SEMESTER 3

INFORMATION TECHNOLOGY

SEMESTER S3

MATHEMATICS FOR COMPUTER AND INFORMATION SCIENCE-3

(Group A)

Course Code	**GAMAT301**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic calculus	**Course Type**	Theory

Course Objectives:

1. To familiarize students with the foundations of probability and analysis of random processes used in various applications in engineering and science.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, the Binomial probability distribution, the Poisson probability distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. **[Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]**	**9**
2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. **[Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2]**	**9**

3	Limit theorems : Markov's Inequality, Chebyshev's Inequality, Strong Law of Large Numbers (Without proof), Central Limit Theorem (without proof), Stochastic Processes: Discrete-time process, Continuous-time process, Counting Processes, The Poisson Process, Interarrival times (Theorems without proof) **[Text 2: Relevant topics from sections 2.7, 2.9, 5.3]**	**9**
4	Markov Chains, Random Walk Model, Chapman–Kolmogorov Equations, Classification of States, Irreducible Markov chain, Recurrent state, Transient state, Long-Run Proportions. (Theorems without proof) **[Text 2: Relevant topics from sections 4.1, 4.2, 4.3, 4.4]**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	**K3**
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	**K3**
CO3	Familiarize and apply limit theorems and to understand the fundamental characteristics of stochastic processes.	**K3**
CO4	Solve problems involving Markov Chains, to understand their theoretical foundations and to apply them to model and predict the behaviour of various stochastic processes.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability and Statistics for Engineering and the Sciences	Devore J. L	Cengage Learning	9th edition, 2016
2	Introduction to Probability Models	Sheldon M. Ross	Academic Press	13th edition, 2024

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability and Random Processes for Electrical and Computer Engineers	John A. Gubner	Cambridge University Press	2012
2	Probability Models for Computer Science	Sheldon M. Ross	Academic Press	1st edition, 2001
3	Probability, Random Variables and Stochastic Processes	Papoulis, A. & Pillai, S.U.,	Tata McGrawHill.	4th edition, 2002
4	Probability, Statistics and Random Processes	Kousalya Pappu	Pearson	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_mg31/preview
2	https://onlinecourses.nptel.ac.in/noc22_mg31/preview
3	https://archive.nptel.ac.in/courses/108/103/108103112/
4	https://archive.nptel.ac.in/courses/108/103/108103112/

SEMESTER S3

COMPUTER ORGANISATION AND ARCHITECTURE

Course Code	PCITT302	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GXEST203: Foundations of Computing - From Hardware Essentials to Web Design	Course Type	Theory

Course Objectives:

1. Students will be able to gain a comprehensive understanding of the fundamental principles and operational concepts of computer architecture.
2. Students will be able to learn about the key elements and mechanisms of pipelining and its implementation in modern processors.
3. Students will be able to acquire knowledge of cache memory and DRAM systems, focusing on their organisation, performance, and optimisation techniques.
4. Students can explore and differentiate various parallel processing architectures and multicore processors.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals:** Basic operational concepts, memory locations and addresses, instructions and instruction sequencing, instruction set principles modes, classifying instruction set architectures, memory addressing, type and size of operands, operations in the instruction set, instructions for control flow, encoding an instruction set, RISC architecture.	11
2	**Pipelining:** Introduction to single cycle and multi cycle processors. Pipelining- Basic and intermediate concepts, Introduction to pipelining, pipeline hazards, structural hazards, data hazards, control hazards, pipelining implementation, RISC V integer pipeline to handle multicycle operations.	12
3	**Memory Organization:** Introduction to cache memory, cache mapping, block replacement techniques, cache performance, six basic cache optimizations. DRAM memory system organization, basic nomenclature,	12

	memory modules, basic DRAM memory access protocol, basic DRAM commands, DRAM controller architecture, row buffer management policy, open page row buffer management policy, close page row buffer management policy.	
4	**Introduction to Parallel Processors:** SISD, MIMD, SIMD, SPMD, and vector hardware multithreading, multicore and other shared memory multiprocessors, Case Study: Intel Core i7.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the fundamental concepts of computer operations, memory organization, and instruction set architectures.	**K3**
CO2	Describe and apply the concepts of pipelining, including pipeline hazards and their implementation in RISC-V architecture.	**K3**
CO3	Apply the principles and performance optimization techniques of cache memory and the organization and protocols of DRAM systems.	**K2**
CO4	Understand different parallel processor architectures and multicore processors, with a case study on Intel Core i7.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	3	-	-	-	-	-	-	-
CO4	3	2	2	-	3	-	-	-	-	2	2	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Organization and Design	Patterson D.A. and J. L. Hennessey	Morgan Kauffmann Publishers	5th Edition 2014
2	Computer Organization	Hamacher C., Z. Vranesic and S. Zaky	McGraw Hill	5th edition 2012
3	Memory Systems: Cache, DRAM, Disk	Bruce Jacob, David T. Wang, and Spencer Ng	Morgan Kauffmann Publishers	1st Edition 2007
4	Computer Organization- A Quantitative Approach	Patterson D.A. and J. L. Hennessey	Morgan Kauffmann Publishers	6th Edition 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Organization and Architecture: Designing for Performance	William Stallings	Pearson	9th edition 2013
2	Parallel Computers- Architecture and Programming	V Rajaraman, C Siva Ram Murthy	PHI learning	2nd Edition 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc19_cs62/preview
2	https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-cs47/

SEMESTER S3

DATA STRUCTURES

Course Code	PCITT303	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	UCEST105: Algorithmic Thinking in Python GXEST204: Programming in C	Course Type	Theory

Course Objectives:

1. Students will be able to understand and classify various data structures and their complexities, analyze algorithms for space and time efficiency, and perform basic operations on arrays, stacks, and queues.
2. Students will be able to implement basic searching, sorting, and hash table operations for efficient data management in computational applications.
3. Students will be able to master operations on linked lists and implement stacks and queues using linked lists effectively.
4. Students will be able to achieve a solid grasp of tree and graph structures, their traversal methods, and applications, including the implementation of binary search trees, heaps, and graph algorithms like Dijkstra's shortest path.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Data Structures:** Definitions, Classifications of Data Structures- ADT and CDT, Linear and Non-Linear, Static and Dynamic. Algorithm/Program Development: Analysis of Algorithms- Space Complexity, Understanding the notion of Time Complexity using graphical and tabular representation for Linear, Quadratic, Cubical, Logarithmic and Exponential functions. Asymptotic Notations- Best Case, Worst Case, Average Case. Arrays: Definition, Properties of Array. Representation of Single/Two-dimensional Arrays, Sparse Matrix, Polynomial representation, and manipulation using Arrays (Addition only). Stack: Operations on Stack using Array Queues: Definition, Operations on Queue using Array, Circular	11

	Queue implementation using Array, Other types of Queues: Dequeue, Priority Queue (Concept only) **Applications of Stack:** Infix to Postfix conversion and Postfix evaluation.	
2	**Searching:** Linear Search and Binary search. **Sorting:** Bubble Sort, Selection Sort, Insertion Sort. Quicksort and Merge Sort (Recursive Algorithms only) Complexity analysis of sorting algorithms (Detailed analysis is not required) and Heap sort. **Hash Tables**: Different Hash Functions: Division method, Multiplication Method, Mid Square Method, Folding Method, Collision Resolution Techniques: Closed Hashing (Linear Probing) -Drawbacks, Open Hashing (Separate Chaining). Remedies-Random Probing, Quadratic Probing, Double Hashing. Load Factor and Re-hashing	**11**
3	**Linked List:** Definition, Array Vs Linked List, Dynamic memory management. Representation of a Linked List, Classification (Singly Linked List, Doubly Linked List, Circular singly linked list), Operations on Singly Linked List- Traversal, Insertion, Deletion and Searching. **Applications of Linked List:** Polynomial representation and manipulation (Addition only). Operations on Doubly Linked List- Traversal, Insertion, Deletion and Searching, Circular Linked List (Concept only) Linked List representation of Stack and Queue, Stack implementation and Operations on Stack using Linked List, Queue implementation and Operations on Queue using Linked list.	**11**
4	**Trees:** Definition, Height, Depth, Degree, Level. **Binary Trees:** Properties of Binary Trees, Complete, Perfect and Full Binary Tree, Linear and Linked List representations of Binary Trees, Binary Tree Traversals - Preorder, In order, and Post order (Recursive Algorithms only), Binary Tree Applications: Expression Tree creation. **Binary Search Tree:** Creation, Insertion, Deletion, and Search operations. **Heap:** Creation **Graph:** Definition, set representations, Directed and Undirected Graph, Adjacency Matrix and Adjacency List representation, Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS), Graph Applications: Shortest Path Problem-Dijkstra's Algorithm.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the concept of data structure and analyze algorithm complexity using graphical and tabular methods in implementing stack and queue operations.	**K3**
CO2	Implement and evaluate searching, sorting, and hash table operations with various collision resolution techniques.	**K3**
CO3	Implement and manipulate linked lists and utilize them for stack and queue operations, including polynomial manipulation	**K2**
CO4	Apply tree and graph algorithms to traverse, search, and solve problems, including shortest path computations in graph structures.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	-	-	2
CO2	3	3	2	2	3	-	-	-	-	-	-	2
CO3	3	3	2	3	2	-	-	-	-	-	-	2
CO4	3	3	3	2	2	-	-	-	-	-	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Classic Data Structures	Debasis Samantha	Prentice Hall	2nd Edition 2008
2	Data Structures Through C	Yashvanth Kanenthkar	BPB Publications	3rd Edition 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Structures and Algorithms	A. Aho, J. Hopcroft, J. Ulman	Pearson Education	2nd Edition 2008
2	Introduction to Algorithms	T.H.Cormen, C.E. Leiserson, R.L. Rivest, C. Stein	MIT Press	4th Edition 2022
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill	2nd Edition 2001
4	Fundamentals of Data Structures in C	E. Horwitz , S. Sahani, D. Mehta	University Press	2nd Edition 2008

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs96/preview

SEMESTER S3

DATABASE MANAGEMENT SYSTEM

Course Code	PBITT304	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	UCEST105: Algorithmic Thinking with Python	Course Type	Theory

Course Objectives:

1. Students will be able to understand the elementary concepts of a database management system.
2. Students will be able to design and implement a database project based on these concepts.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** • Overview of a database project and its scope and objectives. • Importance of database management system in real-world applications. **Database Design:** • **Conceptual Design**: Create an Entity-Relationship Diagram (ERD) to model the entities, relationships, and attributes involved in your project. • **Logical Design**: Translate the ERD into a relational schema. **Database Creation:** • Implement a sample schema in a DBMS of your choice (e.g., MySQL, PostgreSQL, SQLite). **Tables and Relationships:** • Define tables with appropriate attributes (columns). • Establish relationships (foreign keys) between tables.	9
2	**Normalization:** • Ensure your schema is normalized to minimize redundancy and dependency issues.	9

	SQL Queries: • Develop a set of SQL queries to demonstrate CRUD operations (Create, Read, Update, Delete), complex joins, aggregations, and any specialized queries required by your project. **Timeline**: • Create a timeline or project plan with milestones to ensure timely completion.	
3	**Constraints:** • Entity Integrity • Referential Integrity • Domain Constraints **Transaction Management:** • Definition of transactions and transaction properties (ACID properties). • Implementation of transaction processing logic. **Concurrency Control:** • Techniques to manage concurrent access (e.g., locking, time stamping). **Backup and Recovery:** • Strategies for database backup and recovery in case of failures.	**9**
4	**Testing and Validation:** • Execute queries to validate the correctness of the schema and constraints. **Integration with Applications:** • Develop simple applications (eg; using Python) to interact with the database. **Documentation:** • Prepare comprehensive documentation covering project objectives, database schema, constraints, transactions, and implementation details.	**9**

Suggestions on Project Topics:

No.	Project Topics
1	E-commerce Database Platform
2	Registered Vehicle Database Management
3	Library Database Management System
4	Student Database Management
5	Pharmacy Database Management System
6	Restaurant Database Management
7	Payroll Database Management System
8	Insurance Products Database Management
9	Hospital management system.
10	Bank transactions management system.

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop a relational database schema for a given project, utilizing Entity-Relationship Diagrams (ERDs) and translating them into a relational schema.	**K3**
CO2	Normalize a database schema and develop complex SQL queries to manipulate and retrieve data efficiently.	**K3**
CO3	Implement and manage database constraints, transactions, concurrency control mechanisms, and backup/recovery strategies to ensure data integrity and system reliability.	**K3**
CO4	Develop database application and prepare detailed documentation.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Database Systems: Models, Languages, Design and Application Programming	Elmasri R. and S. Navathe	Pearson Education	7th Edition 2016
2	Database System Concepts	Silberschatz A., H. F. Korth and S. Sudarshan	McGraw Hill	7th Edition 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Introduction to Database Systems	C. J. Date, S. Swamynathan and A. Kannan	Pearson Education	8th Edition 2006
2	Database Management Systems	G.K.Gupta	Tata McGraw Hill	2011

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/ini24_cs01

Project Based Learning - Course Elements			
L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity		
Sl. No	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology
2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback
3. **Involvement in the Project Work and Team Work (3 Marks)**
    - Active participation and individual contribution
    - Teamwork and collaboration
4. **Execution and Implementation (10 Marks)**
    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result
5. **Final Presentation (5 Marks)**
    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions
6. **Project Quality, Innovation, and Creativity (3 Marks)**
    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S3

DIGITAL ELECTRONICS AND LOGIC DESIGN

(Common to Group A)

Course Code	**GAEST305**	**CIE Marks**	40
Teaching Hours/Week (L:T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Familiarize the basic concepts of Boolean algebra and digital systems. Further, the design of simple combinational and sequential logic circuits which is essential in understanding organization & design of computer systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to digital Systems :-** Digital abstraction Number Systems – Binary, Hexadecimal, grouping bits, Base conversion; Binary Arithmetic – Addition and subtraction, Unsigned and Signed numbers; Fixed-Point Number Systems; Floating-Point Number Systems Basic gates- Operation of a Logic circuit; Buffer; Gates - Inverter, AND gate, OR gate, NOR gate, NAND gate, XOR gate, XNOR gate; Digital circuit operation - logic levels, output dc specifications, input dc specifications, noise margins, power supplies; Driving loads - driving other gates, resistive loads and LEDs. **Verilog (Part 1)** :- HDL Abstraction; Modern digital design flow - Verilog constructs: data types, the module, Verilog operators.	11

2	**Combinational Logic Design: –** Boolean Algebra - Operations, Axioms, Theorems; Combinational logic analysis - Canonical SOP and POS, Minterm and Maxterm equivalence; Logic minimization - Algebraic minimization, K-map minimization, Dont cares, Code convertors. **Modeling concurrent functionality in Verilog:-** Continuous assignment - Continuous Assignment with logical operators, Continuous assignment with conditional operators, Continuous assignment with delay.	**11**
3	**MSI Logic and Digital Building Blocks** MSI logic - Decoders (One-Hot decoder, 7 segment display decoder), Encoders, Multiplexers, Demultiplexers; Digital Building Blocks - Arithmetic Circuits - Half adder, Full adder, half subtractor, full subtractor; Comparators. Structural design and hierarchy - lower level module instantiation, gate level primitives, user defined primitives, adding delay to primitives.	**8**
4	**Sequential Logic Design** :- Latches and Flip-Flops- SR latch, SR latch with enable, JK flipflop, D flipflop, Register Enabled Flip-Flop, Resettable Flip-Flop. Sequential logic timing considerations; Common circuits based on sequential storage devices - toggle flop clock divider, asynchronous ripple counter, shift register. **Finite State Machines :-** Finite State Machines - logic synthesis for an FSM, FSM design process and design examples; Synchronous Sequential Circuits - Counters; **Verilog (Part 2)** : - Procedural assignment; Conditional Programming constructs; Test benches; Modeling a D flipflop in Verilog; Modeling an FSM in Verilog.	**14**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks. **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the basic concept of different number systems and perform conversion and arithmetic operations between different bases.	**K2**
CO2	Interpret a combinational logic circuit to determine its logic expression, truth table, and timing information and to synthesize a minimal logic circuit through algebraic manipulation or with a Karnaugh map.	**K2**
CO3	Illustrate the fundamental role of hardware description languages in modern digital design and be able to develop the hardware models for different digital circuits.	**K3**
CO4	Develop MSI logic circuits using both the classical digital design approach and the modern HDL-based approach.	**K3**
CO5	Develop common circuits based on sequential storage devices including counter, shift registers and a finite state machine using the classical digital design approach and an HDL-based structural approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3								3
CO3	3	3	3	3	3							3
CO4	3	3	3	3	3							3
CO5	3	3	3	3	3							3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Logic Circuits & Logic Design with Verilog	Brock J. LaMeres	Springer International Publishing	2/e, 2017
2	Digital Design and Computer Architecture - RISC-V Edition	Sarah L. Harris, David Harris	Morgan Kaufmann	1/e, 2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog	M Morris Mano, Michael D Ciletti	Pearson	6/e, 2018
2	Digital Fundamentals	Thomas Floyd	Pearson	11/e, 2015
3	Fundamentals of Digital Logic with Verilog Design	Stephen Brown, Zvonko Vranesic	McGrawHill	3/e, 2014
4	Switching and Finite Automata Theory	Zvi Kohavi Niraj K. Jha	Cambridge University Press	3/e, 2010

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/117105080
2	https://onlinecourses.nptel.ac.in/noc21_ee39/
3	https://onlinecourses.nptel.ac.in/noc24_cs61/

SEMESTER S3

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	**6**
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and	**6**

	equilibrium of a firm)	
3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators-SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	**15**	**12.5**	**12.5**	**50**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7^{TH} Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics** - Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, **Technology and digital revolution**-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places**-accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**.	6

	Basic concepts in Gender Studies - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**

4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	**6**

Course Assessment Method
(CIE: 50 marks , ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S3

PROGRAMMING IN PYTHON LAB

Course Code	PCITL307	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	UCEST105: Algorithm Thinking With Python	Course Type	Lab

Course Objectives:

1. Students will be able to develop skills in text processing, advanced function handling, and exception handling.
2. Students will be able to provide hands-on experience with image processing techniques and object-oriented programming principles.

SYLLABUS

Experiment No.	Experiments
1	a) Creation of List & List Operations b) Advanced List Comprehension c) Tuple and Tuple operations d) Creation of Dictionary and Operations
2	**Text Processing** **Sample Program** a) Given an input file which contains a list of names and phone numbers separated by spaces in the following format: "Phone Number contains a 3- or 2-digit area code and a hyphen followed by an 8-digit number". Find all names having phone numbers with a 3-digit area code using regular expressions. b) Write a Python program to check the validity of a password given by the user. c) Write a Python program to validate mobile number

3	**Working with functions** **Sample Program:** a) Write a program to solve a classic ancient Chinese puzzle: Get the input from the user for the number of heads (eg: 35 heads) and legs (eg: 94 legs) among the chickens and rabbits in a farm. Display the number of rabbits and chickens we have. Use the function solve(heads, legs). Hint: Use for loop to iterate all possible solutions. b)You are given an array A of size N. Your friend gave me an amazing task for you. Your friend likes one type of Sequence. So, he called that type of sequence a fair sequence. You should select a fair sequence of maximum length from an array. Here a fair sequence is nothing but you have to select elements in a pattern like positive element, negative element, positive element… negative element, positive element, negative element, to form a sequence. Your task is to print the maximum sum of elements possible by selecting a fair subsequence with maximum length. (Use functions). Ex: If array A = [-1, 18, 13, 18, 2, 16,7,-1, -213, 11]. Here your minimum length can be 6. The fair subsequence is -1, -18,-7, -2, 7,-1, 11. The Sum is 32 which is the maximum possible. Your friend also kept a timer of 15 min. You will win, will you be able to do it? c) Working with Lambda function
4	**Exception Handling and User defined exception(s)** **Sample Program:** a) Write a python program to catch different types of exceptions b) Write a python program to create user defined exceptions.
5	**File handling** **Sample Program:** Write a Python program that manages book records using a binary file called book.dat. The program should have the following functions: ● add_record() This function should prompt the user to input data for a book, including the Book Number, Book Name, Author, and Price. The data should be stored in a list format:

	[BookNo, Book_Name, Author, Price]. The function should then add the book data to the book.dat binary file using pickling. ● display_records() This function should display all the records stored in the book.dat file on the screen. Each record should be displayed with its corresponding attributes: Book Number, Book Name, Author, and Price. ● books_by_author() This function should ask the user to input an author's name. It should then search through the records in the book.dat file and display all the records for books written by the given author. ● books_by_price(price) This function should receive a maximum price as an argument. It should search through the records in the book.dat file and display all the records for books with a price less than the provided maximum price. ● copy_data() This function should read the contents of the book.dat file. It should copy the records of books whose price is more than $500 to a new file named costly_book.dat using pickling. The function should return the count of records copied. ● delete_record(book_number) This function should receive book number as an argument. If a record with the given book number exists, it should be deleted from the book.dat file. If the record does not exist, display an error message. ● update_record(book_number) This function should receive a maximum price as an argument. If a record with the given book number exists, prompt the user to update the Book Name, Author, and Price for that record. If the record does not exist, display an error message. In the program, include a menu-based interface that allows users to choose which function to execute.
6	**Working with data (Use of user- defined/ Built-in modules)** **Sample Program:** a) Querying an SQL light database- insert, update, select, delete

	b) Comparing data in a .CSV file and write to a new .CSV file.
7	**Working with data (Use of user- defined/ Built-in modules): Getting data from Web, JSON** **Sample Program:** a) Scrap HTML content from a page and pass the code with beautiful soup. b) Serializing/ Deserializing JSON – Access and work with data stored as JSON
8	**Image Processing** **Sample Program:** a) Reading, Saving and displaying an image using OpenCV-PyPI, matplotlib
9	**Advanced Image processing** **Sample Program:** a) Image statistics cropping, b) Converting images from RGB to Gray and Resizing the image c) Skin color detection
10	**Basic Object-Oriented** **Sample Program:** a) Write a Python class named Person with attributes name, age, weight (kgs), height (ft) and takes them through the constructor and exposes a method get_bmi_result() which returns one of "underweight", "healthy", "obese". b) Write a python program to demonstrate operator overloading.
11	**Advanced Object-Oriented** **Sample Program:** a) Write a python program to demonstrate various kinds of inheritance b) Write a python program to create abstract classes and abstract methods
12	**Implement a micro project using any of the Python concepts described in experiments 1-11.** For Projects, Students may be grouped with maximum of 4 persons. Evaluation shall be done on demonstration and presentation of project for maximum 10 minutes.

	Example: Creating a snake and ladder game, PageRank Algorithm implementation etc.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record:*** *Students shall be allowed for the end semester examination only upon submitting the duly certified record.*

- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply advanced list comprehensions, tuples, and dictionaries for efficient data manipulation and develop text processing scripts, including functions with advanced argument handling and lambda functions.	**K3**
CO2	Implement robust programs using exception handling and user-defined exceptions.	**K3**
CO3	Implement file operations, work with relational databases, CSV, and web-based data sources effectively.	**K3**
CO4	Perform basic and advanced image processing using libraries such as OpenCV and matplotlib, and demonstrate basic and advanced object-oriented programming concepts.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	-	-	--	-	-	3	3	-	2
CO2	3	-	3	-	-	-	-	-	3	3	-	2
CO3	3	-	3	-	-	-	-	-	3	3	-	2
CO4	3	-	3	2	3	-	-	-	3	3	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	How to think like a Computer Scientist- Learning with Python	Allen Downey, Jeffrey Elkner, Chris Meyers	Green Tea Press	1st edition, 2002
2	Learning Python: Powerful Object-Oriented Programming	Mark Lutz	O'Reilly Media Inc.	5th edition, 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Problem Solving and PYTHON Programming	S.A.Kulkarni	Yes Dee Publishing Pvt Ltd	2nd edition, 2008
2	Programming in Python 3: A Complete Introduction to the Python Language	Mark Summerfield	Pearson Education	2nd edition, 2018
3	Fundamentals of Python	Kenneth A. Lambert, B. L. Juneja	Cengage Learning India Pvt. Ltd.	1st edition, 2015
4	Let Us Python	Yashavant Kanetkar ,Aditya Kanetkar	BPB Publications	1st edition, 2019

Video Links (NPTEL, SWAYAM…)	
Link No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc19_cs40/preview
2	www.https://realpython.com/
3	https://onlinecourses.nptel.ac.in/noc24_cs113/preview
4	https://docs.python.org/3/reference/

Continuous Assessment (25 Marks):

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**
    - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
    - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks):

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.
2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
3. **Result with Valid Inference/Quality of Output (10 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
4. **Viva Voce (10 Marks)**
    - Ability to explain the experiment, procedure results and answer related question.
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.
5. **Record (5 Marks)**
    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S3

DATA STRUCTURES LAB

Course Code	PCITL308	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GXEST204: Programming in C	Course Type	Lab

Course Objectives:

1. Understand the importance of data structures, abstract data type, and their basic usability in different applications.
2. Implement basic searching, sorting, and hashing algorithms to efficiently solve data organization and retrieval problems.
3. Implement linear and non-linear data structures using arrays and linked lists.
4. Apply various data structures such as stacks, queues, trees, graphs, etc. to solve various computing problems.
5. Identify suitable data structures and algorithms to solve a real-world problem.

Experiment No.	Experiments
1	Implementation of Stack using array.
2	Utilize stack to perform the following tasks: i) Convert an infix expression to a postfix expression. ii) ii) Evaluate a given postfix expression
3	Representation of polynomials using arrays and perform polynomial addition.
4	Implementation of Queue and Circular Queue using arrays.
5	Implementation of various sorting algorithms – Bubble sort, Insertion sort, Selection sort, Quick sort, and Merge sort.
6	Implementation of basic searching algorithms – linear search and binary search.

7	Implementation of hash tables using various mapping functions and resolving collisions (if any) using various collision resolution schemes.
8	Implementation of Singly linked list operations- traversing, searching, insertion, deletion.
9	Implementation of Doubly linked list operations- traversing, searching, insertion, and deletion.
10	Representation of polynomials using linked lists and perform polynomial addition.
11	Implementation of Stack and Queue using linked list.
12	Implementation of preorder, in-order, and post-order traversals on binary trees using recursive algorithm.
13	Implementation of binary search trees – creation, insertion, deletion, searches.
14	Implementation of heap sort.
15	Representation of graph using adjacency list and adjacency matrix and compute various parameters (in degree, out-degree, etc.).
16	Implementation of BFS and DFS for each graph representation.
17	Implementation of Dijkstra's algorithm for finding the shortest path.
18	Any application program using trees.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record:*** *Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Perform operations on fundamental data structures such as arrays, stacks, queues, linked lists, and hash tables.	**K3**
CO2	Implement and analyze various sorting (e.g., bubble, insertion, selection, quick, merge) and searching algorithms (linear and binary search), understanding their efficiency and use cases.	**K3**
CO3	Solve complex problems involving tree and graph data structures.	**K3**
CO4	Analyze and optimize the performance of data structure operations, including polynomial representation and addition, using both arrays and linked lists and different implementations of stacks and queues.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Classic Data Structures	Debasis Samantha	Prentice Hall	2nd Edition 2008
2	Data Structures Through C	Yashvanth Kanenthkar	BPB Publications	3rd Edition 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Structures and Algorithms	A. Aho, J. Hopcroft, J. Ulman	Pearson Education	2nd Edition 2008
2	Introduction to Algorithms	T.H.Cormen, C.E. Leiserson, R.L. Rivest, C. Stein	MIT Press	4th Edition 2022
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill	2nd Edition 2001
4	Fundamentals of Data Structures in C	E. Horwitz , S. Sahani, D. Mehta	University Press	2nd Edition 2008

Video Links (NPTEL, SWAYAM…)	
Link No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs96/preview

Continuous Assessment (25 Marks):

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.

- Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks):

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
   - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.
2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
   - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
3. **Result with Valid Inference/Quality of Output (10 Marks)**
   - Accuracy of Results: Precision and correctness of the obtained results.
   - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
4. **Viva Voce (10 Marks)**
   - Ability to explain the experiment, procedure results and answer related question.
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.
5. **Record (5 Marks)**
   - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 4

INFORMATION TECHNOLOGY

SEMESTER S4

MATHEMATICS FOR COMPUTER AND INFORMATION SCIENCE-4

(Group A)

Course Code	**GAMAT401**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	NIL	**Course Type**	Theory

Course Objectives:

1. To provide a comprehensive understanding of fundamental concepts of graph theory including paths, cycles, trees, graph algorithms, graph coloring and matrix representations, emphasizing their applications across various disciplines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Graphs - Basic definition, Application of graphs, finite and infinite graphs, Incidence and Degree, Isolated vertex, Pendant vertex and Null graph. Isomorphism, Sub graphs, Walks, Paths and circuits, Connected graphs, Disconnected graphs and components. **[Text 1: Relevant topics from sections 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.4, 2.5. Proofs of theorems 2.5, 2.7 are excluded.]**	**9**
2	Euler graphs, Operations on Graphs, Hamiltonian paths and circuits, Travelling Salesman Problem, Connectivity, Edge connectivity, Vertex connectivity, Directed graphs, Types of directed graphs. **[Text 1: Relevant topics from sections 2.6, 2.7, 2.8, 2.9, 2.10, 4.1, 4.2, 4.5, 9.1, 9.2. Proofs of theorems 4.6, 4.11, 4.12 are excluded.]**	**9**
3	Trees- properties, Pendant vertices, Distance and centres in a tree, Rooted and binary trees, Counting trees, Spanning trees, Prim's algorithm and Kruskal's algorithm, Dijkstra's shortest path algorithm, Floyd-Warshall	**9**

	shortest path algorithm. **[Text 1: Relevant topics from sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.10, 11.5. Proofs of theorems 3.10, 3.16 are excluded.]**	
4	Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix, Coloring, Chromatic number, Chromatic polynomial, Greedy colouring algorithm. **[Text 1: Relevant topics from sections 7.1, 7.3, 7.8, 7.9, 8.1, 8.3. Proofs of theorems 7.4, 7.7, 7.8, 8.2, 8.3, 8.5, 8.6 are excluded.]**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamental concepts of graph theory such as types of graphs, degree of a vertex, graph isomorphism, connectedness.	**K2**
CO2	Understand the concepts of Euler graphs, Hamiltonian graphs and connectivity.	**K2**
CO3	Apply Prim's and Kruskal's algorithms for finding minimum cost spanning tree and Dijkstra's and Floyd-Warshall algorithms for finding shortest paths.	**K3**
CO4	Illustrate various representations of graphs using matrices and apply vertex coloring in real life problems.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Graph Theory with Applications to Engineering and Computer Science	Narsingh Deo	Prentice Hall India Learning Private Limited	1st edition, 1979

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Graph Theory 2e	Douglas B. West	Pearson Education India	2nd edition, 2015
2	Introduction to Graph Theory	Robin J. Wilson	Longman Group Ltd.	5th edition, 2010
3	Graph Theory with Applications	J.A. Bondy and U.S.R. Murty	Elsevier Science Publishing Co., Inc	1976

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_ma10/preview
2	https://onlinecourses.nptel.ac.in/noc22_ma10/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs48/preview
4	https://onlinecourses.nptel.ac.in/noc21_cs48/preview

SEMESTER S4

COMPUTER NETWORKS

Course Code	PCITT402	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To familiarise with the fundamental concepts of Computer Networks, Network hardware and Software.
2. To familiarize with the terminologies and concepts and protocols associated with the different layers of the Computer Software with the help of Reference Models.
3. To raise awareness of students with the fundamentals of Internet and internet services.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Uses of computer networks, Network hardware, Network software, Reference Models –The OSI Reference Model, TCP/IP Reference Model, Comparison of the OSI and TCP/IP Reference Models. **Physical Layer:** Guided Transmission Media (twisted pair, coaxial cable, Fiber Cables), Wireless Transmission (Radio Transmission, Microwave Transmission, Infrared Transmission), Communication satellites (GEO, LEO, MEO). **Interfacing devices:** Repeaters, Hubs, Bridges, Switches, Routers, And Gateways	8
2	**Data link layer:** Data link layer design issues, Error detection and correction - Error Correcting codes (Hamming codes, Reed-Solomon codes, Low-Density Parity Check codes), Error-Detecting Codes (Parity, Checksums, Cyclic Redundancy Checks), A Simplex Stop-and-Wait Protocol for a Noisy Channel, Sliding window protocols. **Medium Access Control (MAC) sublayer:** Channel allocation problem,	12

	Multiple access protocols (ALOHA, Slotted ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols -bit map protocol, token passing, binary countdown, Wireless LAN Protocols). **Ethernet:** Frame format, types- Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet.	
3	**Network Layer:** Network layer design issues. Routing algorithms - The Optimality Principle, Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Multicast routing, Routing for mobile hosts. **Congestion control algorithms:** Approaches to Congestion Control- Choke Packets, Random Early Detection. Quality-of-service - Application Requirements, Traffic Shaping - Leaky and Token Buckets. **The Network Layer in the internet:** Internet Protocol, IP Version 4 Protocol, IP Addresses, IP Version 6.	**12**
4	**Transport Layer:** Transport service – Services provided to the upper layers, Transport service primitives. Socket programming, User Datagram Protocol (UDP)- User Datagram, Checksum. Real-Time Transport Protocols (RTP, RTCP), Transmission Control Protocol (TCP)- TCP Service Model, TCP Protocol, TCP Segment Header, TCP Connection Establishment, TCP Connection Release, TCP Sliding Window, TCP Congestion Control. **Application Layer:** Domain Name System (DNS)- Electronic mail. World Wide Web - Architectural Overview, HTTP—The Hypertext Transfer Protocol.	**12**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Distinguish the terminology and concepts of computer networks and Physical Layer	**K2**
CO2	Illustrate different concepts of Data Link Layer including Error Control, Channel allocation and popular wired and wireless LAN technologies	**K2**
CO3	Describe the network layer concepts, routing algorithms, congestion control approaches and IP protocol and addressing fundamentals.	**K2**
CO4	Describe the features and format of different Transport layer and Application layers protocols	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	2	-	-	-	-	-	-	-	3
CO3	3	2	-	2	-	-	-	-	-	-	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networks	Andrew S. Tanenbaum	Pearson	6th Edition 2021

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Communication and Networking	Behrouz A Forouzan	Tata McGraw Hill	4th Edition 2007
2	Computer Networking - A Top-Down Approach featuring the Internet	James F Kurose	Pearson Education	7th edition 2016
3	Computer Networks: A Systems Approach	Larry Peterson and Bruce Davie	The Morgan Kaufmann Series in Networking	5th Edition 2011

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	Computer Networks and Internet Protocol By Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty https://onlinecourses.nptel.ac.in/noc22_cs19/preview

SEMESTER S4

OPERATING SYSTEMS

Course Code	PCITT403	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT302: Computer Organisation and Architecture	Course Type	Theory

Course Objectives:

1. To understand the mechanisms like process management in the Operating System.
2. To understand the mechanisms of process synchronization and dead lock.
3. To understand the functions of memory management, file system implementation and storage structures used in OS.
4. To understand the concepts of Virtual Machines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction**: Functions of OS, Types of OS - Batch, Multi programmed, Time-sharing and Real time systems, System calls, System structure - Simple structure, Layered approach, Microkernel system structure, Monolithic, Modules, Hybrid Systems, System Boot. **Process Management:** Process concept, Process State, PCB-Multithreading - Benefits. Case study: Linux system - process management. **Process Scheduling:** Basic concepts, Non Pre-emptive Scheduling, Pre-emptive Scheduling, Dispatcher, Scheduling criteria, Scheduling Algorithms - FCFS, SJF, Priority scheduling, Round Robin Scheduling.	11
2	**Process Synchronization:** Race Conditions - Critical Sections – Peterson's Solution-Mutual Exclusion - Busy Waiting- Sleep and Wakeup – Bakery Algorithm-Semaphores. **Deadlocks:** Deadlock characteristics - conditions for deadlock - Prevention – Avoidance -Safe state, Resource Allocation Graph, Banker's algorithm, Deadlock Detection, Recovery from dead lock.	11

3	**Memory Management:** Basics, Swapping, Memory Allocation - fixed partitions, variable partitions, Fragmentation, Paging, Segmentation, Virtual memory concepts, Demand paging, Page replacement algorithms - FIFO, Optimal, LRU, Allocation of frames, Thrashing.	**11**
4	**File System:** File concept - Attributes, Operations, File Types - File structure - File access methods (Sequential Access, Direct Access, Indexed Access)– File allocation methods (Contiguous, linked, and indexed allocation), Directory structure (Single-Level, Two-Level, Tree-Structured, Acyclic Graph, General Graph), Case Study: Linux file systems **Disk Management:** Introduction, Disk Scheduling algorithms (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK) **Virtual Machines:** Benefits & Features- Building Blocks- Types of VMs- Virtualization & Operating System Components.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the concepts of operating systems and apply process management and process scheduling concepts to solve problems.	**K2**
CO2	Illustrate process synchronization, deadlock, and deadlock – prevention and avoidance techniques.	**K2**
CO3	Illustrate the memory management techniques	**K2**
CO4	Illustrate disk scheduling algorithm to solve problems and describe the file system implementation and virtual machine.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Operating System Concepts	A. Silberschatz, G.Gagne and P.Galvin	Wiley Publications	9th edition 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Operating Systems	Andrew S. Tanenbaum and Herbert Bos	Pearson	5th Edition 2022
2	Operating Systems A Concept-based Approach	D M Dhamdhere	Tata McGraw Hill	2nd Edition 2006
3	Operating Systems: Internals and Design Principles	William Stallings	Pearson	9th Edition 2018

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106144/

SEMESTER S4

DATA SCIENCE

Course Code	PBITT404	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	UCEST105: Algorithmic Thinking with Python and PCITL307: Programming in Python Lab	Course Type	Theory

Course Objectives:

1. Students will be able to gain a comprehensive understanding of data science, including data preprocessing, exploratory data analysis, building data pipelines, implementing machine learning algorithms, and evaluating model performance.
2. Students will be able to develop practical skills in using Python and relevant data science tools to apply these concepts effectively.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introducing data science and Python:** Definition of data Science, Installing latest version of python:-Step by step installation of python , Installing necessary packages of python , Introducing Jupyter. Data science process, Data loading and preprocessing with pandas- Fast and easy data loading- Data preprocessing- Data selection.	9
2	Data Pipeline, Exploratory data analysis (EDA) - Building new features- Dimensionality reduction- The detection and treatment of outliers- Validation metrics- Testing and validating- Cross-validation- Hyperparameter optimization- Feature selection- Wrapping everything in a pipeline. Preparing tools and datasets, Plotting scatter plots for relationships in data.	9
3	**Machine Learning** **Supervised Learning:** Rule-Based Classification- Using IF-THEN Rules for Classification, K-Nearest-Neighbour Classifier. **Unsupervised Learning:** K-means Clustering, Hierarchical Clustering, Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, Density based Clustering - DBSCAN.	9

	Linear and Logistic Regression, Ensemble strategies.	
4	**Evaluation** Evaluating model performance, Confusion matrices, Precision and recall, Sensitivity and specificity, F-measure, ROC curves. **Case Study:** Building Your First Model in data science, Making Predictions, Evaluating the Model.	**9**

Suggestions on Project Topics:

No.	Project Topics
1	Churn Prediction using Machine Learning
2	Credit Analysis
3	Employee Access-Challenge as a Classification Problem
4	Fake News Detection
5	House Price Prediction using Machine Learning
6	Loan Default Prediction
7	Model Insurance Claim Severity
8	Personalized Medicine Recommending System
9	Price Recommendation using Machine Learning
10	Recommendation System for Retail Stores
11	Sales Forecasting
12	Sentiment Analysis of Product Reviews

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the fundamental concepts and scope of data science, install and utilize Python and Jupyter Notebook for data science applications.	**K3**
CO2	Perform exploratory data analysis (EDA), build effective data pipelines including feature engineering, dimensionality reduction, and hyperparameter optimization.	**K3**
CO3	Implement and evaluate various machine learning algorithms.	**K3**
CO4	Apply various performance metrics on Machine Learning Models.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Python Data Science Essentials	Alberto Boschetti, Luca Massaron	Packt Publishing Ltd.	3rd Edition 2018
2	Introduction to Machine Learning with Python A Guide for Data Scientists	Andreas C. Müller and Sarah Guido	O'Reilly Media, Inc.	2017
3	Data Mining: Concepts and Techniques	Jiawei Han, Micheline Kamber, Jian Pe	Morgan Kaufmann	3rd Edition 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data science: Concepts and practice	Vijay Kotu Bala Deshpande	Morgan Kaufmann	2nd Edition 2019
2	Data Mining Techniques	Arun K Pujari	University Press	3rd Edition 2013

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc20_cs80

Project Based Learning - Course Elements			
L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity		
Sl. No	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology
2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback
3. **Involvement in the Project Work and Team Work (3 Marks)**
    - Active participation and individual contribution
    - Teamwork and collaboration
4. **Execution and Implementation (10 Marks)**
    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result
5. **Final Presentation (5 Marks)**
    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions
6. **Project Quality, Innovation, and Creativity (3 Marks)**
    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S4
OBJECT ORIENTED DESIGN USING JAVA

Course Code	PEITT411	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2:0:1:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Students should be able to understand the concepts of Software Engineering, Object oriented programming and UML
2. To provide students with a comprehensive understanding of the key concepts, activities, and management practices involved in the Requirements Elicitation, Analysis, and System Design phases of software engineering, enabling them to effectively gather, analyze, and structure requirements and design solutions that align with project goals. Work with Concurrency, Collections, and Event Handling in Java
3. To equip students with the skills to apply object-oriented design principles, including reusing pattern solutions and specifying interfaces, and to proficiently map models to code, ensuring that the software design meets functional and non-functional requirements and is implemented effectively.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Software Engineering:** What is Software Engineering, Software Engineering Concepts, Software Engineering Development Activities, Managing Software Development. **Introduction to Java:** Objects, Classes, Constructors, Inheritance **Modeling With UML:** An overview of UML, Modeling Concepts, Use case Diagrams, Class Diagrams, Interaction Diagrams, State Machine Diagrams, Activity Diagrams, Diagram Organization, Diagram Extensions.	9
2	**Requirements Elicitation:** Introduction, Overview, Concepts, Activities, Managing Requirements Elicitation. **Analysis:** Introduction, Overview, Concepts, Activities, Managing Analysis	9

3	**System Design:** Decomposing the system - Introduction, Overview, Concepts, Activities, Addressing Design goals - Introduction, Overview, Concepts, Activities, Managing System Design. **Object Design:** Reusing Pattern Solutions- Introduction, Overview, Reuse Concepts, Reuse Activities, Managing Reuse.	**9**
4	**Object Design:** Specifying Interfaces- Introduction, Overview, Interface Specification Concepts, Interface Specification Activities, Managing Object Design. **Mapping Models to Code:** Introduction, Overview, Mapping Concepts, Mapping Activities, Managing Implementation.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate an understanding of the fundamental concepts and activities of software engineering, including the principles of software development and management, and apply these concepts in designing object-oriented solutions using Java and UML diagrams.	**K3**
CO2	Illustrate the ability to effectively gather, analyze, and manage software requirements, and design system architectures by applying fundamental concepts and best practices in requirements elicitation, analysis, and system decomposition.	**K3**
CO3	Apply system design principles to address design goals and effectively reuse pattern solutions in object design, ensuring the development of robust, maintainable, and scalable software systems.	**K3**
CO4	Develop the ability to specify interfaces in object design and proficiently map models to code, ensuring accurate implementation and effective management of the software development process.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	-	-	2	2	-	2
CO2	3	3	3	2	2	-	-	-	2	2	-	2
CO3	3	3	3	2	3	-	2	-	2	2	-	2
CO4	3	2	3	2	3	-	-	-	2	2	2	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Object Oriented Software Engineering using UML, Patterns and Java	Bernd Bruegge	Prentice Hall	3rd Edition 2010
2	Java: The Complete Reference	Herbert Schildt	McGraw-Hill Education	13th Edition 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Applying UML and Patterns: An Introduction to Object-oriented Analysis and Design and Iterative Development	Craig Larman	Pearson Education	3rd Edition 2005
2	Object Oriented Analysis and Design with Applications	Grady Booch	Pearson Education	3rd Edition 2014
3	Core Java Volume I - Fundamentals	Cay S. Horstmann	Prentice Hall	12th Edition 2024

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105153/

SEMESTER S4

DATA COMMUNICATION AND NETWORKING

Course Code	PEITT412	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GAEST305: Digital Electronics & Logic Design	Course Type	Theory

Course Objectives:

1. To familiarise with the fundamental concepts of analog and digital data communication.
2. To equip students to apply their knowledge in various data communication techniques for signal encoding, and error control.
3. To familiarise with the data link layer concepts and control protocols.
4. To raise awareness of students with the fundamentals of computer communication and internet services.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Data Communication Overview:** Data Communications Model, Networks, The Internet. **Data Transmission:** Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel capacity. **Transmission Media:** Guided Transmission Media, Wireless Transmission, Wireless Propagation.	6
2	**Signal Encoding Techniques:** Digital Data to Digital Signals (NRZ-L, NRZ-I, Bipolar- AMI, Pseudo ternary, Manchester, Differential Manchester, Scrambling techniques), Digital Data to Analog Signals (ASK, PSK, FSK), Analog Data to Digital Signals (PCM, DM), Analog Data to Analog Signals. **Digital Data Communication Techniques:** Asynchronous and Synchronous Transmission, Types of Errors, Error Detection (parity check, CRC), Error Correction, Line Configurations.	11

3	**Data Link Control Protocols:** Flow Control, Error Control, Multiplexing - Frequency-Division Multiplexing, Synchronous Time-Division Multiplexing, Statistical Time-Division Multiplexing, Spread Spectrum - The Concept of Spread Spectrum - Frequency Hopping Spread Spectrum, Direct Sequence Spread Spectrum, Code-Division Multiple Access.	**10**
4	**Circuit Switching and Packet Switching:** Switched Communications Networks, Circuit-Switching Network, circuit switching concepts, softswitch architecture, Packet Switching Principles. **Routing in Packet-Switched Networks:** Routing in Packet-Switching Networks - Characteristics, Routing Strategies. **Wireless LANs:** 802.11 Architecture and Protocol Stack, frame format, Bluetooth- Bluetooth Architecture. **Cellular Wireless Networks:** Principles of Cellular Networks	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts of analog and digital Data Communication and various transmission media.	**K2**
CO2	Apply different signal encoding and error control techniques in data transmission.	**K3**
CO3	Explain data link control protocols and concepts of multiplexing and spread spectrum.	**K2**
CO4	Explain the principles of Networking, Wireless LANs and Cellular Wireless Networks	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	-	2	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2
CO4	2	-	-	-	-	-	-	-	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data and Computer Communication	William Stallings	Pearson Education	8th Edition 2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data communication and Networking	Behrouz A Forouzan	McGraw Hill	4th Edition 2007
2	Computer Networks	Andrew S Tanenbaum	Pearson Education	5th Edition 2011

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106105082
2	https://onlinecourses.nptel.ac.in/noc24_ee135/preview
3	https://nptel.ac.in/courses/106105082

SEMESTER S4

FOUNDATIONS OF SECURITY

Course Code	PEITT413	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT205: Discrete Mathematical Structures	Course Type	Theory

Course Objectives:

1. To build a robust understanding of essential mathematical concepts and apply these theories to understand and develop traditional and modern cryptographic techniques, including substitution techniques, stream and block ciphers, and secret key ciphers.
2. To solve complex mathematical problems related to number theory and algebraic structures, and apply these solutions to practical cryptographic scenarios.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Divisibility and Modular Arithmetic:** Finite Fields – Groups, Rings and Fields. Divisibility - Divisibility and Division Algorithms, Well ordering Principle, Bezout's Identity. Modular Arithmetic- Properties, Euclidean algorithm for the greatest common divisor, Extended Euclidean Algorithm, Least Common multiple, Modular Division.	9
2	**Primes and Congruences:** Prime Numbers - Prime Numbers and prime-power factorization, Fermat and Mersenne primes, Primality testing and factorization. Congruences - Linear congruences, Chinese Remainder Theorem, 2*2 Linear Systems, Fermat's little theorem, Pseudoprimes and Carmichael numbers.	9
3	**Euler's Function & Quadratic Residues:** Euler's Function - Euler's Totient function, Applications of Euler's Totient function, Quadratic Residues-Quadratic Congruences, The group of Quadratic residues, Legendre symbol, Jacobi Symbol, Quadratic reciprocity. **Sum of Squares and Continued Fractions:** Sum of Squares - Sum of two	9

	squares, The Gaussian Integers, Sum of three squares, Sum of four squares. Continued Fractions - Finite continued fractions, Infinite continued fractions.	
4	**Traditional and Modern Cryptosystems:** Substitution Techniques, Monoalphabetic Cipher, Caesar Cipher, Affine Cipher, Polyalphabetic Ciphers, Autokey Cipher, Playfair Cipher, Hill Cipher, Vigenere Cipher, One Time Pad Cipher, Limitations. Stream and Block Ciphers, Modern Secret Key Ciphers - Substitution Box-Permutation Box-Product Ciphers.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamental concepts of divisibility, modular arithmetic, and finite fields, and apply these concepts to solve mathematical problems.	**K2**
CO2	Solve problems related to prime numbers, congruences, and primality testing, including the application of the Chinese Remainder Theorem and Fermat's Little Theorem.	**K3**
CO3	Apply Euler's Totient function, quadratic residues, and concepts of the group of units in various mathematical and cryptographic contexts.	**K3**
CO4	Solve complex problems involving the sum of squares, continued fractions, and traditional cryptosystems, and assess the effectiveness of various cryptographic algorithms and techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-
CO3	3	3	3	-	2	2	-	-	-	-	-	-
CO4	3	3	3	3	2	-	-	-	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Elementary Number Theory with Applications	Thomas Koshy	Elsevier Science	2nd Edition 2007
2	Elementary Number Theory	G.A. Jones & J.M. Jones,	Springer UTM	2007
3	A Friendly introduction to Number Theory	Joseph Silverman	Pearson Ed	2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A Course in Number Theory and Cryptography	Neal Koblitz	Springer New York	2012
2	Cryptography and Network Security: Principles and Practice" by	William Stalling	Pearson Education	4th Edition 2016
3	Introduction to Analytic Number Theory’	Tom M. Apostol	Narosa Publishing House Pvt. Ltd, New Delhi	1996

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_ma89/preview
2	https://onlinecourses.nptel.ac.in/noc22_cs90/preview

SEMESTER S4

COMPUTER GRAPHICS

Course Code	**PEITT414**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To build an understanding of the fundamental concepts of computer graphics.
2. To familiarize the working principles of various display technologies.
3. To understand the three dimensional transformations in graphics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of Computer Graphics and its Applications. Raster Scan & Random Scan systems. Display Technologies: Overview of CRT, LCD, Plasma, LED, OLED, AMOLED, E-Paper displays. Output Primitives – Line Drawing Algorithms - DDA, Bresenham's, Midpoint Circle generation algorithm. Filled Area Primitives – Scan Fill, Flood Fill, Boundary Fill. Inside outside tests.	9
2	Two-dimensional transformations - Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Matrix representations, and homogeneous coordinates. 2-D Clipping- Window to viewport transformation, Point Clipping, Cohen-Sutherland Line Clipping Algorithm, Sutherland-Hodgeman, and Weiler-Atherton Polygon clipping algorithms.	9
3	Three-Dimensional Concepts: Three-Dimensional Display, Methods Parallel Projection, Perspective Projection, Depth Cueing, Visible Line and Surface, Identification, Surface Rendering, Exploded and Cutaway Views, Three-	9

	Dimensional and Stereoscopic Views Three-Dimensional transformation, Translations, Scaling, Rotation, Viewing Transformation, The Perspective, Algorithms, Three-Dimensional Clipping, Perspective view of Cube	
4	Visible Surface Detection Methods: Depth Buffer, A-Buffer, Scan line, Depth sorting methods. Hidden Surface Removal: Back face detection - Z-buffer method - Painter's algorithm - scan-line algorithm – BSP Trees - Area sub-division method - Ray tracing - Animation - Morphing. Introduction to Digital Image Processing.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the working principles of graphics devices. Illustrate line drawing, circle drawing and polygon filling algorithms.	**K3**
CO2	Demonstrate geometric representations and transformations on 2D objects. Explain the working of line and polygon clipping algorithms	**K3**
CO3	Apply 3D transformation and viewing into the real-world applications	**K3**
CO4	Describe visible surface detection methods and digital image processing.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	-	-	-	-	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3
CO4	3	3	2	2	-	-	-	-	-	-	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Graphics with OpenGL	Donald Hearn and M. Pauline Baker	Pearson	4th Edition 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Interactive Computer Graphics	William M. Newman and Robert F. Sproull	McGraw Hill	2nd Edition 2001
2	Computer Graphics Using OpenGL	Francis Hill Jr.	Pearson Education	3rd Edition 2007
3	Computer Graphics Programming in OpenGL with C++	V. Scott Gordon, John Clevenger	De Gruyter	2024

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://youtu.be/V4mP2pQyou0?si=znq_J6ES0MB03Qkm
2	https://youtu.be/8HWvyahgesY?si=1k1hCqfNE19Z00S3
3	https://youtu.be/7iYggzuo6Ks?si=G0Xnf1UA_dRRJaLf
4	https://youtu.be/b1Qpvqm0UAo?si=M6ALob-iLJ9E0i_r

SEMESTER S4

OPERATIONS RESEARCH

Course Code	PEITT415	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GAMAT301: Mathematics for Information Science-3	Course Type	Theory

Course Objectives:

1. This course introduces students to the fundamental concepts and methods of operations research, focusing on applications in Information Technology.
2. Students will learn to model and solve real-world problems using OR techniques and tools.
3. Students will learn to model complex problems in diverse industries and use mathematical optimization and simulation to solve them.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Modelling with Linear Programming:** Two-Variable LP Model, Graphical LP Solution, Linear Programming Applications - Investment, Production Planning and Inventory Control, Workforce Planning, Urban Development Planning - The Simplex Method - LP Model in Equation Form, The Simplex Method - Iterative Nature of the Simplex Method, Computational Details of the Simplex Algorithm-Artificial Starting Solution - M-Method, Two-Phase Method.	9
2	**Special Cases in the Simplex Method:** Degeneracy, Alternative Optima, Unbounded Solution, Infeasible Solution. Sensitivity Analysis - Algebraic Sensitivity Analysis—Changes in the Right-Hand Side, Algebraic Sensitivity Analysis—Objective Function, Sensitivity Analysis with TORA, Solver, and AMPL. Computational Issues in Linear Programming. Dual Problem: Definition of the Dual Problem, Primal–Dual Relationships.	9
3	**Transportation Model:** Definition of the Transportation Model, Nontraditional Transportation Models, The Transportation Algorithm,	9

	Determination of the Starting Solution, Iterative Computations of the Transportation Algorithm. The Assignment Model - The Hungarian Method	
4	**Decision Analysis and Games:** Decision Making Under Certainty—Analytic Hierarchy Process (AHP), Decision Making Under Risk, Decision Tree–Based Expected Value Criterion, Variants of the Expected Value Criterion. Decision Under Uncertainty Game Theory - Optimal Solution of Two-Person Zero-Sum Games.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Examination (Written)	Evaluate Level Assessment	Analyze Level Assessment	Total
5	**15**	**10**	**10**	**40**

Evaluate and Analyze Level Assessment [20 Marks]

Students should evaluate and analyze a real-world optimization problem, assess the proposed solutions, provide a conclusion on which solution is most appropriate for the problem, and implement the chosen solution using Python.

