III

Semester

Probability, Distributions and Statistics			
Course Code	25IC31	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:2:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	56	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Basics of Probability and Statistics
- Understanding of Hypothesis
- Basic Mathematics

Course Objectives:

This course will enable the students to:

CLO1: Introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.

CLO2: Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.

CLO3: Determine whether an input has a statistically significant effect on the system's response through ANOVA testing

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching.

MODULE-1 **12 Hours**

Modular Arithmetic: Introduction of modular arithmetic and its applications in Computer Science and Engineering. Introduction to Congruences, Linear Congruences, The Remainder theorem, Solving Polynomials, Linear Diophantine Equation, System of Linear Congruences, Euler's Theorem, Wilson Theorem and Fermat's little theorem. Applications of Congruences-RSA algorithm.

Text Book: 3 – Chapters 4, 5, 6, 7 and 9.

MODULE-2 **11 Hours**

Statistics: Principles of least squares, Curve fitting by the method of least squares in the form: $y = a + \ ,\ y = a + bx + cx^2$, and $y = ax^b$. Correlation, Coefficient of correlation, Lines of regression, Angle between regression lines, rank correlation.

Text Book: 1 – Chapters 11 and 12.

Text Book: 2 – Chapters 13 and 14.

MODULE-3 **11 Hours**

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation: mean and variance. Binomial, Poisson and normal distributions-problems (derivations for mean and standard deviation for Binomial and Poisson distributions only).

Text Book: 1 – Chapters 3, 4, 5, 6.
Text Book: 2 – Chapters 6 and 7.

MODULE-4 **11 Hours**

Joint Probability Distributions: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. Markov Chain: Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains.

Text Book: 1 - Chapters 3, 4, 5, 6.
Text Book: 4 – Chapter 8.

MODULE-5 **11 Hours**

Statistical Inference: Sampling distribution, standard error. Levels of significance. Testing of hypothesis. Test of significances. Confidence limits, simple sampling of attributes. Sampling variables, central limit theorem and confidences limit for unknown mean.

Test of significance for large samples (mean, proportion). Comparison of large samples (mean, proportion).

Test of Significance for means of two small samples, students-'t' distribution, and Chi-square distribution as a test of goodness of fit.

Text Book: 1 – Chapters 8 and 10.
Text Book: 2 – Chapters 8, 9, 10 and 12.

Course outcomes (Course Skill Set):

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

CO1: **Apply** the concepts of modular arithmetic, congruence's, linear Diophantine equations, Euler's theorem, Fermat's theorem, Wilson's theorem, and the RSA cryptographic algorithm to solve engineering and computational problems. (PO – 1,2,3)

CO2: **Apply** least squares curve fitting, correlation, regression analysis, and rank correlation techniques to analyse engineering data and establish relationships between variables. (PO – 1,2,3)

CO3: **Solve** engineering problems involving discrete and continuous random variables using probability distributions, mathematical expectation, variance, and standard probability models such as Binomial, Poisson, and Normal distributions. (PO – 1,2,3)

CO4: **Analyse** joint probability distributions and Markov chains by determining expectations,

covariance, correlation, transition probabilities, stationary distributions, and absorbing states for stochastic systems. (PO – 1,2,3)

CO5: **Apply** statistical inference techniques including hypothesis testing, confidence intervals, large and small sample tests, Student's *t*-test, Chi-square test, and the Central Limit Theorem to draw valid conclusions from engineering data. (PO – 1,2,3)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the regulations; if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Text Books:

1. Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye "Probability and Statistics for Engineers and Scientists", Pearson Education, Ninth edition, 2012.
2. Murray R. Spiegel, Larry J. Stephens, Statistics, Schaum's outline series, Third edition.
3. Koshy, Thomas. *Elementary number theory with applications*. Academic press, 2nd Edition, 2009.
4. Seymour Lipschutz and Marc Lars Lipson, Probability, Schaum's Outline Series, Second edition, 2011.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9 th Edition, 2006.
2. B. S. Grewal "Higher Engineering Mathematics", Khanna publishers, 44 th Ed., 2021.
3. Irwin Miller & Marylees Miller, John E. Freund's "Mathematical Statistics with Applications" Pearson.
   Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
4. S C Gupta and V K Kapoor, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
5. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, (Reprint), 2003.
6. S. Ross, "A First Course in Probability", Pearson Education India, 6 th Ed., 2002.
7. David M Burton: "Elementary Number Theory" Mc Graw Hill, 7th Ed.,2017

Web links and Video Lectures(e-Resources):

- Probability and statistics: https://nptel.ac.in/courses/111105090
- Introduction to Probability and Statistics for Machine Learning: https://www.classcentral.com/course/codesignal-introduction-to-probability-and-statistics-for-machine-learning-358081
- Probability and Statistics: https://www.classcentral.com/course/probability-statistics-11755 Introduction to probability, statistics, and random processes: https://probabilitycourse.com/
- Introduction to Probability and Statistics: https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/
- VTU e-Shikshana Program
- VTU EDUSAT Program

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

Learning Activity – 1: Tutorial: Practing problems (Two objective type assessments for 5 marks each, total 10 marks) or Conduction of CIA (Continuous Internal Assessment) for 10 marks.

Learning Activity – 2: Assignments: Assigning two assignments each for 5 marks, total 10 marks.

Learning Activity – 3: Choose either Seminar or Project based learning activity with report for 5 marks.

OPERATING SYSTEMS			
Course Code	25IC32	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	42	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisite:

The Students Should have knowledge of

Computer Architecture / Organization

Course objectives:

CLO1: To provide students with a fundamental understanding of the structure, functions, and services of an operating system.

CLO2: To enable students to understand and apply CPU scheduling algorithms for efficient process management.

CLO3: To develop the ability to analyze process synchronization mechanisms and deadlock handling techniques used in operating systems.

CLO4: To familiarize students with memory management strategies and virtual memory concepts, and enable them to apply paging and page replacement techniques.

CLO5: To introduce file system organization, secondary storage management, and protection mechanisms, and develop the ability to apply disk scheduling techniques for efficient storage management.

Teaching-Learning Process (General Instructions):

1. Lecture method (L) need not be only a traditional lecture method; alternative effective teaching methods may be adopted to attain the outcomes.
2. Use of video/animation to explain the functioning of various concepts.
3. Encourage collaborative (group learning) in the class.
4. Ask at least three HOT (Higher Order Thinking) questions in the class to promote critical thinking.
5. Adopt Problem Based Learning (PBL) to foster students' analytical and design thinking skills such as designing, evaluating, generalizing, and analyzing information rather than simple recall.
6. Use animations/videos to help students understand concepts.
7. Demonstrate concepts using a suitable programming language.

MODULE-1 **09 Hours**

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 debugging, Operating System generation; System boot.

Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.11

MODULE-2 **09 Hours**

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

Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues.

Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling,

Textbook 1: Chapter – 3 (3.1-3.4), 4 (4.1-4.4), 5 (5.1 -5.5)

MODULE-3	08 Hours
Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. **Textbook 1:** Chapter – 6 (6.1-6.6), 7 (7.1 -7.7)	
MODULE-4	**08 Hours**
Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. **Textbook 1:** Chapter -8 (8.1-8.6), 9 (9.1-9.6)	
MODULE-5	**08 Hours**
File System: File system: File concept; Access methods; Directory and Disk structure Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. Secondary Storage Structure: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix **Textbook 1:** Chapter -10(10.1-10.3),11(11.1-11.5),12(12.1-12.5),14(14.1-14.4)	

Course outcome (Course Skill Set):

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

CO1: Explain the structure and functionality of operating system. (PO-1,2,3,11, PSO-1,2)

CO2: Apply appropriate CPU scheduling algorithms for the given problem. (PO-1,2,3,11, PSO-1,2)

CO3: Analyse the various techniques for process synchronization and deadlock handling. (PO-1,2,3,11, PSO-1,2)

CO4: Explain memory management strategies and virtual memory concepts, and apply paging and page replacement techniques for efficient memory management. (PO-1,2,3,11, PSO-1,2)

CO5: Explain file system organization and protection mechanisms, and apply disk scheduling algorithms for efficient disk access. (PO-1,2,3,11, PSO-1,2)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

● For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.

● The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered

● Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.

● For the course, CIE marks will be based on a scaled-down sum of two tests and other methods

of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination: Theory SEE will be conducted as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015

Reference Books

1. Ann Mc Hoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE),2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

Web links and Video Lectures(e-Resources):

- https://youtu.be/mXw9ruZaxzQ 14.09.2023 MKV-TEMPLATE for IPCC (26.04.2022) Annexure-III
- https://youtu.be/vBURTt97EkA
- https://www.youtube.com/watch?v=783KABtuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f
- https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Case Study
- Assignments
- Seminars
- MOOC Certifications

Data Structures and Applications			
Course Code	25IC33	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Credits	03	Total Marks	100
Contact Hours	40	Exam Hours	3
Examination type (SEE)	Theory		

Prerequisite:

The students should have knowledge on

- Basic Programming Skills:
- Understanding of Algorithms
- Mathematics
- Problem-Solving Skills

Course objectives:

CLO1. To explain fundamentals of data structures and their applications.
CLO2. To illustrate representation of Different data structures such as Stack and Queues, Linked lists, Trees and Graphs.
CLO3. To Design and Develop Solutions to problems using Linear Data Structures.
CLO4. To discuss applications of Non-linear Data Structures in problem solving such as trees.
CLO5. To introduce advanced Data structure concepts such as Graphs and Hash and Optimal Binary Search Trees.

Teaching-Learning Process (General Instructions)

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching
4. Virtual labs enhance learning

Module-1 **9 Hours**

Introduction to data structures: data structures, classifications (primitive & non-primitive), data structure operations pointers and dynamic memory allocation,
Arrays and structures: arrays, dynamic allocated arrays, structures and unions, polynomials, sparse matrices, representation of multidimensional arrays, strings
Textbook: chapter 1:1.2 chapter 2: 2.1 to 2.7

Module-2 **8 Hours**

Stacks and Queues: Stacks, Stacks Using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues.
Textbook: Chapter 3: 3.1,3.2,3.6 3.3, 3.4, 3.7

Module-3 **8 Hours**

Linked Lists: Singly Linked lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials, Additional List operations, Sparse Matrices, Doubly Linked Lists.
Textbook: Chapter 4: 4.1 to 4.4 4.5,4.7,4.8

Module-4 **8 Hours**

Trees: Introduction to trees, binary trees, binary tree traversals, threaded binary trees. Binary search trees, selection trees, forests, representation of disjoint sets, counting binary trees, leftist trees. Efficient binary search trees: AVL trees, red black tree
Textbook: chapter 5: 5.1 to 5.3, 5.5 ,5.7 to 5.11

Module-5	9 Hours

GRAPHS: The Graph Abstract Data Types, Elementary Graph Operations (BFS/DFS)
HASHING: Introduction, Static Hashing, Dynamic Hashing
Textbook Chapter 6: 6.1, 6.2 Chapter 8: 8.1 to 8.3

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

CO 1: Explain different data structures and their applications. (PO - 1,2,3,4,5, PSO - 1,3)
CO 2: Apply Arrays, Stacks and Queue data structures to solve the given problems. (PO -1,2,3, PSO - 1,2,3)
CO 3: Use the concept of linked list in problem solving. (PO -1,2,3,4,5 PSO -1,3)
CO 4: Develop solutions using trees and graphs to model the real-world problem. (PO -1,2,3,4,5 PSO - 1,3)
CO 5: Explain the advanced Data Structures concepts such as Hashing Techniques and Optimal Binary Search Trees. (PO - 1,2,3,4,5 PSO -1,3)

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Textbook:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014

Reference Books:

1. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
2. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
3. Reema Thareja, Data Structures usingC,3rd Ed, Oxfordpress,2012.
4. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with applications, 2nd Ed, McGraw Hill, 2013.
5. A M Tenenbaum, Data Structures using C, PHI,1989
6. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI,1996.

