces **Text Book 1: Chapter 7,8**	
Teaching-Learning Process	Chalk and board, MOOC
Course Outcomes At the end of the course the student will be able to: CO1:Understand the importance of Augmented reality CO2: Comprehend and analyse the Tracking system. CO3: Compare and Contrast the computer vision for Augmented reality CO4: Analyse and understand Registration and camera simulation of visual coherence. CO5: Acquire knowledge of Situated Visualization	

1.

VII Semester

MULTIAGENT SYSTEMS			
Course Code	21CS742	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. To introduce the concept of a multi agent systems and Distributed Constraints
CLO 2. Explore the main issues surrounding the computer and extended form games.
CLO 3. Develop cooperative learning, stochastic games
CLO 4. Exhibit the awareness about protocols about multi agent resource allocation and auctions
CLO 5. Construct voting mechanism design.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1: Multiagent Problem Formulation

Utility, Markov Decision Processes, Planning
Distributed Constraints: Distributed Constraint Satisfaction, Distributed Constraint Optimization

Textbook 1: Chapters 1 &2, Textbook 2: Chapter 1

Teaching-Learning Process	1. PPT – Decision Processes, Planning 2. Demonstration of constraints and their optimization

Module-2: Standard and Extended Form Games

Games in Normal Form, Games in Extended Form, Self-interested agents, Characteristic Form Games, Coalition Formation

Textbook 1: Chapters 3 & 4, Textbook 2: Chapter 3

Teaching-Learning Process	1. PPT – Games in different forms 2. Demonstration of coalition formation

Module-3: Learning in Multiagent Systems

The Machine Learning Problem, Cooperative Learning, Repeated Games, Stochastic Games, General Theories for Learning Agents, Collective Intelligence

Textbook 1: Chapters 5

Teaching-Learning Process	1. PPT – Cooperative learning, Collective intelligence 2. Demonstration of stochastic games

Module-4: Negotiation

The Bargaining Problem, Monotonic Concession Protocol, Negotiation as Distributed Search, Ad-hocNegotiation Strategies, The Task Allocation Problem.
Protocols for Multiagent Resource Allocation: Auctions: Simple Auctions, Combinatorial Auctions

Textbook 1: Chapters 6&7,Textbook 2: Chapter 11

Teaching-Learning Process	1. PPT – Bargaining problems 2. Demonstration of different auctions for resource allocation

Module-5: Voting and Mechanism Design

The Voting Problem, Mechanism Design. **Nature-Inspired Approaches:** Ants and Termites, ImmuneSystem

Textbook 1: Chapters 8&10,Textbook 2: Chapter 10

Teaching-Learning Process	1. PPT – Voting Problem 2. Demonstration of nature inspired Approaches

Course Outcomes

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

CO 1. Demonstrate the decision process with different constraintsCO 2. Analyze games in different forms
CO 3. Apply the cooperative learning in developing games
CO 4. Analyze different negotiation strategies of Multi-Agent System
CO 5. Design and develop solutions for voting problems

VII Semester

DEEP LEARNING			
Course Code	21CS743	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course Learning Objectives

CLO 1. Understand the fundamentals of deep learning.
CLO 2. Know the theory behind Convolutional Neural Networks, Autoencoders, RNN.
CLO 3. Illustrate the strength and weaknesses of many popular deep learning approaches.
CLO 4. Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.
CLO 5. Learn the open issues in deep learning, and have a grasp of the current research directions.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Deep Learning: Introduction, Deep learning Model, Historical Trends in Deep Learning,

Machine Learning Basics: Learning Algorithms, Supervised Learning Algorithms, Unsupervised Learning Algorithms.

Textbook 1: Chapter1 – 1.1, 1.2, 5.1,5.7-5.8.

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Feedforward Networks: Introduction to feedforward neural networks, Gradient-Based Learning, Back-Propagation and Other Differentiation Algorithms. **Regularization for Deep Learning,**

Textbook 1: Chapter 6, 7

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Optimization for Training Deep Models: Empirical Risk Minimization, Challenges in Neural Network Optimization, Basic Algorithms: Stochastic Gradient Descent, Parameter Initialization Strategies,

Algorithms with Adaptive Learning Rates: The AdaGrad algorithm, The RMSProp algorithm, Choosing the Right Optimization Algorithm.

Textbook 1: Chapter: 8.1-8.5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

Convolutional Networks: The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features- LeNet, AlexNet.

