SEMESTER 3

COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)

Common to B Tech in Cyber Security - CZ

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.

Module No.	Syllabus Description					
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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	
carrying 3 marks	• Each question can have a maximum of 3 sub	60
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

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.	К3
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	К3
CO3	Familiarize and apply limit theorems and to understand the fundamental characteristics of stochastic processes.	К3
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

	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	9 th edition, 2016			
2	Introduction to Probability Models	Sheldon M. Ross	Academic Press	13 th 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	1 st edition, 2001		
3	Probability, Random Variables and Stochastic Processes	Papoulis, A. & Pillai, S.U.,	Tata McGrawHill.	4 th 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

THEORY OF COMPUTATION

(Common to CS/CA/CM/CD/CN/CC)

Course Code	PCCST302	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)	PCCST205	Course Type	Theory

Course Objectives:

- 1. To introduce the concept of formal languages.
- **2.** To discuss the Chomsky classification of formal languages with a discussion on grammar and automata for regular, context-free, context-sensitive, and unrestricted languages.
- 3. To discuss the notions of decidability and halting problem.

Module No.	Syllabus Description	Contact Hours	
	Foundations (Linz, Hopcroft)		
	Motivation for studying computability, need for mathematical modeling -		
	automata, Introducing automata through simple models - On/Off switch,		
	coffee vending machine. Three basic concepts: Alphabet, Strings, and		
	Languages		
	Finite Automata (Linz, Hopcroft)		
1	Formal definition of a finite automaton, Deterministic Finite Automata	11	
	(DFA), Regular languages, Nondeterminism (guess and verify paradigm),		
	Formal definition of a nondeterministic finite automaton, NFA with epsilon		
	transitions, Eliminating epsilon transitions (Proof not expected), Equivalence		
	of NFAs and DFAs (Proof not expected) - The Subset Construction. DFA		
	State Minimization, Applications of finite automata - text search, keyword		
	recognition		
	Regular Expressions (Linz)		
2	The 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, Pattern Matching and Regular Expressions, Regular grammar,	
	Equivalence with FA - Conversion in both directions	11
	Properties of Regular Languages (Linz)	
	Closure and Decision Properties of Regular Languages (with proofs), The	
	Pumping Lemma for Regular Languages (with formal proof), Pumping	
	lemma as a tool to prove non regularity of languages	
	Context-Free Grammars and Applications (Linz)	
	Formal definition of a context-free grammar, Designing context-free	
	grammars, Leftmost and Rightmost Derivations Using a Grammar, Parse	
	Trees, Ambiguous Grammars, Resolving ambiguity, Inherent ambiguity,	
	CFGs, and programming languages	
	Pushdown Automata (Linz)	
	Formal definition of a pushdown automaton, DPDA and NPDA, Examples	
	of pushdown automata	
	Equivalence NPDAs and CFGs (Proof not expected) - conversions in both	
	directions	
	Simplification of Context-Free Languages (Linz)	
3	Elimination of useless symbols and productions, Eliminating epsilon	11
	productions, Eliminating unit productions, Chomsky normal form, Greibach	
	normal form,	
	Properties of Context-Free Languages (Linz)	
	The Pumping Lemma for Context-Free Languages (with formal proof),	
	Closure and Decision Properties of Context-Free Languages (with formal	
	proofs)	
	Turing Machines (Kozen)	
	The formal definition of a Turing machine, Examples of Turing machines -	
	Turing machines as language acceptors, Turing machines as computers of	
	functions, Variants of Turing Machines (Proofs for equivalence with basic	
	model not expected), Recursive and recursively enumerable languages	
4	Chomskian hierarchy, Linear bounded automaton as a restricted TM.	11
	Computability (Kozen)	
	Church Turing thesis, Encoding of TMs, Universal Machine and	
	Diagonalization, Reductions, Decidable and Undecidable Problems, Halting	
	problem, Post Correspondence Problem and the proofs for their	
	undecidability.	

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

Course Outcomes (COs)

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

	Bloom's Knowledge Level (KL)	
CO1	Classify formal languages into regular, context-free, context-sensitive, and unrestricted languages.	K2
CO2	Design finite state automata, regular grammar, regular expression, and Myhill- Nerode relation representations for regular languages.	К3
CO3	Design push-down automata and context-free grammar representations for context-free languages.	К3
CO4	Design Turing Machines to accept recursive and recursively enumerable languages.	К3
C05	Understand the notions of decidability and undecidability of problems, Halting problem.	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
CO3	3	3	3	3								3
CO4	3	3	3	3								3
CO5	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	An Introduction to Formal	Peter Linz and Susan H.	Jones and Bartlett	7/2 2022				
	Languages and Automata	Rodger	Publishers, Inc	7/e, 2022				
	Introduction to Automata	John F. Honoroft	Dainhow Dook					
2	Theory Languages and			3/e, 2015				
	Computation	Jeffrey D.Ullman	Distributiors					
3	Automata and Computability	Dexter C. Kozen	Springer	1/e,2007				

	Reference 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	Michael Sinser	Cengage India Private	3/e, 2014			
	Computation	Wiender Sipser	Limited				
2	Introduction to Languages and	John C Martin	McGraw-Hill	4/e 2010			
	the Theory of Computation	John C Wattin	Education	4/0, 2010			
3	Theory of Computation: A	Kavi Mahesh	Wiley	1/e 2012			
5	Problem-Solving Approach	Kavi Manesh	whey	1/0, 2012			
4	Elements of the Theory of	Harry R. Lewis, Christos	Dearson Education	2/2 2015			
	Computation	Papadimitriou		2/6, 2013			

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

SEMESTER S3

DATA STRUCTURES AND ALGORITHMS

(Common to CS/CA/CM/CD/CR/AI/AM/AD/CB/CN/CC/CU/CI/CG)

Course Code	PCCST303	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	Course Type	Theory

Course Objectives:

- **1.** To provide the learner a comprehensive understanding of data structures and algorithms.
- **2.** To prepare them for advanced studies or professional work in computer science and related fields.

Module No.	Syllabus Description	Contact Hours
	Basic Concepts of Data Structures	
	Definitions; Data Abstraction; Performance Analysis - Time & Space	
	Complexity, Asymptotic Notations; Polynomial representation using Arrays,	
1	Sparse matrix (Tuple representation); Stacks and Queues - Stacks, Multi-	11
	Stacks, Queues, Circular Queues, Double Ended Queues; Evaluation of	
	Expressions- Infix to Postfix, Evaluating Postfix Expressions.	
	Linked List and Memory Management	
	Singly Linked List - Operations on Linked List, Stacks and Queues using	
2	Linked List, Polynomial representation using Linked List; Doubly Linked List;	11
	Circular Linked List; Memory allocation - First-fit, Best-fit, and Worst-fit	
	allocation schemes; Garbage collection and compaction.	
	Trees and Graphs	
	Trees :- Representation Of Trees; Binary Trees - Types and Properties, Binary	
3	Tree Representation, Tree Operations, Tree Traversals; Expression Trees;	
	Binary Search Trees - Binary Search Tree Operations; Binary Heaps - Binary	11
	Heap Operations, Priority Queue.	
	Graphs :- Definitions; Representation of Graphs; Depth First Search and	

	Breadth First Search; Applications of Graphs - Single Source All Destination.		
	Sorting and Searching		
	Sorting Techniques :- Selection Sort, Insertion Sort, Quick Sort, Merge Sort,		
	Heap Sort, Radix Sort.		
4	Searching Techniques :- Linear Search, Binary Search, Hashing - Hashing	11	
	functions : Mid square, Division, Folding, Digit Analysis; Collision Resolution		
	: Linear probing, Quadratic Probing, Double hashing, Open hashing.		

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Identify appropriate data structures for solving real world problems.	К3
CO2	Describe and implement linear data structures such as arrays, linked lists, stacks, and queues.	К3
СО3	Describe and Implement non linear data structures such as trees and graphs.	K3
CO4	Select appropriate searching and sorting algorithms to be used in specific circumstances.	К3

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
CO3	3	3	3									3
CO4	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	Fundamentals of Data Structures in C	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed,	Universities press,	2/e, 2007			
2	Introduction to Algorithms	Thomas H Cormen, Charles Leisesrson, Ronald L Rivest, Clifford Stein	PHI	3/e, 2009			

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Classic Data Structures	Samanta D.	Prentice Hall India.	2/e, 2018			
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication.	1/e, 2003			
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill.	2/e, 2017			
4	Theory and Problems of Data Structures	Lipschuts S.	Schaum's Series	2/e, 2014			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://nptel.ac.in/courses/106102064				
2	https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/				

SEMESTER S3

BASIC CONCEPTS IN COMPUTER NETWORKS

Course Code	PBCCT304	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	4	ESE Marks	40
Credits	3:0:0:1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand and analyse the concepts of computer networking and its performance measures.

- 2. Understand the concepts of physical layer and data link layer
- 3. Understand important aspects and functions of network layer and various routing algorithms.
- 4. Understand and analyse the various transport and application layer protocols.
- 5. Acquire skill sets required for the development and deployment of networking applications

Module No.	Syllabus Description	Contact Hours
1	History of Computer Networks and the Internet , types of networks, Client- server and peer-to-peer architecture. Design issues for the layers – Interface & Service – Service Primitives. Reference models – OSI – TCP/IP. Concept of Quality of Service metrics - throughput, delay, packet loss, and jitter in packet-switched networks.	9
2	 Physical layer design issues - Media, Signal strength and interference. Data encoding, Multiplexing (TDM, FDM). Data Link layer Design Issues - Flow Control and ARQ techniques. Data link Protocols - HDLC. IEEE 802 FOR LANs IEEE 802.3, 802.5. Wireless LANs - 802.11. 	9

	Networking devices - Bridges, Routers, Gateways,	
	Network Layer Protocols - Virtual circuits and datagrams, Principles of	
3	routing, internet protocol Ipv4 CIDR, IPv6, Network Address Translation,	9
5	Firewalls, and VPNs	
	Routing algorithms - Link-state and distance vector routing, Routing on the	
	internet RIP OSPF and BGP.	
	Introduction to transport layer, Multiplexing and de-multiplexing, Principles	
	of Reliable data transfer – end-to - end flow control mechanisms, Connection	
4	oriented transport TCP, Connectionless transport UDP.	9
	Application layer protocols - HTTP and HTTPs, FTP, SMTP- S/MIME,	
	DNS, and Peer-to-peer file sharing networks	

Suggestion on Project Topics

Project: Installation and configuration of the LAMP stack. Design and develop a relevant web application using the LAMP stack. Deploy the web application project in a LAN with a server and clients with distinct IP addresses.

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

Continuous Internal Evaluation Marks (CIE):

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	To understand and apply the concepts of computer networking and its performance measures.	К3
CO2	Understand the concepts of physical layer and data link layer	K2
CO3	Understand important aspects and functions of network layer and various routing algorithms	K2
CO4	Understand and analyse the various transport and application layer protocols.	K2
CO5	Acquire skill sets required for the development and deployment of networking applications	K6

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	2	2			2					2
CO2	3	2	2			2	2					2
CO3	3	2	2				2					2
CO4	3	2	2			2	2					2
CO5	3	2	3	2	3	2	2	2	3	3	3	2

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Computer Networks: A Top- Down Approach	Behrouz A. Forouzan and Firouz Mosharraf	Tata McGraw Hill Education Private Limited	First Edition 2023			
2	Computer Networks-A Systems Approach	Larry L. Peterson & Bruce S. Dave	The Morgan Kaufmann Series in Networking	Sixth Edition, 2021			
3	Computer Networks	Andrew S. Tanenbaum, Nick Feamster, David Wetherall	Pearson	Sixth Edition, 2021			

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Computer Networking A Top-Down Approach	James F. Kurose and Keith W. Ross	Pearson	Seventh Edition, 2017			
2	Computer Networking and the Internet	Fred Halsall	Pearson	Fifth Edition, 2006			
3	The Illustrated Network: How TCP/IP Works in a Modern Network	Walter Goralski	Morgan Kaufmann	Second Edition, 2009			
4	Networking All-in-One for Dummies	Doug Lowe	John Wiley & Sons	Seventh Edition, 2020			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://nptel.ac.in/courses/106105183				
2	https://www.udemy.com/course/networkingbasics/				
3	https://ubuntu.com/server/docs/get-started-with-lamp-applications				

PBL Course Elements

L: Lecture	R: Project (1 Hr.), 2 Faculty Members				
(3 Hrs.)	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		

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

Assessment and Evaluation for Project Activity

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

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

(Common to Group A)

Course Objectives:

- 1. To familiarize the basic concepts of Boolean algebra and digital systems.
- 2. To enable the learner to design simple combinational and sequential logic circuits which is essential in understanding organization & design of computer systems.

Module	Syllabus Description		
No.			
	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,		
1	OR gate, NOR gate, NAND gate, XOR gate, XNOR gate; Digital circuit	11	
	operation - logic levels, output de specifications, input de 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.		
	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		
2	convertors.	11	
	Modeling concurrent functionality in Verilog:-		
	Continuous assignment - Continuous Assignment with logical operators,		
	Continuous assignment with conditional operators, Continuous assignment with		
	delay.		
	MSI Logic and Digital Building Blocks		
	MSI logic - Decoders (One-Hot decoder, 7 segment display decoder),		
	Encoders, Multiplexers, Demultiplexers; Digital Building Blocks - Arithmetic		
3	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.		
	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.		
4	Finite State Machines :-	14	
	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.		

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.	К2
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.	К3
CO4	Develop MSI logic circuits using both the classical digital design approach and the modern HDL-based approach.	К3
C05	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.	К3

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

	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

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

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

	Text Books										
SI. 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/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.

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	6

	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 NIETY	
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 	 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. 	50
(6x3 =18marks)	 Each question carries 8 marks. (4x8 = 32 marks) 	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
	Understand the fundamentals of various economic issues using laws	K2
CO1	and learn the concepts of demand, supply, elasticity and production	
	function.	
	Develop decision making capability by applying concepts relating to	К3
CO2	costs and revenue, and acquire knowledge regarding the functioning of	
	firms in different market situations.	
	Outline the macroeconomic principles of monetary and fiscal systems,	K2
CO3	national income and stock market.	
	Make use of the possibilities of value analysis and engineering, and	K3
CO4	solve simple business problems using break even analysis, cost benefit	
	analysis and capital budgeting techniques.	

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 gendersensitive 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.

Module No.	Syllabus Description						
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 	6					
	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.	
	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.	
2	Ecosystems and Biodiversity: Basics of ecosystems and their functions,	6
	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.	
	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	
3	economy model, Differences between linear and circular economies,	6
	degrowth principles, Strategies for implementing circular economy practices	Ū
	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.	
	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	
4	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/I ndividua l (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	Ι	5
2	Micro project (Detailed documentation of	 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
	the project, including methodologies, findings, and	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
	reflections)	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.	К3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
СО3	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.	К3

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).

DATA STRUCTURES LAB

(Common to CS/CA/CM/CD/CR/AI/AM/AD/CB/CN/CC/CU/CI/CG)

Course Code	PCCSL307	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)	GYEST204	Course Type	Lab

Course Objectives :

1. To give practical experience for learners on implementing different linear and non linear data structures, and algorithms for searching and sorting.

Expt.	Experiments
No.	
1	Find the sum of two sparse polynomials using arrays
2	Find the transpose of a sparse matrix and sum of two sparse matrices.
3	Convert infix expression to postfix (or prefix) and then evaluate using stack,
4	Implement Queue, DEQUEUE, and Circular Queue using arrays.
5	Implement backward and forward navigation of visited web pages in a web browser (i.e.
	back and forward buttons) using doubly linked list operations.
6	Implement addition and multiplication of polynomials using singly linked lists.
7	Create a binary tree for a given simple arithmetic expression and find the prefix / postfix
,	equivalent.
8	Implement a dictionary of word-meaning pairs using binary search trees.
9	Find the shortest distance of every cell from a landmine inside a maze.
	We have three containers whose sizes are 10 litres, 7 litres, and 4 litres, respectively. The
	7-litre and 4-litre containers start out full of water, but the 10-litre container is initially
	empty. We are allowed one type of operation: pouring the contents of one container into
10	another, stopping only when the source container is empty or the destination container is
	full. We want to know if there is a sequence of pourings that leaves exactly 2 litres in the 7
	or 4-litre container. Model this as a graph problem and solve.
11	Implement the find and replace feature in a text editor.

12	Given an array of sorted items, implement an efficient algorithm to search for specific
12	item in the array.
12	Implement Bubble sort, Insertion Sort, Radix sort, Quick Sort, and Merge Sort and
13	compare the number of steps involved.
	The General post office wishes to give preferential treatment to its customers. They have
	identified the customer categories as Defence personnel, Differently abled, Senior citizen,
14	Ordinary. The customers are to be given preference in the decreasing order - Differently
17	abled, Senior citizen, Defence personnel, Normal person. Generate the possible sequence
	of completion.
	Implement a spell checker using a hash table to store a dictionary of words for fast
15	lookup. Implement functions to check if a word is valid and to suggest corrections
	for misspelled words.
16	Simulation of a basic memory allocator and garbage collector using doubly linked
10	list
	The CSE dept is organizing a tech fest with so many exciting events. By participating
	The CSD dept is organizing a teen test with so many exerting events. By participating
	in an event, you can claim for activity points as stipulated by KTU. Each event i gives
17	you A[i] activity points where A is an array. If you are not allowed to participate in more
	you A[1] activity points where A is an array. If you are not anowed to participate in more
	than k events, what's the max number of points that you can earn?
10	Merge K sorted lists into a single sorted list using a heap. Use a min-heap to keep track of
18	the smallest element from each list. Repeatedly extract the smallest element and insert the
	next element from the corresponding list into the heap until all lists are merged.

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/	Conduct of experiment/	Result with valid			
Preparatory	Execution of work/	inference/	Viva	Decord	Total
work/Design/	troubleshooting/	Quality of	voce	Kecoru	Total
Algorithm	Programming	Output			
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	Model a real world problem using suitable data structure and implement the solution.	К3
CO2	Compare efficiency of different data structures in terms of time and space complexity.	K4
CO3	Evaluate the time complexities of various searching and sorting algorithms.	К5
CO4	Differentiate static and dynamic data structures in terms of their advantages and application.	К3

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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	Fundamentals of Data Structures in C	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed,	Universities Press,	2/e, 2007		
2	Introduction to Algorithms	Thomas H Cormen, Charles Leisesrson, Ronald L Rivest, Clifford Stein	PHI	3/e, 2009		

	Reference Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Classic Data Structures	Samanta D.	Prentice Hall India.	2/e, 2018		
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication.	1/e, 2003		
3	Introduction to Data Structures with Applications	Tremblay J. P., P. G. Sorenson	Tata McGraw Hill.	2/e, 2017		
4	Theory and Problems of Data Structures	Lipschutz S.	Schaum's Series	2/e, 2014		

	Video Links (NPTEL, SWAYAM)			
No.	Link ID			
1	https://nptel.ac.in/courses/106102064			
2	https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/			

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 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

SHELL SCRIPTING AND NETWORK ADMINISTRATION USING LINUX

Course Code	PCCSL308	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:2:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None / Course Code	Course Type	Lab

Course Objectives:

- **1.** The course aims to master Shell Scripting and get hands-on exposure to network Administration.
- **2.** The course aims to offer hands-on experience for learners in Python programming and use it for security implementations.
- 3. The course aims to offer exposure to Practical Application of Tools and Utilities

Expt. No.	Experiments
1	 Introduction of Linux and usage of terminal editors. Familiarity with following commands/operations expected 1. man 2. ls, echo, read 3. more, less, cat, 4. cd, mkdir, pwd, find 5. mv, cp, rm ,tar 6. wc, cut, paste 7. head, tail, grep, expr 8. chmod, chown 9. Redirections & Piping 10. useradd, usermod, userdel, passwd 11. df,top, ps 12 ssh, scp, ssh-keygen, ssh-copy-id
2	Study the following aspects of Shell scripting: bash syntax, environment variables, variables, control constructs such as if, for and while, aliases and functions, accessing command line arguments passed to shell scripts.
3	Study of startup scripts, login and logout scripts, familiarity with system d and system V

	init scripts expected.
4	a) Write a script to create a directory structureb) Implement a script to list all files and directories within a specified directory showing date of creation & serial number of file.
5	a) Write a script to automate a task (e.g., backup important files) and schedule it using cron.b) Create a script to clean up old log files periodically.
6	Write a script to monitor system resources such as CPU, memory, and disk usage and Implement a script to send an alert if resource usage exceeds a specified threshold.
7	 a) Study of IPv4 networking, command line tools, and network commands, including ping, traceroute, nslookup, ip, nc, and tcpdump. b) Configuring IP addresses, both dynamic and static Subnet masks, CIDR address schemes. c) Study concepts of iptables, LAN firewall configuration, and application layer (L7) proxies
8	a) Write a script to ping a list of servers and log the results.b) Implement a script to check if a specific port is open on a remote server.
9	a) Write a script to automate common network troubleshooting commandsb) Write a script to capture network packets using tcpdump
10	 a) Write a script to start, stop, and restart network services (e.g., Apache, Nginx, MySQL) b) Implement a script to check the status of these services and restart them if they are not running.
11	a) Write a script to set up basic firewall rules using iptables or firewalld.b) Implement a script to allow or block specific IP addresses or ranges
12	Familiarizing Python- variables, decision statements, iteration statements, functions
13	Write a python program to check the strength of a password.
14	Write a Keylogger / key logger detection tool program using python
15	Write a python program to implement Primality testing using Miller-Rabin Method
16	Write a python program to implement pseudo-random number generation
17	Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.
18	Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.