Web links and Video Lectures(e-Resources):

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
- https://nptel.ac.in/courses/106/105/106105171/
- http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
- https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
- https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
- https://nptel.ac.in/courses/106/102/106102064/
- https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
- 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/tree-traversal/index.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501595428077568125559/overview

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
- Case Study
- Programming Assignment
- Gate Based Aptitude Test
- MOOC Assignment for selected Module

Digital Design and Computer Organization			
Course Code	25IC34	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:2	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	42 Theory+ 28 Practical	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Basic Electronics
- Digital Circuits
- Computer Architecture Concepts

Course Objectives:

- To demonstrate the functionalities of binary logic system
- To explain the working of combinational and sequential logic system
- To realize the basic structure of computer system
- To illustrate the working of I/O operations and processing unit

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Module-1 **9 Hours**

Introduction to Digital Design: Binary Logic, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.

Case Study: Design a solution for a Real Time Problem Using K-Maps.

Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.9

Module-2 **9 Hours**

Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder-Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. **Sequential Logic**: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.

Case Study: Design a real-world control system based on Combinational and Sequential logic circuits to manage specific operational requirements effectively.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, 5.1, 5.2, 5.3, 5.4.

Module-3	8 Hours
Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes. **Text book 2**: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5	
Module-4	**8 Hours**
Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions. **Case Study**: Optimizing Cache Mapping in an AI-Based System **Text book 2:** 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1	
Module-5	**8 Hours**
Basic Processing Unit: Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. **Pipelining:** Basic concepts, Role of Cache memory, Pipeline Performance. **Case Study:** Pipelining in AI-Powered **Text book 2:** 7.1, 7.2, 8.1	

PRACTICAL COMPONENT OF IPCC

Sl.No.	**Experiments** **Simulation packages preferred: Multisim, Model sim, PSpice or any other relevant**
1.	Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using basic gates.
2.	Implement and simulate a 4-bit Full Adder using basic logic gates.
3.	Implement and simulate a 4-bit Full Subtractor using basic logic gates.
4.	Develop simple digital circuits using Verilog HDL based on Structural, Dataflow, and Behavioral modeling.
5.	Design Verilog HDL to implement Binary Half Adder and Half Subtractor.
6.	Design Verilog HDL to implement Binary Full Adder, and Full Subtractor.
7.	Develop a Decimal Adder using Verilog HDL.
8.	Design Verilog program to implement Different types of multiplexers like 2:1, 4:1 and 8:1.
9.	Design Verilog program to implement types of De-Multiplexer.
10.	Implement various types of Flip-Flops, such as SR, JK, and D Flip-Flops, using Verilog HDL.

Course outcomes (Course Skill Set):

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

CO1: Apply the K–Map techniques to simplify various Boolean expressions. (PO – 1,2,3 PSO – 1,3)

CO2: Design different types of combinational and sequential circuits along with Verilog programs. (PO – 1,2,3,5, PSO – 1,3)

CO3: Describe the fundamentals of machine instructions, addressing modes and Processor performance. (PO – 1,2,3,5 PSO – 1)

CO4: Explain the approaches involved in achieving communication between processor and I/O devices. (PO – 1,2,3, PSO – 1)

CO5: Analyze internal Organization of Memory and Impact of cache/Pipelining on Processor Performance. (PO – 1,2,3, PSO – 1)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).

- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

CIE for the practical component of the IPCC

1. 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
2. On completion of every experiment/program in the laboratory, the students shall be evaluated including viva- voce and marks shall be awarded on the same day.
3. The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks of all experiments' write- ups are added and scaled down to 15 marks.
4. The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
5. Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
6. The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbook:

1. M. Morris Mano & Michael D. Ciletti, Digital Design with an Introduction to Verilog Design, 5e, Pearson Education.
2. Carl Hamacher, Zvonko Vranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill.

Web links and Video Lectures(e-Resources):

- https://elearning.vtu.ac.in/econtent/courses/web/CSE/15CS44.html
- https://cse11-iiith.vlabs.ac.in/
- https://infyspringboard.onwingspan.com
- https://onlinecourses.nptel.ac.in/noc21_ee39/preview

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Role Play
- Flipped classroom

Assessment Methods for 25 Marks (opt two Learning Activities)

- Case Study
- Programming Assignment

DATA STRUCTURES LABORATORY			
Course Code	25ICL35	**CIE Marks**	50
Teaching Hours/Week (L: T:P)	0:0:2	**SEE Marks**	50
Credits	01	**Total Marks**	100
Contact Hours	28	**Exam Hours**	3
Examination type (SEE)	Practical		

Prerequisites:

The students should have knowledge on

- Basic Programming Skills
- Understanding of Algorithms
- Problem-Solving Skills

Course Objectives:

This laboratory course enables students to gain practical experience in the design, development, implementation, analysis, and evaluation/testing of:
Dynamic memory management
Linear data structures and their applications such as stacks, queues, and lists
Non-linear data structures and their applications such as trees and graphs

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Programs List:

Sl. No.	Experiments
1.	Develop a program in C for the following: a. Declare a calendar as an array of 7 elements (a dynamically created array) to represent the 7 days of a week. Each element of the array should be a structure having three fields: • The name of the day (a dynamically allocated string) • The date of the day (an integer) • The description of the activity for that day (a dynamically allocated string) b. Write functions create(), read(), and display() to: • Create the calendar • Read the data from the keyboard Display the week's activity details report on the screen
2.	Develop a Program in C for the following operations on Strings. a. Read a main String(STR),a Pattern String(PAT) and a Replace String(REP) b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR

	Support the program with functions for each of the above operations. Don't use Built-in functions.
3.	Develop a menu-driven program in C for the following operations on a STACK of integers (Array implementation of a stack with maximum size MAX): a. Push an element onto the stack b. Pop an element from the stack c. Demonstrate how a stack can be used to check for a palindrome d. Demonstrate overflow and underflow situations on the stack e. Display the status of the stack f. Exit Support the program with appropriate functions for each of the above operations.
4.	Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parent the sized and free parenthesized expressions with the operators:+,,*,/,%(Remainder),^(Power)and alphanumeric operands.
5.	Develop a Program in C for the following Stack Applications a) Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ Solving Tower of Hanoi problem with n disks
6.	Develop a menu-driven program in C for the following operations on a Circular QUEUE of characters (Array implementation of a queue with maximum size MAX): a. Insert an element into the Circular QUEUE b. Delete an element from the Circular QUEUE c. Demonstrate overflow and underflow situations on the Circular QUEUE d. Display the status of the Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations.
7.	Develop a menu-driven program in C for the following operations on a Singly Linked List (SLL) of student data with the fields: USN, Name, Programme, Semester, and Phone Number: a. Create a SLL of *N* students' data by using front insertion b. Display the status of the SLL and count the number of nodes in it c. Perform insertion/deletion at the end of the SLL Perform insertion/deletion at the front of the SLL (demonstration of stack)
8.	Develop a menu-driven program in C for the following operations on a Doubly Linked List (DLL) of employee data with the fields: SSN, Name, Department, Designation, Salary, and Phone Number: a. Create a DLL of *N* employees' data by using end insertion b. Display the status of the DLL and count the number of nodes in it c. Perform insertion and deletion at the end of the DLL d. Perform insertion and deletion at the front of the DLL Demonstrate how this DLL can be used as a double-ended queue
9.	Develop a program in C for the following operations on a Singly Circular Linked List (SCLL) with header nodes: a. Represent and evaluate a polynomial $\mathbf{P(x, y) = 6x^2y^2 - 4y + 3x^3y + 2xy^5 - 2xy}$ Find the sum of two polynomials **POLY1(x, y)** and **POLY2(x, y)** and store the result in **POLYSUM(x, y)**
10.	Develop a menu-driven program in C for the following operations on a Binary Search Tree (BST) of integers:

	a. Create a BST with *N* integers: **6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2** b. Traverse the BST in **In order**, **Preorder**, and **Post order** Search the BST for a given element (**KEY**) and report an appropriate message
11	Develop a program in C for the following operations: Graph of Cities a. Create a graph of *N* cities using an adjacency matrix. Print all the nodes reachable from a given starting node in a directed graph using **DFS**/**BFS** method.
12	Hash Table for Employee Records Given a file **F** of *N* employee records with a set **K** of keys (4-digit integers) that uniquely determine the records in **F**, assume that **F** is maintained in memory by a **Hash Table (HT)** of *m* memory locations with **L** as the set of memory addresses (2-digit integers). Develop a program in C that: • Uses a hash function **H: K → L** defined as **H(K) = K mod m** (remainder method). • Implements a hashing technique to map a given key **K** to the address space **L**. Resolves collisions (if any) using **linear probing**.

Course Outcomes (Course Skill Set):

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

CO1: Analyze various linear and non-linear data structures. *(PO-1,2,3,5)*

CO2: Demonstrate the working principles of different types of data structures and their applications. *(PO-1,2,3,5)*

CO3: Use appropriate searching and sorting algorithms for a given scenario. *PO-1,2,3,5)*

CO4: Apply suitable data structures for solving real-world problems. *(PO-1,2,3,5)*

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural

knowledge will carry a weightage of 60% and the rest 40% for viva-voce.

- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Web links and Video Lectures(e-Resources):

- https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
- 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/tree-traversal/index.html

https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html

Object Oriented Programming with JAVA			
Course Code	25IC36A	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	2:0:2	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	28 Theory + 20 Practical	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge on

- Basic Programming Skills
- Understanding of Algorithms
- Basic Mathematics
- Problem-Solving Skills

Course Objectives:

- To learn primitive constructs JAVA programming language.
- To understand Object Oriented Programming Features of JAVA.
- To gain knowledge on: packages, multithreaded programing and exceptions.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Use Online Java Compiler IDE: https://www.jdoodle.com/online-java-compiler/ or any other.
2. Demonstration of programing examples.
3. Chalk and board, power point presentations
4. Online material (Tutorials) and video lectures.

Module-1 **6 Hours**

An Overview of Java: Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).

Data Types, Variables, and Arrays: The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables.

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

Control Statements: Java's Selection Statements (if, The Traditional switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).

Text Book 1:Chapter 2, 3, 4, 5

Module-2 **6 Hours**

Introducing Classes: Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods**,** Constructors**,** The this Keyword**,** Garbage Collection.

Methods and Classes: Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.

Text Book 1:Chapter 6, 7

Module-3	6 Hours

Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class.

Interfaces: Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods.

Text Book 1:Chapter 8, 9

Module-4	5 Hours

Packages: Packages, Packages and Member Access, Importing Packages.

Exceptions: 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.

Text Book 1:Chapter 9, 10

Module-5	5 Hours

Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using is Alive() and join(), Thread Priorities, Synchronization, Inter thread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State.