Textbook 1: Chapter: 9.1-9.9.

Teaching-Learning Process	Chalk& board, Problem based learning

Module-5

Recurrent and Recursive Neural Networks: Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short- Term Memory and Other Gated RNNs.

Applications: Large-Scale Deep Learning, Computer, Speech Recognition, Natural Language Processingand Other Applications.

Textbook 1: Chapter: 10.1-10.3, 10.5, 10.6, 10.10, 12.

Teaching-Learning Process	Chalk and board, MOOC

Course Outcomes

CO1: Understand the fundamental issues and challenges of deep learning data, model selection, model complexity etc.,
CO2: Describe various knowledge on deep learning and algorithms
CO3: Apply CNN and RNN model for real time applications
CO4: Identify various challenges involved in designing and implementing deep learning algorithms.
CO5: Relate the deep learning algorithms for the given types of learning tasks in varied domain

VII Semester

ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT			
Course Code	21CS744	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course Learning Objectives

CLO 1. To understand basic concepts of RPA
CLO 2. To Describe RPA, where it can be applied and how its implemented
CLO 3. To Describe the different types of variables, Control Flow and data manipulation techniques
CLO 4. To Understand Image, Text and Data Tables Automation
CLO 5. To Describe various types of Exceptions and strategies to handle

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

RPA Foundations- What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 DevOps- Flowcharts.

Textbook 1: Ch 1, Ch 2

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

RPA Platforms- Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by-step examples using the recorder.

Textbook 2: Ch 1, Ch 2

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Sequence, Flowchart, and Control Flow-Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections-Arguments – Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).

Textbook 2: Ch 3, Ch 4

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

Taking Control of the Controls- Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorer-Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.

Textbook 2: Ch 5

Teaching-Learning Process	Chalk& board, Problem based learning

Module-5

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screensHOT- Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA

Textbook 2: Ch 8
Textbook 1: Ch 13

Teaching-Learning Process	Chalk and board, MOOC

Course Outcomes

CO 1. To Understand the basic concepts of RPA
CO 2. To Describe various components and platforms of RPA
CO 3. To Describe the different types of variables, control flow and data manipulation techniques
CO 4. To Understand various control techniques and OCR in RPA
CO 5. To Describe various types and strategies to handle exceptions

VII Semester

NOSQL DATABASE			
Course Code:	21CS745	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Objectives:

CLO 1. Recognize and Describe the four types of NoSQL Databases, the Document-oriented, KeyValue
CLO 2. Pairs, Column-oriented and Graph databases useful for diverse applications.
CLO 3. Apply performance tuning on Column-oriented NoSQL databases and Document-oriented NoSQL Databases.
CLO 4. Differentiate the detailed architecture of column oriented NoSQL database, Document database and Graph Database and relate usage of processor, memory, storage and file system commands.
CLO 5. Evaluate several applications for location based service and recommendation services. Devise an application using the components of NoSQL.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL,

Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-Oriented Databases.

More Details on Data Models; Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access,

Textbook1: Chapter 1,2,3

Teaching-Learning Process	Active learning

Module-2

Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums.

Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes

Textbook1: Chapter 4,5,6

Teaching-Learning Process	Active Learning and Demonstrations

Module-3

Map-Reduce, Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental Map-Reduce

Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets

Textbook1: Chapter 7,8

Teaching-Learning Process	Active Learning, Problem solving based

Module-4

Document Databases, What Is a Document Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E- Commerce Applications, When Not to Use, Complex Transactions Spanning Dif erent Operations, Queries against Varying Aggregate Structure

Textbook1: Chapter 9

Teaching-Learning Process	Active learning

Module-5

Graph Databases, What Is a Graph Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.

Textbook1: Chapter 11

Teaching-Learning Process	Active learning

Course Outcomes (Course Skill Set)

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

CO1. Demonstrate an understanding of the detailed architecture of Column Oriented NoSQL databases, Document databases, Graph databases.

CO2. Use the concepts pertaining to all the types of databases.

CO3. Analyze the structural Models of NoSQL.

CO4. Develop various applications using NoSQL databases.