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

Continuous Internal Evaluation Marks (CIE):

	Preparation/Pre-Lab Work experiments, Viva and Timely		
Attendance	completion of Lab Reports / Record	Internal Examination	Total
5	25	20	50
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	Familiarizing the basic Linux and networking commands/operations	K2
CO2	Illustrate the use of shell scripting in system and network administration	K3
CO3	Create scripts for directories and file structures	K3
CO4	Develop security related programs using python libraries	K3
CO5	Implement Client server communication using standard protocols	K3

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

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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 Linux Command Line: A Complete Introduction	William E. Shotts Jr.	No Starch Press	Second Internet Edition				
2	Learning the bash Shell: Unix Shell Programming"	Cameron Newham	O'Reilly Media	Third edition				
3	Automate the Boring Stuff with Python	Al Sweigart	No Starch Press	Second edition				

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	http://acl.digimat.in/nptel/courses/video/117106113/117106113.html				
2	https://archive.nptel.ac.in/courses/106/106/106106212/				

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 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 4

COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)

MATHEMATICS FOR COMPUTER AND INFORMATION SCIENCE-4

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

(Group A)

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.]	
	Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit	
	Matrix, Path Matrix, Coloring, Chromatic number, Chromatic polynomial,	
4	Greedy colouring algorithm.	9
	[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.]	

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	(0)
carrying 3 marks	• Each question can have a maximum of 3 sub	60
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

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.	К3
CO4	Illustrate various representations of graphs using matrices and apply vertex coloring in real life problems.	К3

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							
	Graph Theory with		Prentice Hall India	1st adition							
1	Applications to Engineering	Narsingh Deo	Learning Private	1979							
	and Computer Science		Limited								

	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	2nd edition,							
			India	2015							
2	Introduction to Graph Theory	Robin J. Wilson	Longman Group Ltd.	5th edition,							
				2010							
3	Crank Theory with Applications	J.A. Bondy and U.S.R.	Elsevier Science	1076							
	Graph Theory with Applications	Murty	Publishing Co., Inc	1970							

Video Links (NPTEL, SWAYAM)								
Module	Link D							
No.								
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							

DATABASE MANAGEMENT SYSTEMS

(Common to CS/CD/CA/CR/AD/AI/CB/CN/CC/CU/CI/CG)

Course Code	PCCST402	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)	PCCST303	Course Type	Theory

Course Objectives:

- 1. Equip the students with a comprehensive understanding of fundamental DBMS concepts as well as the principles and applications of NoSQL databases
- 2. Enable students to design, implement, and manage both relational and NoSQL databases

SYLLABUS

Module	Sullabus Description	Contact				
No.	Synabus Description					
	Introduction to Databases :- Database System Concepts and Architecture-					
	Data Models, Schemas and Instances, Three-Schema Architecture and Data					
	Independence, Database Languages and Interfaces, Centralized and					
1	Client/Server Architectures for DBMSs.					
	Conceptual Data Modelling and Database Design:- Data Modelling Using the	11				
	Entity, Relationship (ER) Model - Entity Types, Entity Sets, Attributes, and Keys,					
	Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak					
	Entity Types. Refining the ER Design for the COMPANY Database.					
	The Relational Data Model and SQL - The Relational Data Model and Relational					
	Database Constraints-Relational Algebra and Relational Calculus - Structured Query					
2	Language (SQL)-Data Definition Language, Data Manipulation Language,					
	Assertions, Triggers, views, Relational Database Design Using ER-to-Relational	11				
	Mapping.					
	Database Design Theory & Normalization - Functional Dependencies -					
3	Basic definition; Normalization- First, Second, and Third normal forms.					
	Transaction Management - Transaction Processing : Introduction, problems and					

failures in transaction, Desirable properties of transaction, Characterizing	
schedules based on recoverability and serializability; Concurrency Control	
with Two-Phase Locking Techniques- Database Recovery management:	
Deferred update-immediate update- shadow paging.	
Introduction To NoSQL Concepts - types of NoSQL databases- CAP	
Theorem- BASE properties- Use Cases and limitations of NoSQL.	
SQL architectural Patterns - Key value Stores, Graph Stores, Column	11
Family stores and Document Stores.	
	 failures in transaction, Desirable properties of transaction, Characterizing schedules based on recoverability and serializability; Concurrency Control with Two-Phase Locking Techniques- Database Recovery management: Deferred update-immediate update- shadow paging. Introduction To NoSQL Concepts - types of NoSQL databases- CAP Theorem- BASE properties- Use Cases and limitations of NoSQL. SQL architectural Patterns - Key value Stores, Graph Stores, Column Family stores and Document Stores.

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

		Bloom's
	Course Outcome	Knowledge
		Level (KL)
CO1	Summarize and exemplify the fundamental nature and characteristics of database systems	K2
CO2	Model and design solutions for efficiently representing data using the relational model or non-relational model	К3
CO3	Discuss and compare the aspects of Concurrency Control and Recovery in Database systems	К3
CO4	Construct advanced SQL queries to effectively retrieve, filter, and manipulate data from relational databases.	K3
CO5	Experiment with NoSQL databases in real world 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	3									3
CO2	3	3	3	3						2	2	3
CO3	3	3	3	3								3
CO4	3	3	3	3								3
CO5	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/sName of the Publisher		Edition and Year				
1	Fundamentals of Database Systems [Module 1,2,3,4]	Elmasri, Navathe	Pearson	7/e,				
2	Making the Sense of NoSQL : A guide for Managers and rest of us [Module 4]	Dan McCreary and Ann Kelly	Manning	2014				

Reference Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	A., H. F. Korth and S. Sudarshan, Database System Concepts,	Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 6/e, McGraw Hill, 2011.	McGraw Hill,	7/e, 2011				
2	Beginning Database Design Solutions	Rod Stephens	Wiley	2/e, 2023				
2	NoSQL Distilled	Pramod J. Sadalage, Martin Fowler	Addison- Wesley	1/e, 2012				
3	NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data),	Olivier Pivert	Wiley	2018				

Video Links (NPTEL, SWAYAM)							
Module	Link ID						
No.							
1	https://onlinecourses.nptel.ac.in/noc21_cs04/preview						
2	https://onlinecourses.nptel.ac.in/noc21_cs04/preview						
3	https://onlinecourses.nptel.ac.in/noc21_cs04/preview						
4	https://archive.nptel.ac.in/courses/106/104/106104135/						

OPERATING SYSTEMS

(Common to CS/CD/CM/CR/CA/AD/AI/CB/CN/CC/CU/CI/CG)

Course Code	PCCST403	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 introduce the structure of a typical operating system and its core functionalities
- **2.** To impart to the students, a practical understanding of OS implementation nuances based on the Linux operating system

SYLLABUS

Module	Syllabus Description			
No.	Synabus Description			
	Introduction to Operating Systems (Book 1 Ch 2 introductory part),			
	Operating System Services (Book 3 Ch 2) Overview of Operating Systems			
	and Kernels, Linux Versus Classic Unix Kernels (Book 2 Ch 1)			
	Process concepts: Process Creation, Process States, Data Structures, Process			
	API (Book 1 Ch 4, 5), Sharing processor among processes - user and kernel			
	modes, context switching (Book 1 Ch 6), System boot sequence (Book 3 Ch			
	2)			
1	Case study: Linux kernel process management (Book 2, Ch 3)			
	Threads and Concurrency: Concept of a thread, Multithreading benefits,			
	Multithreading models (Book 3 Ch 4)			
	Case study: The Linux Implementation of Threads (Book 2, Ch 3)			
	Process scheduling: Concepts and basic algorithms (Book 1 Ch 7), The			
	Multilevel Feedback Queue: Basic Rules (Book 1 Ch 8)			
	Case study: The Linux Completely Fair Scheduler (CFS) (Book 1 Ch 9,			

	Implementation with RB trees not required), The Linux Scheduling Implementation Preemption and Context Switching (Book 2 Ch 4)	
2	 Concurrency and Synchronization - Basic principles (Book 3 Sections 6.1, 6.2), Mechanisms - Locks: The Basic Idea, Building Spin Locks with Test-And-Set, Compare and Swap, Using Queues: Sleeping Instead Of Spinning (Book 1 Ch 28), Semaphores - Definition, Binary Semaphores, The Producer/Consumer (Bounded Buffer) Problem and its solution using semaphores, Reader-Writer Locks (Book 1 Ch 31) <i>Case study: Linux Kernel Synchronization Methods - Spin Locks, Semaphores, Mutexes (Book 2 Ch 10)</i> Concurrency: Deadlock and Starvation - Deadlock Characterization, Deadlock Prevention and Avoidance, Deadlock Detection and recovery (Book 3 Ch 8), Dining Philosophers Problem and its solution (Book 1 Ch 31) 	12
3	 Memory management - Address Space, Memory API, Address Translation An Example, Dynamic (Hardware-based) Relocation, Segmentation: Generalized Base/Bounds, Address translation in segmentation, Support for Sharing (Book 1 Ch 13 to 16) Virtual memory - Paging: Introduction, page tables and hardware support, TLBs, Example: Accessing An Array, - TLB hits and misses, Handling TLB misses, TLB structure, Reducing the page table size (Book 1 Ch 18 to 20) Going beyond physical memory - Swap space, page fault and its control flow, page replacement policies, Thrashing (Book 1 Ch 21, 22) 	11
4	 I/O system: Modern System architecture, Programmed I/O, Interrupts, DMA, Device interaction methods, The Device Driver (Book 1 Ch 36), Hard disk: Geometry (Book 1 Ch 37), disk scheduling (Book 3 Section 11.2) <i>Case study: Linux I/O schedulers - Elevator, Complete Fair Queuing (Book 2 Ch 14)</i> Files and Directories: The File System Interface - File descriptor, reading and writing files (sequential and random access), Removing files - Hard links and Symbolic links, Creating, reading and deleting directories, Permission 	10

bits and Access Control Lists, Mounting a file system (Book 1 Ch 39)

File Organization: The Inode, The Multi-Level Index (Book 1 Ch 40)

Case study: VFS Objects and Their Data Structures - The Inode Object, Inode Operations (Book 2 Ch 13)

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub-	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)	
CO1	Apply the concepts of process management and process scheduling mechanisms employed in operating systems.	К3	
CO2	CO2 Choose various process synchronization mechanisms employed in operating systems.		
СО3	Use deadlock prevention and avoidance mechanisms in operating systems.	К3	
CO4	Select various memory management techniques in operating systems.	K3	
CO5	Understand the storage management in operating systems.	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
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3
CO5	3	3	3									3

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

Text Books										
Sl. No	Title of the Book	Title of the BookName of the Author/s				Title of the BookName of the Author/sName of the Publisher				
	Operating Systems: Three Easy	Andrea Arpaci-Dusseau,								
1	Pieces	Remzi Arpaci-Dusseau	CreateSpace	1/e, 2018						
2	Linux Kernel Development	Robert Love	Pearson	3/e, 2018						
3	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin, Greg Gagne	Wiley	10/e, 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 Herbert Bos	Pearson	5/e, 2012		
2	The Design of the UNIX Operating System	Maurice J. Bach	Prentice Hall of India	1/e, 1994		
3	The Little Book of Semaphores	Allen B. Downey	Green Tea Press	1/e, 2016		

Video Links (NPTEL, SWAYAM)					
Sl. No.	SI. No. Link ID				
1	https://archive.nptel.ac.in/courses/106/105/106105214/				
2	https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx				

COMPUTER ORGANIZATION AND ARCHITECTURE

(Common to CS/CD/CR/CA/AD/CB/CN/CC/CU/CG)

Course Code	PBCST404	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)	GAEST305	Course Type	Theory

Course Objectives

- 1. Introduce principles of computer organization and the basic architectural concepts using RISC.
- 2. Introduce the concepts of microarchitecture, memory systems, and I/O systems.

Module	Syllabus Description	
No.	Synabus Description	Hours
	Basic Structure of computers :- Functional units - Basic operational	
	concepts; Memory map; Endianness.	
	CISC vs RISC architectures:- RISC Introduction - Assembly Language,	
	Assembler directives, Assembling.	
1	Programming concepts - Program flow, Branching, Conditional statements,	11
	Loops, Arrays, Function calls; Instruction execution cycle.	
	Machine language - Instructions, addressing modes, Stored program	
	concept. Evolution of the RISC Architecture.	
	Microarchitecture - Introduction; Performance analysis; Single-Cycle	
	Processor - Single Cycle Datapath, Single Cycle Control; Pipelined	
2	Processor - Pipelined Data Path, Pipelined Control: Hazards, Solving	11
	Data/Control Hazards, Performance Analysis.	
	Memory Systems: Introduction; performance analysis; Caches - basic	
	concepts, Cache mapping, Cache replacement, Multiple-Level Caches,	
3	Reducing Miss Rate, Write Policy; Virtual Memory - Address Translation;	11
	Page Table; Translation Lookaside Buffer; Memory Protection.	

SYLLABUS

	Input / Output - External Devices; I/O Modules; Programmed I/O,	
4	Interrupt Driven I/O; Direct Memory Access; Embedded I/O Systems -	11
	Embedded I/O, General Purpose I/O, Serial I/O, Other Peripherals.	

Suggestion on Project Topics

Use simulators such as Ripes (https://github.com/mortbopet/Ripes) / GEM5 (https://www.gem5.org/) implement components of computer systems such as Various Cache organization and study the effect, Solutions to hazards, TLBs.

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	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	• 2 questions will be given from each module,	
module.	out of which 1 question should be answered.	
• Total of 8 Questions,	• Each question can have a maximum of 2	
each carrying 2 marks	subdivisions.	40
	• Each question carries 6 marks.	
(8x2 =16 marks)	(4x6 = 24 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Identify the basic structure and functional units of a digital computer and the features of RISC architecture.	К2
CO2	Experiment with the single cycle processor, pipelining, and the associated problems.	К3
CO3	Utilize the memory organization in modern computer systems.	К3
CO4	Experiment with the I/O organization of a digital computer.	К3

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	3									3
CO2	3	3	3	3								3
CO3	3	3	3	3								3
CO4	3	3	3	3								3

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Digital Design and Computer Architecture - RISC-V Edition	Sarah L. Harris, David Harris	Morgan Kaufmann	1/e, 2022			
2	Computer Organization and Architecture Designing for Performance	William Stallings	Pearson	9/e, 2013			

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Computer Organization and Design : The Hardware/Software Interface: RISC-V Edition	David A. Patterson John L. Hennessy	Morgan Kaufaman	1/e,2018			
2	Computer Organization and Embedded Systems	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian	McGraw Hil	6/e, 2012			
3	Modern Computer Architecture and Organization	Jim Ledin	Packt Publishing	1/e,2020			

	Video Links (NPTEL, SWAYAM)				
Sl. No.	Sl. No. Link ID				
1	https://archive.nptel.ac.in/courses/106/105/106105163/				
2	https://archive.nptel.ac.in/courses/106/106106166/				

PBL Course Elements

L: Lecture	R: Project (1 Hr.), 2 Faculty Members						
(3 Hrs.)	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				

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

INTRODUCTION TO PARALLEL & DISTRIBUTED PROGRAMMING

Course Code	PECCT411	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. Identify the models and frameworks best suited to various workloads.
- **2.** Constructing parallel and distributed applications, including testing, debugging and performance evaluation

Module No.	Syllabus Description					
1	Distributed System: Definition, Relation to computer system components, Motivation, Primitives for distributed communication, Design issues, Challenges and applications. Leader election algorithm- Bully algorithm, Ring algorithm. Termination detection- Spanning tree-based algorithm.	9				
2	Distributed mutual exclusion algorithms- System model, Requirements of mutual exclusion algorithm. Lamport's algorithm, Ricart- Agrawala algorithm, Quorum based mutual exclusion algorithms- Maekawa's algorithm. Token based algorithm- Suzuki-Kasami's broadcast algorithm.	9				
3	Parallel Computing: Principles of Parallel Algorithm Design DecompositionTechniques, Characteristics of Tasks and interactions, Mapping techniquesfor load balancing.Basic Communication operations: One to All Broadcast and All to OneReduction, All to All Broadcast and Reduction, All Reduce	11				

	And Prefix Sum operations, Scatter and Gather, All to All Personalized							
	communication, Circular Shift, Improving the speed of some communication							
	operation.							
4	Principles of Message Passing Programming, The building blocks: Send							
	and Receive Operations, MPI: The Message Passing Interface, Overlapping							
	Communication with Computation, Collective Communication and	7						
	Computation Operations, Groups and Communicators.							

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Illustrate election algorithm and termination detection algorithm.	K2
CO2	Compare token based, non-token based and quorum based mutual exclusion algorithms	K2
СО3	Appreciate the communication models for parallel algorithm development	K2
CO4	Develop parallel algorithms using message passing paradigms.	K3
CO5	Demonstrate the fundamentals skills of heterogenous computing with shared memory architecture.	К3

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
CO2	3	3	2									2
CO3	3	2										2
CO4	3	2	2	2	2							2
CO5	3	2			2	2						2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation
Text Books							
Sl. No	. No Title of the Book Name of the Author/s Name of the Publisher						
1	Introduction to Parallel Computing	AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar		Second edition,200 3			
2	Distributed Computing Principles, Algorithms, and Systems	Ajay D. Kshemkalyani University of Illinois at Chicago, Chicago and Mukesh Singhal University of Kentucky, Lexington	Cambridge University Press	First Edition,200 8			
3	Distributed system	Maarten van Steen Andrew S Tanebaum	Pearson Education,Inc.	Third edition ,2017			

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	The Art of Multiprocessor Programming	Maurice Herlihy and NirShavit	Morgan Kaufmann Publishers	2008			
2	Principles of Parallel Programming	C. Lin, L. Snyder, Addison-Wesley		2009			
3	Distributed Systems: Concepts and Design	George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair	Addison Wesley	Fifth edition			
4	An Introduction to Distributed Algorithms	Valmir C. Barbosa	MIT Press	2003			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://www.youtube.com/watch?v=R1FfoED7OGo&t=13s&pp=ygUqYnVsbHkgYWxnb3Jpd GhtIGluIGRpc3RyaWJ1dGVkIHN5c3RlbSBjb2Rl				
2	https://www.youtube.com/watch?v=yduKTBqVAH8&pp=ygUvdG9rZW4gYmFzZWQgYWx nb3JpdGhtcyBpbiBkaXN0cmlidXRIZCBjb21wdXRpbmc%3D				
3	https://www.youtube.com/watch?v=huwsVa6wXRM&pp=ygUeYmFzaWMgY29tbXVuaWNh dGlvbiBvcGVyYXRpb25z				
4	https://www.youtube.com/watch?v=QkV_5lNF1Lw&pp=ygUZTVBJIElOIFBBUkFMTEVMI ENPTVBVVElORw%3D%3D				

SEMESTER S4

Course Code	PECCT412	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 code)	Course Type	Theory

INTRODUCTION TO BLOCK-CHAIN TECHNOLOGIES

Course Objectives:

- 1. To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- **2.** To create cryptocurrencies and give a strong technical understanding of Blockchain technologies with an in-depth understanding of applications, open research challenges, and future directions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
	Cryptography: Concepts and Techniques-Introduction, plaintext and cipher	
	text, substitution techniques, transposition techniques, encryption and	
	decryption, symmetric and asymmetric key cryptography.	
1	Introduction to block-chain – basic ideas behind blockchain, generic	
	elements of a blockchain. Types -private, public, hybrid blockchain.	9
	Applications of Blockchain in E-Governance, Land Registration, Medical	
	Information Systems, and others. Benefits & Limitations of blockchain.	
	Blockchain: Versions, variants, usecases, life-usecases of blockchain,	
	Blockchain vs shared database.	
	The real need for mining - Consensus - definition, types, consensus in	
	blockchain, Byzantine Generals Problem, and Consensus as a distributed	
2	coordination problem.	9
	Decentralization – Decentralization using blockchain, Methods of	,
	decentralization, Routes to decentralization, Blockchain and full ecosystem	
	decentralization.	

	Introduction to crypto-currency: definition, types, applications.		
	Introduction to Bitcoins: Definition, Bitcoin Digital Keys & Addresses,		
3	Transactions, Limitations of Bitcoins.	9	
	Introduction to Blockchain platforms: Ethereum, Hyperledger, IOTA, EOS,		
	Multichain, Bigchain etc. Advantages & disadvantages.		
	Smart Contracts - Definition, Smart contract templates, Oracles, Types of		
4	oracles, Deploying smart contracts.		
	Ethereum – The Ethereum network. Components of the Ethereum ecosystem	9	
	- Keys and addresses, Accounts, Transactions and messages.		

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Illustrate the cryptographic building blocks and fundamental concepts of blockchain technology.	K2
CO2	Explain the concepts of consensus and decentralization in blockchain.	K2
CO3	Explain the concepts of first decentralized cryptocurrency bitcoin and blockchain platforms.	К2
CO4	Explain the use of smart contracts and Ethereum.	K2
CO5	Illustrate the development of blockchain applications.	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
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	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	Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming	Josh Thompson	Create Space Independent Publishing Platform	2017				
2	Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more,	Imran Bashir	Packt Publishing	second edition, 2018.				