Enumerations, Type Wrappers and Auto boxing: Enumerations (Enumeration Fundamentals**,** The values() and value Of() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Auto boxing (Auto boxing and Methods, Auto boxing/Unboxing Occurs in Expressions, Auto boxing/Unboxing Boolean and Character Values).

Text Book 1:Chapter 11, 12

Course outcomes (Course Skill Set):

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

- **CO1:** Demonstrate proficiency in writing simple programs involving branching and looping structures (PO-2,3,5)
- **CO2:** Design a class involving data members and methods for the given scenario. (PO-2,3,4,5)
- **CO3:** Apply the concepts of inheritance and interfaces in solving real world problems. (PO-2,3,4,5)
- **CO4:** Use the concept of packages and exception handling in solving complex problem (PO-2,3,4,5)
- **CO5:** Apply concepts of multithreading, autoboxing and enumerations in program development (PO-2,3,4,5)

Programming Experiments (Suggested and are not limited to)

1. Develop a JAVA program to add TWO matrices of suitable order N (The value of N should be read from command line arguments).
2. Develop a stack class to hold a maximum of 10 integers with suitable methods. Develop a JAVA main method to illustrate Stack operations.
3. A class called Employee, which models an employee with an ID, name and salary, is designed as shown in the following class diagram. The method raise Salary (percent) increases the salary by the given percentage. Develop the Employee class and suitable main method for demonstration.

4. A class called MyPoint, which models a 2D point with x and y coordinates, is designed as follows:
   - Two instance variables x (int) and y (int).
   - A default (or "no-arg") constructor that construct a point at the default location of (0, 0).
   - A overloaded constructor that constructs a point with the given x and y coordinates.
   - A method set XY() to set both x and y.
   - A method get XY() which returns the x and y in a 2-element int array.
   - A toString() method that returns a string description of the instance in the format "(x, y)".
   - A method called distance(int x, int y) that returns the distance from this point to another point at the given (x, y) coordinates
   - An overloaded distance(My Point another) that returns the distance from this point to the given My Point instance (called another)
   - Another overloaded distance() method that returns the distance from this point to the origin (0,0) Develop the code for the class My Point. Also develop a JAVA program (called Test My Point) to test all the methods defined in the class.
5. Develop a JAVA program to create a class named shape. Create three sub classes namely: circle, triangle
   and square, each class has two member functions named draw () and erase (). Demonstrate polymorphism concepts by developing suitable methods, defining member data and main program.
6. Develop a JAVA program to create an abstract class Shape with abstract methods calculate Area() and calculate Perimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
7. Develop a JAVA program to create an interface Resizable with methods resize Width(int width) and resize Height(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
8. Develop a JAVA program to create an outer class with a function display. Create another class inside the outer class named inner with a function called display and call the two functions in the main class.
9. Develop a JAVA program to raise a custom exception (user defined exception) for Division By Zero using try, catch, throw and finally.
10. Develop a JAVA program to create a package named my pack and import & implement it in a suitable class.
11. Write a program to illustrate creation of threads using runnable class. (start method start each of the newly created thread. Inside the run method there is sleep() for suspend the thread for 500 milliseconds).
12. Develop a program to create a class My Thread in this class a constructor, call the base class constructor, using super and start the thread. The run method of the class starts after this. It can be observed that both main thread and created child thread are executed concurrently.

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/

course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in the regulation. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

OBJECT ORIENTED PROGRAMMING WITH C++			
Course Code	25IC36B	**CIE Marks**	50
Teaching Hours/Week (L:T:P)	2:0:2	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	28 Theory + 20 Practical	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisite:

The students should have knowledge of

- Basic Programming Skills:
- Knowledge of C

Course objectives:

CLO1: To understand object-oriented programming using C++and Gain knowledge about the capability to store information together in an object.
CLO2: To illustrate the capability of a class to rely upon another class and functions.
CLO3: To Create and process data in files using file I/O functions
CLO4: To understand the generic programming features of C++ including Exception handling

Teaching-Learning Process (General Instructions)

1. Lecture method (L) need not be only a traditional lecture method; alternative effective teaching methods may be adopted to attain the outcomes.
2. Use of video/animation to explain the functioning of various concepts.
3. Encourage collaborative (group learning) in the class.
4. Ask at least three HOT (Higher Order Thinking) questions in the class to promote critical thinking.
5. Adopt Problem Based Learning (PBL) to foster students' analytical and design thinking skills such as designing, evaluating, generalizing, and analyzing information rather than simple recall.
6. Use animations/videos to help students understand concepts.
7. Demonstrate concepts using a suitable programming language.

Module-1 **6 Hours**

An overview of C++: What is object-Oriented Programming? Introducing C++ Classes, The General Form of a C++ Program. Classes and Objects: Classes, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, The Scope Resolution Operator, Passing Objects to functions, Returning Objects, Object Assignment

Text book: Ch 11, Ch 12

Module-2 **6 Hours**

Arrays, Pointers, References, and the Dynamic Allocation Operators: Arrays of Objects, Pointers to Objects, The this Pointer, Pointers to derived types, Pointers to class members. Functions Overloading, Copy Constructors: Functions Overloading, Overloading Constructor Functions. Copy Constructors, Default Function Arguments, Function Overloading and Ambiguity.

Text book: Ch 13, Ch 14

Module-3 **5 Hours**

Operator Overloading: Creating a Member Operator Function, Operator Overloading Using a Friend Function, Overloading new and delete Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Multiple Base Classes, Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes

Text book: Ch 15, Ch 16

Module-4 **6 Hours**

Virtual Functions and Polymorphism: Virtual Functions, The Virtual Attribute is Inherited, Virtual Functions are Hierarchical, Pure Virtual Functions, Using Virtual Functions, Early vs Late Binding. Templates: Generic Functions, Applying Generic Functions, Generic Classes. The type name and export Keywords. The Power of Templates

Text book: Ch 17, Ch 18

Module-5 **5 Hours**

Exception Handling: Exception Handling Fundamentals, Handling Derived-Class Exceptions, Exception Handling Options, Applying Exception Handling. The C++ I/O System Basics: C++ Streams, The C++ Classes, Formatted I/O File I/O: and File Classes, Opening and Closing a File, Reading and Writing Text Files, Detecting EOF.

Text book: Ch 19, Ch 20, Ch21

PRACTICAL COMPONENT

Si. NO	**EXPERIMENT NAME**
1	Develop a C++ program to find the largest of three numbers
2	Develop a C++ program to sort the elements in ascending and descending order.
3	Develop a C++ program using classes to display student name, roll number, marks obtained in two subjects and total score of student
4	Develop a C++ program for a bank empolyee to print name of the employee, account_no. & balance. Print invalid balance if amount<500, Display the same, also display the balance after withdraw and deposit.

5	Develop a C++ program to demonstrate function overloading for the following prototypes. add(int a, int b), add(double a, double b
6	Develop a C++ program using Operator Overloading for overloading Unary minus operator.
7	Develop a C++ program to implement Multiple inheritance for performing arithmetic operation of two numbers
8	Develop a C++ program using Constructor in Derived classes to initialize alpha, beta and gamma and display corresponding values.
9	Develop a C++ program to create a text file, check file created or not, if created it will write some text into the file and then read the text from the file.
10	Develop a C++ program to write and read time in/from binary file using fstream
11	Develop a function which throws a division by zero exception and catch it in catch block. Write a C++ program to demonstrate usage of try, catch and throw to handle exception.
12	Develop a C++ program that handles array out of bounds exception using C++.

Course outcome (Course Skill Set)

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

CO1: Illustrate the basic concepts of object-oriented programming.(PO-1,2,5,11, PSO-1,2,3)
CO2: Design appropriate classes for the given real world scenario. (PO-1,2,5,11, PSO-1,2,3)
CO3: Apply the knowledge of compile-time / run-time polymorphism to solve the given problem. (PO-1,2,5,11, PSO-1,2,3)
CO4: Use the knowledge of inheritance for developing optimized solutions(PO-1,2,5,11, PSO-1,2,3)
CO5: Apply the concepts of templates and exception handling for the given problem(PO-1,2,5,11, PSO-1,2,3)
CO6: Use the concepts of input output streams for file operations (PO-1,2,5,11, PSO-1,2,3)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the

syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report.
- 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Textbooks

1. Herbert schildt, The Complete Reference C++, 4th edition, TMH, 2005

Reference Books

1. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill
2. Education Pvt.Ltd., Sixth Edition 2016.
3. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004.
4. A K Sharma , "Object Oriented Programming with C++", Pearson Education, 2014

Web links and Video Lectures (e-Resources):

1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2. Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw

Tutorial Link:

1. https://www.w3schools.com/cpp/cpp_intro.asp
2. https://www.edx.org/course/introduction-to-c-3
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013843642506788864433 75_shared/overview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Assignment to develop small projects and demonstrate using C++

Python Programming for Data Science			
Course Code	25IC36C	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	2:0:2	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	28 Theory + 28 Practical	**Exam Hours**	3
Examination nature (SEE)	Theory		

Prerequisites: Basic knowledge of a programming language and Statistics

Course Objectives:

- To understand Python constructs and use them to build the programs.
- To analyse different conditional statements and their applications in programs.
- To learn and use basic data structures in python language.
- To learn and demonstrate array manipulations by reading data from files.
- To understand and use different data in a data analytics context.

Teaching-Learning Process (General Instructions)

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

1. Chalk and board, power point presentations.
2. Online Material (Tutorials) and video lectures.
3. Demonstration of programming examples.

MODULE-1 5 **Hours**

Introduction to Data Science: Introduction, Knowledge domains of the data analyst, understanding the nature of data, the data analysis process, Quantitative and Qualitative Data Analysis, Python and Data Analysis

Textbook3: Chapter 1

MODULE-2 6 **Hours**

Python for Data Science: variables and assignment statement, data types in python, operators and expressions, control statements (if, for, while).

Data Structures: Lists (operations on list), Tuples (creating, indexing and slicing, operations on tuples), sets (creating, operations in sets), dictionaries (creating, operations, nested dictionaries)

Textbook1: 3.4, 3.6, 3.7, 4.3, 4.4,4.5, 4.6,5.3

Textbook2: 3.1

MODULE-3 6 **Hours**

Array manipulation using NumPy: Numpy array: Creating Numpy arrays; datatypes for ndarray , indexing and slicing, Transposing Arrays and Swapping Axes, Universal Functions (ufuncs),

Random Number Generation.