Criteria for evaluation:

1. **Problem Definition (K4 - 4 points)**
    a. *Clearly defines the real-world optimization problem.*
    b. *Examine and identifies relevant contextual factors (constraints, resources, objectives).*
2. **Problem Analysis (K4 - 4 points)**
    a. *Break-down and presents a well-reasoned solution approach.*
    b. *Compare and justify the proposed solutions with evidence and logical reasoning.*
3. **Evaluate (K5 - 4 points)**
    a. *Thoroughly evaluate the proposed solutions.*
    b. *Compares trade-offs, advantages, and disadvantages.*
    c. *Considers feasibility, scalability, and practical implications.*
4. **Python Implementation (K5 - 4 points)**
    a. *Select the most feasible solution by implementing the proposed solutions.*
    b. *Successfully translates the chosen solution into Python code.*
    c. *Demonstrates proficiency in coding practices (readability, efficiency, error handling).*

5. **Conclusion (K4- 2 points, K5 – 2 points)**
    a. *Summarizes findings and insights. State which solution is most appropriate for the problem.* ***(K4)***
    b. *Reflects critical thinking and informed decision-making.* ***(K5)***

Scoring:

1. **Accomplished (4 points)**: Exceptional analysis, clear implementation, and depth of understanding.
2. **Competent (3 points)**: Solid performance with minor areas for improvement.
3. **Developing (2 points)**: Adequate effort but lacks depth or clarity.
4. **Minimal (1 point)**: Incomplete or significantly flawed.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Formulate and solve linear programming problems using both graphical methods and the Simplex Method, applying these techniques to real-world scenarios.	**K3**
CO2	Analyze and resolve special cases in linear programming, such as degeneracy, alternative optima, unbounded solutions, and infeasible solutions, and perform sensitivity analysis to understand the impact of changes in problem parameters.	**K4**
CO3	Apply transportation and network modeling techniques, including the transportation algorithm, and the Hungarian method for assignment problems	**K3**
CO4	Utilize decision analysis tools and game theory to make informed decisions under certainty, risk, and uncertainty, employing methods like the Analytic Hierarchy Process (AHP), decision trees, and strategies for solving two-person zero-sum	**K3**
CO5	Evaluate any real-world problem and propose a solution using the concepts learned in this course.	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Operations Research-An Introduction	Hamdy A Thaha	Pearson Education	10th Edition 2017
2	Operations Research	T Veerarajan	Universities Press	2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Operations Research	Federick S Hiller, Gerald J Lieberman	Tata McGraw Hill	9th Edition 2010
2	Operations Research	Prem Kumar Gupta & D S Hira	S Chand Publishing	7th Edition 2014
3	Linear and Nonlinear Programming	David G. Luenberger, Yinyu Ye	Springer	5th Edition 2021

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/cec20_ma10/preview
2	https://onlinecourses.nptel.ac.in/noc22_ma48/preview

SEMESTER S4

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	6

3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators-SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case Study/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	**15**	**12.5**	**12.5**	**50**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics** - Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, **Technology and digital revolution**-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places**-accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies** - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**,	6

	employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:**	**6**

	Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	

Course Assessment Method
(CIE: 50 marks , ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S4

COMPUTER NETWORKS LAB

Course Code	PCITL407	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To familiarize students with internetworking concepts and provide hands-on experience in identifying, configuring, and troubleshooting key network components such as routers, switches, and network interfaces
2. To enable students to configure, implement, and verify both static and dynamic routing protocols, ensuring effective and efficient routing within a network.
3. To equip students with the skills to design, implement, and manage Virtual LANs (VLANs) as well as configure and apply standard and extended access control lists (ACLs) for network security and traffic management.
4. To teach students how to use remote login, file transfer, and automatic network configuration protocols such as Telnet, FTP, and DHCP, enhancing their ability to manage and automate network operations.

Experiment No.	Experiments
1	Familiarization of network components- Hub, Switch, Bridge, Router, Access Point, Network cables, Colour coding, Crimping.
2	Familiarization of Internetworking operating system – access the CLI, switch between different command modes, basic IOS commands - to display device information and configurations, to configure interface and basic troubleshooting.
3	Study of IPv4, IPv6 addresses and subnetting.
4	Configure and verify IPv4 static routing in a network that includes subnetting.
5	Configure and verify Routing Information Protocol (RIP) for dynamic routing in a network that includes subnetting.
6	Configure and verify Enhanced Interior Gateway Routing Protocol (EIGRP) routing in a network that includes subnetting.
7	Configure and verify Open Shortest Path First (OSPF) routing in a network that includes subnetting.

8	Implement Unicast IPv6 Addresses on routers and verify static routing, RIPNG and OSPFv3.
9	Create and apply Standard and Extended ACLs on routers to filter traffic based on IP addresses and protocols.
10	Configure VLANs and implement Inter-VLAN routing using router on a stick technique.
11	Configure TELNET, login to a remote machine and view the files on the remote machine. Configure FTP and transfer files between two machines.
12	Configure and verify the operation of a DHCP (Dynamic Host Configuration Protocol) server in a network.
13	Configure and verify Network Address Translation (NAT) on a router.
14	Familiarize with any popular network simulator.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record:*** *Students shall be allowed for the end semester examination only upon submitting the duly certified record.*

- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate internetworking and network components	**K3**
CO2	Configure and verify both static and dynamic routing protocols	**K3**
CO3	Develop the ability to implement and manage VLANs, standard and extended access lists.	**K3**
CO4	Use remote login, file transfer and automatic network configuration protocols	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	2	-	-	-	-	-	2	-	2
CO2	3	2	3	2	-	-	-	-	3	2	-	2
CO3	3	2	3	2	-	-	-	-	3	2	-	2
CO4	3	2	3	2	-	-	-	-	3	2	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	CCNA 200-301 Official Cert Guide, Volume 1	Wendell Odom	Cisco Press	2nd Edition 2024
2	CCNA –Cisco Certified Network Associate. Study Guide	Todd Lammle	Wiley India	6th Edition 2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networking: The Complete Beginner's Guide to Learning the Basics of Network Security, Computer Architecture, Wireless Technology and Communications Systems	Benjamin Walker	Science & Technology	2019
2	Computer Networking Bible: The Complete Crash Course to Effectively Design, Implement and Manage Networks.	Rick C. Worley	Independently published	2023

Video Links (NPTEL, SWAYAM…)	
Link No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106091/
2	https://archive.nptel.ac.in/courses/106/105/106105081/
3	https://archive.nptel.ac.in/courses/106/105/106105183/
4	https://archive.nptel.ac.in/courses/106/106/106106243/

Continuous Assessment (25 Marks):

5. **Preparation and Pre-Lab Work (7 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
6. **Conduct of Experiments (7 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.
7. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness, and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
8. **Viva Voce (5 Marks)**
   - Oral Examination: Ability to explain the experiment, results, and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks):

6. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.

- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

7. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

8. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

9. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related question.
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

10. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S4

OPERATING SYSTEMS LAB

Course Code	PCITL408	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GXEST204: Programming in C	Course Type	Lab

Course Objectives:

1. Students will be able to perform basic and advanced UNIX commands, system calls, threads and inter process communication essential for operating system functionalities.
2. Students will be able to solve classical synchronization problems using appropriate techniques such as semaphores, threads, and shared memory.
3. Students will be able to understand and implement various memory management schemes, page replacement algorithms, disk scheduling algorithms, and file organization techniques.

Experiment No.	Experiments
1	Familiarization of system calls (fork, exec, getpid, exit, wait, close, stat etc) in operating system and Demonstration of creating partition and installing Operating System (Not for Examination purpose)
2	Implementation of Process and thread (Life cycle of process): (i) Process creation and Termination; (ii) Thread creation and Termination
3	Implement process scheduling algorithms (FCFS, SJF, Round Robin, Priority) and compute average waiting time and average turn-around time.
4	Inter-process communication using pipes, message queues and shared memory.
5	Implement Producer-Consumer Problem and solve the problem using Semaphores
6	Implementation of Dining Philosophers' Problem using threads and semaphores
7	Implementation of banker's algorithm
8	Implement memory management schemes (first fit, best fit and worst fit)
9	Implement page replacement algorithms: FIFO, LRU and Optimal

10	Implementation of Disk Scheduling using FCFS, SCAN, C-SCAN, LOOK, C-LOOK and SSTF algorithm
11	Implement File Organization Technique (Single Level and Multi-Level Directory) and Allocation Strategies (Sequential, Linked and Indexed)
12	Familiarization of Cloud Platforms and Virtualization tools(eg:-VMWare)

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record:*** *Students shall be allowed for the end semester examination only upon submitting the duly certified record.*

- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement process and thread lifecycle management, including creation, termination, and scheduling.	**K3**
CO2	Implement inter-process communication techniques such as pipes, message queues, and shared memory.	**K3**
CO3	Solve classical synchronization problems like Producer-Consumer and Dining Philosophers using semaphores and threads.	**K3**
CO4	Implement memory management and disk scheduling algorithms, and understand file organization and allocation strategies.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	2	-	-	-	-	3	3	-	2
CO2	3	-	3	2	-	-	-	-	3	3	-	2
CO3	3	2	3	2	-	-	-	-	3	3	-	2
CO4	3	2	3	2	-	-	-	-	3	3	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Operating System Concepts	Abraham Silberschatz, Peter B Galvin, Greg Gagne	John Wiley & Sons	10th Edition 2021
2	Programming in C	E. Balagurusamy	Mc Graw Hill	8th Edition 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Operating Systems	Andrew S Tanenbaum	Pearson	4th Edition 2016
2	C Primer Plus	Stephen Prata	Pearson	6th Edition 2020

Video Links (NPTEL, SWAYAM…)	
Link No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs80/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs123/preview

Continuous Assessment (25 Marks):

1. **Preparation and Pre-Lab Work (7 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (7 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks):

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related question.
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 5

INFORMATION TECHNOLOGY

SEMESTER S5

MACHINE LEARNING

Course Code	PCITT501	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PBITT404 Data Science	Course Type	Theory

Course Objectives:

1. Gain a comprehensive core machine learning concepts, pre-process and analyze data, build and assess supervised learning models, and interpret their performance.

2. Acquire the knowledge of implementing and fine-tuning advanced machine learning models, including SVMs and neural networks, and effectively use unsupervised learning, reinforcement learning, and deep learning methods to solve complex problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Overview of Machine Learning** - Introduction to Machine Learning, Examples of Machine Learning Applications - Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. **Parametric Methods -** Maximum Likelihood Estimation- Bernoulli Density, Multinomial Density, Gaussian (Normal) Density, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Regression, Tuning Model Complexity: Bias/Variance Trade-off. **Dimensionality Reduction** – Principal Component Analysis, Linear Discriminant Analysis.	10
2	**Supervised Learning** - Linear Regression - Least squares, Gradient Descent, Assessing Performance: Error Metrics, Overfitting, Linear Classifiers - Logistic regression, Naïve Bayes', Measuring Classifier Performance – Confusion Matrix, Cross Validation. Bootstrapping, Model Selection Procedures, Regularization Techniques – LASSO, RIDGE. **Learning with Trees** - Decision Trees, Types- Classification and Regression	12

	Trees, Feature Selection Measures - Entropy, Information Gain, ID3 Algorithm, Issues in Decision tree Learning, Ensemble Learning – Boosting – Bagging.	
3	**Support Vector Machine** – Optimal Separating hyper plane, Soft-margin & Hard- margin, Kernel trick, Kernel functions. **Neural Networks –** The Perceptron Algorithm, Activation Functions, Feed Forward Network, Back Propagation Algorithm.	**10**
4	**Unsupervised Learning** - Clustering Methods - K-means, Expectation-Maximization Algorithm, Density based clustering. **Reinforcement Learning** - Monte Carlo, TD Learning, Q Learning. **Basics of Deep Learning** - Convolutional Neural Networks – Convolution, Pooling Layers, Hyperparameters, Transformers.	**12**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. • Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain basic machine learning concepts, parametric methods for estimation and dimensionality reduction techniques to improve models.	**K2**
CO2	Use supervised learning methods like linear regression and decision trees, evaluate model performance and ensemble techniques.	**K3**
CO3	Use Support Vector Machines and Neural Networks, including understanding margins, kernel functions, and the basics of the perceptron algorithm and back propagation.	**K3**
CO4	Apply clustering methods, reinforcement learning techniques, and basic deep learning concepts like convolutional neural networks and transformers.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	Third Edition, 2014
2	Machine Learning	Tom M Mitchell	McGraw Hill Education	First Edition, 2013
3	Reinforcement Learning – An Introduction	Richard S. Sutton, Andrew G. Barto, Francis Bach	MIT Press	Second Edition, 2018
4	Deep Learning	Ian Goodfellow, Yoshua Bengio and Aaron Courville	MIT Press	1st Edition, 2016.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Mining Concepts & Techniques	Jiawei Han, Micheline Kamber and Jian Pei.	Morgan Kaufmann	3rd Edition, 2012
2	An Introduction to Statistical Learning: with Applications in R	Gareth James, Daniela Witten, Trevor Hastie , Robert Tibshirani	Springer	2nd Edition, 2021
3	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1995
4	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	Springer	2019

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106106139
2	https://archive.nptel.ac.in/courses/106/106/106106184
3	https://nptel.ac.in/courses/106106198

SEMESTER S5

ALGORITHM ANALYSIS AND DESIGN

Course Code	PEITT502	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT303 - Data structures	Course Type	Theory

Course Objectives:

1. Understand and Apply Fundamental Algorithmic Concepts
2. Master Algorithm Design Paradigms and Complexity Analysis

SYLLABUS

Module No.	Syllabus Description	Contact Hours (44 Hrs)
1	Algorithms – Properties of a Good algorithm, Characteristics, Criteria for Analysing Algorithms. Time and Space Complexity - Best, Worst and Average Case Complexities. Asymptotic Notations and their properties. Time and Space Complexity Calculation of simple algorithms. Analysis of Recursive Algorithms: Recurrence Equations, Solution of Recurrence Equations – Iteration Method, Recursion Tree Method, Substitution method and Master's Theorem (Proof not required). Amortized Complexity – aggregate analysis, Cost-Accounting and Potential Methods.	11
2	Balanced Search Trees - AVL Trees (Insertion and deletion operations with all rotations in detail, algorithms not expected); Red Black Trees – Properties Disjoint Sets- Disjoint set operations, Union and find algorithms, Analysis of union by rank with path compression, Connected components of a Graph. Graphs – Representations, Traversals – BFS, DFS and their analysis, Strongly Connected Components, Topological Sorting.	11

	Divide and Conquer – Control Abstraction, Finding Minimum and Maximum, Quicksort, Merge Sort, Strassen's Matrix Multiplication, analysis	
3	Greedy Algorithms: Control Abstraction, Fractional Knapsack, Minimum Cost Spanning Tree – Kruskal's and Prim's, analysis, Job Sequencing with deadlines Dynamic Programming: Control Abstraction, Optimality Principle, DP Solution for Travelling Salesman Problem and 0/1 Knapsack Problem, Backtracking: Control Abstraction, N – Queens Problem, algorithm.	**11**
4	Branch and Bound: Control Abstraction, FIFO, LIFO and LC Branch and Bound, 15 – Puzzle Problem String Matching – KMP Algorithm, Rabin-Karp Algorithm. Tractable and Intractable Problems, Complexity Classes – P, NP, NP- Hard and NP-Complete Classes. Approximation algorithms- Planar Graph Coloring, Vertex Cover	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain asymptotic notations used in the performance analysis of algorithms, to solve recurrence equations and study the amortized analysis.	**K2**
CO2	Apply divide and conquer strategy to solve practical problems efficiently	**K3**
CO3	Apply greedy and dynamic programming techniques in algorithm design	**K3**
CO4	Apply backtracking and branch and bound techniques in algorithm design.	**K3**
CO5	Explain Balanced Search Trees, Graph Traversals, and sophisticated algorithms such as string matching and approximation algorithms	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Algorithms	T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein	Prentice-Hall India	2nd Edition (2001)
2	Fundamentals of Computer Algorithms	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran	Orient Longman Universities Press	2nd Edition (2008)
3	Computer Algorithms, Introduction to Design and Analysis	Sara Baase and Allen Van Gelder	Pearson Education	3rd Edition (2009)

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Algorithm Design	Jon Kleinberg and Éva Tardos	Pearson	1st Edition 2005
2	Algorithms	Robert Sedgewick and Kevin Wayne	Addison-Wesley	4th Edition 2011
3	Computers and Intractability: A Guide to the Theory of NP-Completeness	Michael R. Garey and David S. Johnson	W. H. Freeman	1st Edition 1979

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs79/

SEMESTER S5

SOFTWARE ENGINEERING

Course Code	PCITT503	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the fundamental concepts of Software Engineering, Software Development Life Cycle (SDLC) and Software Process Models.
2. To develop proficiency in Object-Oriented Modeling and Design.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**The Software Process:** Software Engineering, Software Process, Software Engineering Practice, Phases of Software Development Life Cycle (SDLC)- Requirements, Design, Implementation, Testing, Deployment and Maintenance, Software Process models- Prescriptive and Specialized Process Models, Characteristics of Software Engineer, Software Team, Team Structure, Software Engineering Ethics.	9
2	**Requirements Engineering:** Functional and Non-Functional Requirements, Requirement Engineering Process, Requirements elicitation, Requirements Specification, SRS Template, Requirements Validation, Requirements Change, Requirement Analysis, Case Study.	9
3	**Object Oriented Modeling:** Object Oriented Development, Modeling, Abstraction, Objects and Classes, Link and Association Concepts, Generalization and Inheritance, N-ary Association, Abstract classes, Aggregation, Packages, State Modeling, Interaction Modeling, Structural Modeling, Behavioral Modeling.	9

4	**Object Oriented Design:** Design Process, Design Concepts- Cohesion, Coupling, Design Model, System Design, Class Design, Architectural Design- Architectural design decisions, Architectural Views, Architectural Patterns and Application architectures, Component-level Design, Design and Implementation- Object-oriented design using the UML, Open-source development.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discuss the software process and lifecycle models of software engineering, including the roles of software engineers in various phases of development.	**K2**
CO2	Apply various techniques to elicit requirements from stakeholders, create detailed requirement specifications, and ensure that requirements are well-defined and traceable throughout the software development process.	**K3**
CO3	Apply object-oriented modeling techniques to design and document software systems.	**K3**
CO4	Explain the fundamental principles of software design, including design process and architectural patterns.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	2	-	-	2	2	-	2	2
CO2	2	2	3	2	2	2	-	-	2	2	2	2
CO3	2	2	3	2	3	2	-	-	2	2	2	2
CO4	2	2	3	2	3	2	-	-	2	2	3	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Software Engineering: A Practitioner's Approach	Roger S Pressman, Bruce R Maxim	Tata McGraw Hill	8th edition, 2019
2	Software Engineering	Ian Somerville	Pearson	10th edition,2017
3	Object-oriented modeling and design with UML	Michael R Blaha, James R Rumburg	Pearson	2nd edition, 2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Software Engineering	Rajib Mall	PHI	5th edition, 2018
2	Software Engineering: Theory and Practice	Shari Pfleeger, Joanne Atlee	Pearson	4th edition, 2009
3	Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development	Craig Larman	PHI	3rd edition, 2004
4	Design Patterns: Elements of Reusable object-oriented software	Erich Gamma	Pearson	1st edition, 2015

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs119/preview

SEMESTER S5
WEB APPLICATION DEVELOPMENT

Course Code	PBITT504	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GYEST203: Foundations of Computing: From Hardware Essentials to Web Design and GYEST204: Programming in C	Course Type	Theory

Course Objectives:

1. Students will be able to gain a comprehensive understanding of javascript, node.js and mongodb to develop web applications.
2. Students will be able to develop web application based solutions to real world problems using modern web application development tools.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Javascript:** How javascript makes web pages more interactive, Examples of javascript in the browser, How html, css & javascript fit together, creating a basic javascript, placing the script in the page, where to place your scripts, *basic Javascript instructions:* statements, comments, variables, data types, arrays, expressions, operators; *functions methods and objects:* function, anonymous function, variable scope, object, this keyword, arrays of objects and objects in arrays built-in objects, browser object model, document object model, *Global objects:* string, number, math, date **DOM:** Document Object Model (DOM), working with DOM tree, accessing elements, nodelists, *selecting elements:* using class attribute, tag name, css selectors; repeating actions for an entire nodelist, looping through a nodelist, traversing the DOM, previous & next sibling, first & last child, textcontent, adding or removing html content, update text and markup, adding/removing elements, creating attributes and changing their values, removing attributes **Event handling:** different event types, three ways to bind an event to an element, using DOM event handlers, using event listeners, using parameters with event listeners, the event object, event bubbling, user interface events	9
2	**ECMA Script:** ECMA Script versions, ES5 Features, ES6 introduction, var declarations and hoisting, let declaration, constant declaration, function with default parameter values, default parameter expressions, unnamed parameters, the spread operator, arrow functions, object destructuring, array destructuring, sets and maps, Array.find, Array.findIndex, template strings,	10

	javascript classes, callbacks, promises, async/await **AJAX:** What is Ajax?, why use ajax?, How ajax works?, Handling ajax request and response, *data formats:* XML, JSON; Working with JSON data, Loading HTML with Ajax, Loading JSON with ajax, working with data from other servers **JQUERY:** A basic jquery example, Why use Jquery?, finding elements, jquery selection, getting element content, updating elements, changing content, inserting elements, adding new content, getting and setting attributes, getting and setting css properties, using .each(), events, event object, effects, animating css properties, using animation, traversing the dom, working with forms, jquery and ajax	
3	**Node.js:** What is Node.js?, installing Node.js, creating first server, request and response, responding with HTML, installing custom packages with NPM, introduction to express, handling request with express, serving other html files, serving static files with express, automatic server restart with nodemon, public folder for serving static files, creating page routes, templating engines **MongoDB:** Architecture of MongoDB, installing MongoDB, mongoose, defining a model, CRUD operations with Mongoose models, reading data from MongoDB using Mongoose, updating record, deleting a single record, saving to the database, dynamic data with templating engines, adding fields to the schema, uploading image with express, saving uploaded images to database	**10**
4	**Refactoring to MVC:** Express middleware, custom middleware, registering validation middleware, refactoring to MVC, refactoring validation layer, mongoose validation, password encryption, user login process, user authentication with express sessions, authentication middleware, user logout, handling non-existent routes, displaying validation errors in templates, duplicate entry error, flushing error messages from session, customising error message, persist request data on form, adding a WYSIWYG editor **Deployment:** setting up MongoDB atlas, deploying web apps on Heroku, deployment	**7**

Suggestions on Project Topics:

No.	Project Topics
1	Countdown clock (javascript)
2	To do list (javascript)
3	Rock paper scissors game (javascript)
4	Shopping cart page (javascript)
5	Calculator app (javascript)

6	Memory game (javascript)
7	Movie app (Node.js, Express, MongoDB)
8	Chat app (Node.js, Express, MongoDB)
9	Hotel booking app (Node.js, Express, MongoDB)
10	Library app (Node.js, Express, MongoDB)
11	Job search app (Node.js, Express, MongoDB)
12	E-commerce website (Node.js, Express, MongoDB)

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the fundamental concepts of javascript to add user interaction in the website.	**K3**
CO2	Compare javascript, jquery in terms of performance and ease of use.	**K2**
CO3	Build web applications with Node.js, express and MongoDB.	**K3**
CO4	Develop and deploy web applications with Node.js, express, MongoDB adhering to MVC architecture.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	2	-	-	-	2	-	-	2
CO2	2	2	3	3	3	-	-	-	3	-	2	2
CO3	3	2	3	3	3	-	-	-	3	-	2	3
CO4	3	2	3	3	3	-	-	-	3	-	2	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Javascript and JQuery: Interactive front end development	Jon Ducket	Wiley	1st Edition 2013
2	Understanding ECMASCRIPT6	Nicholas C Zakas	No starch press	1st Edition 2016
3	Beginning Node.js, Express and mongoDB development	Greg Lim	Greg Lim	1st Edition 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	HTML & CSS : Design and build websites	Jon Duckett	Wiley	1st Edition 2011
2	Internet & World Wide Web how to programme	Paul Deitel, Harvey Deitel, Abbey Deitel	Deitel	5th Edition 2013
3	Web development with Node & Express	Ethan Brown	O'Reilly	1st Edition 2014

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/nou24_cs09/preview

Project Based Learning - Course Elements			
L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity		
Sl. No	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology
2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback
3. **Involvement in the Project Work and Team Work (3 Marks)**
    - Active participation and individual contribution
    - Teamwork and collaboration
4. **Execution and Implementation (10 Marks)**
    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result
5. **Final Presentation (5 Marks)**

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S5

SOFT COMPUTING

Course Code	PEITT521	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT303 Data structures	Course Type	Theory

Course Objectives:

1. To provide students with an understanding of computing techniques that handle imprecision, uncertainty, and approximation.
2. To equip students with both theoretical knowledge and practical skills in soft computing, preparing them for advanced studies or professional work in the field.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Soft Computing and Neural Networks: Evolution of Computing, Soft Computing Definition, Comparison with Hard Computing, Soft Computing Basic Components, Scope and Applications, Structure of Artificial Neuron and Biological Neuron, Activation functions, McCulloch-Pitts Neuron, Single-layer Perceptron, Multi-layer Feedforward Networks, Learning Logic GATE Functions, Backpropagation Neural Networks.	9
2	Fuzzy Logic and Fuzzy Sets: Fuzzy Logic, Classical Sets, Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Membership Functions, Fuzzification, Methods of Membership Value Assignments, Defuzzification Methods.	9
3	Fuzzy Rule Base and Approximate Reasoning: Fuzzy Rules- Formation, Decomposition and Aggregation, Fuzzy Reasoning, Fuzzy Inference System-Mamdani Fuzzy Inference System and Takagi Sugeno Fuzzy Model, Comparison between Mamdani and Sugeno Method, Fuzzy Decision Making.	9

4	Genetic Algorithm and Hybrid Systems: Basic Version of Genetic Algorithm, Encoding Methods, Selection Mechanisms, Crossover Techniques, Mutation Operators, Hybrid Soft Computing Systems- Neuro Fuzzy Hybrid System, Neuro Genetic Hybrid System and Fuzzy Genetic Hybrid System.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the role of soft computing techniques and apply various artificial neural networks to learn and approximate logic gate functions.	**K3**
CO2	Design and implement fuzzy logic systems to handle uncertainty and imprecision and apply these systems to solve engineering problems and decision-making tasks.	**K3**
CO3	Apply genetic algorithms to solve complex optimization problems, including defining suitable fitness functions and selecting appropriate genetic operators.	**K3**
CO4	Explain hybrid systems that integrate multiple soft computing techniques to address complex problems.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	2	-	-	2
CO2	3	2	3	3	2	2	-	-	2	-	2	2
CO3	3	3	3	3	3	3	-	-	2	-	2	2
CO4	3	2	2	2	2	2	-	-	2	-	2	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Soft Computing	S.N. Sivanandam, S.N. Deepa	Wiley India Pvt. Ltd.	2nd Edition, 2011
2	Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications	S. Rajasekaran, G.A. Vijayalakshmi Pai	PHI Learning Pvt. Ltd.	2017
3	Fuzzy Sets and Fuzzy Logic-Theory and Applications	George J. Klir, Bo Yuan	Prentice Hall	1996
4	Neuro-Fuzzy and Soft Computing	Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani	Prentice-Hall	2002

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Neural Networks Algorithms, Applications, and Programming Techniques	James A. Freeman, David M. Skapura	Addison Wesley	2003
2	Introduction to Artificial Neural Systems	Jacek M. Zurada	PWS Publishers	1992
3	An Introduction to Genetic Algorithm	Mitchell Melanie	Prentice Hall	1998
4	Genetic Algorithms in Search, Optimization and Machine Learning	David E. Goldberg	Addison Wesley	1997

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105173/

SEMESTER S5

INTERNETWORKING USING TCP/IP

Course Code	PEITT522	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT402 Computer Networks	Course Type	Theory

Course Objectives:

1. To familiarize with various protocols in TCP/IP suit.
2. To equip students to apply their knowledge in solving issues in handling IP networks
3. To familiarize with the different routing scenarios in unicasting & multicasting in IP networks.
4. To familiarize with label switching & technology and MPLS.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	TCP/IP protocol suite- Comparison between OSI and TCP/IP Protocol Suite Layers in the TCP/IP Protocol Suite, Addressing, IPv4 Addresses - Address Space, Notation, Range of Addresses, Classful Addressing, Classless Addressing (simple problems on subnetting), Special Addresses, NAT, Delivery and Forwarding of IP Packets - Delivery, Forwarding - Forwarding Based on Destination Address, Forwarding with Classful Addressing (without and with subnetting), Forwarding with Classless Addressing, Address Aggregation, Longest Mask Matching, Structure of a Router.	9
2	IPv4 - Datagram, Fragmentation, Options, Checksum, Address Mapping- ARP Protocol, ARP Package, ICMPv4- ICMP encapsulation, Messages, Debugging Tool, ICMP package, Mobile IP - addressing, agents, three phases, inefficiency in mobile IP, Unicast Routing Protocols - RIP, OSPF - Areas, Types of Links, OSPF Packets, Common Header, Link State Update Packet (general format & LSA	9

	general header only), Hello Message, Database Description Message, Link State Request Packet, Link State Acknowledgment Packet), BGP.	
3	Multicasting and Multicast Routing Protocols - Multicasting, Multicast Addresses in IPv4, Delivery of Multicast Packets at Data Link Layer, IGMP - Group Management, IGMP Messages (Membership Query Message Format, Three Formats of Query Messages, Membership Report Message Format), Multicast routing, Multicast routing protocols - MOSPF, DVMRP, PIM.	**9**
4	TCP - TCP Services, TCP features, TCP Segment format & encapsulation, State transition diagram (TCP connection management), Windows in TCP, TCP timers, TCP options, TCP Package, IPv6 - Notations, Address Space, Three address types, Address Space allocation Algorithm, Auto Configuration, Renumbering, Packet Format (base header and extension headers), Label Switching, Flows, and MPLS- Switching Technology, Flows and Flow Setup, Large Networks, Label Swapping, and Paths, IP Switching Technologies and MPLS, Labels and Label Assignment, MPLS Encapsulation, Label Switching Router (Text Book 2)	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the IP addressing & IP forwarding concepts in solving addressing problems	**K3**
CO2	Understand the IP layer unicast routing protocols ICMPv4 and ARP.	**K2**
CO3	Illustrate the concepts of multicasting and multicast routing protocols.	**K2**
CO4	Summarize the TCP protocol concepts and TCP package.	**K2**
CO5	Understand IPv6, Label Switching, Flows, And MPLS	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	TCP/IP Protocol Suite	Behrouz A. Forouzan	McGraw-Hill	Fourth Edition
2	Internetworking With TCP/IP Vol I: Principles, Protocols, and Architecture	Douglas E. Comer	Pearson Education	Sixth Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networks: A Systems Approach	Larry Peterson	Larry Peterson and Bruce Davie	Computer Networks: A Systems Approach

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs69/preview

SEMESTER S5
CLOUD COMPUTING

Course Code	PEITT523	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT402 Computer Networks PCITT403 Operating Systems	Course Type	Theory

Course Objectives:

1. Gain a comprehensive understanding of cloud computing principles, including service and deployment models, and the key characteristics that define cloud computing.
2. Familiarize with the cloud computing reference architecture and understand the significance of virtualization in cloud computing.
3. Explore various cloud software environments and the architectural design of computing and storage clouds.
4. Learn about the security challenges in cloud computing, the role of cryptography, and various architectures to ensure secure data storage and processing in the cloud.
5. Gain proficiency in parallel and distributed programming models and develop practical skills in using major cloud platforms.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Cloud Computing – Introduction. Overview of Computing Paradigms-Grid Computing, Cluster Computing, Distributed Computing, Utility Computing. Cloud Service Models - Software as a Service, Platform as a Service, Infrastructure as a Service. Cloud Deployment Models - Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud. Characteristics of Cloud Computing. Advantages and disadvantages of cloud computing. Cloud Computing Reference Architecture-Cloud Consumer, Cloud Provider, Cloud Auditor, Cloud Broker, Cloud Carrier, IBM Cloud Computing Reference Architecture. Cloud Computing Use Cases - Business Use Cases, Technical Use Cases	9
2	Virtualization- Introduction. Characteristics of Virtualization. Importance of Virtualization. Classification of Virtualization-Network Virtualization, Desktop Virtualization, Application Virtualization, Central Processing Unit Virtualization, Memory Virtualization, Input/Output Devices Virtualization. Virtualization to Private Cloud Services -Five High-Level Steps. Virtualization Architecture-Virtualization Platforms, Hypervisor. Tools and Mechanisms for Implementation of Virtualization. Physical and Virtual Clusters and Resource Management. Importance	10

	of Virtualization in Data Center Automation.	
3	Architectural Design of Compute and Storage Clouds-Data Center Interconnection Networks and Design, Architectural Design of Computing Clouds, Cloud Service Models and Platforms, Resource Management and Design Challenges. Fundamental Cloud Security-Threat agents, Cloud security threats, Operating system security, Infrastructure security- Network Level Security, Host Level Security, Application level security. Secure Distributed Data Storage in Cloud - Cryptography as a Primary Technique to Ensure Security, Gartner's Seven Cloud Computing Security Risks, Need for Data Security. Cloud Computing—Attacks. Cloud Data Security Requirements. Cloud Security—Controls. Cloud Security Architecture. Cloud Data Security.	**10**
4	Parallel and Distributed Programming Models. MapReduce- MapReduce Programming Model, Logical Data Flow and Control Flow, Case Study: MapReduce Program to Find Inverted Index of Documents. Twister and Iterative MapReduce, Hadoop Library, Apache Spark. Cloud Software Environments-Eucalyptus, OpenNebula, OpenStack, Aneka, CloudSim. Popular Cloud Databases – MongoDB, HBase. Popular Cloud Platforms. Amazon Web Services- Amazon Web Services (AWS)- Elastic Compute Cloud (EC2), Simple Storage Service (Amazon S3), Elastic Block Store (EBS), Amazon CDN services. Google Cloud Platform (GCP)-Compute Engine (GCE), Google App Engine (GAE), Cloud Storage, Gmail, Google Drive. Microsoft Azure- Azure Virtual Machine, Hyper-V, Azure Storage services.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the fundamental concepts of cloud computing, including service and deployment models, and the cloud computing reference architecture.	**K2**
CO2	Explain the principles of virtualization and its role in enabling cloud services, including different types of virtualization and their applications.	**K2**
CO3	Identify the architectural components of compute and storage clouds and discuss basic security challenges in cloud computing.	**K2**
CO4	Implement parallel and distributed programming models using MapReduce and utilize cloud databases like MongoDB and HBase.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cloud Computing & Big Data From the basics to practical use cases	Sudheep E. M., Sarith D. M., Lija M., Tanmay K. P. & Shubham A.	Cengage Learning	1st Edition, 2024
2	Cloud Computing Concepts, Technology & Architecture	Thomas, E., Zaigham M., & Ricardo P.	Prentice Hall	1st Edition, 2013
3	Mastering cloud computing: foundations and	Buyya, R., Vecchiola, C., & Selvi, S. T.	Morgan Kaufmann	1st Edition, 2017

	applications programming			
4	Cloud computing	Bhowmik, S.	Cambridge University Press	1st Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cloud computing: theory and practice	Marinescu, D. C.	Morgan Kaufmann	2nd Edition, 2017
2	Cloud computing: Principles and paradigms	Buyya, R., Broberg, J., & Goscinski, A. M.	John Wiley & Sons.	1st Edition, 2011

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://youtu.be/NzZXz3fJf6o
2	https://youtu.be/fZ3D6HQrWzs
3	https://youtu.be/LcAPj95KeSA
4	https://youtu.be/TOOSVsxEIpo

SEMESTER S5

DATA MINING AND WAREHOUSING

Course Code	PEITT524	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PBITT404 Data Science	Course Type	Theory

Course Objectives:

1. To understand the fundamental concepts of data mining and data warehousing.
2. To apply data mining techniques to process and interpret large datasets.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Data mining Introduction –Types of data to be mined - Data mining functionalities - Classification of Data mining system- Data mining task primitives - Major issues in Data mining. Data pre-processing – Need of data pre-processing - Descriptive Data summarization – Data cleaning- Data integration and transformation - Data reduction -Data discretization and Concept Hierarchy Generation.	11
2	Data Warehouse and OLAP Technology: Overview – Multidimensional Data Model- Data Warehouse Architecture - Data Warehouse Implementation – From Data Warehousing to Data Mining.	9
3	Classification Techniques - Decision Trees - Naive Bayes - k-Nearest Neighbors - Support Vector Machines Clustering Techniques - k-Means - Hierarchical Clustering and DBSCAN. Association Rule Mining - Apriori algorithm - FP-Growth Algorithm. Model Evaluation and Validation - Cross-validation, confusion matrix, ROC curves.	10

4	Advanced Data Mining Techniques: Multimedia Data Mining —Text Mining - Text Data Analysis and Information Retrieval, Text mining approaches - Web Mining- Web Content Mining, Web Structure Mining, Web Usage Mining. CRM Applications and Data mining - Practical Data Mining Tools: Weka, RapidMiner.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. • Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the basic concepts in data mining and the data preprocessing.	**K2**
CO2	Describe the architecture, components, and design of data warehouses, including ETL processes and schema designs.	**K2**
CO3	Apply various data mining techniques such as classification, clustering, and association rule mining to real-world datasets.	**K3**
CO4	Demonstrate advanced data mining topics and practical applications, demonstrating the ability to integrate and apply knowledge in a real-world context.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2			-	-	-	-	-	-	-	
CO2	2	2	1			-	-	-	-	-	-	1
CO3	2	2	2	1		-	-	-	-	-	-	1
CO4	2	2	2	1	2	-	-	-	-	-	-	1

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Mining Concepts and Techniques	Jaiwei Han, MichelineKamber	Elsevier	2nd Edition, 2006.
2	Data Warehousing, Data Mining & OLAP	AlexBerson and Stephen J. Smith,	TataMcGraw Hill	Edition, Tenth Reprint 2007.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals	Pualraj Ponnaiah	Wiley	2nd edition, 2001
2	Data Mining: Introductory and Advanced Topics	Dunham M H	Pearson Education	New Delhi, 2003.
3	Data Mining; Practical Machine Learning Tools and Techniques	Ian Witten, Eibe Frank	Morgan Kaufmann	3rd edition, 2011
4	Introduction to Data Mining	Pang-Ning Tan and Michael Steinbach	Addison Wesley	2nd edition, 2006
5	Data Mining and Warehousing	M Sudeep Elayidom	Cengage Learning India Pvt. Ltd	1stEdition, 2015

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_cs06/preview

SEMESTER S5

FORMAL LANGUAGES AND AUTOMATA THEORY

Course Code	PEITT525	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GAMAT301: Mathematics for Information Science-3	Course Type	Theory

Course Objectives:

1. To design various computational models useful for solving problems.
2. To understand the relationship among digital computer, algorithm and Turing machine.
3. To discuss the Chomsky classification of formal languages with discussion on grammar and automata for regular, context-free, context-sensitive, and unrestricted languages.
4. To verify whether a given problem is solvable or tractable.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Finite Automata:**Need for mathematical modelling, Symbols, Alphabets, Strings, Languages, Formal definition of a finite automaton, Deterministic Finite Automata (DFA), Regular languages, Formal definition of a nondeterministic finite automaton, Equivalence of NFAs and DFAs (Proof not expected) - Subset Construction. Minimization of DFA NFA with epsilon transitions, Eliminating epsilon transitions, Moore and Mealy machines .	9
2	**Regular Expressions:** Formal definition of a regular expression, Building Regular Expressions, Equivalence with finite automata (Proof not expected) - Converting FA to Regular Expressions, Converting Regular Expressions to FA, Regular languages. **Properties of Regular Languages:** Closure and Decision Properties of Regular Languages, Pumping Lemma for Regular Languages, Myhill-Nerode Theorem(MNT) without proof, Applications of MNT. **Context-Free Grammars and Applications:** Formal definition of a	9

	context-free grammar, Designing context-free grammars, Parse Trees, Ambiguous Grammars, CYK-Algorithm.	
3	**Pushdown Automata:** Formal definition of a pushdown automaton (PDA), Design of Deterministic PDA and Nondeterministic PDA. **Simplification of Context-Free Languages:** Chomsky normal form, Greibach normal form. **Properties of Context-Free Languages:** The Pumping Lemma for Context-Free Languages, Closure and Decision Properties of Context-Free Languages. **Linear Bounded Automata**	**9**
4	**Turing Machines:** Definition of a Turing machine (TM), Design of Turing machines – TM as language acceptors, TM as computers of functions, Variants of Turing Machines, Recursive and recursively enumerable languages Chomsky hierarchy. **Computability:** Universal Machine, Church Turing thesis, Decidable and Undecidable Problems, Halting problem of TM.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Examination (Written)	Evaluate Level Assessment	Analyze Level Assessment	Total
5	**15**	**10**	**10**	**40**

Evaluate and Analyze Level Assessment [20 Marks]

Design and implement a tool that handles various formal language concepts. Your tool should integrate functionalities for the following tasks:

1. Finite Automata Simulation: Simulate both deterministic finite automata (DFA) and non-deterministic finite automata (NFA). Your tool should allow users to input an automaton and a string and should output whether the string is accepted by the automaton.
2. Regular Expression Parsing: Parse regular expressions to construct an equivalent NFA or DFA. The tool should allow users to input a regular expression and a string, and determine if the string matches the regular expression.
3. Context-Free Grammar Checking: Verify if a string can be generated by a given context-free grammar (CFG). Users should be able to input a CFG and a string, and your tool should check if the string can be derived from the CFG.

4. Turing Machine Simulation: Implement a Turing machine simulator where users can define the machine's states, transitions, input alphabet, and initial configuration. The tool should simulate the Turing machine's operation on a given input tape.
5. Automata Conversion: Implement algorithms to convert between different types of automata, such as converting an NFA to a DFA or converting a regular expression to an NFA.
6. Use JFLAP to evaluate and demonstrate your tool's functionalities.

Criteria for evaluation:

1. **Finite Automata Simulation (K4- 4 points)**
   a. **Application (K3- 2 points)**: Ability to simulate DFA and NFA correctly. The tool should accept an automaton and a string, and accurately determine whether the string is accepted.
   b. **Analysis (K4- 2 points)**: Proper handling of different types of automata inputs (DFA/NFA) and edge cases. Includes correct processing of input strings and states.
2. **Regular Expression Parsing (K4- 4 points)**
   a. **Application (K3-2 points)**: Correct parsing of regular expressions to construct equivalent NFA or DFA. The tool should accurately build the automaton and match strings against the regular expression.
   b. **Analysis (K4- 2 points)**: Handling of complex regular expressions and accurate matching results. Proper conversion and processing of regular expressions.
3. **Context-Free Grammar Checking (K4- 4 points)**
   a. **Application (K3- 2 points)**: Correctly verify if a string can be generated by a given CFG. The tool should accept a CFG and a string and check if the string can be derived from the CFG.
   b. **Analysis (K4- 2 points)**: Handling of different CFGs and strings, including edge cases and complex grammars.
4. **Turing Machine Simulation (K4- 4 points)**
   a. **Application (K3- 2 points)**: Functional simulation of a Turing machine based on user-defined states, transitions, and input. Accurate simulation of operations on an input tape.
   b. **Analysis (K4- 2 points)**: Proper handling of various Turing machine configurations and input scenarios. Effective simulation of state transitions and tape operations.
5. **Automata Conversion (K4- 2 points)**
   a. **Application (K3- 1 point)**: Correct implementation of algorithms to convert between different types of automata (e.g., NFA to DFA).
   b. **Analysis (K4- 1 point)**: Accurate conversion processes and handling of edge cases. Effective demonstration of the conversion algorithms in practice.

6. **Integration with JFLAP (K5- 2 points)**
   a. **Evaluation (1 point)**: Effective use of JFLAP for visual representation and evaluation of the tool's functionalities.
   b. **Presentation (1 point)**: Clear and effective demonstration of the tool using JFLAP, including accurate representation of results.

Scoring:

1. **Accomplished (4 points)**: Exceptional analysis, clear implementation, and depth of understanding.
2. **Competent (3 points)**: Solid performance with minor areas for improvement.
3. **Developing (2 points)**: Adequate effort but lacks depth or clarity.
4. **Minimal (1 point)**: Incomplete or significantly flawed.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts in automata theory and formal languages.	**K2**
CO2	Design finite state automata, regular grammar and regular expression for regular languages.	**K3**
CO3	Design push-down automata and context-free grammar representations for context-free languages.	**K3**
CO4	Design Turing Machines to accept recursive and recursively enumerable languages.	**K3**
CO5	Analyse the limitations of computational models and understand decidability and undecidability of problems.	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to the Theory of Computation	Michael Sipser	Cengage India Private Limited	Third Edition, 2014
2	Introduction to Automata Theory Languages and Computation	Hopcroft, Motwani, and Ullman	Pearson Publishers	Third Edition, 2006
3	An Introduction to Formal Languages and Automata	Peter Linz and Susan H. Rodger	Jones and Bartlett Publishers, Inc	Seventh Edition, ,2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Automata and Computability	Dexter C. Kozen	Springer	2007
2	Introduction to Languages and the Theory of Computation	John Martin	McGraw-Hill Education	Third Edition, 2003

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/104/106104148/
2	https://nptel.ac.in/courses/106106049

SEMESTER S5
MACHINE LEARNING LAB

Course Code	PCITL507	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	LAB

Course Objectives:

1. By the end of this course, students will be able to implement and evaluate multiple machine learning models, including Multiple Linear Regression, Logistic Regression, Decision Trees (ID3 & CART), Naïve Bayes' Classifier, and Support Vector Machines, using practical datasets such as house prices, Titanic survival data, and spam emails.
2. Gain hands-on experience in applying advanced machine learning techniques to various tasks, including character recognition using Multilayer Perceptron, clustering with K-Means and DBScan, sentiment analysis with Random Forest, Adaboost, and XGBoost, Q-Learning for game strategies, and image classification using Convolutional Neural Networks (CNNs).

Experiment No.	Experiment
1	Study of Python Libraries for ML applications such as Pandas and Matplotlib.
2	Implement Multiple Linear Regression for House Price Prediction.
3	Implement Logistic Regression for Titanic Survival Prediction without using Libraries.
4	Implement Decision trees – ID3 & CART.
5	Implement Naïve Bayes' Classifier for Diagnosis of Heart Patients.
6	Implement Support Vector Machines to Filter Spam Mails.
7	Implement Multilayer Perceptron for Character Recognition using MNIST Dataset
8	Implement k-Nearest Neighbor without using libraries for IRIS Dataset
9	Implement K-Means Clustering & DBScan.
10	Implement Sentiment Analysis using Random Forest, Adaboost, XGboost
11	Implement Q-Learning for a Simple Game.

12	Implement CNN for Image Classification.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	*Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)*	*Internal Exam*	***Total***
5	**20**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	**Total**
10	**15**	**10**	**10**	**5**	**50**

- **Submission of Record**: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner**: The external examiner shall endorse the record.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		**Bloom's Knowledge Level (KL)**
CO1	Demonstrate proficiency in Python Libraries for Machine Learning**,** Python libraries such as Pandas and Matplotlib to preprocess data, visualize datasets, and gain insights essential for machine learning applications.	**K3**
CO2	Implement various machine learning algorithms, including Multiple Linear Regression, Logistic Regression, Decision Trees (ID3 & CART), and Naïve Bayes' Classifier, and will be able to assess their performance on different datasets.	**K3**

CO3	Build and apply advanced models such as Multilayer Perceptron for character recognition, Support Vector Machines for spam filtering, and Convolutional Neural Networks for image classification, as well as implement clustering techniques like K-Means and DBScan.	**K3**
CO4	Implement Q-Learning for simple game scenarios and perform sentiment analysis using ensemble methods such as Random Forest, Adaboost, and XGboost, demonstrating a comprehensive understanding of both supervised and reinforcement learning techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Python Machine Learning	Sebastian Raschka (Author), Vahid Mirjalili (Author)	Packt	2nd Edition, 2019
2	Machine Learning	Tom M Mitchell	McGraw Hill Education	First Edition, 2013
3	Introduction to Machine Learning with Python	Andreas C. Müller, Sarah Guido	O'Reilly Media, Inc.	2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow,	Aurélien Géron	O'Reilly Media, Inc.	2nd Edition, 2019

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://cse.iitkgp.ac.in/~pabitra/course/ml/ml.html

Continuous Assessment (20 Marks)

1. **Preparation and Pre-Lab Work (5 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (5 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (5 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
   - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.
2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
   - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
3. **Result with Valid Inference/Quality of Output (10 Marks)**
   - Accuracy of Results: Precision and correctness of the obtained results.

- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted.

SEMESTER S5

ALGORITHM ANALYSIS AND DESIGN LAB

Course Code	PCITL508	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITL308: Datastructures Lab	Course Type	Practical

Course Objectives:

1. To equip students to develop proficiency in Algorithmic Techniques and Data Structures
2. Enable students to design and implement algorithms for solving complex computational problems using C programming language.

SYLLABUS

Experiment No.	Experiment
1	Implement BFS on an undirected graph.
2	Implement DFS on a directed graph.
3	Implement the program to find the Strongly Connected Components of a directed graph.
4	Implement a Program to find the Topological Sorting of a Directed Graph.
5	Implement the divide and conquer algorithm to find Minimum and Maximum in an array of elements.
6	Implement Merge Sort
7	Implement Quick Sort
8	Implement Greedy algorithm to find the solution to fractional Knapsack Problem.
9	Implement Kruskal's algorithm to find Minimum Spanning Tree.

10	Implement Prim's Algorithm to find Minimum Spanning Tree.
11	Implement Dynamic Programming algorithm to find the solution to Travelling Salesman Problem.
12	Implement Dynamic Programming algorithm to find the solution to 0/1 Knapsack Problem.
13.	Implement Backtracking algorithm to find the solution to N-Queen's problem.
14.	Implement KMP String Matching Algorithm.
15.	Implement Rabin Karp String Matching Algorithm.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
10	**20**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record:*** *Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record.*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement Graph Traversals and their applications.	**K3**
CO2	Implement Divide and Conquer and Greedy Technique.	**K3**
CO3	Implement Dynamic Programming and Backtracking Techniques	**K3**
CO4	Implement String Matching Algorithms	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2					3	2		2
CO2	3	2	2	2					3	2		2
CO3	3	2	2	2					3	2		2
CO4	3	2	2	2					3	2		2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Algorithms	T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein	Prentice-Hall India	2nd Edition (2001)
2	Fundamentals of Computer Algorithms	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran	Orient Longman Universities Press	2nd Edition (2008)
3	Computer Algorithms, Introduction to Design and Analysis	Sara Baase and Allen Van Gelder	Pearson Education	3rd Edition (2009)

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A Practical Guide : to Analysis and Design of Algorithms	Dr. Deepshikha Agarwal	Notion Press	January 2021
2	Programming In Ansi C	E Balagurusamy	McGraw Hill Education	8th edition, March 2019

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc19_cs47/preview

Continuous Assessment (20 Marks)

1. **Preparation and Pre-Lab Work (5 Marks)**
    - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
    - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (5 Marks)**
    - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
    - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
    - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (5 Marks)**
    - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
    - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 6

INFORMATION TECHNOLOGY

SEMESTER S6

CRYPTOGRAPHY AND NETWORK SECURITY

Course Code	PCITT601	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To explain the basics of Security and mathematical foundations of cryptography
2. To describe Cryptography fundamentals and traditional ciphers
3. To interpret the standard symmetric and asymmetric cryptosystems.
4. To create an awareness for the design of various cryptographic primitives
5. To analyze different types of attacks on various cryptosystems.
6. To create an understanding of the modern applications of cryptography.

SYLLABUS

Module No.	Syllabus Description	Contact Hours (44 Hrs)
1	Introduction to Security:- Security Goals – Security services (Confidentiality, Integrity, Authentication, Non-repudiation, Access control) – Security Mechanisms (Encipherment, Data Integrity, Digital Signature, Authentication Exchange, Traffic Padding, Routing Control, Notarization, Access control), Security Principles. Basics of Algebra and Number Theory:- Integer Arithmetic- Modular Arithmetic- Algebraic structures – Prime Numbers - Fermat's and Euler's Theorem – Factorization - Chinese Remainder Theorem - Linear and Quadratic Congruence - Discrete Logarithms.	**10**
2	Introduction to Cryptography:- Kerckhoff's Principle -Classification of Cryptosystems- Cryptanalytic attacks- Cipher Properties (Confusion, Diffusion). Traditional Secret Key Ciphers:- Substitution Ciphers – (Mono alphabetic ciphers-Ceaser, Affine, Poly alphabetic ciphers-Autokey, Playfair,	**12**

	Vigenere and Hill)- Transposition Ciphers – (Rail Fence, Keyed transposition ciphers) - Stream and Block Ciphers. Modern Secret Key Ciphers:- Substitution Box-Permutation Box-Product Ciphers, Data Encryption Standard (DES) (Fiestel and Non-Fiestel Ciphers, Structure of DES, DES Attacks, 2-DES, 3-DES) - Advanced Encryption Standard (AES) (Structure, Analysis)	
3	Cryptographic Hash Functions:– Properties - Secure Hash Algorithm-(SHA-512 Logic, Round Function), Message Authentication Code (MAC). Public Key Cryptosystems (PKC):- Types of PKC– Trapdoor - one way functions -RSA Cryptosystem (Integer Factorisation Trapdoor, Key Generation, Encryption, Decryption) - El Gamal Cryptosystem (Discrete Logarithm Trapdoor, Key Generation, Encryption, Decryption) - Diffie-Hellman Key Exchange Protocol, Man in the Middle attack on Diffie-Hellman Protocol. Digital Signature:- Signing – Verification - Digital signature forgery (Existential forgery, Selective forgery, Universal forgery) - RSA Digital Signature Scheme - ElGamal Signature Scheme – Elliptic Curve Digital Signature Scheme(ECDSS)	**11**
4	Network Security:- Electronic Mail Security -Pretty Good Privacy- PGP message format - Transmission and Reception of PGP Messages, S/MIME. IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload- Intruders, Intrusion Detection, Distributed Denial of Service attacks- Secure Electronic Transaction – Payment Processing - Dual Signature, Firewalls - Firewall Design Principles. Application of Cryptography:- Blockchain fundamentals(Blockchain defined, Blockchain architecture, Generic elements of a blockchain, Benefits, features, and limitations of blockchain, Types of blockchain) - Secure Multiparty Computation(Outsourced Computation, Multi-Party Computation, Applications).	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions		
Part A	**Part B**	**Total**
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the various network security aspects and apply number theory concepts in solving cryptographic problems.	**K3**
CO2	Illustrate the process of enciphering and deciphering of classical cryptosystems and modern symmetric key cryptosystems.	**K3**
CO3	Apply the principles of asymmetric key cryptosystems and digital signature.	**K3**
CO4	Discuss various protocols to ensure Email Security and Network Security.	**K2**
CO5	Explain the various applications of cryptography	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cryptography and Network Security	William Stallings	Pearson Education	7th Edition, 2017
2	Cryptography & Network Security, Second Edition	Behrouz A. Forouzan and Debdeep Mukhopadhyay	Tata McGraw Hill, New Delhi,	3rd Edition, 2015
3	Mastering BlockChain	Imran Bashir	Packt	3rd Edition 2020
4	A Pragmatic Introduction to Secure Multi-Party Computation	David Evans; Vladimir Kolesnikov; Mike Rosulek	NOW Publishers	2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cryptography and Network Security	Atul Kahate	Tata McGraw Hill	3rd edition 2017
2	Network Security and Cryptography	Bernard Menezes	Cengage Learning India	2011
3	Applied Cryptography: Protocols, Algorthms, and Source Code in C", Second Edition, , 2001.	Bruce Schneier	John Wiley and Sons Inc	2001

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105162/
2	https://onlinecourses.swayam2.ac.in/cec24_cs16/preview

SEMESTER S6

ADVANCED ARTIFICIAL INTELLIGENCE

Course Code	**PCITT602**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To provide a comprehensive overview of modern AI technologies, focusing on both traditional methods and recent advancements.
2. To learn methods and practices for making AI decisions transparent and understandable.
3. To provide a comprehensive understanding of the principles, practices, and implications of responsible AI.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Foundations of Modern Artificial Intelligence (AI): Introduction to AI- Historical Overview and Definitions, AI System Categories- Systems that think like humans, act like humans, think rationally and act rationally, AI Agents and Environment- Simple Reflex, Model Based, Goal Based, and Utility Based Agents. Traditional AI Techniques- Outline of Knowledge based Systems and Expert Systems. Modern AI Techniques- Outline of Federated Learning, Reinforcement Learning and Transfer Learning.	**7**
2	AI Search Strategies: Uninformed Search Strategies-Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Depth-First Search, Informed search strategies- Hill Climbing, Best First Search, A* algorithm, AO* algorithm, Game Playing- Minimax algorithm, Alpha Beta Pruning, Constraint Satisfaction Problem- Backtracking, Constraint Propagation, Comparison between Informed and Uninformed Search Strategies.	**10**