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain	Ritesh Modi	Packt Publishing	First edition, 2018			
2	Blockchain Technology: Concepts and Applications	Kumar Saurabh, Ashutosh Saxena	Wiley Publications	First edition, 2020			
3	Blockchain Technology	Chandramouli Subramanian, Asha A George,	Universities Press (India) Pvt. Ltd.	First edition, August 2020			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://www.youtube.com/watch?v=WeuJqKEfSxM&pp=ygUaaW50cm9kdWN0aW9uIHRvI GJsb2NrY2hhaW4%3D				
2	https://www.youtube.com/watch?v=rYQgy8QDEBI&pp=ygUOY3J5cHRvY3VycmVuY3k%3 D				
3	https://www.youtube.com/watch?v=jxLkbJozKbY&t=34s&pp=ygUQYml0Y29pbiBwbGF0Z m9ybQ%3D%3D				
4	https://www.youtube.com/watch?v=lB81CiQj21E&pp=ygU4Y29uc2Vuc3VzIOKAkyBkZWZ pbml0aW9uLCB0eXBlcywgY29uc2Vuc3VzIGluIGJsb2NrY2hhaW4%3D				

SEMESTER S4

INTRODUCTION TO AI AND ML

Course Code	PECCT413	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 principles of AI and ML, including intelligent agents, problem-solving techniques, knowledge representation, various learning paradigms, and evaluation metrics.
- 2. Develop practical skills in implementing Machine Learning algorithms like supervised and unsupervised learning algorithms, model selection techniques, and basic deep learning architectures.
- **3.** Analyze the applications and ethical implications of AI and ML across different domains including fairness, explainability, and societal impact.

Module	Syllabus Description				
1	Introduction to AI - History and Applications of AI: Intelligent Agents - Types of intelligent agents, Problem-solving & search algorithms (uninformed and informed search): Knowledge Representation and Reasoning - Propositional logic, First-order logic, Reasoning systems Introduction to Machine Learning: Machine learning vs. traditional programming, Types of learning (supervised, unsupervised, reinforcement learning). The Machine Learning Pipeline, Data Preprocessing, Idea of Training, Testing, Validation; Review of Gradient Descent Algorithm	9			
2	Supervised Learning: Linear Regression, Decision Trees, K-Nearest Neighbors(KNN) Unsupervised Learning: Principal Component Analysis (PCA), K-means clustering	9			

SYLLABUS

	Model Selection and Regularization: Underfitting, Overfitting, L1 and L2	
	regularization.	
	Evaluation measures – Mean Squared Error (MSE), Mean Absolute Error	
	(MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of	
	Determination, Precision, Recall, Accuracy, F-Measure, Receiver Operating	
	Characteristic Curve(ROC), Area Under Curve (AUC), Cross-entropy loss.	
	Introduction to Neural Networks and Deep Learning: Perceptron,	
	Multilayer Feed-Forward Network; Activation Functions - Sigmoid, ReLU,	
	Tanh	
3	Backpropagation Algorithm; Artificial Neural Networks (ANNs),	
5	Activation Functions, Convolutional Neural Networks (CNNs),	9
	Architecture, Applications.	
	Case Study: Application of ML for Phishing Detection	
	Recurrent Neural Networks (RNNs) and Long Short-Term Memory	
	(ISTM) naturalize Arabitactura Ambiactiona (Control understanding of	
	(LSTM) networks: Arcmitecture, Applications (General understanding of	
	natural language processing)	0
4	Ethical Considerations in AI and ML: Bias, Fairness, Explainability,	У
	Societal Impact	
	Case Study: Application of AI for Intrusion Detection	
	Case Stady. Approaction of Arrist Indusion Detection	

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Students will Understand and will be able to explain the fundamental principles of AI	K2
CO2	Students will be able to select, apply, implement, regularize and evaluate supervised and unsupervised learning algorithms.	К3
CO3	Students will be able to design, train, and optimize neural networks and will Understand Deep Learning concepts like ANN and CNN	K2
CO4	Students will Understand applications of DL in NLP and will be able to Analyse AI based on ethical considerations.	K2
CO5	Students will be able to analyze and apply AI and ML techniques in cybersecurity through specific case studies, understanding their practical implementations, challenges, and effectiveness in real-world scenarios.	K4

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

CO-PO Manning Table (Manning of Course Outcomes to Program Outcome	CO DO M			
CO I O HUNDDING I WORDDING OF COULDE OUVEOINED TO LIGETUM OUVEOINE	CO-PO Mapping	I able (Mappi	ng of Course Outcome	s to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									2
CO2	3	3	2	2	3					2		2
CO3	3	3	3	2	3					2		2
CO4	3	2	2		3	3		3	2	3		3
CO5	3	3	3	3	3	2		3	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	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson	4th Edition (2022)					
2	Machine Learning for Dummies	John Paul Mueller and Luca Massaron	Wiley	2nd Edition (2021)					

	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)				
2	Artificial Intelligence for Humans	Jeff Heaton	Heaton Research LLC	3rd Edition (2020)				
3	Artificial Intelligence Basics: A Non-Technical Introduction	Tom Taulli	Manning Publications	2019				
4	Machine Learning	Tom Mitchell	McGraw-Hill	1997				
5	The Hundred-Page Machine Learning Book	Andriy Burkov		2019				

Video Links (NPTEL, SWAYAM)						
Module No.	Link ID					
1	https://www.youtube.com/watch?v=pKeVMlkFpRc&list=PLwdnzlV3ogoXaceHrrFVZCJKbm _laSHcH					
2	https://www.youtube.com/watch?v=T3PsRW6wZSY&list=PLIg1dOXc acbdJo- AE5RXpIM_rvwrerwR					
3	https://www.youtube.com/watch?v=QlhHqMnd9Wo					
4	https://www.youtube.com/watch?v=KjDWcYHclOM					

SEMESTER S4

FUNDAMENTALS OF INDUSTRIAL CONTROL SYSTEM SECURITY

Course Code	PECCT414	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)		Course Type	Theory

Course Objectives:

- 1. Enables the learners to understand the basic concepts of Industrial control system.
- **2.** The course helps the students to identify the difference between OT and IT networks in Industrial Systems.
- **3.** Enables the students to describe the different cyber security controls and Access control Mechanisms.
- **4.** Enables the learners to summarize the operation, design and vulnerabilities of Industrial Control System and understand various Networking and Industrial protocols.

Module	Syllabus Description	Contact
No.	Synabus Description	Hours
	Introduction to ICS(Industrial Control System)	
	System Overview: Industrial Control System Architecture-Distributed	
	Control Systems (DCS)-Programmable Logic Controller (PLC) - SCADA	
1	overview.	9
	Building Automation and Control System Overview, Safety Instrumented	,
	Systems, Industrial Internet of Things	
	Purdue Model for Industrial Control Systems, Difference Between OT and	
	IT Networks in Industrial Systems, OT Versus IT	
2	ICS Fundamentals: Operation, Design, and Vulnerabilities, Networking	
	and Industrial Protocols.	10
	Case Study: Stuxnet	
	Cyber security Controls in Industry	
3	Introduction to Cyber security Controls:	10
	Definition and Importance, Types of Cyber security Controls (Preventive,	10

SYLLABUS

	Detective, Corrective)	
	Industry Standards and Frameworks (NIST, ISO/IEC 27001, CIS Controls)	
	Access Control Mechanisms	
	User Authentication (Passwords, Multi-Factor Authentication), User	
	Authorization (Role-Based Access Control, Attribute-Based Access Control)	
	Access Control Models (Discretionary, Mandatory, and Role-Based Access	
	Control)	
	Cyber Attacks and Problems, Anatomy of a Cyber Attack, Defense in Depth	
	Principle, Contemporary Control System Architectures, Asset management	
	in Cyber Security, Network segmentation, Network Discovery	
4	Auditing and Assessing ICS: Methodology and Characterization, System	9
	Assessment and Classification, Vulnerability Identification, Standards and	
	Best Practices for Industrial Security.	
	Applications and benefits of Industry Control systems	

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
C01	Illustrate the basic concepts of Industrial Control systems and differentiate between different types of Industrial Control Systems.	K2
CO2	Identify the difference between OT and IT networks in Industrial Systems and also describe Contemporary Control System Architecture.	K2
СО3	Describe on the types of Cyber Security Controls and Access Control Mechanisms.	K2
CO4	Summarize the operation, design and vulnerabilities of Industrial Control System and understand various Networking and Industrial protocols.	K2
CO5	Outline the System Assessment, Vulnerability Identification and best practices for Industrial Safety and understand the applications of Industrial Control Systems.	К3

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									3
CO3	3	2	2									3
CO4	3	2	2	2	2	2	2					3
CO5	3	3	2	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 Programmable Logic Controllers	Gary Dunning	Delmar Cengage Learning	Thomson 2nd edition, 2013
2	SCADA Supervisory Control and Data Acquisition	Stuart A Boyer	ISA	4 th Edition, 2009
3	Computer Security : Principles and Practice	William Stallings Lawrie Brown	Pearson	3 rd Edition,201 4
4	Industrial Network Security :Securing Critical Infrastructure Networks for Smart Grid, SCADA and other Industrial Control Systems	Eric D Knapp Joel Thomas Langill	Syngress	2 nd Edition, 2014

		Reference Books		
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Automation using PLC , SCADA & DCS	R.G.Jamkar	Global Education Ltd	2 nd Edition, 2018
2	Industrial Automation and Process Control	Jon Stenerson	Prentice Hall	1 st Edition, 2002
3	Effective Cyber security : A Guide to Using Best Practices and Standards	William Stallings	Addison-Wesley Professional	1 st edition, 2018
4	Control Systems Cyber Security: Defense in Depth Strategies	David Kuipers Mark Fabro	Idaho National Laboratory Idaho Falls, Idaho 83415	May 2006

	Video Links (NPTEL, SWAYAM)
Module No.	Link ID
1	https://nptel.ac.in/courses/108105063 https://www.udemy.com/course/cyber-security-industrial-control-system-security
2	https://www.udemy.com/course/cyber-security-industrial-control-system-security
3	https://www.udemy.com/course/mastering-cybersecurity-and-supply-chain-risk-management
4	https://www.udemy.com/course/assessingprotectingics

SEMESTER S4

ADVANCED DATA STRUCTURES

(Common to CS/CD/CM/CA/AM/CB/CN/CC/CU/CI/CG)

Course Code	PECST495	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)	PCCST303	Course Type	Theory

Course Objectives:

- 1. To equip students with comprehensive knowledge of advanced data structures utilized in cutting-edge areas of computer science, including database management, cyber security, information retrieval, and networked systems.
- 2. To prepare students to address challenges in emerging fields of computer science by applying advanced data structures to practical, real-world problems.

|--|

Module No	Syllabus Description					
1	Foundational Data Structures- Overview of Arrays and Linked Lists, implementation of pointers and objects, Representing rooted trees, Hashing - Hash Tables, Hash functions, Cuckoo Hashing; Bloom Filters - Count-Min Sketch, Applications to Networks - Click Stream Processing using Bloom Filters, Applications to Data Science - Heavy Hitters and count-min structures.	11				
2	Advanced Tree Data Structures - Balanced Trees - AVL Trees (review), Red-Black Trees, Suffix Trees and Arrays, Segment Trees, Heaps and Related Structures – Binomial heap, Fibonacci Heaps, Merkle Trees, Applications to information Retrieval and WWW - AutoComplete using Tries.	11				
3	Specialized Data Structures - Spatial Data Structures – Quadtree, K-D Trees (k-dimensional tree); R-trees; Temporal Data Structures- Persistence, Retroactivity; Search and Optimization Trees – Skip List, Tango Trees; Applications to Data Science - Approximate nearest neighbor search,	12				

	Applications to information Retrieval and WWW, Posting List intersection.	
4	Data Structure applications - Distributed and Parallel Data Structures - Distributed Hash Tables (DHTs); Consistent Hashing; Distributed BST; Data Compression and Transformations - Burrows-Wheeler Transform; Histogram: Wavelet Trees: Cryptographic Applications – Hashing.	11

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyze): 20 marks

Implement various real world problems using multiple suitable data structures and compare the performance.

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Implement and use arrays, linked lists, rooted trees and hashing techniques in various programming scenarios.	К3
CO2	Design and implement advanced tree data structures for information retrieval.	K3
CO3	Use spatial and temporal data structures in data science problems.	K3
CO4	Analyze data structures in special scenarios such as distributed, parallel and data compression areas.	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	3						2	3
CO2	3	3	3	3	3						2	3
CO3	3	3	3	3	3						2	3
CO4	3	3	3	3	3						2	2

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

Reference Books						
Sl. No	Title of the Book	Title of the Book Name of the Author/s		Edition and Year		
1	Advanced Data Structures: Theory and Applications	Suman Saha, Shailendra Shukla	CRC Press	1/e, 2019		
2	Advanced Data Structures	Peter Brass	Cambridge University Press	1/e, 2008		
3	Introduction to Algorithms	ntroduction to Algorithms Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein		4/e, 2022		
4	Fundamentals of Computer Algorithms	Ellis Horowitz, SatrajSahani and Rajasekharam	University Press	2/e, 2009		
5	Advanced Data Structures	Reema Thareja, S. Rama Sree	Oxford University Press	1/e, 2018		
6	Data Structures and Algorithm Analysis in C++,	Mark Allen Weiss	Pearson	2/e, 2004.		
7	Design and Analysis of Algorithms	M T Goodrich, Roberto Tamassia	Wiley	1/e, 2021		

Video Links (NPTEL, SWAYAM)						
Module No.	Module No.					
1	https://web.stanford.edu/class/cs166/					

SEMESTER S3/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	6

	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	
	Value Analysis and value Engineering - Cost Value, Exchange Value, Use	
4	Value, Esteem Value - Aims, Advantages and Application areas of Value	
	Engineering - Value Engineering Procedure - Break-even Analysis - Cost-	6
	Benefit Analysis - Capital Budgeting - Process planning	

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

Continuous Internal Evaluation Marks (CIE):

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

Course Outcomes (COs)

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

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

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 gendersensitive 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.

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 	6
	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,	

SYLLABUS

	Gendered technologies & innovations, Ethical values and practices in							
	connection with gender - equity, diversity & gender justice, Gender policy							
	and women/transgender empowerment initiatives.							
	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.							
2	Ecosystems and Biodiversity: Basics of ecosystems and their functions,	6						
	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.							
	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							
3	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.							
	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:							
4	Basics of climate change science, Impact of climate change on natural and	6						
-	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/I ndividua l (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	Ι	5
2	Micro project (Detailed documentation of	 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
	the project, including methodologies, findings and	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
	reflections)	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.	К3
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.	К5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	К4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	К3

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	s in Engineering Practice Research Caroline Whitbeck Cambridg Press &		2nd edition & August 2011			
2	Virtue Ethics and Professional RolesJustin OakleyCambridge University Press & Assessment						
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

OPERATING SYSTEMS LAB

(Common to CS/CD/CM/CR/CA/AI/CB/CN/CC/CU/CI/CG)

Course Code	PCCSL407	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)	GYEST204	Course Type	Lab

Course Objectives:

- 1. To familiarize various Linux commands related to Operating systems.
- 2. To give practical experience for learners on implementing different functions of Operating systems such as process management, memory management, and disk management.

Expt. No.	Experiments
1	Familiarisation with basic Linux programming commands: ps, strace, gdb, strings, objdump, nm, file, od, xxd, time, fuser, top
2	 Use /proc file system to gather basic information about your machine: (a) Number of CPU cores (b) Total memory and the fraction of free memory (c) Number of processes currently running. (d) Number of processes in the running and blocked states. (e) Number of processes forked since the last bootup. How do you compare this value with the one in (c) above? (f) The number of context switches performed since the last bootup for a particular process.
3	Write a simple program to print the system time and execute it. Then use the / proc file system to determine how long this program (in the strict sense, the corresponding process) ran in user and kernel modes.
4	Create a new process using a fork system call. Print the parent and child process IDs. Use the pstree command to find the process tree for the child process starting from the init process.
5	Write a program to add two integers (received via the command line) and compile it to an executable named " myadder ". Now write another program that creates a new process using a fork system call. Make the child process add two integers by replacing its image

	with the "myadder" image using execvp system call.
6	Create a new process using a fork system call. The child process should print the string " PCCSL407 " and the parent process should print the string " Operating Systems Lab ". Use a wait system call to ensure that the output displayed is " PCCSL407 Operating Systems Lab "
	Inter-process Communication (https://www.linuxdoc.org/LDP/lpg/node7.html)
7	 (a) Using Pipe – Evaluate the expression √b² - 4ac. The first process evaluates b². The second process evaluates 4ac and sends it to the first process which evaluates the final expression and displays it. (b) Using Message Queue - The first process sends a string to the second process. The second process reverses the received string and sends it back to the first process. The first process compares the original string and the reversed string received from the second one and then prints whether the string is a palindrome or not.
	 (c) Using Shared Memory - The first process sends three strings to the second process. The second process concatenates them to a single string (with whitespace being inserted between the two individual strings) and sends it back to the first process. The first process prints the concatenated string in the flipped case, that is if the concatenated string is "Hello S4 Students", the final output should be "hELLO s4 sTUDENTS"
8	Write a multithreaded program that calculates the mean, median, and standard deviation for a list of integers. This program should receive a series of integers on the command line and will then create three separate worker threads. The first thread will determine the mean value, the second will determine the median and the third will calculate the standard deviation of the integers. The variables representing the mean, median, and standard deviation values will be stored globally. The worker threads will set these values, and the parent thread will output the values once the workers have exited.
9	Input a list of processes, their CPU burst times (integral values), arrival times, and priorities. Then simulate FCFS, SRTF, non-preemptive priority (a larger priority number implies a higher priority), and RR (quantum = 3 units) scheduling algorithms on the process mix, determining which algorithm results in the minimum average waiting time (over all processes).
10	Use semaphores to solve the readers-writers problem with writers being given priority over readers.
11	Obtain a (deadlock-free) process mix and simulate the banker's algorithm to determine a safe execution sequence.
12	Obtain a process mix and determine if the system is deadlocked.
13	Implement the deadlock-free semaphore-based solution for the dining philosopher's problem.
14	Simulate the address translation in the paging scheme as follows: The program receives

	three command line arguments in the order
	 size of the virtual address space (in megabytes) page size (in kilobytes) a virtual address (in decimal notation) The output should be the physical address corresponding to the virtual address in <frame number,="" offset=""/> format. You may assume that the page table is implemented as an array indexed by page numbers. (NB: If the page table has no index for the page number determined from the virtual address, you may just declare a page table miss!)
15	Simulate the FIFO, LRU, and optimal page-replacement algorithms as follows: First, generate a random page-reference string where page numbers range from 0 to 9. Apply the random page-reference string to each algorithm, and record the number of page faults incurred by each algorithm. Assume that demand paging is used. The length of the reference string and the number of page frames (varying from 1 to 7) are to be received as command line arguments.
16	Simulate the SSTF, LOOK, and CSCAN disk-scheduling algorithms as follows: Your program will service a disk with 5,000 cylinders numbered 0 to 4,999. The program will generate a random series of 10 cylinder requests and service them according to each of the algorithms listed earlier. The program will be passed the initial position of the disk head (as a parameter on the command line) and will report the total number of head movements required by each 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
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	Illustrate the use of various systems calls in Operating Systems.	К3
CO2	Implement process creation and inter-process communication in Operating Systems	К3
CO3	Compare the performance of various CPU scheduling algorithms	K4
CO4	Compare the performance of various disk scheduling algorithms	K4

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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 Systems: Three Easy Pieces	Andrea Arpaci- Dusseau, Remzi Arpaci-Dusseau	CreateSpace	1/e, 2018				
2	Linux Kernel Development	Robert Love	Pearson	3/e, 2018				
3	Unix Network Programming - Volume 2: Interprocess Communications	Richard Stevens	Prentice Hall	2/e, 1999				

Reference Books/Websites								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	The Design of the UNIX Operating System	Maurice J. Bach	Prentice Hall of India	1/e, 1994				
2	The Little Book of Semaphores	Allen B. Downey	Green Tea Press	1/e, 2016				

Video Links (NPTEL, SWAYAM)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105214/
2	https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx

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 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
DBMS Lab

(Common to CS/CD/CR/CA/AD/AI/CB/CN/CC/CU/CI/CG)

Course Code	PCCSL408	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 equip students with comprehensive skills in SQL, PL/SQL, and NoSQL databases.
- **2.** To enable the learner to proficiently design, implement, and manage relational and non-relational databases to meet diverse data management needs

Expt. No.	Experiments
1	Design a database schema for an application with ER diagram from a problem description.
	Creation of database schema - DDL (create tables, set constraints, enforce relationships,
2	create indices, delete and modify tables). Export ER diagram from the database and verify
	relationships (with the ER diagram designed in step 1).
3	Database initialization - Data insert, Data import to a database (bulk import using UI and
5	SQL Commands).
4	Practice SQL commands for DML (insertion, updating, altering, deletion of data, and
-	viewing/querying records based on condition in databases).
5	Implementation of various aggregate functions, Order By, Group By & Having clause in
	SQL.
6	Implementation of set operators nested queries, and join queries.
7	Practice of SQL TCL DCL commands like Rollback, Commit, Savepoint, Practice of SQL
	DCL commands for granting and revoking user privileges.
8	Practice of SQL commands for creation of views and assertions.
9	Creation of Procedures, Triggers and Functions.
10	Creation of Packages and cursors.
11	Design a database application using any front-end tool for any problem selected in

	experiment number 1. The application constructed should have five or more tables**.
12	Perform basic CRUD (Create, Read, Update, Delete) operations on a Cassandra table.
13	Write and execute CQL queries to retrieve specific data from Cassandra tables
14	Create a simple application using Mongodb with python

** The problem must be designed to convey the difference of NoSQL from SQL databases.

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)
C01	Develop database schema for a given real world problem-domain using standard design and modeling approaches	К3
CO2	Construct queries using SQL for database creation, interaction, modification, and updation.	К3
CO3	Plan and implement triggers and cursors, procedures, functions, and control structures using PL/SQL	К3
CO4	Perform CRUD operations in NoSQL Databases	К3
CO5	Design database applications using front-end tools and back-end DBMS	К5

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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	Fundamentals of Database Systems	Elmasri, Navathe	Pearson	7/e, 2017			
2	Professional NoSQL	Shashank Tiwari	Wiley	1/e, 2011			

Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Database System Concepts,	Sliberschatz Korth and S. Sudarshan	McGraw Hill,	7/e, 2017		
2	NoSQL for Dummies	Adam Fowler	John Wiley & Sons	1/e, 2015		
3	NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data),	Olivier Pivert	Wiley	1/e, 2018		
4	Making the Sense of NoSQL : A guide for Managers and Rest of us.	Dan McCreary and Ann Kelly	Manning	1/e, 2014		

	Video Links (NPTEL, SWAYAM)				
Module No.	Link ID				
1	https://onlinecourses.nptel.ac.in/noc21_cs04/preview				
2	https://onlinecourses.nptel.ac.in/noc21_cs04/preview				
3	https://onlinecourses.nptel.ac.in/noc21_cs04/preview				
4	https://archive.nptel.ac.in/courses/106/104/106104135/				

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 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 5

COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)

APPLIED CRYPTOGRAPHY

Course Code	PCCCT501	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)	PCCCT501	Course Type	Theory

Course Objectives:

- 1. Understand the fundamental principles of cryptography and network security.
- 2. Learn and apply cryptographic techniques and protocols.
- 3. Analyse the security mechanisms of symmetric and asymmetric cryptography.
- 4. Explore advanced cryptographic applications and emerging trends.
- 5. Implement security solutions in cloud computing, quantum computing, and IoT.