Textbook2: 4.1, 4.2, 4.3

MODULE-4 6 **Hours**

Data Manipulation using Pandas: Introduction to Pandas, Series and DataFrames, Reindexing, Data Selection and Filtering, Indexing and Sorting

Textbook2: 5.1, 5.2

MODULE-5 5 **Hours**

Data Preparation: Merging, concatenating, Pivoting, Data Transformation, Discretization and Binning, Detecting and Filtering Outliers, Data aggregation

Case Study: Data Analysis for the Iris Dataset

Textbook3: Chapter 6

Practical component of IPCC:

Sl.No.	Experiment
1	A college wants to automate the process of analyzing student marks. The system should accept marks of *n* students, calculate the total, average, highest mark, lowest mark, and assign grades based on the average.
2	An electricity board charges consumers based on the following slab rates: first 100 units at ₹3/unit, next 200 units at ₹5/unit, and remaining units at ₹7/unit. Read the consumer name and units consumed, calculate the total bill amount, and display the result.
3	A small library stores book details such as book ID, title, author, and number of copies. Create a menu-driven Python program to add books, search books by ID, update copies, and display all books.
4	A weather station records temperatures for 30 days. Store the temperatures in a NumPy array and find the average temperature, highest temperature, lowest temperature, and number of days with temperature above the average.
5	Rainfall data of three cities for four months is given in matrix form. Create a 3×4 NumPy array and perform row-wise totals, column-wise averages, transpose of the matrix, and identify the city with maximum rainfall.
6	A retail store records daily sales for different products. The manager wants to identify the best-selling product and calculate total revenue.
7	An organization maintains employee details in a CSV file containing EmployeeID, Department, Salary, and Experience. Read the file using Pandas and display department-wise average salary, highest paid employee, employees with salary

	greater than ₹50,000, and employees sorted by salary.
8	An organization maintains attendance records in a CSV file. HR wants a report showing employees with low attendance (<75%) and the overall attendance percentage.
9	Exploratory Data Analysis and Data Preparation of the Titanic Dataset
10	Exploratory Data Analysis and Data Preparation of the Diabetes Dataset

Course outcomes (Course Skill Set):

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

CO1: Explain the fundamentals of data science and apply Python programming constructs to solve basic computational problems.

CO2: Develop Python programs using control statements and built-in data structures such as lists, tuples, sets, and dictionaries.

CO3: Perform numerical computations and array manipulations using the NumPy library.

CO4: Manipulate, filter, sort, and analyze datasets using Pandas DataFrames and Series.

CO5: Apply data preparation techniques such as merging, transformation, aggregation, pivoting, discretization, and outlier detection to support data analysis.

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in the regulation. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10**

marks for the test to be conducted after the completion of all the laboratory sessions.

- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books:

1. S. Sridhar, J. Indumathi, V.M. Hariharan "Python Programming", Pearson publishers, 1st edition 2023.
2. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, 3rd Edition, O'Reilly Media, 2022.
3. Fabio Nelli, "Python Data Analytics", Apress, Publishing, 1st Edition, 2015.

Web links and Video Lectures (e-Resources):

- Nptel: Introduction to Python for Data Science
- https://www.youtube.com/watch?v=tA42nHmmEKw&list=PLh2mXjKcTPSACrQxPM2_1Ojus5HX88ht7

Activity Based Learning (Suggested Activities)/ Practical Based learning:

Assessment Methods

- Programming Assignment (10 Marks)

IoT Case Studies and Future Trends			
Course Code	25IC37A	CIE Marks	50
Teaching Hours/Week (L: T:P)	0:0:2	SEE Marks	50
Credits	01	Total Marks	100
Contact Hours	28	Exam Hours	3
Examination nature (SEE)	Theory		

Prerequisite:

The students should have knowledge on

- Basic Knowledge of IoT Concepts
- Fundamentals of Networking
- Data Handling and Cloud Basics
- Embedded Systems and Programming

Course objectives:

CLO1.Understand and Explore Internet of Things (IoT)

CLO2.Analyse different components roles in making of Internet of Things.

CLO3.Explore different available options with the component available for designing the IOT applications.

CLO4.Analyse the supportive systems that assist in drawing intelligent inference of the IOT systems.

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 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 **4 Hrs**

Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Emergence of IoT.

MODULE-2 **4 Hrs**

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

MODULE-3	4 Hrs
IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.	
MODULE-4	**4 Hrs**
IOT CASE STUDIES Agricultural IoT –Introduction and Case Studies Vehicular IoT –Introduction.	
MODULE-5	**4 Hrs**
IOT CASE STUDIES AND FUTURE TRENDS Healthcare IoT –Introduction, Case Studies on Emerging Pillars of IoT, IoT Analytics –Introduction.	

Course outcome (Course Skill Set):

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

1. Understand the evolution, components, and enabling technologies of IoT. (PO -1,2,3,5,11 PSO -1,3)
2. Identify and explain the working, types, and characteristics of sensors and actuators used in IoT systems. (PO -1,2,3, 4,5,11 PSO -1,2,3)
3. Describe IoT data processing approaches, topologies, and device design considerations. (PO -1,3, 4,5,11, PSO -1,2,3)
4. Analyse real-world applications of IoT in fields like agriculture and transportation through case studies. (PO -2,3,4, 5,11 PSO -1,3)
5. Evaluate the use of IoT in healthcare, explore IoT analytics, and recognize emerging trends and technologies in the IoT domain. (PO - 2,3, 4,5,11 PSO -1,3)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.

   Textbook 1: Chapter 1-1.1 to 1.3 Chapter 4 –4.1 to 4.4 Textbook 1: Chapter 5 –5.1 to 5.9

   Textbook 1: Chapter 6 –6.1 to 6.5 Textbook 1: Chapter 12-12.1-12.2, Chapter 13–13.1. Chapter 14-14.1-14.2; 15.4 Chapter 17-17.1

Reference:

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
2. Vijay Madisetti and Arshdeep Bhaga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105195/
- https://archive.nptel.ac.in/courses/106/106/106106223/
- https://nptelvideos.com/course.php?id=717
- https://www.coursera.org/learn/iot
-

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Use of open-source IoT simulators like Cisco Packet Tracer, Node-RED, or Tinker cad for hands on learning.
- Conduct mini-projects or case studies on Agricultural, Healthcare, or Vehicular IoT applications.
- Perform sensor and actuator interfacing experiments using Arduino or Raspberry Pi.
- Assign real-time data processing tasks using cloud platforms like Things peak or Google Firebase.
- Assignments

Project Management with Git			
Course Code	25IC37B	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	0:0:2	**SEE Marks**	50
Credits	01	**Total Marks**	100
Contact Hours	28	**Exam Hours**	2
Examination nature (SEE)	Practical		

Prerequisites: NIL

Course Objectives:

- To become familiar with basic Git commands for version control.
- To create and manage branches for effective code organization.
- To understand how to collaborate and work with remote repositories.
- To master version control commands for efficient project management.

List of Experiments:

SI. No	Experiments
1	**Setting up and using basic Git commands** • Create a new repository and configure it with essential settings. • Track changes to files by adding them to the staging area and committing with descriptive messages.
2	**Creating and Managing Branches** Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."
3	**Merging and Conflict Resolution** Write the commands to merge a branch into the main branch and resolve any merge conflicts.
4	**Collaboration and Remote Repositories** Clone a remote Git repository to your local machine.
5	**Collaboration and Remote Repositories** • Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch. Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
6	**Pulling Changes** Write the command to pull the latest changes from the remote "origin" repository.
7	**Git Tags and Releases** Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.

8	**Advanced Git Operations** Write the command to cherry-pick a range of commits from "source-branch" to the current branch.	
9	**Analyzing and Changing Git History** Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message?	
10	**Reviewing and Modifying Git Commit History** Write the command to list all commits made by the author "Pressman" between "2024-01-01" and "2024-12-31."	
11	**Inspecting and Editing Git History** Write the command to display the last five commits in the repository's history.	
12	**Exploring and Refining Git Commit Logs** Write the command to undo the changes introduced by the commit with the ID "xyz12345".	

Course outcomes (Course Skill Set):

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

CO1: Use the basic commands related to git repository. (PO – 1,2,3,5,9,10,11 PSO – 1,2)

CO2: Create and manage the branches. (PO – 1,2,3,5,9,10,11 PSO – 1,2,)

CO3: Apply commands related to collaboration and remote repositories. (PO – 1,2,3,5,9,10,11 PSO – 1,2,3)

CO4: Use the commands related to Git tags, releases and advanced git operations. (PO – 1,2,3,5,9,10,11 PSO – 1,2,3)

CO5: Analyse and change the git history. (PO – 1,2,3,5,9,10,11 PSO – 1,2,)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are 50 Marks.

The split-up of CIE marks for record/ journal and test are in the ratio 60:40.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up.

  Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at

the beginning of the practical session.

- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to 20 marks (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted by the two examiners. One from the same institute as an internal examiner and another from a different institute as an external examiner, appointed by the university.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours.

Suggested Learning Resources:

- "Version Control with Git", 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
- "Pro Git book", written by Scott Chacon and Ben Straub and published by Apress,
- https://gitscm.com/book/en/v2
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01309444334736998 42782_shared/overview?utm_source=chatgpt.com
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01330134712177459 211926_shared/overview?utm_source=chatgpt.com

IV
Semester

Analysis & Design of Algorithms			
Course Code	25IC41	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	42	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge on

- Fundamentals of Data Structures
- Understanding of Algorithms
- Basic Mathematics
- Problem-Solving Skills

Course Objectives:

CLO 1: To learn the methods for analyzing algorithms and evaluating their performance.
CLO 2: To demonstrate the efficiency of algorithms using asymptotic notations.
CLO 3: To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
CLO 4: To learn the concepts of P and NP complexity classes.

Teaching-Learning Process (General Instructions)

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 the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.
2. Utilize video/animation films to illustrate the functioning of various concepts.
3. Promote collaborative learning (Group Learning) in the class.
4. Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.
5. Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.
6. Introduce topics through multiple representations.
7. Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.
8. Discuss the real-world applications of every concept to enhance students' comprehension

Module-1 **9 Hours**

INTRODUCTION: What is an Algorithm? Fundamentals of Algorithmic Problem Solving.
FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non recursive Algorithms, Mathematical Analysis of Recursive Algorithms.
BRUTE FORCE APPROACHES: Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.
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)

Module-2	9 Hours
BRUTE FORCE APPROACHES (contd..): Exhaustive Search (Travelling Salesman problem and Knapsack Problem). **DECREASE-AND-CONQUER:** Insertion Sort, Topological Sorting. **DIVIDE AND CONQUER:** Merge Sort, Quick Sort, Binary Tree Traversals, Multiplication of Large Integers and Strassen's Matrix Multiplication.	
Module-3	**8 Hours**
TRANSFORM-AND-CONQUER: Balanced Search Trees, Heaps and Heapsort. **SPACE-TIME TRADEOFFS:** Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm. **Chapter 6 (Sections 6.3,6.4), Chapter 7 (Sections 7.1,7.2)**	
Module-4	**8 Hours**
DYNAMIC PROGRAMMING: Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms. **THE GREEDY METHOD:** Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes. **Chapter 8 (Sections 8.1,8.2,8.4), Chapter 9 (Sections 9.1,9.2,9.3,9.4)**	
Module-5	**8 Hours**
LIMITATIONS OF ALGORITHMIC POWER: Decision Trees, P, NP, and NP-Complete Problems. **COPING WITH LIMITATIONS OF ALGORITHMIC POWER**: Backtracking (n-Queens problem, Subset-sum problem), Branch-and-Bound (Knapsack problem), Approximation algorithms for NP-Hard problems (Knapsack problem). **Chapter 11 (Section 11.2, 11.3), Chapter 12 (Sections 12.1,12.2,12.3)**	

Course outcome (Course Skill Set)

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

1. Apply asymptotic notational method to analyze the performance of the algorithms in terms of time complexity. (PO 1,2,3,4)
2. Demonstrate divide & conquer approaches and decrease & conquer approaches to solve computational problems. (PO 1,2,3,4)
3. Make use of transform & conquer and dynamic programming design approaches to solve the given real world or complex computational problems. (PO 1,2,3,4,5)
4. Apply greedy and input enhancement methods to solve graph & string based computational problems. (PO 1,2,3,4,5)
5. Analyse various classes (P,NP and NP Complete) of problems Illustrate backtracking, branch & bound and approximation methods. (PO 1,2,3,4,5)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally **reduced to 50 marks**

Suggested Learning Resources:

Textbooks

1. Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2017, Pearson.