VII Semester

PROGRAMMING IN PYTHON			
Course Code	21CS751	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. To understand why Python is a useful scripting language for developers
CLO 2. To read and write simple Python programs
CLO 3. To learn how to identify Python object types.
CLO 4. To learn how to write functions and pass arguments in Python.
CLO 5. To use Python data structures –- lists, tuples, dictionaries.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

INTRODUCTION DATA, EXPRESSIONS, STATEMENTS:08 Hours
Introduction: Creativity and motivation, understanding programming, Terminology: Interpreter and compiler, Running Python, The First Program; Data types: Int, float, Boolean, string, and list, variables, expressions, statements, Operators and operands.

Textbook 1: Chapter 1.1,1.2,1.3,1.6, Chapter 2.1-2.6
Textbook 2: Chapter 1

Teaching-Learning Process	Chalk and board, Active Learning

Module-2

CONTROL FLOW, LOOPS:
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for, break, continue, pass statement.

Textbook 1: Chapter 3.1-3.6, chapter 5

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

FUNCTIONS AND STRINGS:
Functions: Function calls, adding new functions, definition and uses, local and global scope, return values.

Strings: strings, length of string, string slices, immutability, multiline comments, string functions and methods; **Textbook 1: Chapter 6** **Textbook 2: Chapter 3**	
Teaching-Learning Process	Chalk and board, Active Learning, Demonstration
Module-4	
LISTS, TUPLES, DICTIONARIES:08 Hours **Lists:**List operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters, list comprehension; **Tuples:** tuple assignment, tuple as return value, tuple comprehension; **Dictionaries:** operations and methods, comprehension; **Textbook 2: Chapter 10,11,12**	
Teaching-Learning Process	Chalk& board, Active Learning
Module-5	
REGULAR EXPRESSIONS,FILES AND EXCEPTION: **Regular expressions:**Character matching in regular expressions, extracting data using regular expressions, Escape character **Files and exception**: Text files, reading and writing files, command line arguments, errors andexceptions, handling exceptions, modules. **Textbook 1: Chapter 11.1,11.2,11.4** **Textbook 2: Chapter 14**	
Teaching-Learning Process	Chalk and board, MOOC
Suggested Course Outcomes At the end of the course the student will be able to: CO 1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions. CO 2. Demonstrate proficiency in handling Strings and File Systems. CO 3. Represent compound data using Python lists, tuples, Strings, dictionaries. CO 4. Read and write data from/to files in Python Programs	

VII Semester

INTRODUCTION TO AI AND ML			
Course Code	21CS752	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO1. Understands the basics of AI, history of AI and its foundations, basic principles of AI for problem solving

CLO2. Explore the basics of Machine Learning & Machine Learning process, understanding data

CLO3. Understand the Working of Artificial Neural Networks

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence**,** Intelligent Agents: Agents and Environments, Good Behaviour: The concept of rationality, the nature of Environments, the structure of Agents.

Textbook 1: Chapter: 1 and 2

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Problem solving by searching: Problem solving agents, Example problems, Searching for solutions, Uniformed search strategies, Informed search strategies, Heuristic functions

Textbook 1: Chapter: 3

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Introduction to machine learning: Need for Machine Learning, Machine Learning Explained, and Machine Learning in relation to other fields, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications.

Understanding Data: What is data, types of data, Big data analytics and types of analytics, Big data analytics framework, Descriptive statistics, univariate data analysis and visualization

Textbook 2: Chapter: 1 and 2.1 to 2.5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

Understanding Data
Bivariate and Multivariate data, Multivariate statistics **,** Essential mathematics for Multivariate data, Overview hypothesis, Feature engineering and dimensionality reduction techniques,

Basics of Learning Theory: Introduction to learning and its types**,** Introduction computation learning theory, Design of learning system, Introduction concept learning.

Similarity-based learning: Introduction to Similarity or instance based learning, Nearest-neighbour learning**,** weighted k- Nearest **-** Neighbour algorithm**.**

Textbook 2: Chapter: 2.6 to 2.10, 3.1 to 3.4, 4.1 to 4.3

Teaching-Learning Process	Chalk& board, Problem based learning

Module-5

Artificial Neural Network: Introduction, Biological neurons, Artificial neurons, Perceptron and learning theory, types of Artificial neural Network**,** learning in multilayer Perceptron, Radial basis function neural network, self-organizing feature map,

Textbook 2: Chapter: 10

Teaching-Learning Process	Chalk and board, MOOC

Course Outcomes

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

CO 1. Design intelligent agents for solving simple gaming problems.
CO 2. Have a good understanding of machine leaning in relation to other fields and fundamental issues and
Challenges of machine learning
CO 3. Understand data and applying machine learning algorithms to predict the outputs.
CO 4. Model the neuron and Neural Network, and to analyze ANN learning and its applications.