Module No.	Syllabus Description	Contact Hours		
	Introduction to Cryptography and Security			
	Introduction to Cryptography: Definition and History of Cryptography -			
	Importance and Applications - Key Terminologies and Concepts - Types of			
	Attacks			
	Classical Encryption Techniques: Substitution Ciphers: Caesar Cipher,			
	Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polybius Square			
1	Transposition Ciphers: Rail Fence, Columnar Transposition			
	Steganography: Principles of Steganography, Types of Steganography,			
	Steganography Versus Digital Watermarking, Types of Digital Watermarking,			
	Goals of Digital Watermarking.			
	Quick Review of Number Theory: Prime Numbers, Modular Arithmetic,			
	Greatest Common Divisor, Fermat's and Euler's Theorems, Chinese			
	Remainder Theorem			

	Cryptographic Concepts and Techniques				
	Symmetric Key Cryptography: Block Ciphers: DES, 3DES, AES (Block				
	Level only) - Stream Ciphers: RC4 - Modes of Operation: ECB, CBC, CFB,				
2	OFB, CTR				
	Asymmetric Key Cryptography: Principles of Public Key Cryptosystems-				
	RSA Algorithm-Diffie-Hellman Key Exchange-Elliptic Curve Cryptography				
	Cryptographic Hash Functions: Hash Function Requirements and				
	Properties, SHA-256, SHA-3, MD5, HMAC				
2	Message Authentication and Cryptographic Protocols				
3	Message Authentication Codes: Structure and Usage, CMAC, GMAC,				
	Digital Signatures: RSA, DSA, ECDSA				
	Cryptographic Protocols: Key Management and Distribution, Public Key	у			
	Infrastructure (PKI), SSL/TLS Protocol				
	Secure Electronic Transactions: E-commerce Security Requirements,				
	Payment Protocols - SET, 3D Secure, Cryptographic Tokens				
	Advanced Cryptographic Applications and Emerging Trends				
4	Advanced Cryptographic Techniques: Homomorphic Encryption, Zero-	11			
	Knowledge Proofs Quantum Cryptography: Basics and Algorithms;				
	Cryptography in Cloud Computing and IoT: Security Challenges and				
	Cryptographic Solutions in Cloud Computing, Challenges and Cryptographic				
	Solutions in IoT				

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
	Students will be able to understand the fundamental principles and	К3
CO1	historical context of cryptography, including key terminologies and	
	classical encryption techniques.	
	Students will be able to implement and analyze symmetric and	К3
CO2	asymmetric cryptographic algorithms, hash functions, and message	
	authentication codes.	
C03	Students will demonstrate the ability to apply cryptographic protocols to	К2
	secure communication, key management, and electronic transactions.	
	Students will be able to understand advanced cryptographic applications	K2
CO4	and emerging trends, including security in cloud computing, IoT, and	
	quantum computing.	

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

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

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

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 Practices	William Stallings	Pearson	8th Ed, 2021				
2	Introduction to Modern Cryptography: Principles and Protocols	Jonathan Katz and Yehuda Lindell	CRC Press	2020 (3rd Edition)				

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	2015		
2	Cryptography and Network Security: Black Book	William Easttom	Dreamtech Press	2017		
3	Understanding Cryptography: A Textbook for Students and Practitioners	Christof Paar and Jan Pelzl	Springer	2009		
4	Network Security Essentials: Applications and Standards	William Stallings	Pearson	2016		

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://www.youtube.com/watch?v=iTVyKbDCJrA				
2	https://www.youtube.com/watch?v=UxtR-CB69Rw				
3	https://www.youtube.com/watch?v=FOk8TN7HQLo				
4	https://www.youtube.com/watch?v=9XC4mY_3X2I				

NETWORK AND SYSTEM SECURITY

Course Code	PCCCT502	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)		Course Type	Theory

Course Objectives:

- 1. Enables the learners to understand network security domain, the techniques for network protection
- 2. This course helps to identify the attacks and defence in Data and wireless networks.
- **3.** Enables the students to the basic functionalities and hardening of Windows and Linux operating system.
- 4. This course helps to identify the attacks and security in internet and web service.

Module No.	Syllabus Description	Contact Hours
1	Module-1 (Principles of Network Security) Principles of network security,Network Security Terminologies, CIA TRIAD Components of Network Security- Network Firewall-types, rules, personal firewalls,Intrusion Detection and Prevention System, Advanced Threat Protection,Network access Control,Web filtering. Network Security Policies. Network segments,Perimeter Defense, NAT, Penetration testing.	10
2	Module-2(Network Security) Network Attacks, Services and Mechanisms, Network Security model, Network security and their relation to Steganography , Security in Data Networks,Wireless Device security issues- GPRS security, GSM security, IP security. Wireless Transport Layer Security-Secure Socket Layer, Wireless	10

	Transport Layer Security - WAP Security, WAP security Architecture, WAP Gateway.	
3	 Module-3(System Security) Windows Security: Attacks against windows system,Installing applications,Authentication and access control,Upgrades and Patches, Operating Windows safely,. Linux Security- Attacks in Linux system,Physical security, Controlling the configuration, Authentication and access control,Upgrades and Patches, Operating Linux safely. 	9
4	Module-4 (Web Security) Web Browser and Client risk- How a web browser works, Web browser attacks, Operating safely, Web security- How HTTP works, Server and Client contents, Attacking Web servers, Web Services.E-mail security- The e-mail risk, Protocols, Authentication, Operating safely when using email, Domain Name System – DNS basics, Purpose of DNS, Security Issues with DNS, DNS attacks WAP Gateway.	10

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	Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain network security domain, the techniques for network protection and explore new tools and attacks in Network security domain.	K1
CO2	Identify the attacks and defence in wireless and data networks.	K2
СО3	Explain the functionalities and hardening of windows and Linux operating systems.	K1
CO4	Explain the various attacks as well as security measures in Internet and Web services.	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			3		3		3
CO2	2	3	2		2			3		2		2
CO3	2	2	2		2			3		3		2
CO4	2	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	Network Security Bible	Eric Cole, Ronald Krutz, James W. Conley,	Wiley India Pvt Ltd, 2010	First Edition,2010		
2	Principles of Information Security	Michael A Whitman, Herbert J.Mattord	Cengage Learning	4 th Edition, 2016		

	Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	Network Security Essentials	William Stallings	Pearson Education	4th Edition, 2011				
2	Fundamentals of Network security	Michael A Whitman, Herbert J.Mattord	Tata McGraw-Hill	1 st Edition, 2011				

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://nptel.ac.in/courses/106106129 https://onlinecourses.swayam2.ac.in/nou24_cs13/preview				
2	https://onlinecourses.nptel.ac.in/noc24_cs80/preview https://nptel.ac.in/courses/106106129				
3	https://nptel.ac.in/courses/106106129 https://www.udemy.com/course/web-security-and-bug-bounty-learn-penetration-testing/				
4	https://nptel.ac.in/courses/106106129				

MACHINE LEARNING

(Common to CS/AD/CR/CA/CC/CD)

Course Code	PCCST503	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 impart the fundamentals principles of machine learning in computer and science.
- 2. To provide an understanding of the concepts and algorithms of supervised and unsupervised learning.

Module No.	Syllabus Description		
1	Introduction to ML :- Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. Parameter Estimation - Maximum likelihood estimation (MLE) and maximum aposteriori estimation (MAP), Bayesian formulation. Supervised Learning :- Feature Representation and Problem Formulation, Role of loss functions and optimization Regression - Linear regression with one variable, Linear regression with multiple variables : solution using gradient descent algorithm and matrix method.	9	

	Classification - Logistic regression, Naïve Bayes, KNN, Decision Trees – ID3	
	Generalisation and Overfitting - Idea of overfitting, LASSO and RIDGE	
	regularization, Idea of Training, Testing, Validation	
	Evaluation measures – Classification - Precision Recall Accuracy E-	
2	Measure. Receiver Operating Characteristic Curve(ROC). Area Under Curve	9
	(AUC).	
	Regression - Mean Absolute Error (MAE), Root Mean Squared Error	
	(RMSE), R Squared/Coefficient of Determination.	
	SVM – Linear SVM, Idea of Hyperplane, Maximum Margin Hyperplane,	
	Non-linear SVM, Kernels for learning non-linear functions	
2	Neural Networks (NN) - Percentron Neural Network - Multilaver feed-	0
3	forward network. Activation functions (Sigmoid, ReLU, Tanh), Back	9
	propagation algorithm.	
	Unsupervised Learning	
	Clustering - Similarity measures, Hierarchical Clustering - Agglomerative	
	Clustering, partitional clustering, K-means clustering	
4		9
	Dimensionality reduction - Principal Component Analysis, Multidimensional	
	scaling	
	Ensemble methods - bagging, boosting; Resampling methods -	
	Bootstrapping, Cross Validation. Practical aspects - Bias-Variance tradeoff.	

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3	00
	subdivisions.	
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Bloom's Knowledge Level (KL)	
CO1	Illustrate Machine Learning concepts and basic parameter estimation methods.	K2
CO2	Demonstrate supervised learning concepts (regression, classification).	К3
CO3	Illustrate the concepts of Multilayer neural network and Decision trees	К3
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques	К3
CO5	Use appropriate performance measures to evaluate machine learning models	К3

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

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

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

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

Text Books								
Sl. No	Title of the BookName of the Author/s		Name of the Publisher	Edition and Year				
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	4/e, 2020				
2	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki Wagner Meira	Cambridge University Press	1/e, 2016				
3	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1/e, 1998				

Reference Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	Applied Machine Learning	M Gopal	McGraw Hill	2/e, 2018				
2	Machine Learning using Python	Manaranjan Pradhan U Dinesh Kumar	Wiley	1/e, 2019				
3	Machine Learning: Theory and Practice	M.N. Murty, V.S. Ananthanarayana	Universities Press	1/e, 2024				

Video Links (NPTEL, SWAYAM)					
No.	Link ID				
1	https://archive.nptel.ac.in/courses/106/105/106105152/				
2	https://archive.nptel.ac.in/courses/106/106/106106139/				
3	https://nptel.ac.in/courses/106106202				

MICROCONTROLLERS

(Common to CS/CC)

Course Code	PBCST504	CIE Marks	60
Teaching Hours/Week (L:T:P:R)	4	ESE Marks	40
Credits	3:0:0:1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

- 1. To introduce the ARM architecture and ARM-based microcontroller architecture.
- 2. To impart knowledge on the hardware and software components to develop embedded systems using STM32 microcontrollers.

Module No.	Syllabus Description	Contact Hours
1	Introduction to ARM Cortex-M Architecture:- Overview of Embedded Systems, Applications of Embedded Systems, Introduction to Embedded C, Microcontrollers vs. Microprocessors, Classification of processors, Overview of ARM Cortex-M Series, Introduction to the Cortex-M23 and Cortex-M33 processors and the Armv8-mArchitecture, ARM Core Features: Registers, Memory, and Bus Architecture, Comparison with previous generations of Cortex-M processors.	8
2	STM32 Microcontroller Overview and Peripheral Programming:- Introduction to STM32 Family, STM32U575 Features and Specifications, Power Management and Low-Power Features Libraries, Introduction to Integrated Development Environment and HAL, Writing, and Debugging Your First Program(LED Interfacing), Interfacing Seven-Segment Display, LCD Display, and Matrix Keypad, Relay Interfacing, Analog to Digital	10

	Conversion: Potentiometer, temperature sensor, LDR, Microphone, Digital to	
	Analog Conversion: Simple DAC Output Generation, Generating a Sine	
	Wave, Audio Signal Generation, Interrupt Handling, Timer and Counter	
	Applications: Basic Timer Configuration, Timers as Counters, Timer-Based	
	Real-Time Clock (RTC)	
	Communication Protocols and USB:-	
	Serial port terminal Application, Serial communication (USART, I2C, SPI,	
	CAN), Interfacing an I2C Temperature Sensor and Displaying Data on an	
3	LCD, writing to and Reading from an SPI-based EEPROM, Configuring and	10
	Implementing CAN Communication between Multiple STM32U575	
	Microcontrollers, Creating a USB HID Device for Keyboard / Mouse	
	Emulation	
	IoT, Wireless Communication, and RTOS:-	
	Introduction to IoT, IoT Architecture, Protocols (MQTT, CoAP), IoT Security	
	Principles and Common Threats Wireless Communication: Interfacing GSM	
	(Call, SMS, Internet), Bluetooth Communication Basics, LoRa	
	Communication Basics and Applications, Designing an IoT-Based Home	
	Automation System, Introduction to RTOS Concepts, FreeRTOS with	
4	STM32: Task Creation, Scheduling, and Management, RTOS Timers, Delays,	16
	and RTC Integration, Inter-task Communication: Queues and Semaphores	
	Trust Zong Tashnology: Introduction to APM Trust Zong Trust Zong	
	Architecture and Eastures Secure and Nen Secure Worlds: Configuration and	
	Management Implementing Trust Zong in STM22U575 Advanged	
	Debugging and Ontimization, Code and Mamory Ontimization Technicula	
	Debugging and Optimization: Code and Memory Optimization Techniques,	
	Debugging Strategies and 1001s	

Suggestion on Project Topics

• Identify real world problems requiring hardware solutions and develop them using peripheral devices. Some of the examples would be - Home automation, Small home/office security system, ARM based voice response system etc.

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	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	• 2 questions will be given from each module, out	
module.	of which 1 question should be answered.	
• Total of 8 Questions,	• Each question can have a maximum of 2	40
each carrying 2 marks	subdivisions.	40
	• Each question carries 6 marks.	
(8x2 =16 marks)	(4x6 = 24 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the architectural features and instructions of the ARM microcontrollers.	K2
CO2	Develop applications involving interfacing of external devices and I/O with ARM microcontroller.	К3
CO3	Use various communication protocols of interaction with peer devices and peripherals.	К3
CO4	Demonstrate the use of a real time operating system in embedded system applications.	К3
CO5	Apply hardware security features of ARM in real world applications.	К3

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	3									3
CO2	3	3	3									3
CO3	3	3	3	3	3							3
CO4	3	3	3	3	3							3
CO5	3	3	3	3								3

Text Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	The Definitive Guide to ARM Cortex- M3 and Cortex-M4 Processors	Joseph Yiu	Newnes - Elsevier	3/e, 2014				
2	Mastering STM32	Carmine Noviello	Learnpub	2/e, 2022				

Reference Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	ARM System Developer's Guide	Andrew N. Sloss, Dominic Symes, Chris Wright	Morgan Kaufman	1/e, 2008				
2	Embedded System Design with Arm Cortex-M Microcontrollers	Cem Ünsalan, Hüseyin Deniz Gürhan Mehmet Erkin Yücel	Springer	1/e, 2022				
3	Introduction to ARM ® Cortex-M Microcontrollers	Jonathan W. Valvano	Self-Published	5/e, 2014				

Video Links (NPTEL, SWAYAM)						
Module No.	Link ID					
1	https://archive.nptel.ac.in/courses/106/105/106105193/					
2	https://www.st.com/resource/en/datasheet/					

PBL Course Elements

L: Lecture	R: Project (1 Hr.), 2 Faculty Members				
(3 Hrs.)	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		

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

Assessment and Evaluation for Project Activity

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

NETWORK FUNDAMENTALS FOR CLOUD

Course Code	PECCT521	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 knowledge of networking concepts and familiarity with operating systems	Course Type	Theory

Course Objectives:

- 1. To understand core networking concepts, such as IP addressing, subnetting, and routing.
- **2.** To implement cloud networking solutions, including designing and configuring virtual networks and security settings.
- 3. To troubleshoot network issues within cloud environments.
- 4. To integrate cloud and on-premises networks, managing hybrid systems effectively

Module No.	Syllabus Description					
	Introduction to Networking Concepts and Cloud Computing:- Basics of					
	Computer Networks: Overview of Network Types: LAN, WAN, Pan, OSI					
	and TCP/IP Models.IP Addressing and Subnetting: IPv4 vs. IPv6 Addressing,					
	SubnettingConcepts and Techniques.					
1	Introduction to Cloud Computing: Cloud Computing Models: IaaS,PaaS,					
	SaaS. Cloud Architecture Overview.					
	Networking in Cloud Environments: Importance of Networking inCloud,					
	Interaction Between Traditional Networks and Cloud Infrastructures.					
	Networking Protocols and Cloud Connectivity :-					
2	TCP/IP Protocol Suite: Deep Dive into TCP/IP Protocols, Role of TCP/IP	9				
	in Cloud Environments.					

	DNS and DHCP in the Cloud, DNS Configuration in Cloud, DHCP inCloud	
	Networks.	
	Virtual Private Networks (VPN): VPN Implementation in Cloud, Securing	
	VPNs for Cloud Connectivity.	
	Load Balancing in Cloud: Load Balancer Types and Configurations,	
	Implementing Load Balancers in Cloud.	
	Virtual Private Cloud (VPC), VPC Configuration and Management, VPC	
	Peering and Gateways.	
	Hybrid Cloud Connectivity, Integrating Public and Private Clouds,	
	Challenges and Solutions in Hybrid Cloud Connectivity.	
	Cloud Networking Components, Architectures, and Security:	
	Virtual Networking and SDN: Virtual Networks(VNet) Configuration,	
	Principles of SDN and Implementation in Cloud, Network Function.	
	Virtualization (NFV) and Microservices: NFVComponents and Architecture,	
	Networking for Containers (Docker, Kubernetes).	
3	Cloud Network Design Principles: Designing for Scalability and Flexibility,	9
	Redundancy and Disaster Recovery Planning.	
	Security in Cloud Networks: Cloud-Native Security Controls, Intrusion	
	Detection and Prevention Systems (IDPS), Identity and Access Management	
	(IAM), Encryption Techniques and Zero-Trust	
	Architecture.	
	Monitoring, Troubleshooting, and Optimizing Cloud Networks :-	
	Network Monitoring in Cloud: Tools for Cloud Network Monitoring, Setting	
	Up Alerts and Dashboards.	
	Troubleshooting Cloud Networks: Common Cloud Networking Issues and	
	Solutions, Using Diagnostic Tools (e.g., Traceroute, Ping).	
4	Network Traffic Analysis and Optimization: Analyzing Traffic Patterns in	9
	Cloud Networks, Performance Tuning and Cost- Effective Network	
	Configuration.	
	Automation in Cloud Network Management: Automating Network	
	Configuration and Management, Using Infrastructure as Code (IaC)Tools.	

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	Illustrate Fundamental Networking Concepts and Cloud Computing Basics.	К2
CO2	Explain IP Addressing and Subnetting Techniques.	К2
CO3	Apply Networking Protocols and Cloud Connectivity Solutions.	К3
CO4	Illustrate Cloud Networking Components and SecurityMeasures	K2
CO5	Troubleshooting and Optimization Techniques in CloudNetworks.	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
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	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	Computer Networking: A Top- Down Approach	James F. Kurose and KeithW. Ross	Pearson Publications	Eight Edition, 2017.					
2	Cloud Computing: Concepts, Technology & Architecture	Thomas Erl, Ricardo Puttini, and Zaigham Mahmood	Prentice Hall Publications	First edition, 2013.					

	Reference Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year					
1	Cloud Networking: Understanding Cloud-based Data Center Networks	Gary Lee and Lee Hwee Kuan	CRC Press	First edition, 2017.					
2	Network Security Essentials: Applications and Standards	William Stallings	Pearson Publications	Sixth edition, 2020.					
3	AWS Certified Advanced Networking Official Study Guide: Specialty Exam	Brad Bulger, Ather Khan, and Stephen Cole	Wiley Publications	First edition, 2020.					