Reference books

1. Computer Algorithms/C++, Ellis Horowitz, Sartaj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.

Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=tSo9yzBUTHA
- https://www.youtube.com/watch?v=5_5oE5lgrhw
- https://www.youtube.com/watch?v=STL8ESuETmM
- https://www.youtube.com/watch?v=Y2A8RzxegSA
- https://www.youtube.com/watch?v=gBz44smaa9A
- https://www.youtube.com/watch?v=8TVaEGeaGGc

- https://www.youtube.com/watch?v=kPRA0W1kECg
- https://www.youtube.com/watch?v=v0eQ4nXJjsk
- https://www.youtube.com/watch?v=MtQL_ll5KhQ
- https://www.youtube.com/watch?v=jsmMtJpPnhU
- https://www.youtube.com/watch?v=tKwnms5iRBU
- https://www.youtube.com/watch?v=oBt53YbR9Kk
- https://www.youtube.com/watch?v=OQ5jsbhAv_M
- https://www.youtube.com/watch?v=Aa2sqUhIn-E
- https://www.youtube.com/watch?v=SZXXnB7vSm4
- https://www.youtube.com/watch?v=MHXR4PCY8c0
- https://www.youtube.com/watch?v=kJuKy5FqhrE
- https://www.youtube.com/watch?v=TtuNf6XMhiw
- Design and Analysis of Algorithms: https://nptel.ac.in/courses/106/101/106101060/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Promote real-world problem-solving and competitive problem solving through group discussions to engage students actively in the learning process.

- Encourage students to enhance their problem-solving skills by implementing algorithms and solutions through programming exercises, fostering practical application of theoretical concepts.

Assessment Methods -

1. Problem Solving Assignments (Hacker Rank/ Hacker Earth / Leadcode)
    - Gate Based Aptitude Test

DATABASE MANAGEMENT SYSTEMS			
Course Code	25IC42	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	(3:0:0)	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	42	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

Students should have a basic understanding of programming concepts, data structures, computer organization, and operating systems. Familiarity with software development principles and problem-solving techniques is desirable for studying database design, SQL, transaction management, and MongoDB-based application development.

Course Objectives:

CLO1: Understand the fundamental concepts of database systems, data models, database architecture, schemas, and Entity-Relationship (ER) modelling.

CLO2: Learn the principles of the relational data model, relational algebra, and database schema design techniques.

CLO3: Apply various Structured Query Language (SQL) statements for database manipulation.

CLO4: Understand normalization techniques and transaction management to design efficient, reliable, and consistent database systems.

CLO5: To provide knowledge of MongoDB concepts and database operations.

Teaching-Learning Process (General Instructions)

1. Lecture method (L) need not be only a traditional lecture method; alternative effective teaching methods may be adopted to attain the outcomes.
2. Use of video/animation to explain the functioning of various concepts.
3. Encourage collaborative (group learning) in the class.
4. Ask at least three HOT (Higher Order Thinking) questions in the class to promote critical thinking.
5. Adopt Problem-Based Learning (PBL) by assigning real-world database design and querying problems.
6. Demonstrate database application development using MongoDB and the Node.js Driver through practical examples and mini-projects.

Module-1 **9 Hours**

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, and interfaces, The Database System environment. Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams.

Textbook 1:Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.10

Module-2 **8 Hours**

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, Ch 8.1 to 8.5; Ch 9.1 to 9.2 Textbook 2: 3.5

Module-3 **8 Hours**

SQL: SQL data definition and data types, Schema change statements in SQL,SQL Languages (DML,DDL,TCL) specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.

SQL: Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Cursor, Stored Procedure, Views in SQL.

Textbook 1: Ch 6.1 to 6.5 and Ch 7.1 to 7.3, Ch 10.2.2 and 10.4.1

Module-4 **9 Hours**

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.

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Concurrency Control in Databases: Two-phase locking techniques for Concurrency control.

Textbook 1: Ch 14.1 to 14.7 and Ch 20.1 to 20.6

Module-5 **8 Hours**

MongoDB: Basics, Documents, Collections, Databases, Query Language, Installation, The Mongo Shell, MongoDB CRUD Operations, Create, Read, Projection, Update, Delete, Aggregate, MongoDB Node.js Driver, Schema Initialization.

Textbook 2: Chapter 6

Course outcome (Course Skill Set):

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

CO1: Describe database concepts, data models, schemas, and ER modelling. (PO – 1,2,3,4,5) **CO2:** Apply relational model concepts and relational algebra for schema design. (PO – 1,2,3,4,5) **CO3:** Use SQL for database creation, manipulation, and advanced querying. (PO – 1,2,3,4,5) **CO4:** Normalize relations and explain transaction management techniques. (PO – 1,2,3,4,5)
CO5: Implement MongoDB databases using CRUD operations, aggregation, and application integration.
(PO – 1,2,3,4,5)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

● For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.

● The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered

● Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.

● For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

TEXTBOOKS:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Vasan Subramanian, Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node. Apress, 2019.

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, *Database System Concepts*, McGraw Hill, 7th Edition, 2020.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill.
3. C.J. Date, *An Introduction to Database Systems*, Pearson Education, 8th Edition.
4. Amol Nayak, *MongoDB for Developers*, Packt Publishing.

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=GgznCfPjXOk
- https://www.youtube.com/watch?v=I1zbwBqgOQY
- https://www.youtube.com/watch?v=ryeGFOMZhK4
- https://www.youtube.com/watch?v=WK8MHedLFmk
- https://www.youtube.com/watch?v=IBEuwmYsMKI
- https://www.youtube.com/watch?v=rBmo2UAa8Lk
- https://www.youtube.com/watch?v=EjcAqAJjmEo

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

Assessment Methods for 25 Marks (opt two Learning Activities)

- Case Study
- Mini Project
- Quiz

Introduction to Cyber Security			
Course Code	25IC43	**CIE Marks**	50
Teaching Hours/Week (L: T:P: S)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	42	**Exam Hours**	3
Examination type (SEE)	Theory		

Course objectives:

CLO1- To familiarize cybercrime terminologies and perspectives

CLO2- To understand Cyber Offenses and Botnets

CLO3- To gain knowledge on tools and methods used in cybercrimes

CLO4- To understand phishing and computer forensics

Teaching-Learning Process (General Instructions):

These are sample strategies which teachers can use to accelerate the attainment of the various course outcomes and make teaching-learning more effective.

1. Chalk and Board

2. Demonstration

3. Interactive learning

4. Videos and online material

Module-1	**8 Hours**

Introduction to Cybercrime

Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws, Global Perspectives.

Textbook 1: Chapter 1 (1.1 to 1.5, 1.7-1.9)

Module-2	**9 Hours**

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.

Textbook 1: Chapter 2 (2.1 to 2.7)

Module-3	**9 Hours**

Tools and Methods used in Cybercrime

Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyware, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, Attacks on Wireless networks.

Textbook 1: Chapter 4 (4.1 to 4.9, 4.12)

Module-4	**8 Hours**

Phishing and Identity Theft

Introduction, methods of phishing, phishing techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft.

Textbook 1: Chapter 5 (5.1 to 5.3)

Module-5	**8 Hours**

Understanding Computer Forensics

Introduction, Historical Background of Cyber Forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, Network Forensics.

Textbook 1: Chapter 7 (7.1 to 7.5, 7.7 to 7.9)

Course outcomes (Course Skill Set):

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

CO1: Explain the cybercrime terminologies.
CO2: Describe Cyber offenses and Botnets.
CO3: Illustrate Tools and Methods used on Cybercrime.
CO4: Explain Phishing and Identity Theft.
CO5: Justify the need of computer forensics.

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the regulations; if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:
Textbooks:

• Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2011, First Edition (Reprinted 2018).

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=yC_hFm0BX28&list=PLxApjaSnQGi6Jm7LLSxvmNQjS_rt9swsu
- https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_
- https://www.youtube.com/watch?v=6wi5DI6du-4&list=PL_uaeekrhGzJlB8XQBxU3z__hDwT95xlk
- https://www.youtube.com/watch?v=KqSqyKwVuA8

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning:

- **Illustration of a standard case study of cybercrime.**
- **Set up a mock cyber court at the institute level.**

Web links and Video Lectures (e-Resources):

- **OWASP Web Security Testing Guide**
- **https://owasp.org/www-project-web-security-testing-guide/**
- **(Covers common web vulnerabilities and testing methodologies.)**
- **Python Official Documentation**
- **https://docs.python.org/3/**
- **(For syntax, libraries, and built-in modules.)**
- **Requests Library (Python HTTP for Humans)**
- **https://requests.readthedocs.io/en/latest/**
- **(Used for sending HTTP requests in Python.)**
- **Beautiful Soup Documentation https://www.crummy.com/software/BeautifulSoup/bs4/doc/ (Used for web scraping and HTML/XML parsing.)**
- **Scapy – Network Packet Manipulation Tool**
- **https://scapy.readthedocs.io/en/latest/**
- **(Used for crafting and analyzing network packets.)**
- **OWASP Top 10 Security Risks https://owasp.org/www-project-top-ten/ (Industry-standard list of common web security flaws.)**

Microcontroller & IoT			
Course Code	25IC44	**CIE Marks**	50
Teaching Hours/Week (L: T:P: S)	3:0:2	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	42 Theory + 28 Practical	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge on

- Microcontroller Fundamentals
- Basic Programming (C preferred)
- Basic of Internet of Things

Basics of IoT Communication Protocols

Course Objectives:

CLO1. To understand the fundamentals of ARM-based systems and basic architecture of CISC and RISC.

CLO2. To familiarize with ARM programming modules along with registers, CPSR and Flags.

CLO3. Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.

CLO4. Understand how to IoT evolved and why it is important

CLO5. Explore real-life uses of IoT in different fields

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching

Demonstration based Teaching

Module-1	9 Hours

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

Module-2	8 Hours

Introduction to the ARM Instruction Set: Data Processing Instructions, Programmer Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs.

Textbook 1: Chapter 3: Sections 3.1 to 3.6 (Excluding 3.5.2), Chapter 6(Sections 6.1 to 6.6)

Module-3	8 Hours
Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT. **Textbook 2: Chapter -4 :4.1 to 4.5**	
Module-4	**9 Hours**
IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics. **Textbook 2: Chapter 5 – 5.1 to 5.9**	
Module-5	**8 Hours**
IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading. **Textbook 2: Chapter 6 – 6.1 to 6.5**	

PRACTICAL COMPONENT OF IPCC

Sl.No.	Experiments
1.	Develop a program to multiply two 16-bit binary numbers.
2.	Write a program to find the sum of first 10 integer numbers
3.	Write a program to find 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 look-up table

6.	Interface a Stepper motor and rotate it in clockwise and anticlockwise direction
7.	Led Control Using Arduino Board
8.	Potentiometer And IR Sensor Interfacing with Arduino
9.	Controlling Two Actuators Using Arduino
10.	IOT Based Air Pollution Control System

Course outcomes (Course Skill Set):

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

CO1: Explain the architecture, design philosophy, and core components of ARM-based embedded Systems (PO - 1,2,3, PSO - 1,2)

CO2: Demonstrate the use of ARM instruction set and write basic assembly programs with performance considerations. (PO - 1,2,3,4,5 PSO- 1,2)

CO3: To explain the evolution and foundational concepts of IoT (PO - 1,2,3 PSO - 1,2)

CO4: Identify and explain the roles, characteristics, and selection criteria of sensors and actuators in IoT systems. (PO - 1,2,3 PSO - 1,2)

CO5: Analyze the real-world applications and the impact of IoT across various domains. (PO - 1,2,3, PSO - 1,2,3)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's

taxonomy as per the outcome defined for the course

CIE for the practical component of the IPCC

1. 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
2. On completion of every experiment/program in the laboratory, the students shall be evaluated including viva- voce and marks shall be awarded on the same day.
3. The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write- ups are added and scaled down to 15 marks.
4. The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
5. Scale d-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
6. The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

Suggested Learning Resources:

Textbook:

1. ARM System Developer's Guide by Andrew N. Sloss, Dominic Symes, and Chris Wright was published by Morgan Kaufmann (Elsevier) in 2008.
2. Introduction to IoT by Sudip Misra, Anand Arup Mukherjee, and Arijit Roy was published by Cambridge University Press in 2021.