3	Explainable AI (XAI): Introduction to Explainable AI- Importance and challenges of XAI, Overview of XAI techniques, Interpretable Models- Decision trees, linear models, and rule-based models, Trade-offs between interpretability and accuracy, Post-Hoc Explanation Techniques- Local Interpretable Model-agnostic Explanations (LIME), SHapley Additive exPlanations (SHAP), Counterfactual explanation, Evaluating Explanations- Metrics for evaluating the quality and usefulness of explanations, User studies and feedback mechanisms, Regulatory and Ethical Considerations- Compliance with regulations like GDPR and the AI Act, Balancing transparency with privacy.	**11**
4	Responsible AI, Societal Impact, and Future Directions: Responsible AI Practices- Principles of responsible AI (fairness, accountability, transparency), Designing and auditing AI systems for ethical compliance, Societal Impact of AI- AI's role in various sectors (healthcare, finance, transportation), Privacy concerns and data security, Future Directions and Emerging Trends- Advances in AI research: neuromorphic computing, quantum AI, Potential societal transformations and ethical considerations	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the evolution of AI from its historical roots to contemporary techniques, including traditional methods and modern approaches.	**K2**
CO2	Implement various search strategies used in artificial intelligence.	**K3**
CO3	Apply various XAI techniques and assess the trade-offs between interpretability and accuracy in AI systems.	**K3**
CO4	Apply principles of responsible AI, assess AI's societal impact across different sectors, and understand the regulatory and ethical considerations influencing AI development and deployment.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson	2016
2	An introduction to machine learning interpretability	Hall, Patrick, and Navdeep Gil	O'Reilly Media	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Intelligence: A Guide for Thinking Humans	Melanie Mitchell		2019
2	AI Ethics	Coeckelbergh M.	MIT Press	2020

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://www.javatpoint.com/artificial-intelligence-ai
2	https://www.solulab.com/ai-deep-learning-techniques/
3	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
4	https://onlinecourses.nptel.ac.in/noc24_cs132/preview

SEMESTER S6
COMPILER DESIGN

Course Code	PEITT631	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT303 - Data structures PEITT525 - Formal Languages and Automata Theory	Course Type	Theory

Course Objectives:

1. To provide students with a foundational knowledge of compiler design, including the need for compilers, their phases, and the tools used in their construction.
2. To enable students to design and implement lexical and syntax analyzers using various parsing methods, including both top-down and bottom-up approaches.
3. To equip students with the skills to generate intermediate code, optimize code, and develop a basic code generator.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals:** Need of compiler, Analysis of the source program, Phases of a compiler, grouping of phases, compiler writing tools, Cross compiler. **Lexical Analyser:** The role of Lexical Analyzer, Review of Finite Automata, Design of Lexical Analyser using DFAs, Specification of Tokens using Regular Expressions.	9
2	**Syntax Analyser:** Review context-free grammars, Parse Trees, Ambiguous Grammars. Top – Down Parsing: Recursive Descent Parser, Predictive Parser-LL(1). Bottom-Up Parsing: LR(0) parser, SLR(1) parser, CLR(1) parser, LALR parser.	9
3	**Semantic Analyser:** Syntax directed definitions: S-attributed definitions, L-attributed definitions. Bottom- up evaluation of S- attributed definitions, Top-down translation, Bottom-up evaluation of inherited attributes. **Intermediate Code Generation (ICG):** Need of ICG, Different representation of intermediate code, intermediate code for assignment statement.	9
4	**Code Optimization:** Principal sources of optimization, Optimization of basic blocks. **Code Generation:** Issues in the design of a code generator, A simple code generator.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the phases of a compiler, their functions, and the tools utilized in compiler construction.	**K2**
CO2	Design and implement a lexical analyzer using deterministic finite automata (DFAs) and regular expressions.	**K3**
CO3	Apply various parsing techniques, including top-down (recursive descent and LL(1)) and bottom-up (LR(0), SLR(1), CLR(1), and LALR) methods, and construct parse trees.	**K3**
CO4	Develop test automation strategies and utilize automation and testing tools effectively to test object-oriented software and web-based systems, while applying debugging techniques to track and resolve bugs in various environments	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	2	-	-	-	-	-	-	-
CO3	3	3	3	-	2	-	-	-	-	-	-	-
CO4	2	2	2	3	3	-	-	-	-	-	-	-

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Compilers Principles, Techniques and Tools	Alfred Aho, Ravi Sethi and Jeffrey D Ullman	Pearson Education	Updated Second Edition, 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Compiler Construction: Principles and Practice	Kenneth C. Louden	PWS Publishing Company	Second Edition, 1997
2	Lex &Yacc	Levine J.R, Mason T, Brown D	OReilly Associates	First edition, 1992
3	Compiler Design in C	Allen I. Holub	Prentice Hall	First edition, 2003

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105190/
2	https://archive.nptel.ac.in/courses/106/105/106105190/
3	https://nptel.ac.in/courses/106108113
4	https://nptel.ac.in/courses/106108113

SEMESTER S6

METAHEURISTIC OPTIMIZATION

Course Code	PEITT632	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT303 Data structures	Course Type	Theory

Course Objectives:

1. To provide a structured framework for students to grasp both theoretical and practical aspects of metaheuristics.
2. To enable the students to effectively use and evaluate metaheuristics in various optimization scenarios.

SYLLABUS

Module No.	Syllabus Description	Contact Hours (36 Hrs)
1	Fundamentals of Metaheuristics: Classical Optimization Models, Optimization Methods-Exact Methods and Approximate Methods, Metaheuristics Concepts–Representation, Objective Function, Constraint Handling, Parameter Tuning and Performance Analysis.	9
2	Single Solution Based Metaheuristics: Local Search- Neighbor Selection and Escaping from Local Optima, Simulated Annealing- Move Acceptance and Cooling Schedule, Tabu Search- Types of memory, Iterated Local Search- Perturbation Method and Acceptance Criteria, Variable Neighbourhood Search- Variable Neighborhood Descent and General Variable Neighborhood Search.	9
3	Ant Colony Optimization (ACO): Inspiration from Nature-Ant Foraging Behavior, Ant System, Basic Principles of ACO- Pheromone Deposition, Pheromone Updating Rules, Construction of Solutions and Pheromone Evaporation, Ant System Variants-Elitist Ant System, Rank Based Ant	9

	System, Max Min Ant System, Application of ACO to the Travelling Salesman Problem.	
4	Particle Swarm Optimization (PSO): Inspiration from Nature- Social Behavior of Bird Flock, Basic Models of PSO- Local Best PSO and Global Best PSO, gbest versus lbest PSO, Velocity Update Equations, Position Update Equations, Velocity Clamping, Inertia Weight, Constriction Coefficients, Synchronous and Asynchronous Updates, Velocity Models, Basic PSO Parameters, Guaranteed Convergence PSO, Problem Formulation of PSO algorithm, Advantages and Disadvantages of PSO.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain classical optimization models, optimization methods and explain the main concepts of metaheuristics.	**K2**
CO2	Apply single solution based metaheuristics to solve optimization problems.	**K3**
CO3	Analyze the optimization problem and apply ant colony optimization algorithm to solve it.	**K4**
CO4	Analyze real world problems and solve them using particle swarm optimization algorithm.	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	2
CO2	2	3	3	2	2	2	-	-	2	-	2	2
CO3	2	3	3	3	2	2	-	-	2	-	2	2
CO4	2	3	3	3	2	2	-	-	2	-	2	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Metaheuristics: from design to implementation	Talbi, El–Ghazali	John Wiley & Sons	Vol. 74, 2009
2	Essentials of Metaheuristics	Luke, Sean	Lulu	Second edition, 2013
3	Handbook of metaheuristics	Gendreau, Michel, and Jean-Yves Potvin	New York: Springer	Vol. 2, 2010
4	Handbook of approximation algorithms and metaheuristics	Gonzalez, Teofilo F	CRC Press	2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the**	**Edition and**

			Publisher	Year
1	Computational intelligence: an introduction	Engelbrecht, A. P	John Wiley & Sons	2007
2	Ant Colony optimization	Marco Dorigo and Thomas Stutzle	MIT Press	2004
3	Swarm Intelligence: From Natural to Artificial Systems	Eric Bonabeau, Marco Dorigo, Guy Theraulaz	Oxford University Press	2000

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/105103210
2	https://nptel.ac.in/courses/110105096
3	https://nptel.ac.in/courses/103103164

SEMESTER S6

SOFTWARE PROJECT MANAGEMENT

Course Code	PEITT633	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT503 - Software Engineering	Course Type	Theory

Course Objectives:

1. To provide an in-depth understanding of the software project management process, including its key concepts, methodologies, and frameworks.
2. To equip students with the skills required to evaluate, plan, and estimate software projects, ensuring effective management of project portfolios and individual projects.
3. To develop students' ability to apply principles of activity planning, risk management, and resource allocation to ensure efficient sequencing, scheduling, and management of project activities and resources.
4. To enhance students' knowledge of monitoring and control processes, contract management, people management, and teamwork, enabling them to support successful project execution and delivery.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Software Project Management**: Introduction, Importance, Activities, Plans, methods and methodologies, Categorization, Project Charter, Stake holders, Setting Objectives, **Management**: Management Control, Project Management Life Cycle, Traditional vs Modern project management	9
2	**Project Evaluation:** Project portfolio management- Evaluation of individual projects- Cost benefit evaluation techniques- Risk evaluation- Programme Management- Managing allocation of resources-Strategic Programme Management-Creating a Programme- Aids to Programme Management-	9

	Benefits Management. **Project Planning**: Step wise Project Planning **Software Estimation:** Basis for software estimation- Software Effort estimation techniques- Bottom-up and Top-down estimation- Function Point Analysis- COCOMO II. Cost Estimation- Staffing Pattern- Schedule compression.	
3	**Activity Planning:** Objectives- Project Schedules- Projects and Activities- Sequencing and Scheduling Activities- Network Planning Models- Forward Pass- Backward pass- Identifying Critical Path – Activity Float- Shortening the Project Duration- Identifying Critical Activities- Activity-on-arrow networks. **Risk Management:** Risk- Categories of Risk- Risk Management Approaches-Risk Identification- Risk Assessment- Risk Planning- Risk management- Risk Evaluation- PERT, Monte Carlo Simulation, Critical Chain. **Resource Allocation:** Nature of Resources- Identifying and Scheduling Resources- Creating Critical Paths- Cost Schedule- Scheduling sequence.	**9**
4	**Monitoring and Control:** Creating the framework- Collecting data- Review - Visualizing Progress- Cost Monitoring- Earned Value Analysis- Prioritizing Monitoring-Getting the project back to target- Change control- Software Configuration Management. **Managing Contracts**- Types of Contract-Stages in Contract Placement- Contract Management **Managing People:** Organizational Behaviour- Selecting the right Person- Motivation- The Oldham-Hackman Job Characteristics Model-Stress- Stress Management- Health and Safety- Ethical and Professional Concerns **Working in Teams**- Becoming a Team- Decision Making- Organization and Team Structures- Coordination Dependencies- Dispersed and Virtual Teams – Communication Genres- Communication Plans- Leadership.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamentals of software project management	**K2**
CO2	Apply project evaluation, planning, and software estimation techniques to effectively manage project portfolios, individual projects ensuring optimal resource allocation and cost estimation	**K3**
CO3	Describe the principles of activity planning, risk management and resource allocation to effectively sequence, schedule and manage project activities and resources	**K2**
CO4	Explain the principles of monitoring and control, contract management, people management, and team work to effectively support project execution and delivery	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	-	-	2	3	2
CO2	3	2	-	-	-	-	-	-	2	2	3	2
CO3	3	-	-	-	2	-	-	-	2	3	3	2
CO4	3	-	-	-	-	-	-	-	3	2	3	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Software Project Management	Bob Hughes, Mike Cotterell, Rajib Mall	Mc Graw Hill India	6th edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Software Project Management in Practice	Pankaj Jalote	Pearson	1st edition, 2015
2	Software Engineering	Ian Somerville	Pearson	10th edition,2017
3	Software Engineering : A Practitioner's Approach	Roger S Pressman, Bruce R Maxim	Tata McGraw Hill	8th edition, 2019

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_mg78/preview

SEMESTER S6
QUANTUM COMPUTING

Course Code	PEITT634	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GAPHT121: Physics for Information Science	Course Type	Theory

Course Objectives:

1. Understand the fundamentals of quantum computing and quantum information.
2. Explore and implement quantum algorithms.
3. Learn and apply principles of linear algebra and quantum mechanics.
4. Design and analyze quantum circuits and universal quantum gates.
5. Explore advanced topics in quantum computation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamental Concepts:** History of quantum computation and quantum information, Quantum bits, Quantum computation – Single qubit gates-Multiple qubit gates-Quantum Circuits-Qubit copying circuit-Example: Bell states. Quantum algorithms-Classical computations on a quantum computer-Quantum parallelism-Deutsch's algorithm-The Deutsch–Jozsa algorithm.	9
2	**Introduction to quantum mechanisms**: Linear algebra, Bases and linear independence- Linear operators and matrices- The Pauli matrices- Inner products-Eigenvectors and eigenvalues-Adjoints and Hermitian operators-Tensor products-Operator functions.	9
3	**The Postulates of Quantum Mechanics:** State space-Evolution-Quantum measurement-Distinguishing quantum states-Projective measurements-POVM measurements-Phase- Composite systems.	9
4	**Quantum Computation:** Quantum circuits-Universal quantum gates-Simulation of quantum systems. The quantum Fourier transform- Phase estimation-Application: order-finding-Quantum search algorithms-Quantum search as a quantum simulation.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discuss the historical evolution, foundational concepts, and essential algorithms in quantum computation and quantum information, encompassing qubits, gates, and circuits.	**K2**
CO2	Describe the fundamental concepts of quantum mechanics, including linear algebra, bases, linear independence, operators, matrices, and key elements like the Pauli matrices and eigenvalues.	**K2**
CO3	Discuss the postulates of quantum mechanics, including state space, evolution, quantum measurement, distinguishing quantum states, projective measurements, POVM measurements, phase, and composite systems.	**K2**
CO4	Apply knowledge of quantum computation to design quantum circuits using universal quantum gates, simulate quantum systems, perform the quantum Fourier transform, estimate phases, implement order-finding applications, and utilize quantum search algorithms for quantum simulation.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2				3					
CO2	3	3	2									
CO3	3	2	3									
CO4	3	3	2									2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Quantum Computation and Quantum Information	Michael A. Nielsen & Isaac L. Chuang	Cambridge University Press	10th Edition, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Introduction to Quantum Computing	Kaye P, Laflamme R	Oxford University Press	2007
2	Quantum Computer Science: An Introduction	Mermin N.D.	Cambridge University Press	2007

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106106232
2	https://onlinecourses.nptel.ac.in/noc21_cs103/preview

SEMESTER S6

DATA ANALYTICS

Course Code	PEITT635	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PBITT404: Data Science	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts of data analytics, including data collection, cleaning, and preprocessing.
2. To explore statistical methods and data mining techniques for data analysis and pattern discovery.
3. To understand the role of machine learning algorithms in predictive analytics and their implementation.
4. To examine advanced data analytics topics such as big data analytics, real-time data processing, and data visualization.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Data Analytics and Preprocessing: Overview of Data Analytics: Definitions, Types, and Applications Data Collection Techniques: Sources, Tools, and Methods Data Cleaning: Handling Missing Data, Outlier Detection, Data Imputation Data Transformation: Normalization, Standardization, Feature Engineering Introduction to R for Data Analytics	9
2	Statistical Methods and Data Mining: Descriptive Statistics: Mean, Median, Mode, Variance, Standard Deviation Inferential Statistics: Hypothesis Testing, Confidence Intervals, p-Values Data Mining Techniques: Classification, Clustering, Association Rule Mining Feature Selection and Dimensionality Reduction: PCA, LDA Applications of Data Mining: Market Basket Analysis, Customer Segmentation	9

3	Predictive Analytics and Machine Learning: Introduction to Predictive Analytics: Concepts and Applications Supervised Learning: Linear Regression, Decision Trees, Random Forests Unsupervised Learning: k-Means Clustering, Hierarchical Clustering Model Evaluation and Optimization: Cross-Validation, Grid Search Case Studies in Predictive Analytics: Financial Forecasting, Health Analytics	**9**
4	Advanced Topics in Data Analytics: Big Data Analytics: Hadoop, Spark, NoSQL Databases Real-Time Data Processing: Streaming Data, Apache Kafka Data Visualization Techniques: Dashboards, Reports, Data Storytelling Ethical Considerations in Data Analytics: Privacy, Security, and Bias Future Trends in Data Analytics: AI-Driven Analytics, Automated Data Science.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Examination (Written)	Evaluate Level Assessment	Analyze Level Assessment	Total
5	**15**	**10**	**10**	**40**

Evaluate and Analyze Level Assessment [20 Marks]

Students should evaluate and analyze a real-world optimization problem, assess the proposed solutions, provide a conclusion on which solution is most appropriate for the problem, and implement the chosen solution using Python.

Criteria for evaluation:

1. **Problem Definition (K4 - 4 points)**
    a. *Clearly defines the real-world analytical problem.*
    b. *Data is collected from reliable sources and is thoroughly cleaned, transformed, and preprocessed with no errors.*
2. **Problem Analysis (K4 - 4 points)**
    a. *Exploratory Data Analysis is comprehensive, revealing deep insights and*

trends with clear visualizations and interpretations.

b. *Advanced and appropriate analytical methods are to applied*

3. **Evaluate (K5 - 4 points)**
    a. *Thoroughly evaluate the proposed solutions.*
    b. *Demonstrates strong awareness and adherence to ethical standards in data usage, privacy, and compliance..*
    c. *Considers feasibility, scalability, and practical implications.*
4. **Python Implementation (K5 - 4 points)**
    a. *Select the most feasible solution by implementing the proposed solutions.*
    b. *Successfully translates the chosen solution into Python code.*
    c. *Demonstrates expert use of data analytics tools and technologies*
5. **Conclusion (K4- 2 points, K5 – 2 points)**
    a. *Demonstrates exceptional creativity and innovation in problem-solving.* ***(K4)***
    b. *Results are interpreted accurately with strong, well-supported conclusions and actionable insights.* ***(K5)***

Scoring:

1. **Accomplished (4 points)**: Exceptional analysis, clear implementation, and depth of understanding.
2. **Competent (3 points)**: Solid performance with minor areas for improvement.
3. **Developing (2 points)**: Adequate effort but lacks depth or clarity.
4. **Minimal (1 point)**: Incomplete or significantly flawed.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply various techniques for data preprocessing and analytics	**K3**
CO2	Implement statistical and data mining methods for data analysis and pattern discovery.	**K3**
CO3	Utilize machine learning algorithms for predictive analytics in real-world scenarios.	**K3**
CO4	Analyse big data and implement real-time data processing and visualization techniques.	**K3**
CO5	Synthesize and evaluate complex data analytics solutions for large-scale and real-time applications.	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking	Foster Provost, Tom Fawcett	O'Reilly Media	1st Edition, 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython	Wes McKinney	O'Reilly Media	2nd Edition, 2017
2	Data Mining: Concepts and Techniques	Jiawei Han, Micheline Kamber, Jian Pei	Morgan Kaufmann	3rd Edition, 2011
3	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media	2nd Edition, 2019
4	Big Data: Principles and Best Practices of Scalable Real-Time Data Systems	Nathan Marz, James Warren	Manning Publications	1st Edition, 2015

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://www.youtube.com/watch?v=ua-CiDNNj30
2	https://www.youtube.com/watch?v=7eh4d6sabA0
3	https://www.youtube.com/watch?v=7eh4d6sabA0
4	https://www.youtube.com/watch?v=s0dMTAQM4cw

SEMESTER S6

INTERNET OF THINGS

Course Code	PBITT604	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Programming Basics	Course Type	Theory

Course Objectives:

1. Students will be able to gain a comprehensive understanding of IoT, from its foundational technologies to emerging trends and future directions.
2. Students will be able to develop IoT applications using Arduino and Raspberry Pi, focusing on real-world scenarios and problem-solving.

SYLLABUS

Module No.	Syllabus Description	Contact Hours (44 Hrs)
1	**The Internet of Things Today**: Time for Convergence, Towards the IoT Universe(s), Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications. Internet of Things and related future Internet technologies, Infrastructure, Networks and Communication, Processes, Data management, Security, Privacy & Trust, Device Level Energy Issues. Current trends in Internet: Internet of Everything, Internet of Thing-Storage, Databases.	11
2	**IoT Standardisation**: Status, Requirements, Initiatives and Organisations, M2M Service Layer Standardisation, OGC Sensor Web for IoT, IEEE and IETF, ITU-T. A Common Architectural Approach- The IoT-A Reference Model. IoT Software Platforms: Node-RED, ThingSpeak, Blynk, IoTivity IoT Operating Systems: Contiki, RIOT, TinyOS Cloud Platforms for IoT: AWS IoT, Google Cloud IoT, Microsoft Azure.	11
3	**IoT Protocols:** Physical Data Link Layer: IEEE 802.15.4, LoRa, NFC, Zigbee,	11

	Bluetooth/Bluetooth Low Energy (BLE), 6LoWPAN Network Layer: IPv4/IPv6, RPL, CoAP Transport Layer: TCP, UDP, DTLS Session & Application Layer: CoAP, MQTT, HTTP/HTTPS, XMPP, AMQP, DDS MQTT Publisher-Subscriber Model using MQTT Broker (Implementation) HTTP - WebSocket communication	
4	**IoT Hardware:** Arduino – Introduction-Making the Sketch. ESP32 System on a Chip (SoC) microcontroller. Simple Digital and Analog Input-Using a Switch, Reading a Keypad, Reading Analog Values Getting Input from Sensors-Detecting Movement, light, motion, distance, vibration, sound and temperature Reading RFID Tags, Getting Location from a GPS Visual Output-Connecting and Using LEDs Physical Output-Controlling the Position of a Servo Remotely Controlling External Devices-Controlling a Digital Camera Connect Arduino to wired and wireless networks. Raspberry Pi – Introduction, Python/Micro python and Raspberry Pi, Arduino and Raspberry Pi, Basic Input and Output, Programming Inputs and Outputs with Python. IoT deployment for Raspberry Pi /Arduino/Equivalent development platforms	**11**

Suggestions on Project Topics:

No.	Project Topics
1	Smart Home Automation System
2	Smart Garden with Environmental Monitoring
3	RFID-based Attendance System
4	GPS-based Vehicle Tracking System
5	IoT-based Weather Station
6	Remote Surveillance System with Camera Control
7	Health Monitoring System
8	Smart Traffic Management System
9	Air Quality Monitoring System
10	Smart Waste Management System
11	IoT-based Smart Parking System
12	Smart Door Lock System
13	IoT-based Personal Safety Device
14	Smart Irrigation System
15	Smart City Infrastructure Monitoring

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions		
Part A	**Part B**	**Total**
● 2 Questions from each module. ● Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 2 sub divisions. ● Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the current state and future of the Internet of Things (IoT), covering its key technologies, infrastructure, data management, security, and energy challenges.	**K2**
CO2	Explain IoT standardization, including major organizations and standards, and understand current trends like the Internet of Everything and how storage and databases are used in IoT.	**K2**
CO3	Identify and describe key IoT protocols across different layers.	**K3**
CO4	Apply Arduino and Raspberry Pi to develop and deploy IoT solutions effectively.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems	Dr. Ovidiu Vermesan, Dr. Peter Friess	River Publishers.	1st Edition 2013
2	Arduino Cookbook	Michael Margolis	O'Reilly Media	3rd Edition 2020
3	Getting Started With Raspberry Pi	Matt Richardson, Shawn Wallace	O'Reilly Media	3rd Edition 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Building The Internet of Things with IPv6 And MIPv6	Daniel Minoli	Wiley	2nd Edition 2019
2	The Internet of Things: Key Applications and Protocols	Olivier Hersent, David Boswarthick, and Omar Elloumi	Wiley	2nd Edition, 2012

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs115/
2	https://onlinecourses.swayam2.ac.in/ntr24_ed44/
3	https://onlinecourses.nptel.ac.in/noc24_cs115

Project Based Learning - Course Elements			
L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity		
Sl. No	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology
2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback
3. **Involvement in the Project Work and Team Work (3 Marks)**
    - Active participation and individual contribution
    - Teamwork and collaboration
4. **Execution and Implementation (10 Marks)**
    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result
5. **Final Presentation (5 Marks)**
    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions
6. **Project Quality, Innovation, and Creativity (3 Marks)**
    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S6

OBJECT-ORIENTED PROGRAMMING IN JAVA

Course Code	OEITT611	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1.To equip students with the fundamental concepts of Object-Oriented Programming (OOP) using Java.

2.Students will learn how to design, implement, and test Java programs, focusing on encapsulation, inheritance, and polymorphism principles.