Video Links (NPTEL, SWAYAM)								
Module No.	Link ID							
1	https://youtu.be/fErDcUtd8fA?si=vk5rYduwokgAqUMh							
2	https://youtu.be/3NDhETVfrp0?si=MyOfYaRDJRJ0gn9F							
3	https://youtu.be/RWgW-CgdIk0?si=HN9mHIo4w9-J4IaJ							
4	https://youtu.be/YmYWevNdcik?si=8dO1vCGjO1yPQ8XE							

Code	PECCT522	CIE Marks	40

BLOCKCHAIN AND CRYPTOCURRENCY

Course Code	PECCT522	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 undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- 2. To create cryptocurrencies and give a strong technical understanding of Blockchain technologies with an in-depth understanding of applications, open research challenges, and future directions.

Module No.	Syllabus Description	Contact Hours			
	INTRODUCTION TO BLOCKCHAIN				
	Block chain- Public Ledgers, Blockchain as Public Ledgers – Block in a				
1	Blockchain, Transactions-The Chain and the Longest Chain - Permissioned	9			
	Model of Blockchain, Cryptographic -Hash Function, Properties of a hash				
	function-Hash pointer and Merkle tree				
	BITCOIN AND CRYPTOCURRENCY				
	A basic crypto currency, Creation of coins, Payments and double spending,				
2	\ensuremath{FORTH} – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P	9			
	Network, Transaction in Bitcoin Network, Block Mining, Block propagation				
	and block relay				
	BITCOIN CONSENSUS				
3	Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin	9			
	PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn -				

	Proof of Elapsed Time – Bitcoin Miner, Mining Difficulty, Mining Pool-									
	Permissioned model and use cases.									
	HYPERLEDGER	FABRIC	&	ETHEREUM						
	Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum									
4	network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity. BLOCKCHAINAPPLICATIONS.									
4										
	Blockchain Applications in Supply Chain Management, Logistics, Smart									
	Cities, Finance and Banking, Insurance, etc- Case Study.									

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

Course Outcomes (COs)

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

	Bloom's Knowledge Level (KL)	
CO1	Understand emerging abstract models for Blockchain Technology	K2
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	K4
CO3	It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.	K2
CO4	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application	К3
C05	Understand the applications of blockchain in various fields.	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
CO2	2	3	2									2
CO3	3	2	2									2
CO4	2	3	2									2
CO5	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	Mastering Blockchain: Inner workings of blockchain, from cryptography and decentralized identities, to DeFi, NFTs and Web3, 4th Edition	Bashir and Imran	Kindle Edition	2023
2	"Mastering Bitcoin: Unlocking Digital Cryptocurrencies",	Andreas Antonopoulos Drescher	O'Reilly	2023
3	Handbook of Research on Blockchain Technology		Elsevier Inc. ISBN: 978012819816	2020.

Video Links (NPTEL, SWAYAM)				
Module No.	Link ID			
1	https://youtu.be/fu8SFiO948A?feature=shared			
2	https://www.youtube.com/live/hixM4u7ep58?feature=shared			
3	https://youtu.be/fw3WkySh_Ho?feature=shared			
4	https://youtu.be/sro4PhmKg?feature=shared			

AI IN CYBER SECURITY

Course Code	PECCT523	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)	PECCT413 Introduction to AI and ML	Course Type	Theory

Course Objectives:

- 1. Understand the application of AI in various aspects of Cyber Security.
- 2. Identify and describe Machine Learning techniques used in threat detection.
- **3.** Utilize AI-based tools for cybersecurity tasks.
- 4. Apply AI-driven data analysis to identify and mitigate cyber threats.

SYLLABUS

Module No.	Syllabus Description			
	AI in Cyber Security			
	Role of AI in Cyber Security: Introduction to the role of AI in cybersecurity:			
	how AI is transforming cyber defences, Discussion on the current state of			
	cyber threats and how AI can mitigate them			
	Review of Basic Cyber Threats: Overview of basic cyber threats: malware,			
	phishing, DDoS attacks, etc.			
1	Introduction to AI Tools in Cyber Security: Overview of commonly used AI			
	tools (e.g., antivirus software, intrusion detection systems)			
	Case Studies: AI Applications in Cyber Security			
	Case Study 1: How AI stopped a major phishing campaign (e.g., Google's			
	Safe Browsing)			
	Case Study 2: Using AI to detect anomalies in network traffic (e.g.,			
	DARPA's Cyber Grand Challenge)			
		1		

	Machine Learning in Threat Detection			
	Application of Supervised Learning in Threat Detection: Introduction to			
	supervised learning: concepts and algorithms, Practical examples of			
	supervised learning in detecting malware			
2	Introduction to Unsupervised Learning Techniques for Anomaly			
	Detection: Overview of unsupervised learning: clustering, anomaly			
	detection			
	Case Study: Unsupervised learning in detecting insider threats (e.g., detecting			
	insider trading in financial institutions)			
	AI-Based Tools and Techniques in Cyber Security			
	Overview of AI-Powered Cybersecurity Tools: Introduction to advanced			
	AI-powered tools: firewalls, intrusion detection systems, Discussion on how			
	AI enhances traditional cybersecurity tools, AI-based firewalls and their real-			
3	world applications			
	Introduction to AI-Driven Data Analysis Techniques: Basic concepts of			
	AI-driven data analysis in cybersecurity			
	Case Study: How AI-driven data analysis thwarted a cyber-attack (e.g.,			
	IBM's Watson in Cybersecurity)			
	Ethical Considerations and Challenges in AI for Cyber Security			
	Ethical Implications of AI in Cyber Security: Ethical issues surrounding AI			
	in cybersecurity (privacy, bias, etc.)			
	Challenges in Implementing AI for Cyber Security: Technical challenges			
	in AI-based cybersecurity (data quality, model robustness), Future Trends and	0		
4	Ethical Balances in AI and Cyber Security, Emerging trends in AI for	9		
	cybersecurity			
	Case Study: Privacy concerns with AI-driven surveillance (e.g., AI in facial			
	recognition by law enforcement)			

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	To describe the role of AI in modern cybersecurity.	K2
CO2	To explain the application of supervised learning in threat detection.	K2
CO3	To analyze real-world applications of AI in virus detection and intrusion prevention.	K3
CO4	To explain the ethical implications of AI in cybersecurity, including privacy and bias issues.	K2

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

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

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 in Cyber Security: Theories and Applications	Himanshu Upadhyay, Steven Lawrence Fernandes, Tarun Kumar Sharma, Tushar Bhardwaj	Springer International Publishing	2023	
2	ARTIFICIAL INTELLIGENCE IN CYBER SECURITY	Rahul Neware Khaja Mannanuddin, Mukesh Madanan, Dr. Shikha Gupta	Book Rivers	2022	

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Artificial Intelligence in Cybersecurity	Leslie F. Sikos	Springer International Publishing	2018			
2	Artificial Intelligence for Cybersecurity: Techniques, Challenges and Research	Mark Stamp	Springer International Publishing	2022			
3	Machine Learning and Security: Protecting Systems with Data and Algorithms	Clarence Chio, David Freeman	O'Reilly Media	2018			

Video Links (NPTEL, SWAYAM)							
Module No.	e Link ID						
1	Cyber Security and Privacy by Prof. Saji K Mathew (NPTEL)						
2	Applied Accelerated Artificial Intelligence By Prof. Satyajit Das, Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof.Ashrut Ambastha						
3	Applied Accelerated Artificial Intelligence By Prof. Satyajit Das, Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof.Ashrut Ambastha						
4	Applied Accelerated Artificial Intelligence By Prof. Satyajit Das, Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof.Ashrut Ambastha						

ADVANCED INDUSTRIAL CYBER SECURITY

Course Code	PECCT524	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)	PECCT414 FUNDAMENTALS OF INDUSTRIAL CONTROL SYSTEM SECURITY	Course Type	Theory

Course Objectives:

- 1. Enables the learners to understand the advanced concepts of Network Security and Endpoint Security.
- **2.** Enables the learners to apply the best practices in each phase of SDLC and gain an insight on data classification and data loss prevention.
- **3.** Enables learners to manage the full life cycle of digital entities, gain skills in deploying SIEM systems and apply threat intelligence to improve organizational security.
- **4.** Enables the learners to understand the Compliance and regulatory controls and gain knowledge on emerging technologies related to industrial cyber security.

SILLADUS	SYL	LA	BU	S
----------	-----	----	----	---

Module No.	Syllabus Description	Contact Hours
1	Network Security Controls : Firewalls - Types of Firewalls, Configuration of Firewalls, Intrusion Detection and Prevention Systems (IDPS), Virtual Private Networks (VPNs), Network Segmentation.	9

	Endpoint Security : Antivirus and Antimalware, Endpoint Detection and	
	Response (EDR),	
	Patch Management, Device Encryption.	
	Application Security Controls: Secure Software Development Lifecycle	
	(SDLC), Code Review	
	And Static Analysis, Web Application Firewalls (WAF), Database Security.	
2	Data Protection Controls: Data Classification and Handling, Data Loss	9
	Prevention (DLP),	
	Encryption (At Rest, In Transit), Backup and Recovery.	
	Identity and Access Management (IAM) : Identity Lifecycle	
	Management, Single Sign-On (SSO), Federation and Trust Models,	
	Privileged Access Management (PAM).	
3	Security Monitoring and Incident Response: Security Information and	9
	Event Management (SIEM), Threat Intelligence, Incident Response	
	Planning,Forensics and Post-Incident Analysis	
	Compliance and Regulatory Controls: General Data Protection Regulation	
	(GDPR) Health Insurance Portability and Accountability Act (HIPAA).	
	Sarbanes-Oxley Act (SOX) Payment Card Industry Data Security Standard	
	(PCI DSS) Emerging Trends and Technologies: Zero Trust Architecture	
4	Artificial Intelligence in Cyber Security Block chain for Security Quantum	10
	Computing Implications	
	Companing improductions.	
	Case Study: Analysis of Real-World Cyber security Incidents	

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	Able to configure firewall rules and policies and identify different types of malware.	К2
CO2	Integrate security practices into each phase of SDLC and apply the principles of encryption for data protection	К3
CO3	Design and implement Identity management processes and understand the role of SIEM systems in analysing security events.	К3
CO4	Integrate Threat Intelligence into security operations and conduct post- incident analysis to determine the root cause of security incidents.	К3
CO5	Understand the compliance and regulatory controls and gain knowledge on emerging technologies related to industrial cyber security.	К2

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

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

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 Security Essentials: Applications and Standards.	William Stallings	Pearson	6 th Edition,2016		
2	Network Intrusion Detection and Prevention: Concepts and Practices	Ali A Ghorbani, Wei Lu, Mahabod Tavallaee	Springer-Verlag NewYork Inc.	1 st Edition, 2010		
3	Malware Analyst's Cookbook and DVD: Tools and Techniques for fighting malicious code	Michael Ligh, Steven Adair, Blake Heartstein	Wiley	1 st Edition,2010		
4	Software Security: Building Security In	Gary Mcgraw	Addison-Wesley	1 st Edition,2006		
5	Identity and Access Management :Business Performance through Connected Intelligence	Ertem Osmanoglu	Syngress	1 st Edition,2013		
6	Zero Trust Networks: Building Secure systems in Untrusted Networks	Evan Gilman, Doug Barth	O'Reilly	1 st Edition 2017		

Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Web Application Security: Exploitation and Countermeasures for Modern Web Applications	Andrew Hoffman	Orielly and Associates Inc.	2 nd Edition,2020		
2	Security Information and Event Management Implementation	David Miller, Shon Harris, Allen Harper, Stephen Wandyke, Chris Blask	McGraw Hill Education	2 nd Edition,2010		
3	Block chain Basics : A Non- Technical Introduction in 25 steps	Daniel Drescher	Apress	1 st edition, 2017		

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	http://www.digimat.in/nptel/courses/video/106105031/L40.html				
2	https://nptel.ac.in/courses/128106006				
3	https://onlinecourses.nptel.ac.in/noc24_cs85/preview				
4	https://onlinecourses.nptel.ac.in/noc24_cs121/preview http://www.digimat.in/nptel/courses/video/106104220/L01.html				

SOFTWARE PROJECT MANAGEMENT

(Common CS/CD/CM/CR/CA/AD/AM)

Course Code	PECST521	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)	PECST411	Course Type	Theory

Course Objectives:

- 1. To learn the techniques to effectively plan, manage, execute, and control projects within time and cost targets with a focus on Information Technology and Service Sector.
- 2. To learn agile project management techniques such as Scrum and DevOps.

SYLLABUS

Module No.	Syllabus Description				
1	Project scheduling and feasibility study : - Project Overview and Feasibility Studies - Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal; Project Scheduling - Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.	8			
2	Resource Scheduling, Cost Control and Project management Features :- Cost Control and Scheduling - Project Cost Control (PERT/Cost), Resource Scheduling & Resource Levelling; Project Management Features - Risk Analysis, Project Control, Project Audit and Project Termination.	8			

3	Agile Project Management :-Agile Project Management - Introduction, Agile Principles, Agilemethodologies, Relationship between Agile Scrum, Lean, DevOps and ITService Management (ITIL;. Other Agile Methodologies - Introduction to XP,FDD, DSDM, Crystal.	9
4	Scrum and DevOps in project management :- Scrum - Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum, Case Study; DevOps - Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test-Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Case Study.	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 	 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. 	60
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand how effectively plan, and schedule projects within time and cost targets	К2
CO2	Apply project estimation and evaluation techniques to real world problem	К3
CO3	Discuss different Agile Project Methodologies	К2
CO4	Apply various SCRUM practices in project management.	K3
CO5	Demonstrate the techniques used in DevOps.	К3

CO-PO Mapping Table:

	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
CO5	3	3	3								2	2

Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Succeeding with Agile: Software Development Using Scrum	Mike Cohn	Addison-Wesley	1/e, 2009		

Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Agile Product Management with Scrum	Roman Pichler	Addison-Wesley	1/e, 2010		
2	Agile Project Management with Scrum	Ken Schwaber	Microsoft Press	1/e, 2004		

Video Links (NPTEL, SWAYAM)				
No.	Link ID			
1	https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs70/			
2	https://www.youtube.com/watch?v=TPEgII1OilU			
3	https://www.youtube.com/watch?v=7Bxdds2siU8			

DATA MINING

(Common to CS/CD/CM/CA/AM)

Course Code	PECST525	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)	None	Course Type	Theory

Course Objectives:

- 1. To provide a thorough understanding of the key processes and concepts involved in data mining and data warehousing within application domains
- 2. To enable students to understand the different data preprocessing techniques, fundamentals and advanced concepts of classification, clustering, association rule mining, text mining and web mining, and apply these techniques in real-world scenarios

Module No.	ule Syllabus Description				
1	Data Mining Fundamentals :- Data Mining - concepts and applications, Knowledge Discovery in Database Vs Data mining, Architecture of typical data mining system, Data Mining Functionalities Data warehouse - Differences between Operational Database Systems and Data Warehouses, Multidimensional data model- Warehouse schema, OLAP Operations, Data Warehouse Architecture	10			
2	Data Preprocessing :- Data Preprocessing - Need of data preprocessing, Data Cleaning- Missing values, Noisy data, Data Integration and Transformation	11			

	Data Reduction - Data cube aggregation, Attribute subset selection, Dimensionality reduction, Numerosity reduction, Discretization and concept hierarchy generation.	
3	Classification And Clustering :- Classification - Introduction, Decision tree construction principle, Information Gain, Gini index, Decision tree construction algorithm - ID3, Neural networks, back propagation, Evaluation measures - accuracy, precision, recall, F1 score Clustering - Introduction to clustering, distance measures, Clustering Paradigms, Partitioning Algorithm - k means, Hierarchical Clustering, DBSCAN	11
4	Association Rule Analysis And Advanced Data Mining : - Association Rule Mining - Concepts, Apriori algorithm, FP Growth Algorithm Web Mining - Web Content Mining, Web Structure Mining- Page Rank, Web Usage Mining- Preprocessing, Data structures, Pattern Discovery, Pattern Analysis Text Mining - Text Data Analysis and information Retrieval, Basic measures for Text retrieval, Text Retrieval methods, Text Indexing Technique	12

Criteria for Evaluation(Evaluate and Analyse): 20 marks

Students must be asked to identify problems involving large datasets and identify the right solution from the concepts already learned. A comparison of the results with a similar approach also need to be performed to assess the Knowledge Level 5.

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the key process of data mining and data warehousing concepts in application domains.	К2
CO2	Apply appropriate pre-processing techniques to convert raw data into suitable format for practical data mining tasks	К3
CO3	Illustrate the use of classification and clustering algorithms in various application domains	К3
CO4	Comprehend the use of association rule mining techniques	К3
CO5	Explain advanced data mining concepts and their applications in emerging domains	К2

CO-PO Mapping Table:

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

	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, Micheline Kamber	Elsevier	3/e, 2006				
2	Data Mining: Introductory and Advanced Topics	Dunham M H	Pearson Education	1/e, 2006				

	Reference Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year					
1	Introduction to Data Mining	Pang-Ning Tan, Michael Steinbach	Addison Wesley	1/e, 2014					
2	Data Mining: Concepts, Models, Methods, and Algorithms	Mehmed Kantardzic	Wiley	2/e, 2019					

	Video Links (NPTEL, SWAYAM)					
Module No.	Link ID					
1	https://youtu.be/ykZUGcYWg?si=qiqynQyjI1sNNiHE					
2	https://youtu.be/NSxEiohAH5o?si=ZIJHMiRvpFcNQNMA					
3	https://youtu.be/VsYKqOokgaE?si=rgndBZqpzB29LUGg					
4	https://youtu.be/N_whCVtfL9M?si=VPMH9NP4vdAaiuPe					

CRYPTOGRAPHY LAB

Course Code	PCCCL507	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. Develop Practical Skills in Cryptographic Techniques: To equip students with hands-on experience in implementing and analyzing various cryptographic algorithms, including classical ciphers, symmetric encryption, and asymmetric encryption techniques.
- 2. Enhance Understanding of Cryptographic Principles and Applications: To enable students to demonstrate and apply fundamental cryptographic principles in real-world scenarios, ensuring data integrity, confidentiality, and authentication through practical coding exercises.
- **3.** Foster Proficiency in Secure Communication and Memory Management: To cultivate students' ability to design and implement secure communication protocols and to simulate memory allocation and garbage collection using linked lists, integrating cryptographic methods with effective memory management techniques.

Expt. No.	Experiments
	Represent a string (char pointer) with a value "Hello world". The program should XOR
1	each character in this string with 0 and displays the result.*
2	Represent string (char pointer) with a value "Hello world" The program should AND, OR,
-	and XOR each character in this string with 127 and display the result.
	Perform encryption and decryption using the following algorithms*
3	a. Ceaser cipher b. Substitution cipher c. Hill Cipher
4	Implementation of Encryption and Decryption using DES*
5	Implementation of RSA Encryption Algorithm

6	Implementation of Hash Functions*
7	Implementation of Blowfish algorithm logic*
8	Implement the Diffie-Hellman Key Exchange mechanism
9	Implement RC4 logic using Java*
10	Encrypt the text "Hello world" using Blowfish.
11	Implement the SIGNATURE SCHEME –Digital Signature Standard*
12	Implement LSB Steganography.

PRACTICE QUESTIONS

- 1. Write a C program that contains a string (char pointer) with a value"Helloworld". The program should XOR each character in this string with 0 and displays the result.
- 2. Write a C program that contains a string (char pointer) with a value "Hello world". The program should AND, OR, and XOR each character in this string with 127 and display the result.
- 3. Write a Java program to perform encryption and decryption using the following algorithms
 - a. Caeser cipher
 - b. Substitution cipher
 - c. Hill Cipher
- 4. Write a C/JAVA program to implement DES Encryption and Decryption
- 5. Write a C/JAVA program to implement RSA Encryption Algorithm
- 6. Write a C/JAVA program to implementation of Hash Functions.
- 7. Write a C/JAVA program to implement the Blowfish algorithm logic.
- 8. Write the RC4 logic in Java Using Java cryptography; encrypt the text Hello world using Blowfish. Create your own key using Java key tool.
- 9. Write a C/JAVA program to implement the Diffie-Hellman Key Exchange mechanism
- 10. Implement the SIGNATURE SCHEME -Digital Signature Standard
- 11. Embed a short text message (up to 8 characters) into the least significant bits of the image's pixel data. Read the modified image and extract the hidden message.

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	Students will implement various classical and modern cipher techniques to	K3
	understand the process of securing information.	
CO2	Students will code and distinguish between symmetric and asymmetric	K3
	cryptographic methods, gaining practical knowledge of both types.	
CO2	Students will explore and implement different encryption techniques and	K3
	message authentication codes (MACs) to ensure data integrity and security.	
	Students will write programs to implement the DES (Data Encryption	K3
CO4	Standard) and RSA (Rivest-Shamir-Adleman) algorithms, understanding	
	their mechanisms and uses.	
	Students will create a program using linked lists to simulate memory	K3
CO5	allocation and garbage collection, applying data structure concepts to	
	memory management.	