Reference Books:

1. Microcontroller (ARM) and Embedded System by Raghunandan G. H. was published by Cengage Learning in 2019.
2. Introduction to Industrial Internet of Things and Industry 4.0 by S. Misra, C. Roy, and A. Mukherjee was published by CRC Press in 2020.

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=GZAg9XSIs_Q
- https://www.youtube.com/watch?v=6ptZr9VRxPs
- https://www.youtube.com/watch?v=GrX4WfT5FI4
- https://www.youtube.com/watch?v=Vx6VwdhDCEc
- https://www.youtube.com/watch?v=6hqExG7mL5c

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
  - Case Study
  - Programming Assignment
  - Gate Based Aptitude Test

Analysis & Design of Algorithms Lab			
Course Code	25ICL45	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	0:0:2	**SEE Marks**	50
Credits	01	**Total Marks**	100
Contact Hours	28	**Exam Hours**	3
Examination type (SEE)	Practical		

Prerequisites:

The students should have knowledge on

- Fundamental of Data Structures and Programming Language
- Understanding of Algorithms
- Basic Mathematics
- Problem-Solving Skills

Course Objectives:

CLO 1: To design and implement various algorithms in C/C++ programming using suitable development tools to address different computational challenges.
CLO 2: To apply diverse design strategies for effective problem-solving.
CLO 3: To Measure and compare the performance of different algorithms to determine their efficiency and suitability for specific tasks.

Sl.No	Experiments
1	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
2	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
3	a. Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm. b. Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.
4	Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
5	Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph.
6	Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.
7	Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.
8	Design and implement C/C++ 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.
9	Design and implement C/C++ Program to 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.

10	Design and implement C/C++ Program to 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.
11	Design and implement C/C++ Program to 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.
12	Design and implement C/C++ Program for N Queen's problem using Backtracking.

Course outcomes (Course Skill Set):

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

CO1: Develop programs to solve computational problems using suitable algorithm design strategy. (PO 1,2,3,4,5)

CO2: Compare algorithm design strategies by developing equivalent programs and observing running times for analysis (Empirical). (PO 1,2,3,4,5)

CO3: Make use of suitable integrated development tools to develop programs (PO 1,2,3,4,5)

CO4: Choose appropriate algorithm design techniques to develop solution to the computational and complex problems. (PO 1,2,3,4,5)

CO5: Demonstrate and present the development of program, its execution and running time(s) and record the results/inferences. (PO 1,2,3,4,5)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student’s performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Linear Algebra			
Course Code	25IC46A	CIE Marks	50
Teaching Hours/Week (L: T: P)	2:2:0	SEE Marks	50
Credits	03	Total Marks	100
Contact Hours	40	Exam Hours	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge on

- Basic Mathematics Skills
- Logical Reasoning and Analytical Thinking
- Problem Solving Skills
- Clarity in Conceptual Thinking

Course Objectives:

This course will enable the students to:

CLO1: To equip the students with standard concepts and tools in Linear algebra which will find them useful in their disciplines
CLO2: Gain the knowledge of linear algebra tools and concepts to implement them in their core domain.
CLO3: Improve their mathematical thinking and acquire skills required for sustained lifelong learning
CLO4: Knowledge on Computing Eigen values and Eigenvectors for the linear transformations
CLO5: Knowing to Determine orthogonality of inner product spaces.

Module-1 **9 Hrs**

VECTOR SPACES: Introduction, Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Problems.

Text Book:1, 3.1,3.2,3.3,3.4 and 3.5

Module-2 **9 Hrs**

LINEAR TRANSFORMATIONS: Introduction, Linear Mappings, Geometric linear transformation of i2, Kernel and Image of a linear transformations, Rank-Nullity Theorem (No proof), Matrix representation of linear transformations, Singular and Non-singular linear transformations, Invertible linear transformations, Problems

Text Book:1, 8.1,8.2 and 8.3

Module-3 **8 Hrs**

EIGENVALUES AND EIGENVECTORS: Introduction, Polynomials of Matrices, Applications of Cayley-Hamilton Theorem, Eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.

Text Book:1, 6.1,6.2,6.3,6.4 and 6.5

Module-4 **8 Hrs**

INNER PRODUCT SPACES: Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error

Text Book:1, 3.4 **Text Book:2,** 6.7

Module-5	8 Hrs

OPTIMIZATION TECHNIQUES IN LINEAR ALGEBRA: Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction – Principal component analysis.
Text Book:2, 9.1,9.2,9.3 and 9.4

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:
CO.1. Explain the concepts of vector spaces, subspaces, bases, dimension and their properties (PO -1,2,3)
CO.2. Use matrices and linear transformations to solve the given problem (PO - 1,2,3)
CO.3. Compute Eigenvalues and Eigenvectors for the linear transformations (PO -1,2,3)
CO.4. Determine orthogonality of inner product spaces (PO - 1,2,3)
CO.5. Apply the optimization techniques to solve the problems (PO -1,2,3)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and f Determine orthogonality of inner product spaces.

Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.
Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the regulations; if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Textbook:

1. David C. Lay, Steven R. Lay, Judi J Mc. Donald: "Linear Algebra and its applications", Pearson Education, 6th Edition, 2021.
2. Gilbert Strang: "Linear Algebra and its applications", Brooks Cole, 4th edition 2005.

Reference Books:

1 Richard Bronson & Gabriel B. Costa: "Linear Algebra: An Introduction", 2nd edition. Academic Press, 2014.
2. Seymour Lipschutz, Marc Lipso: "Theory and problems of linear algebra", Schaum's outline series - 6th edition, 2017, McGraw-Hill Education.
3. Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong: "Mathematics for Machine learning", Cambridge University Press, 2020

Web links and Video Lectures(e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Quizzes
- Assignments
- Seminar

DISCRETE MATHEMATICS			
Course Code	25IC46B	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	2:2:0	SEE Marks	50
Total Hours of Pedagogy	42	Total Marks	100
Credits	03	Exam Hours	03
Examination type(SEE)	Theory		

Prerequisites:

Basic mathematical skills

Fundamental understanding of functions and relations Analytical thinking and problem-solving abilities

Course objectives:

CLO 1: To help students to understand discrete and continuous mathematical structures.

CLO 2: To impart basics of relations and functions.

CLO 3: To facilitate students in applying principles of Recurrence Relations to find the generating functions and solve the Recurrence relations.

CLO 4: To have the knowledge of groups and their properties to understand the importance of algebraic properties relative to various number systems.

Teaching Learning Process Pedagogy (General Instructions):

These are sample strategies teachers can use to accelerate the attainment of the various course outcomes. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills. State the need for Mathematics with Engineering Studies and provide real-life examples. Support and guide the students for self–study.

You will assign homework, grade assignments and quizzes, and document students' progress. Encourage the students to group learning to improve their creative and analytical skills.

Show short related video lectures in the following ways:

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As additional material of challenging topics (pre- and post-lecture activity).
- As a model solution for some exercises (post-lecture activity).

Module-1 **9 Hours**

Basic Connectives and Truth Tables, Logic Equivalence– The Laws of Logic, Logical Implication– Rules of Inference. The Use of Quantifiers, Quantifiers, Definitions and the Proofs of Theorems.

(RBT Levels:L1,L2andL3)

Module-2 **9 Hours**

Mathematical Induction, The Well Ordering Principle– Mathematical Induction, Recursive Definitions. Fundamental Principles of Counting: The Rules of Sum and Product, Permutations, Combinations–The Binomial Theorem, Combinations with Repetition.

(RBT Levels:L1,L2andL3)

Module-3	8 Hours
Cartesian Products and Relations, Functions –Plain and One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions. Properties of Relations, Computer Recognition–Zero-One Matrices and Directed Graphs, Partial Orders – Hassel Diagrams, Equivalence Relations and Partitions **(RBT Levels:L1,L2andL3)**	
Module-4	**8 Hours**
The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials. Recurrence Relations: First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients**.** **(RBT Levels:L1,L2andL3)**	
Module-5	**8 Hours**
Definitions and Examples of Particular Groups Klein 4-group, Additive group of Integers modulo n, Multiplicative group of Integers modulo-p and permutation groups, Properties of groups, Sub groups, cyclic groups, Cosets, Lagrange's Theorem **(RBT Levels:L1,L2andL3)**	

Course outcome (Course Skill Set)

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

- CO1. Apply concepts of logical reasoning and mathematical proof techniques in proving theorems and statements. (PO-1,2)
- CO2. Demonstrate the application of discrete structures in different fields of computer science. (PO-1,2,4)
- CO3. Apply the basic concepts of relations, functions, and partially ordered sets for computer representations. (PO-1,2,4)
- CO4. Solve problems involving recurrence relations and generating functions. (PO-1,2,3,4)
- CO5. Illustrate the fundamental principles of Algebraic structures with problems related to computer science & engineering. (PO-1,2,4)

Assessment Details (both CIE and SEE)

The weight age of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE(Continuous Internal Evaluation)and SEE(Semester End Examination)Taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the 22OB2.4. If an assignment is project-based, then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks.)
- The final CIE marks of the course out of 50 will be the sum of the scaled-down marks of tests and assignment/s marks.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions) should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author / Title of the Book / Name of the publisher / Edition and Year) Text Books:

1. Ralph P. Grimaldi, B.V. Ramana: Discrete Mathematical Structures – An Applied Introduction, 5th Edition, Pearson Education, 2004.
2. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education, 2004.

Reference Books:

1. Basavaraj S. Anami and Venakanna S. Madalli: Discrete Mathematics – A Concept-based Approach, Universities Press, 2016.
2. Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007.
3. Jayant Ganguly: A Treatise on Discrete Mathematical Structures, Sanguine-Pearson, 2010.
4. D. S. Malik and M. K. Sen: Discrete Mathematical Structures – Theory and Applications, Latest Edition, Thomson, 2004.
5. Thomas Koshy: Discrete Mathematics with Applications, Elsevier, 2005, Reprint 2008.

http://nptel.ac.in/courses.php?disciplineID=111
http://www.class-central.com/subject/math(MOOCs)
http://academicearth.org/
http://www.themathpage.com/
http://www.abstractmath.org/
http://www.ocw.mit.edu/courses/mathematics/

Graph Theory			
Course Code	25IC46C	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	2:2:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	42	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge on

- Basic Algebra
- Discrete Mathematics
- Proof Techniques
- Linear Algebra

Course Objectives:

CLO 1: Appreciate the definition and basics of graphs along with types and their examples. Understand the notion of planarity and coloring of a graph.