3.Students will be equipped with problem-solving, algorithm development, and good programming practices.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Java and OOP:** Overview of programming languages, Setting up the development environment (IDE, JDK), Writing and running a simple Java program **Basics of Java:** Variables, data types, and operators, control structures (conditional control statements, loops), Input/output Basics (reading console input, writing console output)	9
2	**Classes and Objects:** Defining classes and objects, Constructors and instance variables, Methods and method overloading **Encapsulation and Access Modifiers:** Encapsulation principles, Access modifiers (public, private, protected), Getters and setters	9
3	**Inheritance:** Inheritance hierarchy, Method overriding Superclass and subclass relationships **Polymorphism:** Method overloading vs. method overriding, Dynamic method dispatch, Abstract classes and interfaces	9

4	**Exception Handling:** Handling exceptions (try-catch blocks), Custom exceptions, Checked vs. unchecked exceptions. Errors: Understanding common Error types in Java, using Java Error information for root cause analysis and JVM tuning. **Collections and Data Structures:** Lists, sets, and maps, ArrayList, HashSet, HashMap, Iterators	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate the ability to set up the Java development environment and write a simple Java program.	**K3**
CO2	Define and instantiate classes and objects in Java, implement constructors and instance variables, and apply encapsulation principles and access modifiers	**K3**
CO3	Implement inheritance hierarchy and polymorphism principles, including method overriding, dynamic method dispatch, and the use of abstract classes and interfaces	**K3**
CO4	Apply exception handling mechanisms and use custom exceptions, and utilize Java collections and data structures like lists, sets, and maps.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2								2
CO2	3	3	3	3								2
CO3	3	3	3	3								2
CO4	3	3	3	3								2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Java: The Complete Reference	Herbert Schildt, Danny Coward	McGraw Hill	13th Edition, 2023
2	Programming with Java	E. Balagurusamy	McGraw Hill	7th Edition, 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Core Java Volume –I Fundamentals	Cay S. Horstmann, Gary Cornell	Prentice Hall	9th Edition, 2013.
2	Java SE 8 for Programmers	Paul Deitel, Harvey Deitel	Pearson	3rd Edition, 2015
3	Beginning Java Programming	Bart Baesens, Aimee Backiel, Seppe vanden Broucke	Wrox,O'Reilly	2015
4	Learn Java Fundamentals – Object-Oriented Programming	Vahe Aslanyan	freeCodeCamp	2023

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_cs47/
2	https://nptel.ac.in/courses/106105191

SEMESTER S6

DATA STRUCTURES USING C++

Course Code	OEITT612	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts of data structures and their implementation using C++.
2. To explore linear data structures such as arrays, linked lists, stacks, and queues.
3. To understand non-linear data structures such as trees and graphs, and their applications.
4. To examine advanced data structures and algorithms for efficient data management and retrieval.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Module 1: Introduction to Data Structures and C++ Basics** Overview of Data Structures: Definition, Importance, and Applications C++ Programming Basics: Pointers, References, Dynamic Memory Allocation Introduction to Abstract Data Types (ADTs) Complexity Analysis: Time and Space Complexity Basic C++ STL Containers: Vectors, Lists, Stacks, and Queues	9
2	**Module 2: Linear Data Structures** Arrays and Strings: One-Dimensional and Multidimensional Arrays, String Manipulation Linked Lists: Singly Linked List, Doubly Linked List, Circular Linked List Stacks: Implementation using Arrays and Linked Lists, Applications Queues: Implementation using Arrays and Linked Lists, Circular Queue, Priority Queue	9

	C++ STL Implementation of Linear Data Structures	
3	**Module 3: Non-Linear Data Structures** Trees: Binary Trees, Binary Search Trees (BST) Tree Traversal Techniques: Inorder, Preorder, Postorder, Level Order Heaps: Min-Heap, Max-Heap, Heap Sort Graphs: Representation (Adjacency Matrix, Adjacency List), Graph Traversal (DFS, BFS) Applications of Trees and Graphs in Problem Solving	**9**
4	**Advanced Data Structures and Algorithms** Hashing: Hash Functions, Collision Resolution Techniques, Applications Search Algorithms: Binary Search, Interpolation Search, Exponential Search Sorting Algorithms: Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Merge Sort, Heap Sort, Radix Sort C++ STL Implementation of Advanced Data Structures	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course, students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply basic data structure concepts to develop simple programs using C++	**K3**
CO2	Implement linear data structures using C++ for various computational tasks.	**K3**
CO3	Utilize non-linear data structures like trees and graphs for complex problem-solving	**K3**
CO4	Analyze and implement advanced data structures and algorithms for optimized performance.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Structures Through C++	Yashwant Kanetkar	BPB	5th Edition,2019
2	Data Structures and Algorithm Analysis in C++	Mark Allen Weiss	Pearson	4th Edition, 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	C++ Programming: Principles and Practice Using C++	Bjarne Stroustrup	Addison-Wesley	2nd Edition 2014
2	Data Structures and Algorithms in C++	Adam Drozdek	Cengage Learning	4th Edition, 2012
3	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	MIT Press	3rd Edition, 2009
4	The Art of Computer Programming, Volumes 1-4A Boxed Set	Donald E. Knuth	Addison-Wesley Professional	Box Set Edition, 2011

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://www.youtube.com/watch?v=ZyRLdtKXW4s
2	https://www.youtube.com/watch?v=MeNaA-eG25k
3	https://www.youtube.com/watch?v=6oL-0TdVy28
4	https://www.youtube.com/watch?v=oaY3m2hVGw8

SEMESTER S6
AI WITH PYTHON

Course Code	**OEITT613**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To provide a comprehensive overview of artificial intelligence and its practical applications.
2. To demonstrate proficiency in AI problem definition, algorithm design, and Python implementation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Artificial Intelligence (AI) and Python: Overview of AI and Agents- Definition and History of AI, Narrow AI vs. General AI, AI Applications, Definition and Components of AI Agents, Types of Agents- Simple Reflex, Model Based, Goal Based, and Utility Based Agents, Agent Architectures and Environments. Python for AI- Python basic data structures, Setting Up Python Environment, Key Libraries and Tools- NumPy, Pandas, Matplotlib.	**9**
2	AI Problems: Definition and formulation of AI problems, State space representation, actions, and goals, Problem characteristics- problem decomposability, solution steps consideration, problem solution predictability, absolute or relative problem solution, state or path solution, role of knowledge in problem solving, human interaction in problem solving. Problem definition and Python implementation of Water Jug Problem, 8-Puzzle Problem & Missionaries and Cannibals Problem.	**9**
3	AI Search Algorithms: Uninformed Search Algorithm- Breadth First Search and Depth First Search algorithms description and implementation using Python, Informed Search Algorithms- Hill Climbing, A* Search algorithm, and AO* Search algorithm description and implementation using Python, Comparison of informed and uninformed search algorithms.	**9**

4	Game Playing and Constraint Satisfaction Problem (CSP): Minimax algorithm and Alpha-Beta Pruning, Game Playing Implementation- Tic-Tac-Toe with minimax and alpha-beta pruning, Introduction to CSP- Definitions and basic concepts, Techniques for CSP- Backtracking and Constraint Propagation.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the evolution and types of AI, outline the role of different AI agents, and set up a Python environment for AI development.	**K2**
CO2	Understand, represent, and solve fundamental AI problems using Python.	**K3**
CO3	Implement various search algorithms used in AI to efficiently solve problems.	**K3**
CO4	Implement game-playing algorithms and constraint satisfaction techniques using Python.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson	4th Edition, 2020
2	Artificial Intelligence: Foundations of Computational Agents	Poole, D. L. and Mackworth, A.K.	Cambridge University Press	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Intelligence: A Guide for Thinking Humans	Melanie Mitchell	Penguin Books	1st Edition, 2019
2	Introduction to Artificial Intelligence	Wolfgang Ertel	Springer	1st Edition, 2018
3	Principles of Artificial Intelligence	Nils J. Nilsson	Morgan Kaufmann	2014

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_ge47/preview
2	https://onlinecourses.nptel.ac.in/noc22_cs32/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs79/preview
4	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
5	https://onlinecourses.nptel.ac.in/noc22_cs06/preview

SEMESTER S6

NETWORK SECURITY LAB

Course Code	**PCITL607**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT402: Computer Networks	**Course Type**	Lab

Course Objectives:

1. To understand and implement modern symmetric key algorithms and public key infrastructure in network security.
2. To explore and apply digital signatures and cryptographic hash functions in secure communication.
3. To study and implement intrusion detection and prevention systems for securing networks.
4. To configure and test firewalls, network security protocols, and cryptographic protocols.

Experiment No.	Experiments
1	Implementation of AES and DES algorithms for data encryption and decryption.
2	Setting up and configuring a public key infrastructure (PKI) for secure communication.
3	Key management using RSA algorithm and certificate generation in a simulated environment.
4	Implementation of digital signatures using RSA and DSA algorithms.
5	Application of cryptographic hash functions (SHA-256, MD5) for data integrity verification.
6	Secure message transmission using digital signatures and hash functions.
7	Configuration and deployment of Snort as an Intrusion Detection System (IDS).
8	Implementation of an Intrusion Prevention System (IPS) using open-source tools.

9	Analysis of network traffic and identification of malicious activities using IDS/IPS.
10	Configuration of a network firewall using iptables/pfSense.
11	Implementation of VPN protocols (IPSec, SSL/TLS) for secure communication.
12	Testing and validation of cryptographic protocols (SSL/TLS) in securing web transactions.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record:*** *Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement modern symmetric key algorithms and configure public key infrastructure to secure data transmission.	**K3**
CO2	Use digital signatures and cryptographic hash functions for secure communication and data integrity.	**K3**
CO3	Apply and evaluate intrusion detection and prevention systems to protect network infrastructures.	**K3**
CO4	Configure and test firewalls and network security protocols to safeguard networks.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cryptography and Network Security: Principles and Practice	William Stallings	Pearson Education Press	7th Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Applied Cryptography: Protocols, Algorithms, and Source Code in C	Bruce Schneier	Wiley	20th Anniversary Edition, 2015
2	Network Security Essentials: Applications and Standards	William Stallings	Pearson Education	6th Edition, 2017

3	Network Security with OpenSSL	John Viega, Matt Messier, Pravir Chandra	O'Reilly Media	1st Edition, 2002
4	Firewalls and Internet Security: Repelling the Wily Hacker	William R. Cheswick, Steven M. Bellovin, Aviel D. Rubin	Addison-Wesley	2nd Edition, 2003

Video Links (NPTEL, SWAYAM…)	
Link No.	**Link ID**
1	https://www.youtube.com/watch?v=ZD71JeX4VkI
2	https://www.youtube.com/watch?v=3QnD2c4Xovk
3	https://www.youtube.com/watch?v=jvf4eCW1XI4
4	https://www.youtube.com/watch?v=8yKpQSHpYP0

Continuous Assessment (25 Marks):

1. **Preparation and Pre-Lab Work (7 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (7 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness, and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**
    - Oral Examination: Ability to explain the experiment, results, and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks):

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
3. **Result with Valid Inference/Quality of Output (10 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
4. **Viva Voce (10 Marks)**
    - Ability to explain the experiment, procedure results and answer related question.
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.
5. **Record (5 Marks)**
    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 7

INFORMATION TECHNOLOGY

SEMESTER S7

NATURAL LANGUAGE PROCESSING

Course Code	PEITT741	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

- Students will be able to understand fundamental concepts of natural language processing (NLP).
- Students will be able to understand advanced NLP techniques for syntactic and semantic understanding, including POS tagging, HMM tagging, named entity recognition, coreference resolution, and semantic role labelling
- Students will be able to understand practical NLP applications such as machine translation, question answering systems, chatbots, dialogue systems, automatic speech recognition, and text-to-speech technologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Natural Language Understanding: Applications, Levels of NLP, Basic Text Processing, Empirical Laws, Minimum Edit Distance. N-gram Language Models: N-grams, Evaluating Language Models, Smoothing:Knesser-Ney Smoothing, Perplexity's Relation to Entropy. Naive Bayes, Text Classification, and Sentiment: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Evaluation: Precision, Recall, F-measure, Test sets and Cross-validation.	9
2	POS Tagging, HMM POS Tagging, Viterbi Algorithm, Morphology, Named Entity Recognition, Conditional Random Fields.	9

	Lexical Semantics, Vector Semantics, TF-IDF, PMI, Word2Vec, Word Senses, Word Sense Disambiguation, WordNet Context-Free Grammars and Constituency Parsing, Treebank.	
3	Semantic Roles, Logical Representations of Sentence Meaning, Semantic Role Labeling, Lexicons for Sentiment, Affect, and Connotation, Coreference Resolution, Discourse Coherence.	**9**
4	NLP Applications: Machine Translation, Question Answering and Information Retrieval, Chatbots & Dialogue Systems, Automatic Speech Recognition and Text-to-Speech, Relation and Event Extraction.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain and implement basic text processing, n-gram language models, and Naive Bayes classifiers	**K2**
CO2	Illustrate advanced natural language processing techniques to analyze and process natural language text effectively.	**K2**
CO3	Describe semantic role labeling, logical representations of sentence meaning, and coreference resolution to ensure discourse coherence and accurate semantic understanding.	**K2**
CO4	Summarize different natural language processing (NLP) applications by applying appropriate NLP techniques and evaluating their effectiveness.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	-	-	-	-	-	2
CO2	3	2	2	-	2	-	-	-	-	-	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	-
CO4	3	2	2	-	2	2		2	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Speech and Language Processing	Dan Jurafksy, James H Martin	Pearson Education India	3rd edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Natural Language Understanding	James Allen	Pearson	2nd edition
2	Foundations of Statistical Natural Language Processing	Christopher Manning	MIT Press	1st edition

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2	https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs56/
3	https://web.stanford.edu/~jurafsky/slp3/

SEMESTER S7

SOFTWARE DEVELOPMENT WITH AGILE AND DEVOPS

Course Code	**PEITT742**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT503: Software Engineering	**Course Type**	Theory

Course Objectives:

1. To understand the core concepts of DevOps and how they integrate with Agile practices to enhance software development and deployment.
2. To understand the core concepts of DevOps and how they integrate with Agile practices to enhance software development and deployment.
3. To equip students with the knowledge and skills to develop secure software by integrating security best practices throughout the development lifecycle.
4. To explore advanced concepts in Agile and DevOps, with a focus on scaling and continuous improvement in large and complex environments.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Agile Development** Introduction to Agile Methodology: Overview of traditional vs. Agile development, Agile Manifesto and Principles. Agile Frameworks: Scrum, Kanban, XP (Extreme Programming). Agile Project Management: User Stories, Backlogs, Sprints, and Releases. Roles in Agile Teams: Product Owner, Scrum Master, Development Team. Agile Planning and Estimation: Story Points, Velocity, and Burndown Charts. Agile Metrics and Reporting: Measuring progress, continuous improvement.	9
2	**DevOps Fundamentals and Practices** Introduction to DevOps: Definition, need for DevOps, DevOps lifecycle.	9

	Continuous Integration and Continuous Deployment (CI/CD): Jenkins, GitLab CI, Travis CI. Infrastructure as Code (IaC): Terraform, Ansible, Docker, and Kubernetes. Version Control Systems: Git, Git workflows, branching strategies. Automated Testing in DevOps: Unit tests, integration tests, deployment testing.	
3	**Secure Software Development** Introduction to Secure Software Development: Importance of security in software, common vulnerabilities. Secure Coding Practices: OWASP Top 10, secure coding standards. Threat Modeling: Identifying threats, security design principles. Security Testing: Static Application Security Testing (SAST), Dynamic Application Security Testing (DAST), and penetration testing. Security in CI/CD Pipeline: Integrating security into DevOps (DevSecOps), automated security tools.	**9**
4	**Advanced DevOps and Agile Practices** Advanced CI/CD Pipelines: Custom pipelines, Blue-Green deployments, Canary releases. Monitoring and Logging: Prometheus, Grafana, ELK Stack (Elasticsearch, Logstash, Kibana). Cloud and DevOps: DevOps practices in AWS, Azure, and GCP. Agile at Scale: Scaling Agile in large organizations, SAFe (Scaled Agile Framework), LeSS (Large Scale Scrum). Continuous Feedback and Improvement: Retrospectives, continuous learning and adaptation.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discuss Agile principles and practices to manage and deliver software projects effectively.	**K2**
CO2	Explain DevOps practices to automate and streamline software development, testing, and deployment processes.	**K2**
CO3	Describe secure coding practices and integrate security into the software development process.	**K2**
CO4	Illustrate advanced DevOps practices in a cloud environment to enhance software delivery.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	-	-	-	-	-	-	2	2
CO2	3	3	3	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	-	-	-	-	-	-	2	2
CO4	3	3	3	3	2	-	-	-	-	-	2	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Agile Software Development, Principles, Patterns, and Practices	Robert C. Martin	Prentice Hall	1st Edition, 2002

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Scrum: The Art of Doing Twice the Work in Half the Time	Jeff Sutherland	Crown Business	1st Edition, 2014
2	The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win	Gene Kim, Kevin Behr, George Spafford	IT Revolution Press	5th Anniversary Edition, 2018
3	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws	Dafydd Stuttard, Marcus Pinto	Wiley	2nd Edition, 2011
4	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation	Jez Humble, David Farley	Addison-Wesley	1st Edition, 2010

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://www.youtube.com/watch?v=VFQtSqChlsk&t=4223s
2	https://www.youtube.com/watch?v=hQcFE0RD0cQ
3	https://www.youtube.com/watch?v=ONe_P09MSKM
4	https://www.youtube.com/watch?v=egTi9U9vw3E&list=PLjNII-Jkdjfz5EXWlGMBRk63PC8uJsHMo

SEMESTER S7

BLOCKCHAIN TECHNOLOGY

Course Code	**PEITT743**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT601: Cryptography and Network Security	**Course Type**	Theory

Course Objectives:

1. Students will be familiar with the working of popular blockchain platforms: bitcoin & Ethereum and will acquire understanding of underlying principles of blockchain.
2. Students will be able to develop and deploy smart contracts in Ethereum blockchain.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Blockchain Introduction:** *Fundamentals of blockchain* - historical background, basic terminologies in Blockchain, structure of a block *(till this from Ref. 3)*, Blockchain architecture, generic elements of a blockchain, How blockchain works, benefits, features, and limitations of blockchain *(till this from Textbook 1)*, Types of Blockchain, The Evolutionary Transformation of Blockchain, Comparison of different generation of blockchain *(till this from Ref. 3)* **Decentralization using blockchain:** Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, IPFS basics	8
2	**Cryptography for blockchain:** cryptographic primitives - Secure Hash algorithms, Applications of cryptographic hash functions, Message Authentication Codes, Digital signatures, Merkle tree, Elliptic curve cryptography fundamentals	9

	Consensus Algorithms: Introducing the consensus problem, The Byzantine generals problem, Fault tolerance, FLP impossibility, Classification and categories of consensus algorithms - CFT algorithms, BFT algorithms, Nakamoto consensus, Proof of Stake, Choosing a consensus algorithm	
3	**Bitcoin:** The beginnings of Bitcoin, Bitcoin Definition, Bitcoin - a user's perspective, Cryptographic keys, Addresses in Bitcoin, Transactions, The transaction lifecycle, The transaction data structure, The Script language, Types of scripts, Coinbase transactions, Transaction validation, Transaction bugs, Bitcoin blockchain, The genesis block, Mining, Proof of work, The mining algorithm, The hash rate, Mining systems, Mining pools, wallets	**7**
4	**Ethereum:** A General-Purpose Blockchain, Ethereum's components, Ethereum and Turing Completeness, From General-Purpose Blockchains to Decentralized Applications (DApps), Ether currency units, Getting Started with MetaMask, Introducing the world Computer, Externally Owned Accounts (EOAs) and Contracts **A simple Contract:** A Test Ether Faucet, Compiling the Faucet Contract, Creating the Contract on the Blockchain, Interacting with the Contract, The Structure of a Transaction, Special Transaction: Contract Creation, A Blockchain Based Supply Chain Management Testcase (from Ref. 3) **Smart Contracts and Solidity:** Life Cycle of a Smart Contract, Building a Smart Contract with Solidity, The Ethereum Contract ABI, Programming with Solidity **Tokens:** How Tokens Are Used, The ERC20 Token Standard, Launching Our Own ERC20 Token,	**12**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	summarize foundational concepts of decentralization with blockchain	**K2**
CO2	Interpret the importance of cryptography and consensus in Blockchain	**K2**
CO3	Outline the working of Bitcoin blockchain	**K2**
CO4	Build and deploy smart contract in Ethereum blockchain	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	3	-	-	-	-	-	-	-	3
CO2	3	-	-	3	2	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mastering Blockchain	Imran Bashir	Packt Publishing Ltd.	3rd Edition 2020
2	Mastering Ethereum	Andreas M. Antonopoulos and Dr. Gavin Wood	O'Reilly Media, Inc	1st Edition 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mastering Blockchain	Lorne Lantz and Daniel Cawrey	O'Reilly Media, Inc.,	1st Edition 2020
2	Solidity Programming Essentials	Ritesh Modi	Packt Publishing	1st Edition 2018
3	Blockchain 1.0 to Blockchain 4.0—The Evolutionary Transformation of Blockchain Technology	Pratyusa Mukherjee, Chittaranjan Pradhan	De Gruyter	May, 2021
4	Bitcoin: A Peer-to-Peer Electronic Cash System	Satoshi Nakamoto	Bitcoin.org	Oct, 2008

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106105235
2	https://nptel.ac.in/courses/106105235
3	https://nptel.ac.in/courses/106105235
4	https://onlinecourses.swayam2.ac.in/aic21_ge01/preview

SEMESTER S7

MOBILE APP DEVELOPMENT

Course Code	PEITT744	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2:0:1:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce students to the fundamentals of mobile application development, including different mobile platforms and development environments.
2. To familiarize students with UI/UX design principles and their application in creating user-friendly and aesthetically pleasing mobile applications.
3. To provide knowledge on backend integration, including APIs, cloud services, and database management for mobile applications.
4. To explore advanced topics in mobile app development such as performance optimization, security practices, cross-platform development, and future trends.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Mobile App Development - Overview of Mobile Application Development: History, Trends, and Importance, Mobile Platforms: Android, iOS, and Cross-Platform Development, Development Environments: Android Studio, Xcode, and Visual Studio Code, Basic App Development Lifecycle: Design, Development, Testing, and Deployment, Introduction to Programming Languages: Java, Kotlin, Swift, and Dart. **Lab:** Setting up development environments (Android Studio, Xcode, Visual Studio Code), Building a simple "Hello World" app using Java (Android) and Swift (iOS), Exploring cross-platform development with Flutter	11

2	UI/UX Design for Mobile Apps - UI/UX Design Principles: Visual Design, Information Architecture, Interaction Design - Wireframing and Prototyping Tools: Figma, Sketch, Adobe XD - Responsive Design for Multiple Devices and Screen Sizes - Material Design Guidelines for Android and Human Interface Guidelines for iOS - Accessibility in Mobile App Design **Lab**: Creating wireframes and prototypes using Figma or Sketch - Implementing responsive design in Android and iOS apps - Applying Material Design and Human Interface Guidelines in simple UI components -Testing app accessibility features on various devices	**11**
3	Backend Integration and APIs- Connecting Mobile Apps to Backend Services: RESTful APIs, GraphQL-Cloud Services for Mobile Apps: Firebase, AWS Amplify, Google Cloud-Working with Databases: SQLite, Realm, Firebase Realtime Database-Data Storage and Management in Mobile Apps-Implementing Push Notifications and In-App Messaging **Lab:** Setting up and integrating a Firebase backend with a mobile app-Implementing RESTful API calls in an app using Retrofit (Android) and URLSession (iOS)-Storing and retrieving data using SQLite and Firebase Realtime Database-Configuring push notifications and sending in-app messages	**11**
4	Advanced Topics in Mobile App Development-Performance Optimization: Profiling, Memory Management, and Battery Efficiency-Mobile App Security: Secure Coding Practices, Encryption, and Authentication-Cross-Platform Development: React Native, Flutter, Xamarin-App Store Deployment: Google Play Store, Apple App Store. **Lab**: Profiling and optimizing app performance using Android Studio and Xcode tools, Implementing secure coding practices and encryption in mobile apps, Developing and deploying a cross-platform app using Flutter, Preparing and submitting apps to the Google Play Store and Apple App Store.	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate an understanding of mobile application development fundamentals, including platform architecture and development environments.	**K3**
CO2	Apply UI/UX design principles to develop user-centric mobile applications with effective interface designs.	**K3**
CO3	Use backend services, APIs, and databases in mobile applications to enhance functionality and data management.	**K3**
CO4	Implement mobile applications by optimizing for performance and security, and apply cross-platform development strategies and future technologies.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Android Programming: The Big Nerd Ranch Guide	Bill Phillips, Chris Stewart, Kristin Marsicano	Big Nerd Ranch Guides	4th Edition 2019
2	iOS Programming: The Big Nerd Ranch Guide	Christian Keur, Aaron Hillegass	Big Nerd Ranch Guides	7th Edition 2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Flutter for Beginners: An Introductory Guide to Building Cross-Platform Mobile Applications	Alessandro Biessek	Packt Publishing	2nd Edition 2021
2	Kotlin Programming: The Big Nerd Ranch Guide	Josh Skeen, David Greenhalgh	Big Nerd Ranch Guides	1st Edition 2018
3	Pro iOS 14 Development with Swift 5	Wallace Wang	Apress	2021Bonnie Eisenman
4	Learning React Native: Building Native Mobile Apps with JavaScript	Bonnie Eisenman	O'Reilly Media	2nd Edition 2017
5	Mobile App Development with Ionic, Revised Edition: Cross-Platform Apps with Ionic, Angular, and Cordova	Chris Griffith	O'Reilly Media	2017

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/nou21_ge41/preview
2	https://archive.nptel.ac.in/courses/106/106/106106156/

SEMESTER S7

DEEP LEARNING

Course Code	**PEITT745**	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT501: Machine Learning	Course Type	Theory

Course Objectives:

1. To enable students to understand the fundamental deep learning techniques and apply them to solve real-world problems.
2. To enable students to analyze and evaluate advanced deep learning models and their applications to determine the most suitable approach for complex problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Deep Learning Fundamentals:** Principal Component Analysis, Conditional Probability- Chain Rule, Bayes' Rule, Hyper parameter Optimization - Gradient- Based Optimization – SGD, Adaptive GD, RMSprop, Constrained Optimization, Regularization - L1 and L2 regularization. **Deep Feedforward Networks:** Gradient-Based Learning, Hidden Units, Architecture Design, Backpropagation	9
2	**Recurrent Neural Networks:** Architecture, Challenges, Bi-directional RNN, Enocder- Decoder Sequence-to-Sequence Application, LSTM, Gated Recurrent Unit networks, Applications of RNN.	9

3	**Convolutional Networks:** Basic Structure of Convolutional Network**,** Training a Convolutional Network, Transfer learning models - AlexNet, GoogleNet, VGG Net, ResNet, Applications of CNN	**9**
4	**Advanced Deep Learning**: Transformers and Pre-trained networks, Generative Adversarial Network, Autoencoder: Basic Principles, Deep Autoencoder, Applications, Competitive Learning- Self Organising Map, Applications of Deep Learning	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Examination (Written)	Evaluate Level Assessment	Analyze Level Assessment	Total
5	**15**	**10**	**10**	**40**

Evaluate and Analyze Level Assessment [20 Marks]

Students should evaluate and analyze a real-world problem, assess the proposed solutions, provide a conclusion on which solution is most appropriate for the problem, and implement the chosen solution.

Criteria for evaluation:

1. **Problem Definition (K2 - 4 points)**
    a. *Clearly defines the real-world problem, ensuring it is specific and relevant.*
    b. *Problem is excellently defined with precise, impactful objectives that highlight the importance and scope of the issue.*
2. **Problem Analysis (K4 - 4 points)**
    a. *Break-down and presents a well-reasoned solution approach, including the rationale behind chosen methods.*
    b. *Performance metrics are expertly selected, analysis is deep, insightful, and*

demonstrates strong understanding of the problem and proposed solutions.