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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	Applied Cryptography: Protocols, Algorithms and Source Code in C	Bruce Schneier	Wiley	2015					

Video Links (NPTEL, SWAYAM)						
Module No.	Link ID					
1	https://cse29-iiith.vlabs.ac.in/ (AICTE Virtual Labs)					

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 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

NETWORK AND SYSTEM SECURITY LAB

Course Code	PCCCL508	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 Code	Course Type	Lab

Course Objectives:

- 1. Familiarize tools to prevent latest threats
- 2. Analyze the network traffic using sniffing tools.
- **3.** Use network scanning tools
- 4. Familiarize various Steganography tools
- 5. Use tools for Penetration testing

Expt. No.	Experiments
1	Preventing PC against latest threats using Windows Defender.
2	Data hiding using Xiao Steganography
3	Website mirroring using HTTrack
4	Monitor, capture and analyze network packets using Wireshark.
5	Network mapping and analysing. Using Nmap
6	Port Scanning using Angry IP Scanner or Advanced IP Scanner.
7	Penetration testing and Vulnerability Scanning using Burp Suit.
8	Password Cracking-Use John The ripper /hydra

PRACTICE QUESTIONS

- 1. You need to protect a Windows computer from malware and viruses without installing any third-party software. Which built-in tool can you use to scan and remove malicious threats?
- 2. A user reports that their computer is behaving strangely, and you suspect malware. Which default Windows tool would you use to perform a quick or full system scan to identify and eliminate the threat?
- 3. You need to troubleshoot network latency issues by examining the timing of packet transmissions. Which tool will help you capture and analyze the packet flow to identify the cause of the delay?
- 4. To verify the integrity of communication between two endpoints on your network, you want to capture and analyze the packets being exchanged. Which tool would be best suited for this task?
- 5. You need to scan a network to discover active devices and identify open ports on each device. Which tool can you use to perform this network discovery and security auditing?
- 6. You need to create an offline copy of a website for analysis and reference. Which tool can you use to download the entire site, including HTML, images, and other files?
- 7. You want to back up a website's content and structure to ensure you have a local copy in case the site becomes unavailable. Which tool should you use to accomplish this task efficiently?
- 8. You need to hide sensitive data within an image file to ensure it remains undetected by unauthorized users. Which tool would you use to embed and later extract this hidden information?
- 9. During a network inventory process, you want to quickly discover and document all the IP addresses currently in use. Which tool would help you perform this task efficiently?
- 10. To test the security of a web application, you need to perform automated vulnerability scanning and manual testing for common web application flaws. Which tool provides integrated features for both types of testing?

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					
CO1	Familiarize tools to prevent latest threats	K3				
CO2	Analyze the network traffic using sniffing tools	К3				
CO3	Use network scanning tools	К3				
CO4	Familiarize various Steganography tools	К3				
CO5	Use tools for Penetration testing	К3				

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

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 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

COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)

COMPILER DESIGN

(Common to CS/CD/CU/CC/CN/CB)

Course Code	PCCST601	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)	PCCST302	Course Type	Theory

Course Objectives:

- 1. To provide a comprehensive understanding of the compiler construction process through its various phases viz. lexical analysis, parsing, semantic analysis, code generation, and optimization.
- 2. To introduce compiler construction tools like Lex and YACC and use them in lexical analysis and parsing.

SYLLABUS

Module	Syllabus Description	Contact		
No.		Hours		
	Introduction - Compiler Structure, Overview of Translation: The Front			
	End; The Optimizer; The Back End.			
1	Scanners - Recognizing Words, Regular Expressions, From Regular	6		
	Expression to Scanner: FSA (Brush-up only), Implementing Scanners			
	Hands-on: Recognizing Words with Lex, Regular Expressions in Lex			
	Parsing - Introduction, Expressing Syntax			
	Top-Down Parsing - Transforming A Grammar: Eliminating Left			
2	Recursion; Backtrack-free Parsing; Left-Factoring To Eliminate	10		
	Backtracking, Recursive Descent Parsers, Table-Driven LL(1) Parsers			
3	Bottom-Up Parsing - Shift Reduce Parser, The LR(1) Parsing			
	Algorithm, Building LR(1) Tables, Errors in the Table Construction,	16		

	Reducing the Size of LR (1) Tables.	
	Hands-on: Building a calculator with YACC	
	Intermediate Representations: An IR Taxonomy, Graphical IRs - Syntax-Related Trees, Graphs; Linear IRs - Stack-Machine Code - Three-Address Code - Representing Linear Codes	
	Syntax-Driven Translation: Introduction, Translating Expressions,	
	Translating Control-Flow Statements	
4	Code generation: Code Shape - Arithmetic Operators, Boolean and Relational Operators, Control-Flow Constructs (Conditional Execution, Loops and Iteration, Case Statements only), Procedure Calls Code Optimization - Introduction, Opportunities for Optimization, Scope Of Optimization Local Optimization: Local Value Numbering, Tree-Height Balancing Regional Optimization: Superlocal Value Numbering, Loop Unrolling Global Optimization: Finding Uninitialized Variables with Live Sets,	14
	Global Code Placement	

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	(0
carrying 3 marks	• Each question can have a maximum of 3	00
	subdivisions.	
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Use lexical analysis techniques to build a scanner for a given language specification. (Cognitive Knowledge Level: Apply)	К3
CO2	Construct parse trees for input programs using parsing algorithms and detect syntactic errors. (Cognitive Knowledge Level: Apply)	К3
CO3	Develop semantic analysis techniques to check program correctness. (Cognitive Knowledge Level: Apply)	К3
CO4	Build intermediate code representations by applying intermediate code generation techniques. (Cognitive Knowledge Level: Apply)	К3
C05	Optimize generated code using code optimization strategies to improve performance. (Cognitive Knowledge Level: Apply)	К3

	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	3		3							2
CO5	3	3	3		3							2

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

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	Engineering a Compiler	Keith D. Cooper, Linda Torczon	Elsevier Science	3/e, 2023		
2	Lex and YACC	John R. Levine, Tony Mason, Doug Brown	O' Reily	2/e, 1992		

		Reference 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	Aho A.V., Ravi Sethi and D. Ullman.	Addison Wesley,	2/e, 2010.
2	Compiler Construction - Principles and Practice	Kenneth C Louden	Thomson Learning	1/e, 2007
3	Compiler Design in C	Allen Holub	Prentice-Hall software series	1/e, 1990
4	Modern Compiler Implementation in C	Andrew W. Appel	Cambridge University Press	2/e, 2004

Video Links (NPTEL, SWAYAM)			
Module No.	Link ID		
1-4	https://archive.nptel.ac.in/courses/106/105/106105190/		

CYBER FORENSICS

Course Code	РСССТ602	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 about Computer Forensics and the procedures for investigations and incident response.
- **2.** To study about data acquisition and to have an understanding of different forensic acquisition tools.
- 3. To explore the various cyber threats, attacks and the different anti forensic techniques.
- 4. To study the theory behind Network Forensics, Mobile Forensics and various types of Forensics.

Module No.	Syllabus Description					
1	Cyber Forensics and Investigations: Introduction- Computer Forensic Investigations - Forensics Investigation Process -Preparing for computer investigations, understanding Public and private investigations. Data Acquisition - storage formats for digital evidence, determining the best acquisition method -Forensic Protocol for Evidence Acquisition - Digital Forensics Standards and Guidelines – Incident Response stages -Digital Evidence – identification, collection, processing, seizing documenting and	9				
2	Storing - contrigency planning for image acquisitions. Cyber Forensics Tools and Types of Forensics: Cyber Forensics Tools-Computer Forensics software and hardware tools - Open Source and Proprietary -Challenges in Cyber Forensics, Skills	9				

SYLLABUS
	Required to Become a Cyber Forensic Expert- Physical Requirements of a Cyber forensics Lab. Types of Cyber forensics.	
	File System Forensics-Working with windows and CLI systems- file	
	systems, exploring Microsoft file structures, examining FA1 and NIFS	
	disks, whole disk encryption, the windows registry, Microsoft start up tasks-	
	Windows/, Windows 8, Windows 10- Examining UNIX and LINUX disk	
	devices.	
	OS and Network Forensics	
	Windows Forensics-Live Response: Data Collection- Introduction, Locard's	
	Exchange Principle, Order of Volatility - Volatile and Non Volatile Data	
	Live-Response Methodologies: Data Analysis, Windows Memory Analysis,	
	Rootkits and Rootkit detection. Linux Forensics: Live Response- Data	
	Collection- Data Analysis- Log Analysis, Keyword Searches, User Activity,	
	Network Connections, Running Processes, Open File Handlers, The Hacking	
3	Top Ten and Reconnaissance Tools.	9
	Network Forensics: The OSI Model, Forensic Footprints, Seizure of	
	Networking Devices, Network Forensic Artifacts, ICMP Attacks, Drive-By	
	Downloads, Network Forensic Analysis Tools, Network Log analysis, Case	
	Study: Wireshark. Web Attack Forensics: OWASP Top 10, Web Attack	
	Tests, Penetration Testing.	
	Mobile Device Forensics and Internet of Anything- Cloud Forensics.	
	Cyber Security and Anti Forensics	
	Cyber Security : Cybercrimes, Types of Cybercrimes –Cyber Security Steps	
	taken to protect ICT and prevent Misuse of Internet- IT Act 2000 and	
	amendments- Email and Social Media Investigations Cyber Technology-	
4	Technological/Governance/Judicial/Legal Aspects and perspectives of Cyber	9
	Forensics/Security. Cyber-attack Frameworks-Mitre Framework-Crypto	
	currency.	

Anti-Forensics
Anti-forensic Practices - Data Wiping and Shredding- Data Remanence,
Degaussing, Case Study: USB Oblivion, Eraser - Trail Obfuscation:
Spoofing, Data Modification, Case Study: Timestamp - Encryption, Case
Study: VeraCrypt, Anti-forensics Detection Techniques
Study: veraCrypt, Anti-forensics Detection Techniques

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)

Part A	Part B	Total
• 2 Questions from each	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

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

	Bloom's Knowledge Level (KL)	
CO1	Explain the basic concepts in cyber forensics, forensics Investigation Process and the usage of Cyber Forensics Tools in investigations	K2
CO2	Infer the basic concepts of file systems, its associated attribute definitions	K2
CO3	Utilize the methodologies used in memory analysis and network analysis for detection of artifacts	К3
CO4	Explain the basic concepts in cyber security and study the essence of IT Act.	K2
CO5	Summarize anti forensics practices and data hiding methods.	К2

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
CO2	2	2										2
CO3	2	2	3	3	3							2
CO4	2	2	3	3	3							2
CO5	2	2			2							2

Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Guide to computer forensics and investigations	Bill Nelson, Amelia Philipps and Christopher Steuart	Cengage	6 th Edition 2020		
2	File System Forensic Analysis	Brian Carrier	Pearson Education, Inc.	1 st Edition,2005		
3	Windows Forensic Analysis DVD Toolkit	Harlan Carvey	Syngress	2 nd Edition,2009		
4	Unix and Linux Forensic Analysis DVD Toolkit	Chris Pogue , Cory Altheide, Tode Haverkos	Syngress	1 st Edition,2008		
5	Fundamentals of Network Security	E. Maiwald	McGraw-Hill	1 st Edition, 2017		
6	Network Security Essentials Applications and Standards	William Stallings	Pearson Education	6 th Edition, 2018		

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
Ι	Information Security and Cyber Forensics NPTEL/SWAYAMBy Prof. Pratosh Bansal Devi Ahilya Vishwavidyalaya, Indore				
II/III	Digital Forensics NPTEL/SWAYAM By Dr. Jeetendra Pande Uttarakhand Open University, Haldwani				
IV	Cyber Security and Privacy By Prof. Saji K Mathew IIT Madras				

CLOUD INFRASTRUCTRE AND SYSTEMS

Course Code	PECCT631	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)	PECCT602	Course Type	Theory

Course Objectives:

- **1.** To provide students with a comprehensive understanding of cloud computing concepts and infrastructure.
- 2. To explore various cloud service models and deployment models.
- 3. To understand the security challenges and solutions in cloud computing environments.

Module No.	Syllabus Description	Contact Hours
1	Traditional computing: Limitations, Overview of Computing Paradigms: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, NIST reference Model, Basic terminology and concepts, Cloud characteristics, benefits and challenges, Cloud delivery (service) models: Infrastructure-as-a-Service (IaaS), Platform- as-a-Service (PaaS), Software-asaService (SaaS), XaaS (Anything-as-a- service), Cloud deployment models: Public cloud, Community cloud, Private cloud, Hybrid cloud, Open Cloud Services.	9
2	Basic Terms and Concepts in Security, Threat Agents, Cloud Security Threats, Identity Management and Access Control, Cloud Security Working Groups, Elements of Cloud Security Model, Cloud Security Reference Model, Examining Cloud Security against Traditional Computing	9

3	Introduction to AWS, AWS history, AWS global Infrastructure, AWS services, AWS ecosystem, comparison of AWS, Azure and Google cloud.	9
	Security Management in the Cloud Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS,	
4	IaaS, Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud,	9
	in Relation to Cloud Computing, Legal and Regulatory Implications	

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)

Part A	Part B	Total
• 2 Questions from each	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	To provide students with a comprehensive understanding of cloud computing concepts and infrastructure	К2
CO2	To explore various cloud service models and deployment models	K2
CO3	To understand the security challenges and solutions in cloud computing environments	K2
CO4	To understand fundamental of Identity and Access Management and compliance	К3
CO5	Identify the industry security standards, regulatory mandates, audit policies and compliance requirements for Cloud based infrastructures	К3

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
CO2	3	3	2									2
CO3	3	2										2
CO4	3	2	2	2	2							2
CO5	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	Cloud computing	Bhowmik, S.	Cambridge University Press, 2017	First edition ,2017						
2	Cloud Computing Concepts, Technology & Architecture	Thomas, E., Zaigham, M., Ricardo, P	Prentice Hall,	First Edition,2013						
3	Cloud Security: A Comprehensive Guide to Secure Cloud Computing	Ronald L. Krutz, Russell Dean Vines	Wiley Publishing, 2010	First edition ,2010						
4	Cloud Security and Privacy	Tim Mather, SubraKumaraswamy, and ShahedLatif	O'Reilly Media, Inc., 2009	First edition 2009						

CRYPTOGRAPHIC ALGORITHMS IN BLOCK CHAIN

Course Code	PECCT632	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)	CCT 412	Course Type	Theory

Course Objectives:

- 1. To understand building blocks of Blockchain.
- 2. The course introduces the cryptographic principles behind blockchain

Module No.	Syllabus Description								
	Foundations of Blockchain								
	Blockchain Architecture -Challenges -Applications -Blockchain Design								
	Principles -The Blockchain Ecosystem - The consensus problem -								
1	Asynchronous Byzantine Agreement - AAP protocol and its analysis - peer-	7							
	to-peer network – Abstract Models - GARAY model - RLA Model-Proof of								
	Work (PoW) -Proof of Stake (PoS) based Chains - Hybrid models.								
	Fundamentals of Cryptography								
	Introduction to Cryptography, Symmetric cryptography – AES. Asymmetric								
	cryptography – RSA. Elliptic curve cryptography, Digital signatures – RSA	_							
2	digital signature algorithms. Secure Hash Algorithms - SHA-256.	7							
	Applications of cryptographic hash functions - Merkle trees, Distributed								
	hash tables.								
3	Crypto Primitives, Securing and Interconnecting Public and Private								
	Block Chains								
	Hash Function and Merle Tree-Security Properties-Security Considerations								
	for block chain Digital Signature-Public Key Cryptography-Bitcoin								

	blockchain incentive structures- Nash Equilibriums- evolutionary stable strategies,-and Pareto efficiency (game theory) Weaknesses and news Points of Failure, Mitigation Methods, Redundancies and fall-back methods.	
4	Blockchain Protocols Ethereum tokens –Augur -Golem -Understanding Ethereum tokens -App Coins and Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Token sale structure - Ethereum Subreddit.	6

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)

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 Outcome	Bloom's Knowledge Level (KL)
CO1	Understand Blockchain ecosystem and its services in real world sceneries.	K2
CO2	Distinguish between Symmetric cryptography and asymmetric cryptography.	K4
CO3	Explain the working of AES algorithm.	K4
CO4	Understanding the methods for Securing and Interconnecting Public and Private Block Chains	K2
CO5	Acquaint the protocol and assess their computational requirements	K2

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

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	1							2
CO2	2	2		3	1				2			2
CO3	2	2		3	1				2			2
CO4	2	2		3	1				2			2
CO5	2	2		3	1			3				2

Text Books										
Sl. No	Title of the Book	Title of the BookName of the Author/s		Edition and Year						
1	Blockchain enabled applications	Dhillon, V., Metcalf, D., and Hooper, M	CA: Apress, Berkeley	1st Edition, 2017						
2	Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more	Imran Bashir	Packt Publishing	Third edition, 2020						

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Blockchains, digital assets, smart contracts, decentralized autonomous organizations	Diedrich, H. Ethereum	Wildfire publishing, Sydney.	1st Edition, 2016
2	Blockchain Technology: Concepts and Applications	Kumar Saurabh, Ashutosh Saxena	Wiley Publications	1st Edition,2020
3	Blockchain Technology	Chandramouli Subramanian, Asha A George, et al	Universities Press (India) Pvt. Ltd	First edition, August 2020
4	Distributed Ledger Technology: The Science of the Blockchain	Wattenhofer, R. P	Createspace Independent Pub, Scotts Valley, California, US.	2 nd Edition

Video Links (NPTEL, SWAYAM)				
Module No.	Link ID			
1	https://youtu.be/mzPoUjQC4WU			
2	https://youtu.be/LjEZzYe5uOo?feature=shared			
3	https://youtu.be/3FnEwnOpo_k?feature=shared			
4	https://youtu.be/v1MSq7m7lzA?feature=shared			

Course Code	PECCT633	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)	PECCT413 Introduction to AI and ML PECCT523 AI in Cyber Security	Course Type	Theory

AI AND ML IN CYBER SECURITY DEFENCE

Course Objectives:

- 1. To provide students with a comprehensive understanding of the importance, challenges, and promises of AI in the cybersecurity landscape.
- 2. To familiarize students with various machine learning techniques and their applications within the cybersecurity domain, including anomaly detection and intrusion detection.
- **3.** To introduce students to generative AI concepts, algorithms, and models, and explore their applications in cybersecurity, including threat detection and incident response.
- **4.** To equip students with the knowledge to identify potential security risks associated with AI and generative AI, and to develop best practices for securing AI systems in cybersecurity.

Module No.	Syllabus Description	Contact Hours	
	Introduction: Role of AI in Cyber Security and Security Framework		
	Review of Artificial Intelligence in Cyber Security: Definition and		
	Importance, Challenges and promises, Security Threats of Artificial		
	Intelligence: Types and Examples		
1	Machine Learning in Cyber Security		
	Introduction to Machine Learning: Concepts and Terminology,	8	
	Applications of Machine Learning in the Cyber Security Domain, Machine		
	Learning Tasks and Approaches: Supervised vs. Unsupervised Learning		
	Anomaly Detection Techniques in Cybersecurity,		

	Privacy Preserving Nearest Neighbour Search; Techniques and Applications,					
	Machine Learning Applied to Intrusion Detection					
	Fundamentals of Generative AI:					
	Concepts, Algorithms, and Models; Generative AI Techniques: Variational					
	Autoencoders (VAEs), Generative Adversarial Networks (GANs),					
2	Transformer-Based Models					
	Applications of Generative AI in Various Domains: Text Generation, Image	10				
	Synthesis					
	Case Study: Successful Generative AI Applications and their Impact					
	Generative AI for Cybersecurity					
	Overview of Cybersecurity Challenges and the Potential of Generative					
	AI: Applications of Generative AI in Cybersecurity; Anomaly Detection,					
	Threat Hunting, Vulnerability Analysis					
3	Generative AI for Automated Incident Response and Mitigation					
	Case Study: Generative AI in Real-World Cybersecurity Scenarios					
	Generative AI Security Risks and Challenges					
	Potential Security Risks Associated with Generative AI: Data Poisoning,	isoning,				
	Model Inversion, Adversarial Attacks					
	Overview of Generative AI Applications in Cybersecurity Defence:					
	Predictive Analytics for Threat Detection Using Generative AI, Automated					
	Security Patch Generation and Vulnerability Management, Strengthening					
4	Encryption Protocols	9				
	Case Study: Real-World Applications of Generative AI in Cybersecurity	ty				
	defence, Best Practices for Securing Generative AI Systems, Future Trends					
	in Generative AI for Cybersecurity defence					

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	To explain the significance of AI in cybersecurity, including its challenges and potential threats.	К2
CO2	To identify and apply machine learning techniques relevant to cybersecurity tasks, such as anomaly detection and intrusion detection.	К3
CO3	To evaluate the effectiveness of generative AI techniques in addressing cybersecurity challenges, including incident response and threat mitigation.	K4
CO4	To assess security risks related to AI systems and propose best practices for securing generative AI applications in cybersecurity.	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	1									
CO2	2	3	2									
CO3	2	2	1									
CO4	3	2	2					1				

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
		Himanshu Upadhyay,		
	Artificial Intelligence in Cyber	Steven Lawrence		2023
1	Security: Theories and	Fernandes, Tarun Kumar	Springer International	
	Applications	Sharma, Tushar	Publishing	
		Bhardwaj		
		Rahul Neware Khaja		
2	INTELLIGENCE IN CYBER	Mannanuddin, Mukesh		2022
	SECURITY	Madanan, Dr. Shikha	Book Rivers	2022
		Gupta		

	Reference Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
	Hands-on Artificial Intelligence for	Alessandro	Dockt Dublishing	2022		
1	Cybersecurity	Parisi	r ackt r ublishing	2022		
_	Artificial Intelligence for Cybersecurity:	Mort Stores	Springer International	2022		
2	Techniques, Challenges and Research		Publishing	2022		
3	Generative AI for Cybersecurity	Edited Volume	Springer	2023		

Video Links (NPTEL, SWAYAM)			
Module No.	Link ID		
1	https://www.youtube.com/watch?v=fC7V8QsPBec		
2	https://www.youtube.com/watch?v=oJlb4jBbKWw		
3	https://www.youtube.com/watch?v=oJlb4jBbKWw		
4	https://www.youtube.com/watch?v=oJlb4jBbKWw		

OT THREAT PREVENTION

Course Code	PECCT634	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)	Fundamentals and advanced Industrial Cyber Security	Course Type	Theory

Course Objectives:

- **1.** Enables the learners to understand the Distinctions and Integration of OT and IT Systems and helps the students to identify the difference between OT and IT networks in Industrial Systems.
- 2. Enables the students to identify and classify OT Assets based on criticality.
- 3. Enables the learners to implement Access Control and Secure Network Access.
- 4. Enables the learners to monitor, analyze, and respond to Threats and Vulnerabilities

Module No.	Syllabus Description				
	Understanding OT and IT Systems				
	Overview of OT and IT Systems: Defining Operational Technology (OT)				
	and Information Technology (IT), Key differences between OT and IT in				
	terms of architecture, functionality, and security, Independent OT networks:				
	Architecture, use cases, and benefits.				
	Integration of OT with IT Networks: Drivers for OT-IT convergence,				
1	Challenges in integrating OT with IT networks, Common architectures for	9			
	OT-IT integration				
	Threats and Vulnerabilities in Integrated Networks: Threat landscape for				
	integrated OT-IT environments, Vulnerabilities specific to OT, IT, and their				
	integration, Case studies of security incidents in integrated networks				

	Asset Identification and Criticality Classification: Identifying OT	
	Assets: Techniques for asset discovery in OT environments, Importance of	
	maintaining an up-to-date asset inventory, Tools and technologies for OT	
	asset identification	
	Criticality Classification: Criteria for classifying OT assets based on	
2	criticality, Impact analysis of OT asset failure on overall operations,	
	Prioritizing security efforts based on asset criticality	10
	Risk Management and Compliance: Applying risk management	
	frameworks in integrated networks, Compliance considerations in OT-IT	
	integration, Standards and best practices (e.g., NIST, IEC 62443)	
	Securing Access and Dynamic Network Segmentation:	
	Securing Wired and Wireless Access: Best practices for securing wired	
	access in OT-IT networks, Wireless security protocols and their application	
	in OT environments, Managing and securing remote access in integrated	
	networks	
	Dynamic Network Segmentation: Concepts of network segmentation and	
3	micro-segmentation, Implementing dynamic network segmentation in OT-IT	12
	environments.	
	Monitoring, Analysis, and Threat Response	
	Monitoring and Threat Detection: Importance of continuous monitoring in	
	integrated OT-IT networks, Tools and techniques for monitoring OT and IT	
	systems.	
	Analyzing Threats and Vulnerabilities: Techniques for analyzing security	
	data from integrated networks, Vulnerability management and patching in	
	OT-IT systems, Incident detection and analysis for OT-IT integrated	
	environments.	
4	Incident Response and Recovery: Developing incident response plans	10
T	specific to OT-IT integration, Threat hunting and proactive security	
	measures, Recovery strategies and business continuity planning for	
	integrated networks.	