CLO 2: Understand the definition of a tree and learn its applications to fundamental circuits. Know the applications of graph theory to network flows.

CLO 3: To give the learner a broad exposure of combinatorial Mathematics through applications especially the Computer Science application.

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

Module-1	9 Hours

Introduction to Graph Theory: Definition and properties of a graph, subgraph, and Examples, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles, Graph Colouring, and Chromatic Polynomials. Directed graphs and their properties.

Module-2	9 Hours

Trees: Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Weighted Trees and Prefix Codes.

Optimization and Matching: Dijkstra"s Shortest Path Algorithm, Minimal Spanning Trees – The algorithms of Kruskal and Prim, Transport Networks – Max-flow, Min-cut Theorem. Matching Theory.

Module-3	8 Hours

Fundamental Principles of Counting: The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition, The Catalon Numbers

The Principle of Inclusion and Exclusion: The Principle of Inclusion and Exclusion, Generalizations

of the Principle

Module-4	8 Hours

Generating Functions: Introductory Examples, Definition and Examples – Calculational Techniques, Partitions of Integers, the Exponential Generating Function. The Summation Operator.

Module-5	8 Hours

Recurrence Relations: First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients, The Non-homogeneous Recurrence Relation. The Method of Generating Functions.

Course outcomes (Course Skill Set):

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

CO1: Know the history and development of graph theory and apply the fundamental results of graph theory. (PO-1,2,11)

CO 2: Apply various proof techniques in proving theorems in graph theory. (PO-1,2,3)

CO 3: Write algorithms to solve problems in graph theory. (PO-1,2,3,4)

CO 4: The learner able to apply combinatorial Mathematics to the applications in the Computer Science field. (PO-1,2,3,4)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the regulations; if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Textbooks

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5 th Edition, Pearson Education, 2004.
2. Narasingh Deo: Graph Theory with Applications to Engineering and Computer Science. 2016.

Reference Books

1. Kenneth H Rosen: Discrete Mathematics & its Applications with Combinatorics and Graph Theory. 6th Edition, 2009.
2. D.S. Chandrasekharaiah: Graph Theory and Combinatorics, Prism, 2005
3. Chartrand Zhang: Introduction to Graph Theory, TMH, 2006.
4. Richard A. Brualdi: Introductory Combinatorics, 4th Edition, Pearson Education, 2004.
5. Geir Agnarsson & Raymond Geenlaw: Graph Theory, Pearson Education, 2007.

Web links and Video Lectures(e-Resources):

- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- http://www.bookstreet.in/
- http://www.bookstreet.in/

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Quiz
- Assignment
- Seminar

OPTIMIZATION TECHNIQUE			
Course Code	25IC46D	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	2:2:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	42	**Exam Hours**	3
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge on

- Basic Programming Skills
- Understanding of Algorithms
- Basic Mathematics
- Problem-Solving Skills

Course Objectives:

CLO 1: Appreciate the importance of linear algebra in computer science and allied engineering science.
CLO 2: Gain the knowledge of linear algebra tools and concepts to implememt them in their core domain.
CLO 3: Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.
In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
State the need for Mathematics with Engineering Studies and Provide real-life examples.
Support and guide the students for self–study.
You will assign homework, grading assignments and quizzes, and documenting students' progress.
Encourage the students to group learning to improve their creative and analytical skills.
Show short related video lectures in the following ways:

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).
- As a model solution of some exercises (post-lecture activity).

Module-1	**9 Hours**

VECTOR CALCULUS: Functions of several variables, Differentiation and partial differentials, gradients of vector-valued functions, gradients of matrices, useful identities for computing gradients, linearization **.**

Text Book: 1,2,3

Module-2	**9 Hours**

APPLICATIONS OF VECTOR CALCULUS: Backpropagation and automatic differentiation, gradients in a deep network, The Gradient of Quadratic Cost, Descending the Gradient of Cost, The Gradient of Mean Squared Error.

Text Book: 1,2,3

Module-3	**8 Hours**

Convex Optimization-1: Local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization, Optimization using gradient descent, Sequential search 3-point search and Fibonacci search.

Text Book: 1,2,3

Module-4	**8 Hours**

Convex Optimization-2: Unconstrained optimization -Method of steepest ascent/descent, NR method, Gradient descent, Mini batch gradient descent, Stochastic gradient descent.

Text Book: 1,2,3

Module-5	**8 Hours**

Advanced Optimization: Momentum-based gradient descent methods: Adagrad, RMSprop and Adam. Non-Convex Optimization: Convergence to Critical Points, Saddle-Point methods.

Text Book: 1,2,3

Course outcomes (Course Skill Set):

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

CO1: Apply the concepts of vector calculus to solve the given problem. (PO-1,2,4)

CO2: Apply the concepts of partial differentiation in machine learning and deep neural networks. (PO-1,2,3,4)

CO3: Analyze the convex optimization algorithms and their importance in computer science & engineering. (PO-1,2,3,4)

CO4: Apply the optimization algorithms to solve the problem. (PO-1,2,3,4)

CO5: Analyze the advanced optimization algorithms for machine learning. (PO-1,2,3,4)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the regulations; if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and

assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. 4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Textbook:

1. Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press.
2. S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization, 2015.
3. S. Boyd, N. Parikh, and E. Chu," Distributed optimization and statistical learning via the alternating direction method of multipliers", Foundations and Trends in Machine Learning, Now Publishers Inc.

Reference Books:

1. Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal, Springer, 2020.
2. Beck, First-Order Methods in Optimization, MOS-SIAM Series on Optimization, 2017.
3. F. Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc.

Web links and Video Lectures(e-Resources):

- https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-_2011/index.htm
- https://www.math.ucdavis.edu/~linear/linear.pdf
- https://www.coursera.org/learn/linear-algebra-machine-learning
- https://nptel.ac.in/syllabus/111106051/
- https://github.com/epfml/OptML_course
- https://www.youtube.com/playlist?list=PL4O4bXkI-fAeYrsBqTUYn2xMjJAqlFQzX

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
  - Case Study
  - Programming Assignment
  - Gate Based Aptitude Test
  - MOOC Assignment for selected Module

Workplace Security Practices			
Course Code	25IC47A	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Hours of Pedagogy	01	Total Marks	100
Credits	28	Exam Hours	3
Examination nature (SEE)	Practical		

Prerequisite:

- Basics of Computer Networks
- Basics of Operating System

Course objectives:

This course will enable the students to:

CLO1: Understand various techniques for providing workspace security to secure file & password.

CLO2: Apply appropriate tools for network packet sniffing, attack detection and security incident reporting.

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 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.

SL NO	Experiments
	PART A
1	Explore Compare It Tool Compare of two file for Forensic Investigation
2	Explore the Snow tool for hiding the information in Text file
3	Write a program to illustrate Buffer overflow attack
4	Write the steps to download a website using Website copier tool to perform passive reconnaissance
5	Analyse and scan the system vulnerability using Microsoft Baseline Security Analyz (MBSA) tool
	PART B

	1	Password Strength Checker: Develop a Python script that assesses the strength of passwords based on criteria such as length, complexity, and the presence of common patterns
	2	File Encryption and Decryption: Create a Python program that encrypts and decrypts files using cryptographic algorithm such as AES
	3	Network Packet Sniffer: Build a packet sniffing tool in the Python that captures and analyses network traffic on a local network.
	4	Brute Force Attack Detector: Develop a Python script that detects and logs brute force login attempts on a server or application.
	5	Security Incident Reporting Tool: Develop a Python-based incident reporting tool where employees can report security incidents such as lost devices, suspicious emails, or physical security breaches.

Course outcome (Course Skill Set):

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

CO1 Implement python program to assess the strength of password for complexity measures (PO - 1,2,3,4,5 PSO - 1,3)

CO2. Apply cryptographic algorithms for a given file (PO - 1,2,34,5, PSO - 1, 2,3)

CO3. Apply appropriate python modules for network packet sniffing, attack detection and security incident reporting (PO - 1,2,3,4,5 PSO - 1,2, 3)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

CIE marks for the practical course are 50 Marks. The split-up of CIE marks for record/ journal and test are in the ratio 60:40.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.

Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).

- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to 20 marks (40% of the maximum marks). The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student

- Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

SEE marks for the practical course are 50 Marks.

- SEE shall be conducted jointly by the two examiners of the same institute; examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question from PART-A and one question from PART-B (experiment) from the questions lot prepared by the examiners jointly and 50% weightage for each part.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 02 hours

Suggested Learning Resources:

Reference Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, **Author**: Nina Godbole, Sunit Belapure, **Publisher**: Wiley India
2. Computer Security: Principles and Practice, **Authors**: William Stallings & Lawrie Brown, **Publisher:** Pearson

Web links and Video Lectures(e-Resources):

- Compare It Tool Demo
  https://www.youtube.com/watch?v=t6LbAZl2_fA
- Snow Tool - Steganography in Text
  https://www.youtube.com/watch?v=TkRXDQFeNnM
  Website Copier & Reconnaissance
  HTTrack Website Copier
  https://www.youtube.com/watch?v=6RgGWLK0C2w
- MBSA Tool (Microsoft Baseline Security Analyzer)
  MBSA Overview and Demo
  https://www.youtube.com/watch?v=ZflKUpw0ozs
- Brute Force Attack Detector Concept
  https://www.youtube.com/watch?v=FGdiKzSY77g

Security Incident Reporting System in Python https://www.youtube.com/watch?v=i4PddpL_pZ8

DBMS with SQL and Mongo DB			
Course Code	25IC47B	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	0:0:2	**SEE Marks**	50
Credits	01	**Total Marks**	100
Contact Hours	28	**Exam Hours**	3
Examination type (SEE)	Practical		

Prerequisites:

- Basic Programming Skills
- Understanding of Algorithms
- Problem-Solving Skills

Course Objectives:

CLO 1: Practice relational (SQL) and NoSQL (MongoDB) database operations.
CLO 2: Develop skills in schema creation, data manipulation, and complex queries.
CLO 3: Work with real-world data examples.

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

PART-A

1. Creating Tables, Users, and Constraints

Table: Employee(EMPNO, ENAME, JOB, MANAGER_NO, SAL, COMMISSION)

a) Create a new user and grant all permissions to the user.
b) Create the Employee table.
c) Insert three records into Employee table using INSERT.
d) Use ROLLBACK to undo the transaction.
e) Check the results after rollback.
f) Add PRIMARY KEY and NOT NULL constraints to the Employee table.
g) Try to insert NULL values and verify the constraint enforcement.

2. Altering Tables and DML Operations

Table: Employee(EMPNO, ENAME, JOB, MGR, SAL)

a) Add a new column COMMISSION with appropriate data type.
b) Insert five records into the Employee table.
c) Update JOB column details for any employee.
d) Rename a column in the Employee table using the ALTER command.
e) Delete the employee whose EMPNO is 105.

3. Queries using Aggregate Functions

Table: Employee(E_id, E_name, Age, Salary)

a) Create the Employee table with specified attributes.
b) Count the number of employees in the table.
c) Find the maximum age of employees.
d) Find the minimum age of employees.

e) Display salaries in ascending order.
f) Find grouped salaries using GROUP BY.