3. **Evaluate (K5 - 4 points)**
    a. *Thoroughly evaluate the proposed solutions, comparing their effectiveness and relevance.*
    b. *Data is excellently selected; preprocessing is sophisticated and enhances model performance.*
    c. *Training process is expertly handled, validation is extensive, demonstrating strong generalization and robustness of the model.*
4. **Implementation (K3 - 4 points)**
    a. *Select the most feasible solution based on evaluation and implements it.*
    b. *Successfully translates the chosen solution into code with a clear, working implementation.*
    c. *Design is innovative, implementation is flawless and optimized for performance.*
5. **Conclusion (K4- 2 points, K5 – 2 points)**
    a. *Provides a highly creative and innovative conclusion, pushing the boundaries of standard methods.* ***(K4)***
    b. *Demonstrates an excellent grasp of deep learning concepts, applied creatively and effectively in the context of the solution.* ***(K5)***

Scoring:

1. **Accomplished (4 points)**: Exceptional analysis, clear implementation, and depth of understanding.
2. **Competent (3 points)**: Solid performance with minor areas for improvement.
3. **Developing (2 points)**: Adequate effort but lacks depth or clarity in analysis or implementation.
4. **Minimal (1 point)**: Incomplete or significantly flawed analysis or implementation.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply fundamental concepts of deep learning to design, train, and evaluate deep feedforward networks.	**K3**
CO2	Implement and compare various gradient-based optimization techniques to optimize deep learning models.	**K3**
CO3	Design and develop deep feedforward networks and recurrent neural networks, including architectures like LSTM and GRUs, to address specific tasks.	**K3**
CO4	Explore and apply various CNN to solve complex visual recognition tasks.	**K3**
CO5	Analyze and evaluate advanced deep learning techniques, to innovative applications.	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	Springer International Publishing AG	1st ed. 2018
2	Speech and Language Processing	James H Matin, Dan Jurafsky	https://web.stanford.edu/~jurafsky/slp3/	(3rd ed. draft)
3	Deep Learning: Foundations and Concepts	Christopher M. Bishop, Hugh Bishop	Springer-Nature New York Inc	2 November 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Machine Learning: Theory and Practice	M. Narasimha Murty, Ananthanarayana V S	Univerities Press	1st Edition, 2024
2	Deep Learning (Adaptive Computation and Machine Learning Series)	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	2016
3	Pattern Recognition and Machine Learning	Bishop C M	Springer	1st Edition Reprint, Jan 2009

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_cs76/preview
2	https://onlinecourses.nptel.ac.in/noc20_cs62/preview

SEMESTER S7

APPROXIMATION ALGORITHMS

Course Code	**PEITT751**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT502: Algorithm Analysis and Design	**Course Type**	Theory

Course Objectives:

1. To introduce the fundamental concepts of approximation algorithms and their importance in solving NP-hard problems.
2. To explore various design techniques used in approximation algorithms, including greedy methods, layering, primal-dual method and semidefinite programming.
3. To understand the analysis of approximation algorithms and the concepts of approximation ratio, performance guarantees and inapproximability results.
4. To introduce the fundamental concepts of fixed-parameter tractable algorithms and various design techniques used in parameterized complexity to solve NP-hard problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Module 1: Overview of Computational Complexity and Introduction to Approximation Algorithms** **Overview of Computational Complexity:** Decision problem vs Optimization problem - P, NP, co-NP, NP-Hard, and NP-Complete classes—along with their interrelationships- Intractability of NP-Complete problems: Challenges and Importance- Polynomial time reductions- Examples of NP-Complete problems -SAT, 3-SAT, Clique, Vertex Cover. **Approaches to solve NP-Complete Problems (Concept only):** Approximation algorithms, Exact algorithms, Randomized algorithms,	9

	Fixed-parameter tractable algorithms. **Introduction to Approximation Algorithms:** Definition and Motivation- Approximation Ratio: Definition - Basic Techniques : *Greedy Algorithms and Local Search.* : Basic Concept, Algorithm and analysis of approximation factor (detailed analysis not required) of Set Cover problem, Scheduling jobs on identical parallel machines, Travelling Salesman problem, Metric Steiner Tree problem.	
2	**Module 2: Advanced Techniques for Designing Approximation Algorithms** **Primal Dual Schema:** Introduction to Linear Programming, Concept of Primal Dual Schema- LP Duality Theorem, Complementary Slackness Theorem. Linear programming formulation of the Set Cover, Vertex Cover, Minimum Multicut, Multiwaycut and Weighted Vertex Cover Problems - Approximation algorithm for the SET Cover problem - using simple rounding technique and primal dual schema - analysis of approximation factor. **Randomized Algorithms:** Concept of randomization, Randomized rounding -Set Cover Problem, Randomized algorithm for MAX CUT problem, Derandomization of MAX CUT algorithm. **Semidefinite Programming (SDP)** : Basics of SDP and its relation to LP, Formulating approximation problems using SDP, SDP-based approximation algorithm and analysis of approximation ratio for the MAX-CUT problem.	**9**
3	**Module 3: Hardness of Approximation Algorithms** **Hardness of Approximation:** Reductions, gaps, and hardness factors, PCP Theorem, Hardness of MAX-3SAT, Hardness of MAX-3SAT with bounded occurrence of variables, Hardness of vertex cover and Steiner tree, Hardness of Clique.	**9**
4	**Module 4: Introduction to Parameterized Complexity Theory** **Introduction to Parameterized Complexity Theory** : Parameterized problem- Definition and Example, Fixed-parameter Tractable (FPT) algorithms - Definition. **Design Techniques in Parameterized Complexity** : *Kernelization*- Concept, FPT algorithms for Vertex Cover problem and 3-Hitting set problem, *Bounded Search Tree* - Concept, FPT algorithms for Vertex Cover problem and Feedback Vertex Set problem, *Iterative Compression* - Concept, FPT algorithms for Vertex Cover problem. **Parameterized Intractability:** Parameterized reductions, W-hierarchy.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of computational complexity and apply the basic concepts of approximation algorithms to solve NP-hard problems with near-optimal solutions.	**K3**
CO2	Integrate advanced techniques in approximation algorithms to tackle complex computational problems.	**K3**
CO3	Analyze the hardness of approximation for various problems.	**K3**
CO4	Design Fixed-parameter tractable (FPT) algorithms for practically relevant NP-hard problems.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	2	2
CO2	3	3	3	2	2	-	-	-	-	-	2	2
CO3	3	3	3	3	2	2	-	-	-	-	2	2
CO4	3	3	3	3	3	2	2	-	-	-	2	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Design of Approximation Algorithms	David P. Williamson, David B. Shmoys	Cambridge University Press	1st Edition, 2011
2	Approximation Algorithms	Vijay V. Vazirani	Springer	1st Edition, 2001
3	Parameterized Algorithms	Cygan et. al	Springer	1st Edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Randomized Algorithms	Rajeev Motwani, Prabhakar Raghavan	Cambridge University Press	1st Edition, 1995
2	Approximation Algorithms for NP-Hard Problems	Dorit Hochbaum	PWS Publishing	1st Edition, 1997
3	Complexity and Approximation: Combinatorial Optimization Problems and Their Approximability Properties	Giorgio Ausiello, Pierluigi Crescenzi, Giorgio Gambosi	Springer	1st Edition, 2003

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs97
2	https://onlinecourses.nptel.ac.in/noc20_cs39
3	https://onlinecourses.nptel.ac.in/noc21_cs92

SEMESTER S7

SOFTWARE QUALITY ASSURANCE

Course Code	PEITT752	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PEITT633: SOFTWARE PROJECT MANAGEMENT	Course Type	Theory

Course Objectives:

1. To provide students with a deep understanding of Software Quality Assurance (SQA) concepts, and models, including McCall's Classic Model and ISO/IEC 25010, as well as the ability to evaluate software compliance with quality factors and navigate the challenges associated with maintaining software quality.
2. To enable students to design and implement effective SQA processes, including pre-project quality components, SQA plans, and project plans, while understanding the cost implications of software quality
3. To prepare students to apply various tools and methods, including templates, checklists, configuration management, and case tools/IDEs, to support SQA processes.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** SQA: Definitions and Concepts, McCall's Classic Model, ISO/IEC 25010 Model and other alternative models, Software compliance with quality factors, software quality challenges, Organization for assuring software quality, Components of SQA System. **Pre-Project Software Quality Components:** Contract Review, Development and Quality Plans	9

2	**SQA Process Implementation Plan and Activities:** Establishing SQA Process, SQA Plan and Project Plan, Cost of Software Quality, The SQA Model, SQA records and documentation control	**9**
3	**Product Assurance Activities for conformance**: Evaluation of Products, Reviews, Software Testing, Product Quality Metrics. **Process Assurance Activities**: Improvement Processes, Process Quality Metrics, Change Control Process.	**9**
4	**Tools and Methods**: Templates and Checklists, Configuration Management, Case Tools and IDEs. **Process Standards:** Quality Assurance Standards, Quality Management Standards and Models, Project Progress Control, From SDLC to Agile	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	**Assignment/ Micro project**	**Internal Examination-1 (Written)**	**Internal Examination- 2 (Written)**	**Total**
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the foundational concepts of Software Quality Assurance (SQA) and apply pre-project quality components to ensure software compliance with quality factors.	**K2**
CO2	Develop and implement a comprehensive Software Quality Assurance (SQA) process	**K3**
CO3	Describe product and process assurance activities to ensure software conformance.	**K2**
CO4	Use tools and methods to effectively manage and improve software quality and familiarize with Agile methodologies.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3		2						3	3
CO2	3	3	3	3	2						3	3
CO3	3	3	3	**3**							3	3
CO4	3	3	3	3	3				3		3	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Software Quality:Concepts and Practice	Daniel Galin	Wiley	1st edition, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Software Quality Assurance From theory to implementation	Daniel Galin	Pearson Education	2nd edition, 2009
2	Software Engineering: A Practitioner's Approach	Roger S Pressman	McGrawHill	8th edition, 2014
3	Software Quality: Theory and Management	Alan Gillies		3rd edition, 2018

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106101061
2	https://onlinecourses.swayam2.ac.in/cec21_cs21/preview

SEMESTER S7

AUGMENTED AND VIRTUAL REALITY

Course Code	PEITT753	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the foundational concepts and technologies behind augmented and virtual reality systems.
2. To explore the development of AR and VR applications, focusing on interaction techniques and user experience.
3. To understand the hardware and software components used in AR and VR systems.
4. To examine the practical applications, challenges, and future trends in augmented and virtual reality.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Augmented and Virtual Reality**- Overview of AR and VR: Definitions, History, and Evolution, Basic Concepts in AR and VR: Immersion, Presence, Interaction, Components of AR and VR Systems: Display Devices, Input Devices, Tracking Systems, AR vs. VR: Differences and Similarities, Applications of AR and VR: Gaming, Education, Healthcare, Industry.	9
2	**AR and VR Application Development -** AR Application Development: SDKs and Tools (ARCore, ARKit) - VR Application Development: Game Engines (Unity, Unreal Engine) - Interaction Techniques: Gesture Recognition, Voice Commands, Haptic Feedback-User Experience (UX) Design in AR and VR: Design Principles, Best Practices-Case Studies:	9

	Successful AR and VR Applications.	
3	**AR and VR Hardware and Software-**AR Hardware: Smart Glasses, Head-Up Displays, Mobile Devices-VR Hardware: Head-Mounted Displays (HMDs), Motion Controllers, Treadmills-Software Architectures for AR and VR Systems-Rendering Techniques in AR and VR: Real-Time Graphics, 3D Audio, Physics Engines-Performance Optimization in AR and VR: Latency Reduction, Frame Rate Optimization.	**9**
4	**Advanced Topics and Applications in AR and VR-**Challenges in AR and VR: Technical, Ethical, and Social Issues-AR and VR in Education, Training, and Simulation-AR and VR in Healthcare: Therapy, Surgery, Rehabilitation-Future Trends in AR and VR: Mixed Reality (MR), Augmented Virtuality (AV), Metaverse-Ethical Considerations: Privacy, Security, and Impact on Society.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify and describe the basic principles of augmented and virtual reality, including their systems and applications.	**K2**
CO2	Demonstrate the ability to develop simple AR and VR applications with a focus on user interaction and experience	**K2**
CO3	Understand the appropriate hardware and software tools for building AR and VR systems.	**K2**
CO4	Discuss potential applications and future trends in AR and VR technology.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	2	-	-	-	-	-	-	-
CO2	2	-	3	3	2	-	2	-	-	-	-	-
CO3	2	2	3	3	2	-	-	-	-	-	-	-
CO4	2	-	-	-	3	2	2	2	-	-	-	-

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Augmented Reality: Principles and Practice	Dieter Schmalstieg, Tobias Hollerer	Addison-Wesley Professional	1st Edition 2016
2	Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile	Tony Parisi	O'Reilly Media	1st Edition 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Augmented Reality and Virtual Reality: The Power of AR and VR for Business	Timothy Jung, M. Claudia tom Dieck	Springer	1st Edition 2021
2	Virtual Reality and Augmented Reality: Myths and Realities	Bruno Arnaldi, Pascal Guitton, Guillaume Moreau	CRC press	1st Edition 2018
3	Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR	Steve Aukstakalnis	Addison-Wesley Professional	1st Edition, 2017

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/nou23_ge34/preview
2	https://www.youtube.com/watch?v=zLMgdYI82IE
3	https://www.youtube.com/watch?v=MGuSTAqlZ9Q

SEMESTER S7

NETWORK SCIENCE

Course Code	PEITT754	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GAMAT301-Mathematics for Information Science, GAMAT401-Mathematics for Information Science	Course Type	Theory

Course Objectives:

4. The students will learn the main concepts and characteristics of network science.
5. The students will learn the evolution of random networks based on graph theoretical concepts.
6. To equip the students to analyse the robustness of the network by assessing the structural vulnerabilities.
7. To equip the students to model disease spreading patterns in communities.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to network science - The main premise of network science, History and relation to graph theory, physics, sociology, and other disciplines, Examples of networks from different application domains, The characteristics of Network Science, societal and scientific impact. Familiarisation of Network analysis and visualization tools - NetworkX, Gephi, Cytoscape, Infomap, Igraph, Statnet, Network Workbench, Pajek network visualization, Jung network analysis, GraphViz, Matlab's Random Boolean Networks (RBN) toolbox.	9
2	Relevant Concepts From Graph Theory - Undirected, directed, signed, weighted and spatial networks, Paths, connected components,Directed Acyclic Graphs, Bipartite graphs, Clustering coefficients. The Random Network Model - Introduction, Number of Links, Degree	9

	Distribution in random network, The Evolution of a Random Network, Small Worlds, Clustering Coefficient in random network, Watts-Strogatz model. The Barabasi-Albert model- Growth and Preferential Attachment, The Barabási-Albert Model.	
3	Network Robustness- Percolation Theory, Inverse Percolation Transition and Robustness, Robustness of Scale-free Networks, Molloy-Reed Criterion, Critical Threshold, Attack Tolerance, Cascading Failures, Modelling Cascading Failures, Failure Propagation Model, Branching Model, Building Robustness, Designing Robust Networks.	**9**
4	Communities- Basics of Communities, Hierarchical Clustering, Agglomerative Procedures: the Ravasz Algorithm, Divisive Procedures: the Girvan-Newman Algorithm, Hierarchy in Real Networks, Modularity. Spreading Phenomena- Epidemic Modelling, Susceptible-Infected (SI) Model, Susceptible-Infected-Susceptible (SIS) Model, Susceptible-Infected-Recovered (SIR) Model, Network Epidemics, Susceptible-Infected (SI) Model on a Network, SIS Model and the Vanishing Epidemic Threshold, Contact Networks, Digital Viruses, Immunization, Random Immunization, Vaccination Strategies in Scale-Free Networks.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discuss the main concepts and characteristics of network science	**K2**
CO2	Explain the evolution of random network based on graph theoretical concepts.	**K2**
CO3	Build robust network by assessing the structural vulnerabilities	**K3**
CO4	Model disease spreading pattern in communities.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		-	-		-	-	-	-	-	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2
CO3	3	3	3	3	3	2	-	-	-	-	-	2
CO4	3	3	3	3	3	3	-	-	-	-	-	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Network Science	A-L. Barabási	Cambridge University Press	2016
2	Networks - An introduction_	M.E.J. Newman	Oxford Univ Press	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Complex Networks - Structure, Robustness and Function	R. Cohen and S. Havlin	Cambridge University Press	2010
2	Social and Economic Networks	M.O. Jackson	Princeton Univ Press	2008
3	Dynamical Processes on Complex Networks	Barrat, M. Barthelemy and A. Vespignani	Cambridge Univ Press	2008
4	Statistical analysis of network data	E. Kolaczyk	Springer	2009

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106105154,
2	https://www.youtube.com/watch?v=oqOyTdLsq3o
3	https://www.youtube.com/watch?v=2pnLsvz1fSw,
4	https://www.youtube.com/watch?v=WABtTfTnVCI
5	https://www.youtube.com/watch?v=Q7M79w1ZAy8
6	https://www.youtube.com/watch?v=DmwFt5QjL1s
7	https://www.youtube.com/watch?v=TYod3lGidPo
8	https://www.youtube.com/watch?v=W8sR_sq_Lec, ,,
9	https://www.youtube.com/watch?v=qEjhXvqADTQ,
10	https://www.youtube.com/watch?v=X3xE9oj5-3o

SEMESTER S7

CYBER AND NETWORK FORENSICS

Course Code	PEITT755	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT402: Computer Networks	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts of cyber forensics and its importance in investigating cybercrimes.
2. To explore the techniques and tools used in network forensics for detecting and analysing network intrusions.
3. To understand the legal aspects, standards, and procedures involved in cyber and network forensics investigations.
4. To examine advanced topics in cyber and network forensics, including incident response and digital evidence management.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Cyber Forensics: Overview of Cyber Forensics: Definition, Importance, and Applications Types of Cybercrimes: Hacking, Phishing, Identity Theft, Cyberstalking Digital Evidence: Collection, Preservation, and Analysis Cyber Forensics Tools: EnCase, FTK, Autopsy Case Studies: Real-World Cybercrime Investigations	9
2	Network Forensics: Introduction to Network Forensics: Definition and Importance Network Traffic Analysis: Packet Sniffing, Protocol Analysis, Flow Analysis	9

	Intrusion Detection and Prevention Systems: Snort, Suricata Network Forensics Tools: Wireshark, tcpdump, NetFlow Case Studies: Network Breach Investigations	
3	Legal Framework for Cybercrime Investigations: Laws and Regulations Digital Forensics Standards and Best Practices: ISO/IEC 27037 Chain of Custody: Importance, Documentation, and Maintenance Report Writing and Presentation in Forensics: Documentation, Expert Testimony Ethical Issues in Cyber and Network Forensics	**9**
4	Advanced Topics in Cyber and Network Forensics: Incident Response: Preparation, Detection, Containment, Eradication, Recovery Digital Evidence Management: Storage, Archiving, and Retrieval Cloud Forensics: Challenges and Solutions Forensics in Mobile Devices and IoT: Techniques and Tools Future Trends in Cyber and Network Forensics: AI in Forensics, Blockchain Forensics	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Examination (Written)	Evaluate Level Assessment	Analyze Level Assessment	Total
5	**15**	**10**	**10**	**40**

Evaluate and Analyse Level Assessment [20 Marks]

Students should evaluate and analyze a real-world problem, assess the proposed solutions, provide a conclusion on which solution is most appropriate for the problem, and implement the chosen solution.

Criteria for evaluation:

- **Problem Definition (K4 - 4 points)**
    - *Clearly defines the real-world problem.*
    - *Collects and preserves evidence meticulously, following all legal and procedural guidelines.*
- **Problem Analysis (K4 - 4 points)**
    - *Break-down and presents a well-reasoned solution approach.*
    - *Provides insightful and accurate analysis of the evidence, drawing well-supported conclusions..*
- **Evaluate (K5 - 4 points)**
    - *Demonstrates exceptional understanding and application of advanced forensic tools and techniques.*
    - *Shows a strong commitment to ethical standards, ensuring privacy and legal compliance throughout the project.*
- **Implementation (K5 - 4 points)**
    - *Demonstrates expert handling of incidents with clear, effective, and timely response strategies.*
    - *Demonstrates exceptional creativity and problem-solving skills*
- **Conclusion (K4- 2 points, K5 – 2 points)**
    - *Summarizes findings and insights.* ***(K4)***
    - *Reflects critical thinking and informed decision-making.* ***(K5)***

Scoring:

- **Accomplished (4 points)**: Exceptional analysis, clear implementation, and depth of understanding.
- **Competent (3 points)**: Solid performance with minor areas for improvement.
- **Developing (2 points)**: Adequate effort but lacks depth or clarity.
- **Minimal (1 point)**: Incomplete or significantly flawed.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the basic principles of cyber forensics to investigate and analyze digital evidence.	**K3**
CO2	Implement network forensics techniques to detect and analyze network intrusions.	**K3**
CO3	Utilize legal standards and procedures in conducting cyber and network forensics investigations	**K3**
CO4	Analyse and manage digital evidence in advanced cyber forensics scenarios.	**K4**
CO5	Synthesize and evaluate comprehensive cyber and network forensics strategies for large-scale and complex investigations	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Forensics and Cyber Crime: A Hands-On Approach	Nilakshi Jain, Dhananjay Kalbande	Wiley	11st Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Forensics: Investigating Network Intrusions and Cybercrime	EC-Council	Cengage Learning	2nd Edition, 2010
2	Network Forensics: Tracking Hackers through Cyberspace	Sherri Davidoff, Jonathan Ham	Prentice Hall	1st Edition, 2012
3	Legal Principles of Digital Forensics	Kim-Kwang Raymond Choo	Springer	1st Edition, 2019
4	Incident Response & Computer Forensics	Kevin Mandia, Chris Prosise, Matt Pepe	McGraw-Hill Education	3rd Edition, 2014

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://www.youtube.com/watch?v=PgS8XHnOzbU
2	https://www.youtube.com/watch?v=8wF5WysAUzU
3	https://www.youtube.com/watch?v=3FZMy5TJ4HQ
4	https://www.youtube.com/watch?v=93-hn8QIgr8

SEMESTER S7

MACHINE LEARNING

Course Code	OEITT721	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students the overview of machine learning, including various types of learning, data preprocessing techniques, and key algorithms.
2. To enable students to acquire the knowledge of model selection, regularization techniques and neural network architectures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Machine Learning: Overview of Machine Learning- Definition, Types of Machine Learning- Supervised Learning, Unsupervised Learning and Reinforcement Learning, Data Preprocessing- Cleaning, Normalization and Splitting Data-Training St, Test Set and Validation Set, Feature Engineering- Feature Selection and Extraction.	9
2	Supervised Learning Algorithms: Linear Models- Linear Regression and Logistic Regression, Decision Trees- Basics, Splitting Criteria and Overfitting, Ensemble Methods- Random Forests and Gradient Boosting Machines, Support Vector Machines (SVMs)- SVM Concepts and Kernels.	11

3	Model Selection and Neural Networks: Model Evaluation Metrics- Accuracy, Precision, Recall, F1 Score, Receiver Operating Characteristic Curve (ROC Curve), Area Under ROC Curve (AUC Curve), Model Selection- Cross-Validation and Bias-Variance Trade-off, Regularization Techniques- L1 and L2 Regularization, Introduction to Neural Networks- Perceptron, Multi-Layer Perceptron and Perceptron Training Algorithm.	**9**
4	Unsupervised Learning Algorithms: Clustering- K-Means, Hierarchical Clustering and Density-based Spatial Clustering of Applications with Noise (DBSCAN), Dimensionality Reduction- Principal Component Analysis (PCA), Reinforcement Learning (RL)- RL Concepts and Q-Learning.	**7**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain machine learning concepts and gain insights into data preprocessing techniques and feature engineering.	**K2**
CO2	Demonstrate proficiency in implementing supervised learning algorithms and understand the key concepts in SVMs.	**K3**
CO3	Gain insights into model selection and architecture of neural networks as well as apply cross-validation techniques to address bias-variance trade-offs and implement regularization methods.	**K3**
CO4	Explore and apply unsupervised learning techniques and reinforcement learning.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Pattern Recognition and Machine Learning	Bishop, C. M.	Springer, New York	2006
2	Introduction to Machine Learning	E. Alpaydin	PHI	2005
3	Machine Learning	Tom Mitchell	McGraw Hill	1997
4	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Elements of Statistical Learning	Hastie, T., Tibshirani, R. and Friedman, J.	Springer	2001
2	Introduction to Machine Learning	Alex Smola and SVN	Cambridge University Press	2008

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_cs97/preview
2	https://onlinecourses.nptel.ac.in/noc24_ma87/preview

SEMESTER S7

DATA SCIENCE FOR ENGINEERS

Course Code	OEITT722	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. **Develop proficiency in R programming** by mastering foundational concepts such as variables, data types, and data manipulation techniques, including data frames, recasting, and joining. Students will also gain experience in implementing functions, control structures, and performing arithmetic, logical, and matrix operations in R, enabling them to handle complex data analysis tasks.
2. **Apply key data science techniques** across linear algebra, statistics, supervised, and unsupervised learning. This includes solving linear equations, understanding statistical modeling, executing linear and logistic regression, and performing clustering methods like k-means and hierarchical clustering, all with practical implementation in R.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**R for Data Science** - Introduction to R, Variables, and Datatypes in R, Data Frames, Recasting and Joining of Dataframes, Arithmetic, Logical and Matrix operations in R, Functions, Control structures, Data visualization in R.	9
2	**Linear Algebra for Data Science** - Solving Linear Equations, Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors. **Statistics for Data Science**- Statistical Modelling, Random Variables and Probability Mass/Density Functions, Sample Statistics, Hypotheses Testing,	9

3	**Foundations of Data Science** - Introduction to data science, Properties of data, Classification of Data Science, Data Science Process. **Supervised Learning** - Regression - Simple Linear Regression, Multiple Linear Regression, Model Assessment, Implementation of Linear Regression Models in R, Cross Validation, Classification - Logistic Regression, Performance Measures, Logistic Regression Implementation in R, k - Nearest Neighbors (kNN), k - Nearest Neighbors Implementation in R.	**11**
4	**Unsupervised Learning** – Clustering - k- means Clustering, k-means implementation in R, Hierarchical Clustering – Agglomerative Clustering Algorithm, Implementation in R.	**7**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	**4.** Each question carries 9 marks. **5.** Two questions will be given from each module, out of which 1 question should be answered. **6.** Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Utilize R for data science, including variable management, data frames manipulation, recasting, and joining operations, as well as performing arithmetic, logical, and matrix operations using R.	**K2**
CO2	Discuss linear algebra concepts crucial to data science, such as solving linear equations, understanding distances, hyperplanes, halfspaces, and calculating eigenvalues and eigenvectors.	**K2**
CO3	Explain statistical modeling, random variables, probability distributions, and hypotheses testing, and will be able to apply these concepts to real-world data science problems.	**K2**
CO4	Implement various supervised learning models, such as linear regression and logistic regression, and unsupervised learning techniques, such as k-means and hierarchical clustering, using R, and will be able to assess model performance and validate results effectively	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Science for Engineers	Raghunathan Rengaswamy, Resmi Suresh	CRC Press	1st Edition, 2022
2	Applied Statistics and Probability for Engineers	Douglas C. Montgomery and George C. Runger	Wiley	6th Edition, 2016
3	Data science: Concepts and practice	Kotu, V., & Deshpande, B	Morgan Kaufmann	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data	David Dietrich, Barry Heller and Beibei Yang	EMC Education Services	1st Edition, 2015
2	An Introduction to Statistical Learning: with Applications in R.	James, G., Witten, D., Hastie, T., Tibshirani, R.	Springer	2017
3	R for Data Science: Import, Tidy, Transform, Visualize, and Model Data	Hadley Wickham, Garrett Grolemund	O'Reilly	2017

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://nptel.ac.in/courses/106106179

SEMESTER S7

INTERNET OF THINGS

Course Code	OEITT723	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts, architecture, and protocols of the Internet of Things (IoT).
2. To explore the hardware and software platforms used in IoT systems.
3. To understand the role of data analytics and cloud integration in IoT.
4. To examine the applications, security challenges, and future trends in IoT.