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	Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Differentiate Between OT and IT Systems and Understand Their Integration.	К2
CO2	Identify, Inventory, and Classify OT Assets Based on Criticality.	К2
CO3	Implement Effective Access Control and Secure Network Access Mechanisms.	К3
CO4	Deploy Continuous Monitoring and Advanced Threat Detection Systems.	К3
CO5	Develop and Execute Comprehensive Incident Response and Recovery Plans.	К3

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		1	1	2				1
CO2	3	2	2	2	1	1	1	2				1
CO3	3	3	2	3	1	2		2	2		1	1
CO4	3	3	3	3	2	3	2	3	2	2	1	2
CO5	3	3	3	3	3	3	2	3	3	3	2	3

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Practical Industrial Cybersecurity: ICS, OT, and IIoT	Philip A. Craig	Delmar Cengage Learning	Thomson 2nd edition, 2013			
2	Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS	Tyson Macaulay, Bryan L. Singer	CRC Press	I st edition, 2012			
3	Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure	Eric D. Knapp, Raj Samani	Syngress	I st edition, 2013			
4	Industrial Network Security :Securing Critical Infrastructure Networks for Smart Grid, SCADA and other Industrial Control Systems	Eric D Knapp Joel Thomas Langill	Syngress	2 nd Edition, 2014			
5	Industrial Cybersecurity: Efficiently Secure Critical Infrastructure Systems	Pascal Ackerman	Packt Publishing	2 nd Edition, 2021			
6	Building an Effective Cybersecurity Program: Lessons Learned from an Industrial Control Systems Environment	Tari Schreider	Rothstein Publishing	I st edition, 2017			

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Industrial Automation using PLC , SCADA & DCS	R.G.Jamkar	Global Education Ltd	2 nd Edition, 2018			
2	Handbook of SCADA/Control Systems Security	Robert Radvanovsky, Jacob Brodsky	CRC Press	2 nd Edition, 2016			
3	Effective Cyber security : A Guide to Using Best Practices and Standards	William Stallings	Addison-Wesley Professional	1 st edition, 2018			

Video Links (NPTEL, SWAYAM)				
Module No.	Link ID			
1	https://nptel.ac.in/courses/106/105/106105217/ https://nptel.ac.in/courses/108/105/108105088/			
2	https://nptel.ac.in/courses/108/101/108101167/ https://nptel.ac.in/courses/106/105/106105217/			
3	https://nptel.ac.in/courses/106/106/106106220/ https://nptel.ac.in/courses/108/108/108108122/			
4	https://nptel.ac.in/courses/108/108/108108098/ https://nptel.ac.in/courses/106/105/106105217/			

BIOMETRIC SECURITY

Course Code	PECCT635	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)	None	Course Type	Theory

Course Objectives:

- 1. To provide students with a comprehensive understanding of the principles, technologies, and processes involved in biometric systems, including various recognition techniques and performance measures.
- 2. To enable students to critically evaluate security issues, privacy concerns, and biometric standards, while exploring the practical applications of biometric systems across different fields.

Module No.	Syllabus Description	Contact Hours
	Biometric fundamentals – Biometric technologies – Biometrics Vs	
	traditional techniques - Characteristics of a good biometric system -	
	Benefits of biometrics - Key biometric processes: verification, identification	
1	and biometric matching - Performance measures in biometric systems, FAR,	
	FRR, FTE rate, EER and ATV rate, Applications of Biometric Systems,	8
	Security and Privacy Issues, Physiological Biometrics and Behavioural	
	Biometrics.	
	Fingerprint recognition: Friction ridge patterns, Acquisition, Feature	
	extraction, matching, indexing, synthesis, palm print. Face recognition:	
2	Introduction, image acquisition, face detection. Feature extraction of face	
	recognition, matching, heterogeneous face recognition. Signature-scan,	11
	Keystroke Scan- components, working principles.	

3	Iris recognition, Image acquisition, iris segmentation, normalization. Encoding and matching, quality assessment, performance evaluation Ear detection and recognition – challenges, gait and hand geometry. Feature extraction and matching	8
4	Security of bio-metric systems: adversary attacks, attacks on user interface, attacks on bio-metric processing, database attacks. Biometric standards, biometric databases	7

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

End Semester Examination Marks (ESE):

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

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the fundamental concepts of biometric systems, including	K2
	their technologies and key processes.	
CON	Understand key performance metrics of biometric systems and their	K2
	relevance to system accuracy.	
	Apply various biometric recognition techniques, including fingerprint,	K3
CO3	face, iris, and palm print recognition, understanding the acquisition,	
	feature extraction, and matching processes.	
	Identify potential security and privacy threats in biometric systems,	К3
CO4	and recommend strategies to mitigate attacks on biometric processing,	
	user interfaces, and databases.	
	Understand the biometric standards, databases, and their applications	K2
CO5	across different industries, as well as the differences between	
	physiological and behavioural biometrics.	

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
CO2	2	2	2									2
CO3	3	3	2	2	2							2
CO4	3	3	2	2	2							2
CO5	2	2	2	2	2							2

	Text Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year					
1	Introduction to Biometrics	Anil K. Jain, Arun A. Ross, Karthik Nandakumar,	Springer	2011					
2	Handbook of Biometrics	Jain, P. Flynn, A. Ross	Springer	2008					

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Biometric Technologies and Verification Systems	John R. Vacca	Elsevier	2007			
2	Biometrics – Identity Verification in a Networked World	Samir Nanavati, Michael Thieme, Raj Nanavati	Wiley-dreamtech India Pvt Ltd, New Delhi	2003			
3	Biometrics for Network Security	Paul Reid	Pearson Education, New Delhi	2004			

Video Links (NPTEL, SWAYAM)				
Modu	Link ID			
le No.				
1	https://www.youtube.com/watch?v=GMDggxifxqk&list=PLbMVogVj5nJSCwX0N6MAXPsKGW			
-	FRI5Y5m&index=1			
2	https://www.youtube.com/watch?v=7aQgQGeZ_qo&list=PLbMVogVj5nJSCwX0N6MAXPsKGW			
-	FRI5Y5m&index=5			
3	https://www.youtube.com/watch?v=ZEV3th6_olk&list=PLbMVogVj5nJSCwX0N6MAXPsKGWF			
5	RI5Y5m&index=8			
4	https://www.youtube.com/watch?v=eNPAas0XgVI&list=PLbMVogVj5nJSCwX0N6MAXPsKGW			
-	FRI5Y5m&index=15			

ETHICAL HACKING & IOT SECURITY

Course Code	PBCCT604	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)	None/ (Course code)	Course Type	Theory

Course Objectives:

- 1. To learn ethical hacking and security challenges in computer networking.
- 2. To protect the network system using firewalls and filters, about the legal, professional and ethical issues.

Module No.	Syllabus Description	Contact Hours
	Elements of Information Security, Authenticity and Non-Repudiation, Security	
	Challenges, Effects of Hacking, Hacker - Types of Hacker, Ethical Hacker,	
	Role of Security and Penetration Tester, Penetration Testing Methodologies:-	
	OSSTMM, NIST, OWASP, Categories of Penetration Test, Types of	
1	Penetration Tests, Vulnerability Assessment.	
•	Tools for Foot Printing, Conducting Competitive Intelligence, Google	11
	Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms,	
	Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering-	
	shoulder surfing, Dumpster Diving, Piggybacking.	
	Vulnerability Data Resources - Exploit Databases - Network Sniffing -	
	Types of Sniffing - MITM Attacks - ARP Attacks - Denial of Service	
•	Attacks - Hijacking Session with MITM Attack -DNS Spoofing - ARP	
2	Spoofing Attack Manipulating the DNS Records – DHCP Spoofing -Remote	11
	Exploitation - Attacking Network Remote Services - Overview of Brute	11
	Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL	

	Servers – Testing for Weak Authentication.	
	Routers, Firewall & Honey pots, IDS &IPS, Web Filtering, Vulnerability,	
	Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross	
	Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering,	
	Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles	
	Phone Hacking.	
	What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence	
	of IT and IoT, IoT Challenges, IoT Network Architecture and Design,	
	Drivers Behind New Network Architectures, Comparing IoT Architectures,	
	A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data	
	Management and Compute Stack.	
3	Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects,	11
	Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT	
	Access Technologies.	
	IP as the IoT Network Layer, The Business Case for IP, The need for	
	Optimization, Optimizing IP for IoT, Profiles and Compliances, Application	
	Protocols for IoT, The Transport Layer, IoT Application Transport Methods.	
	Data and Analytics for IoT, An Introduction to Data Analytics for IoT,	
	Machine Learning, Big Data Analytics Tools and Technology, Edge	
	Streaming Analytics, Network Analytics, Securing IoT, A Brief History of	
4	OT Security, Common Challenges in OT Security, Differences between IT	11
	and OT Security Practices and Systems, Formal Risk Analysis Structures:	
	OCTAVE and FAIR.	

Continuous Internal Evaluation Marks (CIE):

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts of Ethical hacking	K2
CO2	Utilize the tools to conduct competitive intelligence and social engineering.	К3
CO3	Appreciate the security considerations in IoT.	K2
CO4	Outline the fundamentals of IoT and its underlying physical and logical architecture	K2
CO5	Implement IoT applications using the available hardware and software.	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										2
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

	Text Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	"Hands on ethical hacking and network defense", Cengage Learning.	Michael T Simpson, Kent Back man, James Corley,		2nd edition, 2010		
2	"Ethical Hacking and Penetration Testing Guide"	Rafay Baloch	CRC Press	2014.		
3	"Internet of Things: A hands- on approach"	Arshadeep Bahga, Vijay Madisetti,	University Press	2015 (First edition)		
4	Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems,	Dr. Ovidiu Vermesan, Dr. Peter Friess	River Publishers	2013		

	Reference Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	"Certified Ethical Hacker: A Study Guide", Wiley Publishing, Inc., 2010.	Kimberly Graves,	Wiley Publishing, Inc.	2010		
2	"Hacking Exposed 7 :Network Security Secrets & Solutions"	Stuart Mc Clure, Joel Scambray,	McGraw-Hill publishing,	edition 7, 2012		
3	"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things"	David Hanes, Gonzalo Salgueiro, Patrick rossetete, Robert Barton, Jerome Henry ,	Pearson Education	1st Edition		
4	"Internet of Things: Architecture and Design Principles"	Rajkamal	McGraw Hill (India) Private Limited			

	Video Links (NPTEL, SWAYAM)				
Module No.	Link ID				
1	https://www.youtube.com/watch?v=fNzpcB7ODxQ				
2	https://www.youtube.com/@HackerSploit				
3	https://www.youtube.com/watch?v=7zWVxrjjIpE				
4	https://www.youtube.com/playlist?list=PL1ljc761XCiaTRgucelgZS8pbTEyt1BjX				

PBL Course Elements

L: Lecture	R: Project (1 Hr.), 2 Faculty Members			
(3 Hrs.)	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

DESIGN THINKING AND PRODUCT DEVELOPMENT

Course Code	GXEST605	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	60
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

(Common to Group A & Group B)

Course Objectives:

- 1. To guide students through the iterative stages of design thinking, including empathizing with users, defining problems, ideating solutions and developing Proof of Concepts (PoC) and technical feasibility studies.
- 2. To promote the development of critical thinking skills by engaging students in integrative inquiry, where they ask meaningful questions that connect classroom knowledge with real-world applications.
- 3. To equip students with the ability to involve in product design considering the sustainability, inclusivity, diversity and equity aspects.

Module No.	Syllabus Description			
	Fundamentals of design thinking and product development: Overview of			
	stages of product development lifecycle; Design thinking -Definition-Design			
	thinking for product innovation; Bringing social impact in ideation-			
1	Identifying societal needs-understanding multi-faceted issues-community	6		
	engagement and empathetic design- technological innovation meeting			
	societal needs; Understanding and Bridging the divide using Human			
	Centered Design (HCD); Designing for inclusivity in product development-			

	embracing user diversity - Long term impact - sustainability encompassing	
	environmental, economic and social dimensions; Technology Readiness	
	Level in the Innovation Life-cycle; Performing a self-check on innovative	
	ideas - Originality of idea- understanding innovation landscape -	
	patentability - understanding the economic landscape - Unique Selling	
	Proposition (USP) - Repeatability and Manufacturability - Sustainability -	
	Leveraging business models for comprehensive analysis	
	Empathize: Design thinking phases; Role of empathy in design thinking;	
	Methods of empathize phase - Ask 5 Why/ 5 W+H questions; Empathy	
	maps - Things to be done prior to empathy mapping - Activities during and	
2	after the session; Understanding empathy tools - Customer Journey Map -	6
	Personas.	
	Define: Methods of Define Phase: Storytelling, Critical items diagrams,	
	Define success.	
	Ideation : Stages of ideation; Techniques and tools - Divergent thinking	
	tools - Convergent thinking tools - Idea capturing tools; Cross-industry	
	inspiration; Role of research in ideation - Market research - consumer	
	research - leveraging research for informed ideation; Technological trends -	
	navigating the technological landscape - Integrating emerging technologies;	<i>.</i>
3	Feasibility studies - technical, economic, market, operational, legal, and	6
	ethical feasibility; Ideation session- techniques and tips.	
	Proof of Concept (PoC) : Setting objectives; Risk assessment; Technology	
	scouting; Document and process management; Change management;	
	Knowledge Capture; Validating PoC; Story telling in PoC presentation	
	Design: Navigating from PoC to detailed design; Developing Specification	
	Requirement Document (SRD)/Software Requirement Specification (SRS);	
	Design for manufacturability; Industrial standards and readability of code;	
	Design to cost; Pre-compliance; Optimized code; Design Failure Mode and	
	Effects Analysis (DFMEA); Forecasting future design changes.	
4	Prototyping: Alpha prototypes; Beta prototypes; Transition from design to	0
	prototype; Goals and expectations for Alpha and Beta prototypes; Effective	
	strategies for maintaining timeline in prototyping; Testing and refining	
	Alpha prototypes; Transitioning to Beta prototypes.	
	Pilot build: Definition and purpose of a pilot build; setting objectives;	

Identification and selection of manufacturing partner for pilot build; Testing	
procedures in pilot build; Scaling from pilot build to full-scale production /	
implementation.	

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignments	Internal Examination	Reflective Journal and Portfolio	Total	
5	20	10	5	40	

End Semester Examination Marks (ESE)

Part A	Part B	
 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

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

	Bloom's Knowledge Level (KL)	
CO1	Empathize to capture the user needs and define the objectives with due consideration of various aspects including inclusivity, diversity and equity	К5
CO2	Ideate using divergent and convergent thinking to arrive at innovative ideas keeping in mind the sustainability, inclusivity, diversity and equity aspects.	K6
CO3	Engage in Human Centric Design of innovative products meeting the specifications	K5
CO4	Develop Proof of Concepts (PoC), prototypes & pilot build of products and test their performance with respect to the Specification Requirement Document.	K4
CO5	Reflect on professional and personal growth through the learnings in the course, identifying areas for further development	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	3	3	3	2	2		3
CO2	3	2	3		2	3	3	3	2	2		3
CO3	3	2	3		2	3	3	2	2	2		3
CO4	3	2	2		3	3	3	2	2	2		3
CO5	3					3	3	2	2	2		3

Text Books									
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year					
1	Product Sense: Engineering your ideas into reality	Dr. K R Suresh Nair	NotionPress.com	2024					
2	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation	Tim Brown	HarperCollins Publishers Ltd.	2009					
3	Design Thinking for Strategic Innovation	Idris Mootee	John Wiley & Sons Inc.	2013					
Sample Assignments:

- 1. Evaluate and prepare a report on how the aspects including inclusivity, diversity and equity are taken into consideration during the empathize and define phases of the Miniproject course.
- 2. Evaluate and prepare a report on how the aspects including sustainability, inclusivity, diversity and equity are taken into consideration during the ideate phase of the Miniproject course.
- 3. Evaluate and prepare a report on how User-Centric Design (UCD) is used in the design and development of PoC of the product being developed in the Miniproject course.
- 4. Prepare a plan for the prototype building of the product being developed in the Miniproject course.
- 5. Report on the activities during the empathize phase including the maps & other materials created during the sessions.
- 6. Report on the activities during the define phase including the maps & other materials created during the sessions.
- 7. Report of all the ideas created during the ideation phase of the Miniproject course through the tools including SCAMPER technique, SWOT analysis, Decision matrix analysis, six thinking hats exercise
- 8. Prepare a full scale production plan for the product being developed in the Miniproject course.
- 9. Create a Stanford Business Model Canvas related to the Miniproject.

An industrial visit of at least a day for experiential learning and submit a report on the learnings, for example industry standards and procedures.

SEMESTER 6

DATA STRUCTURES

Course Code	OECST611	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)	-	Course Type	Theory

Course Objectives:

- 1. To provide the learner a comprehensive understanding of data structures and algorithms.
- 2. To prepare them for advanced studies or professional work in computer science and related fields.

Module No.	Syllabus Description	Contact Hours
1	Basic Concepts of Data Structures Definitions; Data Abstraction; Performance Analysis - Time & Space Complexity, Asymptotic Notations; Polynomial representation using Arrays, Sparse matrix (<i>Tuple representation</i>); Stacks and Queues - Stacks, Multi- Stacks, Queues, Circular Queues;	9
2	Linked List and Memory Management Singly Linked List - Operations on Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List; Doubly Linked List.	9
3	Trees and GraphsTrees :- Representation Of Trees; Binary Trees - Types and Properties,Binary Tree Representation, Tree Operations, Tree Traversals; Binary Search	9

	Trees - Binary Search Tree Operations; Graphs :- Definitions; Representation of Graphs; Depth First Search and Breadth First Search.	
4	Sorting and Searching Sorting Techniques :- Selection Sort, Insertion Sort, Quick Sort, Merge Sort; Searching Techniques - Linear Search, Binary Search, Hashing - Hashing functions : Division; Collision Resolution : Linear probing, Open hashing.	9

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	Identify appropriate data structures for solving real world problems.	К3
CO2	Describe and implement linear data structures such as arrays, linked lists, stacks, and queues.	K3
CO3	Describe and Implement non linear data structures such as trees and graphs.	К3
CO4	Select appropriate searching and sorting algorithms to be used in specific circumstances.	К3

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
CO3	3	3	3									3
CO4	3	3	3									3

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Fundamentals of Data Structures in C	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed,	Universities Press	2/e, 2007			
2	Introduction to Algorithms	Thomas H Cormen, Charles Leisesrson, Ronald L Rivest, Clifford Stein	PHI	3/e, 2009			

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Classic Data Structures	Samanta D.	Prentice Hall India.	2/e, 2018			
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication.	1/e, 2003			
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill.	2/e, 2017			
4	Theory and Problems of Data Structures	Lipschuts S.	Schaum's Series	2/e, 2014			

Video Links (NPTEL, SWAYAM)				
Module No.	Link ID			
1	https://nptel.ac.in/courses/106102064			
2	https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/			

DATA COMMUNICATION

(Common to CS/CM/CD/CA)

Course Code	OECST612	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 details of data communication at the lower level and the associated issues.
- **2.** To gain insight into the important aspects of data communication and computer networking systems and to apply the in practical applications.