VII Semester

INTRODUCTION TO BIG DATA			
Course Code	21CS753	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. Understand Hadoop Distributed File system and examine MapReduce Programming
CLO 2. Explore Hadoop tools and manage Hadoop with Sqoop
CLO 3. Appraise the role of data mining and its applications across industries
CLO 4. Identify various Text Mining techniques

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Hadoop Distributed file system:HDFS Design, Features, HDFS Components, HDFS user commands Hadoop MapReduce Framework**:** The MapReduce Model, Map-reduce Parallel Data Flow,Map Reduce Programming

Textbook 1: Chapter 3,5,68hr

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Module-2

Essential Hadoop Tools: Using apache Pig, Using Apache Hive, Using Apache Sqoop, Using Apache Apache Flume, Apache H Base

Textbook 1: Chapter 78hr

Teaching-Learning Process	Chalk and board, Active Learning, Demonstration

Module-3

Data Warehousing: Introduction, Design Consideration, DW Development Approaches, DW Architectures

Data Mining: Introduction, Gathering, and Selection, data cleaning and preparation, outputs ofData Mining, Data Mining Techniques

Textbook 2: Chapter 4,5

Teaching-Learning Process	Chalk and board, Problem based learning, Demonstration

Module-4

Decision Trees: Introduction, Decision Tree Problem, Decision Tree Constructions, Lessons from Construction Trees. Decision Tree Algorithm **Regressions:** Introduction, Correlations and Relationships, Non-Linear Regression, Logistic Regression, Advantages and disadvantages. **Textbook 2: Chapter 6,7**	
Teaching-Learning Process	Chalk& board, Problem based learning
Module-5	
Text Mining: Introduction, Text Mining Applications, Text Mining Process, Term Document Matrix, Mining the TDM, Comparison, Best Practices **Web Mining:** Introduction, Web Content Mining, Web Structured Mining, Web Usage Mining, Web Mining Algorithms. **Textbook 2: Chapter 11,14**	
Teaching-Learning Process	Chalk and board, MOOC
Suggested Course Outcomes At the end of the course the students will be able to: CO 1. Master the concepts of HDFS and MapReduce framework. CO 2. Investigate Hadoop related tools for Big Data Analytics and perform basic CO 3. Infer the importance of core data mining techniques for data analytics CO 4. Use Machine Learning algorithms for real world big data.	

VII Semester

INTRODUCTION TO DATA SCIENCE			
Course Code	21CS754	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives

CLO 1. To provide a foundation in data Science terminologies
CLO 2. To familiarize data science process and steps
CLO 3. To Demonstrate the data visualization tools
CLO 4. To analyze the data science applicability in real time applications.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

PREPARING AND GATHERING DATA AND KNOWLEDGE
Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data, Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data - The Big data Eco system: Distributed file system, Distributed Programming framework, Data Integration frame work, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security.

Textbook 1: Ch 1.1 to 1.4

Teaching-Learning Process	Chalk and board, Active Learning, PPT Based presentation

Module-2

THE DATA SCIENCE PROCESS-Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Build the models, presenting findings and building application on top of them.

Textbook 1:,Ch 2

Teaching-Learning Process	Chalk and board, Active Learning, PPT Based presentation

Module-3

MACHINE LEARNING: Application for machine learning in data science- Tools used in machine learning- Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms.

Textbook 1: Ch 3.1 to 3.3

Teaching-Learning Process	Chalk and board, Active Learning, PPT Based presentation, Video
Module-4	
VISUALIZATION–Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools. **Textbook 1: Ch 9**	
Teaching-Learning Process	Chalk and board, Active Learning, PPT Based presentation, MOOC
Module-5	
CASE STUDIES Distributing data storage and processing with frameworks - Case study: e.g, Assessing risk when lending money. **Textbook 1: Ch 5.1, 5.2**	
Teaching-Learning Process	Chalk and board, Active Learning, PPT Based presentation, Video
Course Outcomes At the end of the course the student will be able to: CO 1. Describe the data science terminologies CO 2. Apply the Data Science process on real time scenario. CO 3. Analyze data visualization tools CO 4. Apply Data storage and processing with frameworks	