SYLLABUS

Module No.	Syllabus Description	Contact Hours (36 Hrs)
1	Introduction to IoT: Internet, Intranet and Extranet. Comparison, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues. IoT reference model, IoT Architecture and core IoT function, Layers, Components, and Protocols.	8
2	**IoT Protocols:** Physical Data Link Layer: IEEE 802.15.4, LoRa, NFC, Zigbee, Bluetooth/Bluetooth Low Energy (BLE), 6LoWPAN Network Layer: IPv4/IPv6, RPL, CoAP	8

	Transport Layer: TCP, UDP, DTLS Session & Application Layer: CoAP, MQTT, HTTP/HTTPS, XMPP,AMQP, DDS	
3	IoT Hardware and Software Platforms : IoT Hardware Platforms:Sensors -LED, Switch,LDR, Temperature Sensor,Fiber Optic. Actuators and Smart Objectives. Raspberry Pi Development Kit, Arduino IDE and board types, ESP8266 IoT Software Platforms: Node-RED, ThingSpeak, Blynk, IoTivity IoT Operating Systems: Contiki, RIOT, TinyOS Cloud Platforms for IoT: AWS IoT, Google Cloud IoT, Microsoft Azure. Introduction to Data Analytics in IoT: Importance, Techniques, and Tools Data Storage and Management in IoT: Edge Computing, Fog Computing Data Visualization and Reporting in IoT	**11**
4	Building IoT Applications: Data Collection, Processing, and Actuation, Security. IoT Security Challenges: Threats, Vulnerabilities, and Solutions. IoT Privacy and Data Protection: Best Practices and Standards Future Trends in IoT: AI Integration, 5G, IoT for Sustainability Case Studies: Smart Homes, Smart Parking , Transportation, Wearables. Industrial IoT-Smart Agriculture, Smart Cities, Healthcare IoT, Smart and connected Cities- Street layer, City Layer, Data Center Layer.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions		
Part A	**Part B**	**Total**
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Apply the basic principles of IoT to understand its architecture, components, and protocols.	**K3**
CO2	Develop IoT applications using appropriate hardware and software platforms.	**K3**
CO3	Integrate data analytics and cloud services in IoT systems for enhanced functionality.	**K3**
CO4	Analyse the security challenges and future trends in IoT applications.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Internet of Things: A Hands-On Approach	Arshdeep Bahga, Vijay Madisetti	Universities Press	1st Edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Internet of Things: Key Applications and Protocols	Olivier Hersent, David Boswarthick, Omar Elloumi	Wiley	2nd Edition, 2012
2	Building the Internet of Things: Implement New Business Models, Disrupt Competitors, and Transform Your Industry	Maciej Kranz	Wiley	1st Edition, 2016
3	Cloud Computing and the Internet of Things: Technologies, Applications and Security	Amita Kapoor, Arshdeep Bahga, Vijay Madisetti	Springer	1st Edition, 2020
4	Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations	Fei Hu	CRC Press	1st Edition, 2016
5	Arduino Cookbook	Michael Margolis	O'Reilly Media	3rd Edition 2020
6	Getting Started With Raspberry Pi	Matt Richardson, Shawn Wallace	O'Reilly Media	3rd Edition 2013

Video Links (NPTEL, SWAYAM…)	
No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs115/
2	https://onlinecourses.swayam2.ac.in/ntr24_ed44/
3	https://onlinecourses.nptel.ac.in/noc24_cs115

SEMESTER 8

INFORMATION TECHNOLOGY

SEMESTER S8

BIOINFORMATICS

Course Code	**PEITT861**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Students should be able to grasp the foundational principles of molecular biology to effectively navigate and utilize them in research and analysis.
2. To equip students with a range of computational tools and algorithms to perform pairwise and multiple sequence alignments, and construct phylogenetic trees, enabling the identification of evolutionary relationships and genetic variations.
3. Students will be able to utilize statistical and computational algorithms to predict the secondary structures of proteins and RNA, aiding in the understanding of their functions and interactions in biological systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Bioinformatics** – scope, elementary tasks in bioinformatics, Molecular biology basics - human genome organization, central dogma, DNA and RNA structure, Genetic codes, Datatypes - Gene expression data, Micro Arrays, NGS, Pathways, molecular interactions, Biological Databases - Types of databases, Sequence databases – GenBank, DDBJ, EMBL, Entrez, Unigene, Protein sequence databases – SwissProt, UniProt, PDB	9
2	**Sequence Alignment** – local and global alignment, similarity vs homology, dot matrices and hash coding, FASTA files, Algorithms for pairwise sequence alignment – Needleman and Wunsch, Scoring Matrices – basic concepts, BLAST and its variants, Multiple Sequence Alignment – Goals, scoring, substitution matrices, PAM and BLOSUM, gap penalties, CLUSTAL and its variants	9

3	Phylogenetic trees, Topologies, Distance matrix based and Character based tree construction, Algorithms for Phylogenetic tree construction – UPGMA, Neighbor-Joining, Maximum Parsimony, Pattern representations – deterministic and probabilistic patterns, algorithms for pattern discovery – HMM, gene discovery using GeneMark	**9**
4	**Introduction to Protein structures** – primary, secondary and tertiary, measures of prediction accuracy, statistical algorithms for protein secondary structure prediction – Chou-Fasman, Protein Folding – Lattice models, algorithms for predicting RNA secondary structure – Nussinov algorithm	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain basic concepts in molecular biology and familiarize various biological datatypes and databases	**K2**
CO2	Discuss various algorithms and tools for performing pairwise and multiple sequence alignment	**K2**
CO3	Apply various algorithms for the construction of phylogenetic trees and familiarize basic algorithms for gene discovery	**K3**
CO4	Apply various statistical algorithms for predicting protein and RNA secondary structure	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			3	3						
CO2	3	2	3		3	3	2					3
CO3	3	2	3		3	3	2					3
CO4	3	3	3		3	3	2					3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Bioinformatics Databases and Algorithms	N Gautham	Narosa Publications	2006
2	Fundamental Concepts of Bioinformatics	D. E. Krane , M. L. Raymer	Pearson Education	2003
3	Bioinformatics: Basics, Algorithms and Applications	Ruchi Singh, Richa Sharma	Universities Press	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Introduction to Bioinformatics Algorithms	Neil C Jones and Pavel A Pevzner	MIT Press	2004
2	Introduction to Bioinformatics	T. K. Attwood and D. J. Parry-Smith	Pearson	2003
3	Bioinformatics: Sequence and Genome Analaysis	David W. Mount	CBS Publishers	2005

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_bt06/preview

SEMESTER S7

SOFTWARE TESTING

Course Code	**PEITT862**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT503: Software Engineering	**Course Type**	Theory

Course Objectives:

1. To provide students with foundational knowledge of essential software testing techniques, including unit testing, boundary value testing, equivalence class testing, and decision table-based testing.
2. To introduce students to life cycle-based and agile testing methodologies to ensure software quality throughout various stages of development and learn about test management, planning, and the use of automated testing tools.
3. To equip students with the skills to apply system testing and object-oriented testing techniques to identify and resolve software defects.
4. To foster Test-Driven Development Practices: Encourage students to adopt test-driven development to produce reliable and maintainable software solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction- Software Testing Terminology- STLC-Software Testing Methodology- Verification and Validation Activities-Verification – Verification of Requirements- Verification of High level Design- Verification of Low level Design - How to verify Code- Validation, Functional testing, Non Functional Testing, SDLC and STLC relationship.	9
2	Testing Techniques: Dynamic Testing: Black Box Testing, Dynamic Testing: White Box Testing, Static Testing, Validation Activities, Regression Testing, Unit Testing, Integration Testing, Sanity Testing, Smoke Testing,	9

	Performance Testing, Load Testing, Stress Testing, Usability Testing, Compatibility Testing	
3	Managing The Test Process:Test Management, Software Metrics, Testing Metrics for Monitoring and Controlling the Testing Process, Efficient Test Suite Management, Testing Process Maturity Models, Introduction to Test Management Tool - Jira	**9**
4	Test Automation: Automation and Testing Tools - Testing For Specialized Environment: Testing Object Oriented Software, Testing Web based Systems, Tracking The Bug: Debugging	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain software testing life cycle (STLC) to ensure comprehensive software quality.	**K2**
CO2	Apply various software testing techniques to ensure comprehensive validation and reliability of software systems.	**K3**
CO3	Perform the software testing process effectively to monitor, control, and improve the testing process.	**K3**
CO4	Apply test automation strategies to effectively test object-oriented software and web-based systems	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	2	-	-	-	-	-	2	2
CO2	2	3	2	2	2	-	-	-	-	-	2	2
CO3	2	3	3	2	2	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	-	2	2	2	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Software testing : principles and practices	Naresh Chauhan	Oxford University Press	2nd edition, 2016
2	Software Testing: A Craftsman's Approach	Paul C. Jorgensen	CRC Press	4th Edition, 2014
3	Introduction to Software Testing,	Paul Ammann and Jeff Offutt	Cambridge University Press.	2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Art of Software Testing	Glenford J. Myers, Tom Badgett, Corey Sandler	John Wiley & Sons Publication	3rd Edition, 2012
2	Software Testing and Quality Assurance: Theory and Practice	KshirasagarNaik and PriyadarshiTripathy	Wiley-Spektrum	1st edition, 2008

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	https://www.youtube.com/playlist?list=PLrpK1inhO61VDiW_RBhkizmTYyUE0eoAF
2	https://nptel.ac.in/courses/106105150
3	https://www.youtube.com/watch?v=BlJEP7XG5iY
4	https://youtu.be/b1Qpvqm0UAo?si=M6ALob-iLJ9E0i_r

SEMESTER S8

ADHOC AND WIRELESS SENSOR NETWORKS

Course Code	PEITT863	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT402: Computer Networks	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts and characteristics of Adhoc networks.
2. To understand the routing protocols and techniques used in Adhoc networks.
3. To explore the architecture and protocols of Wireless Sensor Networks (WSNs).
4. To examine the applications, challenges, and security concerns in Adhoc and Wireless Sensor Networks

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Adhoc Networks: Definition and Characteristics, Types of Adhoc Networks: MANETs, VANETs, and FANETs, Challenges in Adhoc Networks: Scalability, Mobility, Energy Efficiency, Medium Access Control in Adhoc Networks, Case Studies and Examples.	9
2	Introduction to Routing in Adhoc Networks, Proactive, Reactive, and Hybrid Routing Protocols, AODV, DSR, OLSR, and TORA Protocols, Quality of Service (QoS) in Adhoc Networks, Performance Analysis of Routing Protocols.	9
3	Introduction to Wireless Sensor Networks: Architecture and Protocols, Sensor Node Architecture and Design, Communication Protocols in WSNs: MAC, Routing, and Transport Layer Protocols, Energy Management in WSNs, WSN Applications in Environmental Monitoring, Healthcare, and Industrial Automation.	9
4	Key Applications of Adhoc Networks and WSNs, Challenges in Deployment and Maintenance, Security Issues in Adhoc Networks and WSNs: Attacks, Intrusion Detection, Privacy Concerns and Mitigation Techniques, Future Trends and Emerging Technologies in Adhoc and WSNs.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the principles of Adhoc networks to design and implement basic network configurations.	**K3**
CO2	Analyze and implement routing protocols specific to Adhoc networks.	**K3**
CO3	Design and evaluate Wireless Sensor Networks for various applications	**K3**
CO4	Assess the challenges, applications, and security measures in Adhoc and Wireless Sensor Networks.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3
CO4	3	3	2	2	-	-	-	-	-	-	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ad Hoc and Sensor Networks: Theory and Applications	Carlos Corderio, Dharma P. Agrawal	World Scientific	2nd Edition, 2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Module I: Mobile Ad Hoc Networking: The Cutting Edge Directions	Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic.	Wiley-IEEE Press	2nd Edition, 2013
2	Module II: Ad Hoc Wireless Networks: Architectures and Protocols	C. Siva Ram Murthy, B. S. Manoj	Pearson Education	1st Edition, 2004
3	Module III: Wireless Sensor Networks: An Information Processing Approach	Feng Zhao, Leonidas J. Guibas	Morgan Kaufmann	1st Edition, 2004
4	Module IV: Security in Wireless Ad Hoc and Sensor Networks	Erdal Cayirci, Chunming Rong	Wiley	1st Edition, 2009

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	https://www.youtube.com/watch?v=Jh46Ivv6gQ0
2	https://www.youtube.com/watch?v=YFPln8wDMEg
3	https://www.youtube.com/watch?v=B3ZNjE_gO6w
4	https://www.youtube.com/watch?v=zQWE7HEBOck

SEMESTER S8
SEMANTIC WEB

Course Code	PEITT864	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PBITT504 - Web Application Development	Course Type	Theory

Course Objectives:

1. To introduce the foundational concepts and architecture of the Semantic Web.
2. To explore RDF and SPARQL as the core technologies for representing and querying data on the Semantic Web.
3. To provide an understanding of Ontology design and the use of OWL for Semantic Web applications.
4. To investigate the practical applications of the Semantic Web and the role of reasoning techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to the Semantic Web and RDF:** Evolution of the Web and the need for the Semantic Web, Semantic Modeling, Semantic Web Technologies: RDF, RDFS, OWL, and SPARQL RDF (Resource Description Framework): Syntax , Semantics URI, Vocabularies, Metadata and the Semantic Web	9
2	**RDF and SPARQL:** Semantic Web Application Architecture, RDF and Interfacing, RDF Schema, RDFS-Plus, SKOS,FOAF, The Semantic Web, RDF, and Linked Data (and SPARQL) , SPARQL Queries- Copying, Creating, and Converting Data (and Finding Bad Data)	9
3	**Ontologies and OWL:** Introduction to Ontologies: Concepts and Importance, Ontology Design Principles Basic OWL(Web Ontology Language), Ontologies in OWL, OWL Formal Semantics, Ontologies and Rules, Ontology Engineering	9
4	**Semantic Web Applications:** Applying Machine Reasoning and Learning in Real World Applications, Case Studies of Semantic Web Applications - Achieving Balance Between Innovation and Security in the Cloud With Artificial Intelligence of Things: Semantic Web Control Models- Traffic: An Intelligent System for Detecting Traffic Events Based on Ontologies- Multi-Factor Authentication Web	9

	Security System Based on Facial Recognition, One Time Password, and Hashed Secure Question- Enhancing Usability and Control in Artificial Intelligence of Things Environments (AIoT) Through Semantic Web Control Models- Emerging Trends in Artificial Intelligence of Things With Machine Learning and Semantic Web Convergence	

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Apply the principles of the Semantic Web to describe its layered architecture.	**K3**
CO2	Construct and query RDF data using SPARQL in Semantic Web environments.	**K3**
CO3	Develop and implement ontologies using OWL for semantic data representation.	**K3**
CO4	Utilize reasoning techniques in Semantic Web applications to solve complex problems.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL	Dean Allemang, James Hendler	Morgan Kaufmann	2nd Edition, 2011
2	Foundations of Semantic Web Technologies	Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph	Chapman and Hall/CRC	1st Edition, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Learning SPARQL	Bob DuCharme	O'Reilly Media	2nd Edition, 2013
2	Ontology Engineering in a Networked World	Mari Carmen Suárez-Figueroa, Asunción Gómez-Pérez, Enrico Motta	Springer	1st Edition, 2012
3	Reasoning Web: Logical Foundation of Knowledge Graph Construction and Query Answering	Gerhard Lakemeyer, Bernhard Nebel	Springer	1st Edition, 2015
4	Semantic Web Technologies and Applications in Artificial Intelligence of Things	Fernando Ortiz-Rodriguez, Amed Leyva-Mederos, Sanju Tiwari, Ania R. Hernandez-Quintana, Jose L. and Martinez-Rodriguez	IGI Global	May, 2024

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	https://www.youtube.com/watch?v=sLnbDyG2z3Q
2	https://youtu.be/8LBS5S3-4bI
3	https://youtu.be/HEQDRWMK06I
4	https://www.youtube.com/watch?v=3JZ7l_OeQyE

SEMESTER S8

ROBOTICS AND AUTOMATION

Course Code	PEITT865	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCITT501: Machine Learning, PCITT602: Advanced Artificial Intelligence	Course Type	Theory

Course Objectives:

1. To introduce students to the fundamental concepts and history of robotics, and familiarize them with basic robotic systems and programming.
2. To provide an in-depth understanding of the kinematics and dynamics of robotic systems, and to develop skills in trajectory planning and control.
3. To introduce automation concepts and industrial robots, focusing on their application in modern manufacturing and production systems.
4. To explore advanced topics in robotics and automation, including machine learning, human-robot interaction, and future trends.
5. To develop students' abilities to critically analyze, evaluate, and design complex robotics and automation systems by applying advanced concepts, tools, and frameworks.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**History and Overview of Robotics:** Evolution of robotics, types of robots, and applications. **Fundamental Concepts in Robotics:** Kinematics, dynamics, control systems, sensors, and actuators. **Robot Classification:** Based on geometry, degrees of freedom, and application areas. **Basic Programming for Robots:** Introduction to robot programming languages and simulators (e.g., Python, ROS basics).	9

2	**History and Overview of Robotics:** Evolution of robotics, types of robots, and applications. **Fundamental Concepts in Robotics:** Kinematics, dynamics, control systems, sensors, and actuators. **Robot Classification:** Based on geometry, degrees of freedom, and application areas. **Basic Programming for Robots:** Introduction to robot programming languages and simulators (e.g., Python, ROS basics).	**9**
3	**Introduction to Automation:** Concepts of automation, types of automation (fixed, programmable, flexible). **Industrial Robots:** Types of industrial robots, applications in manufacturing, assembly, and inspection. **PLC and SCADA Systems:** Basics of Programmable Logic Controllers (PLCs), Supervisory Control and Data Acquisition (SCADA) systems. **Sensors and Actuators in Automation:** Types of sensors (proximity, vision, force), actuators (electric, hydraulic, pneumatic).	**9**
4	**Machine Learning in Robotics:** Introduction to machine learning algorithms and their applications in robotics (e.g., vision, decision-making). **Human-Robot Interaction (HRI):** Fundamentals of HRI, collaborative robots (cobots), safety in HRI. **Robot Operating System (ROS):** Advanced ROS concepts, ROS packages for manipulation and navigation. **Future Trends in Robotics and Automation:** Autonomous systems, robotics in healthcare, AI-driven automation.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Examination (Written)	Evaluate Level Assessment	Analyze Level Assessment	Total
5	**15**	**10**	**10**	**40**

Evaluate and Analyze Level Assessment [20 Marks]

Students should evaluate and analyze a real-world optimization problem, assess the proposed solutions, provide a conclusion on which solution is most appropriate for the problem.

Criteria for evaluation:

1. **Case Study Analysis (K4 - 4 points)**

   Assignment:

   - *Provide students with a case study of a real-world robotics or automation system. This could involve a specific robot used in manufacturing, a robotic surgery system, or an automated warehouse system.*
   - ***Task**: Ask students to analyze the system by breaking it down into its components (e.g., sensors, actuators, control systems, software). They should evaluate how each component contributes to the overall functionality and how these components interact with each other.*
   - ***Expected Output:** A detailed report where students identify key elements, explain their roles, and analyze the strengths and weaknesses of the system's design.*

2. **Comparative Evaluation of Robotics Frameworks (K4 – 4 Points)**

   Project:

   - *Have students work on a project where they compare two different robotics frameworks or automation tools (e.g., ROS vs. a proprietary robotics framework, or different PLC brands in automation).*
   - ***Task:** They should evaluate the frameworks/tools based on criteria such as ease of use, scalability, cost, community support, and performance in specific tasks.*
   - ***Expected Output:** A comparative study report or presentation that not only compares the tools but also provides a well-reasoned conclusion about which tool is better suited for particular applications, supported by evidence and critical evaluation.*

3. **Design and Critique (K5 - Evaluating)**

   Design Task:

   - *Ask students to design a simple robotic system or automation process for a given problem, such as automating a repetitive task in a manufacturing line or designing a robot for a specific healthcare application.*

- ***Task:*** *Once the design is completed, have them critique their own design by identifying potential weaknesses, risks, and areas for improvement. This self-evaluation should consider factors like efficiency, safety, and cost-effectiveness.*
- ***Expected Output:*** *A design document with a critical evaluation section where students justify their design choices and propose enhancements based on their evaluation.*

4. **Simulation-Based Problem Solving (K5 - 4 points)**

   Lab Task:

   - *Use a robotics simulation software (e.g., Gazebo with ROS) where students are given a scenario with specific goals (e.g., navigate an environment, complete a task).*
   - ***Task:*** *Students must analyze the problem, develop a solution within the simulation environment, and then evaluate the effectiveness of their solution, including how they could optimize the process or improve performance.*
   - ***Expected Output:*** *A simulation report or demonstration video, accompanied by an analysis of the performance and a critique of the solution, with suggestions for improvements.*

5. **Peer Review (K4- 2 points, K5 – 2 points)**

   Activity:

   - *Organize a peer review session where students present their projects to their peers. Each student group reviews another group's project, analyzing its strengths and weaknesses.*
   - ***Task:*** *Students must provide constructive feedback and evaluate the feasibility and effectiveness of the approach taken by their peers, based on criteria such as technical soundness, innovation, and potential for real-world application.*
   - ***Expected Output:*** *Written feedback and evaluation reports from peers (**K4**), followed by a discussion where students defend their design decisions based on the critiques received (**K5**).*

Scoring:

1. **Accomplished (4 points)**: Exceptional analysis, clear implementation, and depth of understanding.
2. **Competent (3 points)**: Solid performance with minor areas for improvement.
3. **Developing (2 points)**: Adequate effort but lacks depth or clarity.
4. **Minimal (1 point)**: Incomplete or significantly flawed.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply basic principles of robotics to program and simulate simple robotic tasks.	**K3**
CO2	Apply kinematic and dynamic models to design and control robotic manipulators.	**K3**
CO3	Implement automation systems using industrial robots, PLCs, and SCADA systems.	**K3**
CO4	Apply advanced techniques in robotics and automation to develop innovative solutions in emerging areas.	**K3**
CO5	Critically evaluate and optimize robotics and automation systems by analyzing their design, performance, and impact.	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Robotics: Mechanics and Control	John J. Craig	Pearson	4th Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Robotics: Modelling, Planning and Control	Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo	Springer	2nd Edition, 2010
2	Robot Modeling and Control	Mark W. Spong, Seth Hutchinson, M. Vidyasagar	Wiley	1st Edition, 2005
3	Automation, Production Systems, and Computer-Integrated Manufacturing	Dafydd Stuttard, Marcus Pinto	Wiley	2nd Edition, 2011
4	Probabilistic Robotics	Sebastian Thrun, Wolfram Burgard, Dieter Fox	MIT Press	1st Edition, 2005

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	https://www.youtube.com/watch?v=rYWJdZ5qg6M&list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_
2	https://www.youtube.com/watch?v=gXX-4rrB4tw&list=PLQ3sZ7NCnFlEej8AWH_BfO9W7xlirvK6l
3	https://www.youtube.com/watch?v=uOtdWHMKhnw
4	https://www.youtube.com/watch?v=LyC9RAYE96M

SEMESTER S8

COMPUTER VISION

Course Code	OEITT831	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Linear Algebra, Probability	Course Type	Theory

Course Objectives:

1. To equip students of image processing techniques for computer vision
2. Enable students to analyze various geometric techniques in computer vision
3. To enable students to summarize various feature detectors and descriptors and feature-matching algorithms
4. To equip students to describe motion analysis and object recognition techniques
5. To enable students to explore the applications of computer vision

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction and Goals of Computer Vision** **Review of image processing techniques**: Image filtering, Image enhancement, Image segmentation, thresholding, Image Transforms, Color Image Processing, Mathematical morphology and use in texture analysis,Binary shape analysis and connectedness	9
2	**Measuring Light and Radiometry**: Reflectance and BRDF(basics only), Monocular and binocular imaging system, Geometric Transformation,Orthographic & Perspective Projection, Camera model-Basic Pinhole Camera model **Stereo vision**: introduction; concept of disparity and its relationship with depth	9
3	**Feature Detection and Description**: Harris Corner Detection, Canny Edge Detection, Blob Detection, Line and curve detection, Hough transform **Feature Descriptors**: Histogram of Oriented Gradients, Scale Invariant Feature Transform(SIFT),Mosaics and Snakes, Feature Matching algorithms:	9

	Brute Force Matcher, Need for feature detection and description and limitations	
4	Shape from X - Shape from shading, Photometric stereo. Occluding contour detection. **Motion Analysis**-Regularization theory, Optical Flow: brightness constancy equation, Lucas- Kanade method, Principles of Structure from motion(Introduction). **Object recognition**: Hough transforms and other simple object recognition methods **Application**: Face detection, Face recognition and Eigen faces	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement fundamental image processing techniques required for computer vision	**K3**
CO2	Describe various geometric techniques in computer vision	**K2**
CO3	Illustrate various feature descriptors and image matching algorithms used in computer vision	**K3**
CO4	Explain various applications of computer vision that use motion tracking, object detection and recognition techniques	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2										
CO3	3	2	2									
CO4	3	2	2									

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer vision: A modern approach	Forsyth and Ponce	Prentice Hall of India	Second Edition,2015
2	Computer Vision: Algorithms & Applications	Richard Szeleski	Springer	Second Edition,2022
3	Robot Vision	B K P Horn	McGraw-Hill	1986

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the**	**Edition and**

			Publisher	Year
1	Multiple View Geometry in Computer Vision	Richard Hartley and Andrew Zisserman	Cambridge University Press	Second Edition,2004
2	Computer & Machine Vision	E R Davies	Academic Press	Fourth Edition,2012

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	Link to an NPTEL course on Computer Vision: https://archive.nptel.ac.in/courses/106/105/106105216/
2	Computer Vision Models: https://udlbook.github.io/cvbook/

SEMESTER S8

DEEP LEARNING

Course Code	OEITT832	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	OEITT721	Course Type	Theory

Course Objectives:

1. To provide students the understanding of deep learning principles and neural network architectures.
2. To enable students to explore generative models and transfer learning, the latest trends in deep learning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours (36 Hrs)
1	**Introduction to Deep Learning:** Traditional Machine Learning to Deep Learning, Neural Networks- Feedforward Neural Networks, Activation Functions -Sigmoid, ReLU, Tanh, Softmax, Training Neural Networks- Forward and Backward Propagation Algorithm, Optimization Algorithms (Gradient Descent, Stochastic Gradient Descent, Adam).	9
2	**Convolutional Neural Networks (CNNs):** CNN Basics- Convolutional Layers, Pooling Layers, CNN Architectures- LeNet, AlexNet, VGG, ResNet, Applications of CNNs.	8
3	**Recurrent Neural Networks (RNNs) and Transformers:** RNN Basics- RNN Structure, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Advanced RNN Architectures- Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Transformers and Attention Mechanisms- Attention Mechanism Basics, Transformer Architecture (BERT, GPT).	11
4	**Generative Models and Transfer Learning:** Generative Adversarial Networks (GANs)- GAN Basics, Applications of GANs, Autoencoders- Architecture, Transfer Learning and Fine-Tuning- Pre-trained Models, Fine-Tuning Strategies.	8

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Build basic Neural Network models using appropriate activation functions and optimization techniques.	**K3**
CO2	Apply Convolutional Neural Networks and their architectures to various tasks.	**K3**
CO3	Develop Recurrent Neural Networks and Transformer models.	**K3**
CO4	Explain the principles of Generative Adversarial Networks and Autoencoders.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Deep Learning	Ian Goodfellow, Yoshua Bengio, and Aaron Courville	MIT Press	1st Edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	Springer	1st Edition, 2018
2	Deep Learning for Computer Vision	Rajalingappaa Shanmugamani	Packt Publishing	1st Edition, 2018
3	Natural Language Processing with PyTorch	Delip Rao and Brian McMahan	O'Reilly Media	1st Edition, 2019
4	Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play	David Foster	O'Reilly Media	1st Edition, 2020

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106198/
2	https://archive.nptel.ac.in/courses/106/106/106106184/

SEMESTER S8

WEB DESIGNING

Course Code	OEITT833	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Gain a comprehensive understanding of web development, from structuring and styling web pages with HTML and CSS to adding interactivity with JavaScript and jQuery, and understanding server interactions and web hosting.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Website creation roles, Gearing up for web design, Web Page Addresses- URL. HTML: HTML document structure, identifying text elements, adding an image, Changing the look with a style sheet, marking up Elements: Text, Paragraph, Heading, Horizontal Rule, Lists, Links, href attribute, Linking to pages on the web, Linking within your site, Targeting a new browser window, Mail links. Images: image formats, img element, adding SVG elements, Responsive image markup. Table, Forms, Embedded media: iframe, object, video and audio, canvas.	8
2	Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties), Navigation Bar, CSS Color, Creating page Layout and Site Designs, Positioning: Floating and positioning: normal flow, floating, fancy text wrap with CSS shapes, positioning basics, relative positioning, Absolute positioning, fixed positioning; CSS Layout with Flexbox and Grid. Responsive Web Design: RWD, The responsive recipe, choosing	10

	breakpoints, designing responsively, Transition, Transforms, and Animations: CSS transitions, CSS transforms, Keyframe animations	
3	**Introduction to JavaScript:** JavaScript, Adding JavaScript to a page, the anatomy of a script, the browser object, Events, putting it all together, Meet the DOM, Polyfills, JavaScript libraries **jQuery:** jQuery, A basic jQuery example, jQuery use, finding elements, jQuery selection, Getting element content, Updating elements, Changing content, Inserting elements, Adding new content, Getting and setting attributes, Getting and setting CSS properties, Using .each(), events, The event object, Effects, Animating CSS properties, Using animation, traversing the DOM, Working with forms, JavaScript libraries, jQuery and Ajax.	**10**
4	Introduction to XML: syntax, element, attribute, HttpRequest SVG: Drawing with XML, Features of SVG as XML, SVG tools, SVG production tips, Responsive SVG. Web Servers: Introduction, HTTP Transactions, Multitier Application Architecture, Client-Side Scripting versus Server-Side Scripting, Accessing Web Servers. Introduction to Web Publishing or Hosting.	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub-divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course, students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarise HTML tags.	**K2**
CO2	Apply CSS to add presentation style to web pages.	**K3**
CO3	Apply JavaScript to add functionality to web pages.	**K3**
CO4	Understand the basics of XML, SVG, and web servers.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Learning Web Design	Jennifer Niederst Robbins	O'Reilly	Fifth/2018
2	JavaScript and JQuery: Interactive Front–End Web Development	Jon Duckett	Wiley	First/2014
3	MASTERING HTML, CSS & Java Script Web Publishing	Laura Lemay Rafe Colburn Jennifer Kyrnin	BPB Publications	First/2016
4	Internet and World Wide Web How To Program	Paul J. Deitel, Harvey M. Deitel, Abbey Deitel	Pearson Education	Fifth/2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	HTML and CSS: Design and Build Websites	Jon Duckett	Wiley	1st Edition 2011
2	CSS: The Definitive Guide	Eric A. Meyer	O'Reilly Media	4th Edition 2017
3	CSS Secrets: Better Solutions to Everyday Web Design Problems	Lea Verou	O'Reilly Media	1st Edition 2015
4	Bulma: A Modern CSS Framework	Michael L. Smith	Packt Publishing	1st Edition 2019
5	JavaScript: The Good Parts	Douglas Crockford	O'Reilly Media	1st Edition 2008
6	Eloquent JavaScript: A Modern Introduction to Programming	Marijn Haverbeke	No Starch Press	3rd Edition 2018

Video Links (NPTEL, SWAYAM…)	
Sl. No	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106156/