4. Triggers

Table: CUSTOMERS(ID, NAME, AGE, ADDRESS, SALARY)

Create a row-level trigger for the CUSTOMERS table that fires on INSERT, UPDATE, or DELETE operations and displays the salary difference between the old and new SALARY.

5. Cursors

Table: Employee(E_id, E_name, Age, Salary)

Create a cursor for the Employee table:

- Declare variables
- Open the cursor
- Extract values from the table using the cursor
- Close the cursor

PART-B

6. Creating Tables, Users, and Constraints

Table: Employee(EMPNO, ENAME, JOB, MANAGER_NO, SAL, COMMISSION)

a) Create a new user and grant all permissions to the user.
b) Create the Employee table.
c) Insert three records into Employee table using INSERT.
d) Use ROLLBACK to undo the transaction.
e) Check the results after rollback.
f) Add PRIMARY KEY and NOT NULL constraints to the Employee table.
g) Try to insert NULL values and verify the constraint enforcement.

7. Altering Tables and DML Operations

Table: Employee(EMPNO, ENAME, JOB, MGR, SAL)

a) Add a new column COMMISSION with appropriate data type.
b) Insert five records into the Employee table.
c) Update JOB column details for any employee.
d) Rename a column in the Employee table using the ALTER command.
e) Delete the employee whose EMPNO is 105.

8. Queries using Aggregate Functions

Table: Employee(E_id, E_name, Age, Salary)

a. Create the Employee table with specified attributes.
b. Count the number of employees in the table.
c. Find the maximum age of employees.
d. Find the minimum age of employees.
e. Display salaries in ascending order.
f. Find grouped salaries using GROUP BY.

9. Triggers

Table: CUSTOMERS(ID, NAME, AGE, ADDRESS, SALARY)

Create a row-level trigger for the CUSTOMERS table that fires on INSERT, UPDATE, or DELETE operations and displays the salary difference between the old and new SALARY.

10. Cursors

Table: Employee(E_id, E_name, Age, Salary)

Create a cursor for the Employee table:

- Declare variables
- Open the cursor
- Extract values from the table using the cursor
- Close the cursor

Additional Programs

13. Text Search

a. Develop a query to perform text search on a Catalog data collection for a given word.

b. Develop queries to exclude documents containing certain words or phrases. Reference: Book 2, Chapter 9

14. Aggregation Pipeline for Text Search

Develop an aggregation pipeline to demonstrate text search on a Catalog data collection. Reference: Book 2, Chapter 9

Course outcomes(Course Skill Set):

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

CO1: Design, implement, and query relational schemas. (PO – 1,2,3,5,11)
CO2: Perform CRUD and aggregation with MongoDB. (PO – 1,2,3,5,11)
CO3: Demonstrate proficiency with SQL joins views, indexing, and transactions. (PO – 1,2,3,5,11) CO4: Apply database concepts in small applications. (PO – 1,2,3,5,12)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- CIE marks for the practical course are 50 Marks. The split-up of CIE marks for record/ journal and test are in the ratio 60:40.
- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.

- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to 20 marks (40% of the maximum marks). The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student
- Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

SEE marks for the practical course are 50 Marks.

- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question from PART-A and one question from PART-B (experiment) from the questions lot prepared by the examiners jointly and 50% weightage for each part.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in - 60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero. The minimum duration of SEE is 02 hours

Text Books:

1: MongoDB: The Definitive Guide — Kristina Chodorow, 2nd Edition, O'Reilly, 2013.
2: MongoDB in Action — Kyle Banker et al., 2nd Edition, Manning Publications, 2016.

Reference Book:

1: MongoDB Complete Guide — Manu Sharma, 1st Edition, BPB Publications, 2023.

Web links and Video Lectures(e-Resources):

1) Installation of MongoDB: https://www.youtube.com/watch?v=dEm2AS5amyA
2) Aggregation in MongoDB: https://www.youtube.com/watch?v=vx1C8EyTa7Y

Additional Resources:

1) MongoDB in Action — Source Code Download: https://www.manning.com/downloads/529

2) MongoDB Practice Exercises: https://www.w3resource.com/mongodb-exercises/

Data Analytics for IOT			
Course Code	25IC47C	CIE Marks	50
Teaching Hours/Week (L: T: P)	1:0:0	SEE Marks	50
Credits	01	Total Marks	100
Contact Hours	14	Exam Hours	01
Examination type (SEE)	Theory (MCQ)		

Prerequisites:

The students should have knowledge on

- Basic Programming Knowledge
- Logical Thinking and Problem-Solving Skills

Course Objectives:

This course will enable the students to:

CLO1: Understand the basics of IoT analytics
CLO2: Understand Elastic analytics concepts
CLO3: Exploring and Visualizing data
CLO4: Learn about the basic concepts of Machine Learning
CLO5: Know about Linked analytical Datasets

Teaching-Learning Process (General Instructions)

Teachers can use following strategies 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 Case study Based Learning (CBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	3 Hours
The situation, Defining IoT analytics, IoT analytics challenges. Chapter 1 (Except Business value concerns)	

Module-2	3 Hours

Building Elastic analytics, Elastic analytics concepts, Designing for scale, Cloud security and analytics
Chapter 3 (Only the above-mentioned topics)

Module-3 **3 Hours**

Exploring and Visualizing Data-The Tableau Overview, Techniques to understand data quality, Basic time series analysis, Get to know categories in the data, Bring in Geography, Using R for statistical Analysis.
Chapter 6 (Only the above-mentioned topics)

Module-4 **3 Hours**

Machine Learning Basics: What is machine learning, Generalization, Feature Engineering with IoT data, Validation methods, Random Forest model using R.
Chapter 10 (Only the above-mentioned topics)

Module-5 **2 Hours**

Linked analytical Datasets, Managing Data lakes, The Data retention strategy.
Chapter 11

Course outcomes (Course Skill Set):

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

CO1: Identify the requirement and measurements for capacity planning by considering the goal, issues, and processes. (PO - 1,2,3, PSO - 1,2)

CO2: Explain capacity measurement and monitoring**.** (PO -1,2,3, PSO -1)

CO3: Make use of measurement data for prediction towards the overall planning process. (PO -1,2,3, PSO - 1,3)

CO4: Explain the concepts related to deployment, installation, configuration, and management. (PO - 1,2,3, PSO -1,3)

CO5: Demonstrate how the virtualization and cloud services fit into a capacity plan**.** (PO - 1,2,3, PSO - 1,2,3)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Semester End Examinations (SEE) SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Solving Industry specific analysis problems (Chapter 6)
- Learn and use basics of R Programming concepts Role Play

Problem Management in Cyber Security			
Course Code	25IC47D	CIE Marks	50
Teaching Hours/Week (L: T: P)	1:0:0	SEE Marks	50
Credits	01	Total Marks	100
Contact Hours	14	Exam Hours	1
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge on

- Explain how incidents lead to problems
- Recognize the importance of tracking IT assets
- Apply simple root cause analysis methods
- Understand the need for teamwork and policies

Course Objectives:

CLO1: Understand importance of problem management in cyber security.
CLO2: Distinguish between Incident Management, Problem Management and Change management
CLO3: Learn different approaches and methods to implement Problem Management in organization

Teaching-Learning Process (General Instructions)

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and Documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short, related video lectures in the following ways:
    - As an introduction to new topics (pre-lecture activity).
    - As a revision of topics (post-lecture activity).
    - As additional examples (post-lecture activity).
    - As an additional material of challenging topics (pre-and post-lecture activity).
    - As a model solution of some exercises (post-lecture activity)

Module-1 **8 Hours**

Introduction to Problem Management: Definition and importance of Problem Management. Difference between Incident Management and Problem Management. Difference between Change Management and Problem Management. Benefits of Problem Management.

Module-2	8 Hours
Problem Management Process - Problem Detection, Categorization and Prioritization, Investigation and Diagnosis, Creation of Known error record, Creation of work around if necessary and resolution and closure of the problem.	
Module-3	**8 Hours**
Root Cause Analysis (RCA) - When is RCA is required? Objectives of RCA, Different types of RCA, Key principles of RCA, RCA process and best practices.	
Module-4	**8 Hours**
Problem management best practices – Introduction to Brain Storming, Kepner-Tregoe (K-T) method, Ishikawa analysis or Fish bone diagram analysis, Pareto Analysis	
Module-5	**8 Hours**
Problem management practice in Industry – Introduction to Proactive and Reactive Problem Management. Introduction to role of ITSM (IT Service Management) and ITIL (Information Technology Infrastructure Library) in Problem Management.	

Course outcomes (Course Skill Set):

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

CO1: Compare Incident Management, Problem Management and Change Management. (PO - 1,2,3, PSO -1,3)

CO2: Illustrate the importance of Problem management in cyber security. (PO - 1,2,3, PSO -1,3)

CO3: Explain best practices in Problem management. (PO -1,2,3, PSO - 1,3)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the regulations; if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned

properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Textbook:

1. Cyber Incident and Crisis Management: A Guide for Managers, by Dr.IshaiDror, EAN/UPC, ISBN: 9781090168962, 2019.

Reference Books:

1. Root Cause Analysis: Simplified Tools And Techniques, by Bjorn Anderson and Tom Fagerhaug, Second Edition, ISBN-0873896920, AsqPr, 2006

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=SBlKdEFAnlM - Problem Management | ITIL V3 Foundation | ITIL Basics | Simplilearn

Activity Based Learning (Suggested Activities in Class)/Practical Based Learning

- Learn and Practice RCA.
- Understand Problem Management Process.

Universal Human Values			
Course Code	25UH48	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	1:0:0	**SEE Marks**	50
Credits	01	**Total Marks**	100
Contact Hours	14:0:0	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites: NIL

Course Objectives:

This course is intended to:

- To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
- This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Teaching-Learning Process (General Instructions):

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

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.
3. State the need for UHV activities and its present relevance in the society and provide real-life examples.
4. Support and guide the students for self-study activities.
5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self-evolution.
7. Encourage the students for group work to improve their creative and analytical skills.

Module- 1 **2 Hours**

Introduction to Value Education:

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of

Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module- 2 **3 Hours**

Harmony in the Human Being :

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health

Module- 3 **3 Hours**

Harmony in the Family and Society :

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-toHuman Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order

Module- 4 **3 Hours**

Harmony in the Nature/Existence :

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Module- 5 **3 Hours**

Implications of the Holistic Understanding – a Look at Professional Ethics :

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

Course outcomes (Course Skill Set):

At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature):

CO1: Apprehend the need of Value Education over Human aspirations (PO-6, PO-7)

CO2: Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. (PO-6, PO-7)

CO3: Recognize the need of Harmony in the Family and Society for a better World. (PO-6, PO-7)

CO4: Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. (PO-6, PO-7)

CO5: Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. (PO-6, PO-7)

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered.
- Any two assignment methods, if an assignment is project-based, then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

The sum of two tests, two assignments, will be out of 100 marks and will be scaled down to 50 marks

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Text Books:

1. "The Textbook: A Foundation Course in Human Values and Professional Ethics", R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2010. ISBN 978- 8-174-46781-2
2. The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books:

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5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
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13. Gandhi - Romain Rolland (English)

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Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
2. https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4
3. **Course handouts:** https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3 Osr?usp=sharing
4. **Presentation slides:** https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp_b1mpS-duNRcwS6YH?usp=sharing