Module No.	Syllabus Description	Contact Hours
	Communication model - Simplex, Half duplex, Full duplex transmission.	
	Periodic analog signals - Sine wave, Amplitude, Phase, Wavelength, Time	
	and frequency domain, Bandwidth. Analog & digital data and signals.	
	Transmission impairments - Attenuation, Delay distortion, Noise. Data rate	
	limits - Noiseless channel, Nyquist bandwidth, Noisy channel, Shannon's	
1	capacity formula.	10
	Guided transmission media - Twisted pair, Coaxial cable, Optical fiber. Unguided media - Radio waves, Terrestrial microwave, Satellite microwave, Infrared. Wireless propagation - Ground wave propagation, Sky wave propagation, Line-of-Sight (LoS) propagation.	
2	Digital data to digital signal – Non-Return-to-Zero (NRZ), Return-to-Zero (RZ), Multilevel binary, Biphase. Analog data to digital signal - Sampling theorem, Pulse Code Modulation (PCM), Delta Modulation (DM). Digital	9

	data to analog signal - Amplitude Shift Keying (ASK), Frequency Shift	
	Keying (FSK), Phase Shift Keying (PSK). Analog data to analog signal -	
	Amplitude Modulation (AM), Frequency Modulation (FM), Phase	
	Modulation (PM).	
	Multiplexing - Frequency Division Multiplexing (FDM), Wavelength	
	Division Multiplexing (WDM), Time Division Multiplexing (TDM),	
	Characteristics, Synchronous TDM, Statistical TDM. Spread spectrum	
3	techniques - Direct Sequence Spread Spectrum (DSSS), Frequency Hopping	8
	Spread Spectrum (FHSS), Code Division Multiplexing, Code Division	
	Multiple Access (CDMA).	
	Digital data communication techniques - Asynchronous transmission,	
	Synchronous transmission. Detecting and correcting errors - Types of errors,	
4	Parity check, Checksum, Cyclic Redundancy Check (CRC), Forward Error	9
	Correction (FEC), Hamming distance, Hamming code. Basic principles of	
	switching - Circuit switching, Packet switching, Message switching.	

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	Identify the characteristics of signals for analog and digital transmissions so as to define the associated real world challenges.	К3
CO2	Select transmission media based on characteristics and propagation modes.	К3
CO3	Choose appropriate signal encoding techniques for a given scenario	К3
CO4	Illustrate multiplexing and spread spectrum technologies	К2
CO5	Use error detection, correction and switching techniques in data communication	К3

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	2								3
CO3	3	3		2								3
CO4	3	3	3	2								3
CO5	3	3	3	2								3

Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Data Communications and Networking	Forouzan B. A	McGraw Hill	6/e, 2019		
2	Data and Computer Communication	William Stallings	Pearson	10/e, 2016		

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Mobile Communications	Schiller J	Pearson	2/e, 2009			
2	Fundamentals of Networking and Communication	Curt M. White	Cengage	7/e, 2010			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://nptel.ac.in/courses/106105082				

FOUNDATIONS OF CRYPTOGRAPHY

Course Code	OECST613	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 a foundational understanding of mathematical concepts in cryptography,
- 2. Gain comprehensive knowledge of cryptographic methods.
- 3. Understand the principles and need for computer security.

Module No.	Syllabus Description	Contact Hours	
	Integer Arithmetic - Divisibility, Greatest Common Divisor Euclid's and		
	Extended Euclid's Algorithm for GCD; Modular Arithmetic - Operations,	0	
1	Properties, Polynomial Arithmetic; Algebraic Structures - Group Ring	9	
	Field.		
	Prime numbers and Prime Factorisation - Primitive Roots, Existence of		
	Primitive Roots for Primes, Fermat's Theorem, Primality Testing, Euler's		
2	Theorem, Euler's Totient Function, Discrete Logarithms, Modular	9	
	Arithmetic, Chinese Remainder Theorem.		
	Principles of security - Types of Security attacks, Security services, Security		
	Mechanisms; Cryptography - Introduction, cryptographic notations,	0	
3	substitution techniques, Transposition Techniques, limitations of classical	9	
	cryptography.		
4	Symmetric key Ciphers - Block Cipher principles & Algorithms- DES, AES,		
	Differential and Linear Cryptanalysis; Asymmetric Key Ciphers- RSA, ECC;	9	
	Hash Functions - MD5, SHA-1.		

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the integer arithmetic operations including divisibility and GCD algorithms, modular arithmetic operations and properties, polynomial arithmetic, and algebraic structures such as groups, rings, and fields.	K2
CO2	Describe the number theory concepts essential for cryptographic applications and mathematical problem-solving.	К2
CO3	Explain the security principles, types of attacks, and protective measures, alongside a thorough understanding of cryptographic techniques and their applications in securing data.	K2
CO4	Discuss symmetric and asymmetric key cryptography, including block cipher principles, algorithms, public key cryptosystems, and hash functions	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	2										2
CO3	2	2										2
CO4	2	2										2

	Text Books										
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year							
1	Cryptography & Network Security	Behrouz A. Forouzan	McGraw Hill	3/e, 2007							
2	Security in Computing	Charles P. Pfleeger, Shari L. Pfleeger, Jonathan Margulies	Prentice Hall	5/e, 2015							
3	Introduction to Cryptography: Principles and Applications	H. Delfs, H. Knebl	Springer	1/e, 2002							
4	A Classical Introduction to Cryptography: Applications for Communications Security	Serge Vaudenay	Springer	1/e, 2009							

		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	William Stallings	Pearson Education	7/e,2017

	Video Links (NPTEL, SWAYAM)								
Module No.	Link ID								
1	https://archive.nptel.ac.in/courses/111/101/111101137/								
2	https://nptel/courses/video/106105031/L17.html								
3	https://onlinecourses.nptel.ac.in/noc22_cs90/preview								

MACHINE LEARNING FOR ENGINEERS

(Common to CS/CA/CD/CM/CR/AD/AM/AI)

Course Code	OECST614	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 the basic concepts and algorithms in machine learning.
- 2. To discuss the standard and most popular supervised and unsupervised learning algorithms.

Module No.	Syllabus Description	Contact Hours
1	 Introduction to ML Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. Basics of parameter estimation - maximum likelihood estimation (MLE) and maximum aposteriori estimation (MAP), Bayesian formulation. Supervised Learning Feature Representation and Problem Formulation, Role of loss functions and optimization Regression - Linear regression with one variable, Linear regression with multiple variables - solution using gradient descent algorithm and matrix method. 	10

2	 Classification - Naïve Bayes, KNN Generalisation and Overfitting - Idea of overfitting, LASSO and RIDGE regularization, Idea of Training, Testing, Validation Evaluation measures – Classification - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve (AUC). Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination. 	8
3	 Neural Networks (NN) - Perceptron, Neural Network - Multilayer feed-forward network, Activation functions (Sigmoid, ReLU, Tanh), Back propagation algorithm. Decision Trees – Information Gain, Gain Ratio, ID3 algorithm 	8
4	 Unsupervised Learning Clustering - Similarity measures, Hierarchical Clustering - Agglomerative Clustering, partitional clustering, K-means clustering Dimensionality reduction - Principal Component Analysis, Multidimensional scaling Ensemble methods - bagging, boosting Resampling methods - Bootstrapping, Cross Validation. Practical aspects - Bias-Variance trade-off 	10

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	Illustrate Machine Learning concepts and basic parameter estimation methods	К2
CO2	Demonstrate supervised learning concepts (regression, classification)	К3
CO3	Illustrate the concepts of Multilayer neural network and Decision trees	К3
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques	К3
CO5	Use appropriate performance measures to evaluate machine learning models	К3

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							2
CO3	3	3	3	3	2							2
CO4	3	3	3	3	2							2
CO5	3	3	3	3	2							2

	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	2/e, 2010				
5	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki, Wagner Meira	Cambridge University Press	1/e, 2016				

Reference Books						
Sl. No	Title of the BookName of the Author/s		Name of the Publisher	Edition and Year		
1	Machine Learning	Tom Mitchell	McGraw-Hill	1997		
2	Applied Machine Learning	M Gopal	Pearson	2/e, 2018		
3	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1995		
4	Machine Learning: A Probabilistic Perspective	Kevin P Murphy	MIT Press	1/e, 2012		
5	The Elements Of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer	2/e, 2007		

	Video Links (NPTEL, SWAYAM)				
Module No.	Link ID				
1	https://youtu.be/fC7V8QsPBec?si=8kqBn7x1RG5V1J				
2	https://youtu.be/g_LURKuIj4?si=Xj10NPfMfpQSOhVx				
3	https://youtu.be/yG1nETGyW2E?si=ySlxpeWuFAUQBf7-				
4	https://youtu.be/zop2zuwF_bc?si=W7TpSHLdi4rykva4				

OBJECT ORIENTED PROGRAMMING

(Common to CS/CA/CD/CM/AM/AD)

Course Code	OECST615	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 teach the core object-oriented principles such as abstraction, encapsulation, inheritance, and polymorphism, robust error-handling using exception mechanisms to ensure program reliability.
- 2. To equip the learner to develop object oriented programs encompassing fundamental structures, environments, and the effective utilization of data types, arrays, strings, operators, and control statements for program flow in Java.
- **3.** To enable the learner to design and develop event-driven graphical user interface (GUI) database applications using Swing and database connection components.

Module No.	Syllabus Description				
1	Introduction to Java - Java programming Environment and Runtime Environment (Command Line & IDE); Java compiler; Java Virtual Machine; Primitive Data types and Wrapper Types; Casting and Autoboxing; Arrays; Strings; Vector class; Operators - Arithmetic, Bitwise, Relational, Boolean	10			
	Logical, Assignment, Conditional (Ternary); Operator Precedence; Control Statements - Selection Statements, Iteration Statements and Jump Statements; Functions; Command Line Arguments; Variable Length Arguments; Classes; Abstract Classes; Interfaces; OOP Concepts - Data				

	abstraction, encapsulation, inheritance, polymorphism, Procedural and object oriented programming paradigm; Microservices; Object Oriented Programming in Java - Declaring Objects; Object Reference; Introduction to Methods; Constructors; Access Modifiers; <i>this</i> keyword.	
2	Polymorphism - Method Overloading, Using Objects as Parameters, Returning Objects, Recursion; Static Members, Final Variables, Inner Classes. Inheritance - Super Class, Sub Class, Types of Inheritance, The <i>super</i> keyword, protected Members, Calling Order of Constructors; Method Overriding, Dynamic Method Dispatch, Using <i>final</i> with Inheritance.	8
3	Packages and Interfaces – Packages - Defining a Package, CLASSPATH, Access Protection, Importing Packages; Interfaces - Interfaces v/s Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface(s); Exception Handling - Checked Exceptions, Unchecked Exceptions, <i>try</i> Block and <i>catch</i> Clause, Multiple catch Clauses, Nested <i>try</i> Statements, <i>throw</i> , <i>throws</i> and <i>finally</i> , Java Built-in Exceptions, Custom Exceptions.	9
4	Swings fundamentals – Overview of AWT, Swing v/s AWT, Swing Key Features, Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings– JFrame, JLabel, The Swing Buttons, JTextField; Event handling – Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model; Developing Database Applications using JDBC – JDBC overview, Types, Steps, Common JDBC Components, Connection Establishment.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/	Internal Examination-1	Internal Examination- 2	Total
	Microproject	(Written)	(Written)	
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 	 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. 	60
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the process of developing Java programs, including their structure and components, to demonstrate proficiency.	K2
CO2	Utilize object-oriented programming principles in the design and implementation of Java applications.	К3
CO3	Develop and manage Java packages and interfaces, enhancing code modularity and reusability.	К3
CO4	Implement error handling using Java's exception mechanisms and leverage interfaces for modular applications.	К3
CO5	Develop event-driven Java GUI applications with database connectivity.	К3

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										3
CO2	3	3	3									3
CO3	3	3	3		3							3
CO4	3	3	3		3							3
CO5	3	3	3		3							3

	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	Tata McGraw Hill	13/e, 2024			
2	Introduction to Java Programming, Comprehensive Version	Y Daniel Liang	Pearson	10/e, 2014			
3	Head First Design Patterns	Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra	O'Reilly Media	1/e, 2004			

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Head First Java: A Brain Friendly Guide	Kathy Sierra & Bert Bates	O'Reilly	3/e, 2022			
2	JAVA [™] for Programmers	Paul Deitel	PHI	11/e, 2018			
3	Clean Code : A Handbook of Agile Software Craftsmanship	Robert C. Martin	Prentice Hall	1/e, 2008			
4	Programming with Java	E Balagurusamy	McGraw Hill	6/e, 2019			
5	Java For Dummies	Barry A. Burd	Wiley	8/e, 2022			
6	Effective Java	Joshua Bloch	Pearson	3/e, 2018			

Video Links (NPTEL, SWAYAM)						
Module No.	Link ID					
1	https://nptel.ac.in/courses/106105191 (Lecture no: 9, 10, 1, 2, 3, 4)					
2	https://nptel.ac.in/courses/106105191 (Lecture no: 1, 7, 8, 11, 12, 13, 14, 15, 16)					
3	https://nptel.ac.in/courses/106105191 (Lecture no: 17, 18, 19, 20, 21, 22, 23, 24, 25, 26)					
4	https://nptel.ac.in/courses/106105191 (Lecture no: 43, 44, 45, 46, 47, 50, 51, 52, 53, 54, 55)					

CYBER FORENSICS LAB

Course Code	PCCCL607	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)	PCCCT602	Course Type	Lab

Course Objectives:

- 1. The course aims to master Cyber Forensics procedures and get hands-on exposure to different Cyber Forensics tools.
- 2. The course aims to offer hands-on experience on integrity check of files and use it for security implementations.
- **3.** The course aims to offer exposure to live and static forensic analysis.

Expt. No.	Experiments
1	Registry Viewing and Editing using native tools of Operating Systems.
2	Hex analysis using Hex Workshop tool Using Hex Workshop perform file signature analysis. Write down the hex values of popular file types
3	Bit level Forensic Analysis of evidential image using FTK or Encase or ProDiscoverTools.Image Acquisition and perform static analysis to mount an image of a drive.
4	Hash code generation, comparison of files using tools like HashCalc Using HashCalc write down the Hash values of popular hashing algorithms.
5	Command line Analysis of disk images using The SleuthKit(TSK) tool
6	File System Forensic Analysis using Autopsy tool. Using Autopsy perform file signature analysis. Write down the investigation report.

7	Network Protocol Analysis using Wireshark and nmap.
8	Live Forensics and Memory Dump Analysis using LiME and Volatility Framework
9	Network Log analysis

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	Use the Windows Registry and Registry Editor.	К3
CO2	Use the different Cyber Forensics Tools for static and dynamic forensics analysis.	К3
CO3	Familiarize file signature analysis and applications.	K3
CO4	Use FTK or Encase or ProDiscover tools for bit level forensic analysis of evidential image.	К3
CO5	Prepare an investigation report following the chain of custody.	К3

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

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

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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	Guide to computer forensics and investigations	Bill Nelson, Amelia Philipps and Christopher Steuart	Cengage	6 th Edition 2020		
2	Windows Forensic Analysis DVD Toolkit	Harlan Carvey	Syngress	2 nd Edition,2009		
3	Unix and Linux Forensic Analysis DVD Toolkit	Chris Pogue , Cory Altheide, Tode Haverkos	Syngress	1 st Edition,2008		

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 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

Computer Science and Engineering (Cyber Security)

MALWARE FORENSICS

Course Code	PECCT741	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)	PECCT602	Course Type	Theory

Course Objectives:

- **1.** Acquire the ability to identify and assess various forms of malware, enabling students to tackle the difficulties presented by newly evolving malware.
- **2.** Applying both automatic and manual methods to examine malware, comprehend malware activity monitoring tools and various malware analysis techniques.

Module No.	Syllabus Description	Contact Hours
	Introduction to malware, malware threats, evolution of malware, malware	
	types. Types of malware Analysis - Static Analysis, Dynamic Analysis,	
1	Malware Analysis Techniques - Obfuscated, Deobfuscated, Malware Analysis	8
	Tools - Static Analysis Tools, Dynamic Analysis Tools. Static Analysis	
	Dynamic analysis: Live malware analysis, dead malware analysis, analyzing	
	traces of malware, system-calls, api-calls, registries, network activities. Anti-	
	dynamic analysis techniques anti-vm, runtime-evasion techniques, Malware	
	Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark,	
	Kernel vs. User-Mode, Debugging-OllyDbg, Breakpoints, Tracing, Exception	
2	Handling, Patching.	11
	Malware Detection Techniques: Signature-based techniques: malware	
	signatures, packed malware signature, metamorphic and polymorphic	
	signature. Non-signature based techniques: similarity-based techniques,	
	machine-learning methods.	
•	Malware Incident response: Volatile Data Collection and Examination on a	10
3	Live Windows Systems - Volatile Data collection methodology from	10

	Windows systems- Preservation of Volatile data, Collecting Subject System	
	details, Identifying users Logged into the System, Inspect Network	
	Connections and Activity, Current and Recent Network Connections,	
	Collecting Process Information, Correlate Open Ports with Running Processes	
	and Programs, Identifying Services and Drivers, Determining Scheduled	
	Tasks, Collecting Clipboard Contents, Non-Volatile Data Collection from a	
	Live Windows System, Volatile Data collection methodology from Linux	
	systems, Non volatile Data collection from a live Linux system	
	Post-Mortem Forensics - Malware Discovery and Extraction from a Windows	
	and Linux system, Examine Windows and Linux file system, Examine	
4	application traces, Examine Windows registry, keyword searching from	7
	Windows and Linux systems, Forensic reconstruction of compromised Linux	
	and Windows system.	

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
C01	Understand the evolution, types, and threats of malware, and enable the identification and classification of malicious software.	Understand
CO2	Understand static and dynamic analysis techniques to investigate malware, utilizing tools to assess and mitigate malware impacts on systems.	Understand
СО3	Understand anti-dynamic analysis techniques to enhance the effectiveness of malware analysis and detection.	Understand
CO4	Analyse and employ both signature-based and non-signature-based malware detection techniques to detect and prevent advanced malware threats.	Analyse
CO5	Understand malware incident response strategies and post-mortem forensics on compromised Windows and Linux systems, to ensure comprehensive system recovery and threat mitigation.	Understand

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		2							3
CO3	3	3	3		2							3
CO4	3	3	3		2							3
CO5	3	3	3	3	2							3

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides	James M. Aquilina, Cameron H. Malin ,Eoghan Casey	Syngress Publishing	First Edition,2012			
2	Malware Forensics Field Guide for Linux Systems: Digital Forensics Field Guides",	James M. Aquilina, Cameron H. Malin, Eoghan Casey	Syngress Publishing	Second Edition,2014			
3	Practical malware analysis T he Hands-On Guide to Dissecting Malicious Software	Michael Sikorski and Andrew Honig	No starch press	First Edition,2012			
4	Malware Forensics Investigating and Analysing Malicious code	Eoghan Casey, James M. Aquilina, Cameron H. Malin,	Syngress Publishing,	First Edition,2008			

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Malware & rootkits: malware & rootkits security secrets & Solutions	Michael Davis, Sean Bodmer, Aaron Lemasters	McGraw Hill	Second Edition,2010			
2	Windows Malware Analysis Essentials	Victor Marak	Packt Publishing	First Edition, 2015			

Video Links (NPTEL, SWAYAM)						
Module No.	Link ID					
1	https://www.youtube.com/watch?v=Bvqyg51Czdk					
2	https://www.youtube.com/watch?v=uHhKkLwT4Mk&list=PLBf0hzazHTGMSlOI2HZGc0 8ePwut6A2Io&index=1					
3	https://www.youtube.com/watch?v=lwUve1VdFYs&list=PLt9cUwGw6CYEpBwasTz7W WgphfRWof0_O					
4	https://www.youtube.com/watch?v=D0VLE1RnPmE					

INTRUSION DETECTION & PREVENTION SYSTEM

Course Code	PECCT742	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 of the fundamental concepts of Intrusion detection and prevention systems and the different control strategies used to implement IDPS.
- **2.** To understand of the usage of different Intrusion detection systems so that protection against attacks can be minimized.

Module No.	Syllabus Description	Contact Hours
	Introduction-Intrusion Detection and Prevention Systems, IDPS terminology,	
	Network attacks- Probes, Privilege Escalation Attacks, Denial of Service	
	(DoS) and Distributed Denial of Service (DDoS) Attacks, Worms Attacks,	
1	Routing Attacks, Why use an IDPS, Types of IDPS, IDPS Detection methods-	
	Signature-Based IDPS, Statistical Anomaly-Based IDPS, Stateful Protocol	9
	Analysis IDPS, Log File Monitors, IDPS Response Options Selecting IDPS	
	Approaches and Products, Strengths and Limitations of IDPSs.	
	IDPS Control Strategies-Centralized Control Strategy, Fully Distributed	
	Control Strategy, Partially Distributed Control Strategy, IDPS Deployment-	
	Deploying Network-Based IDPSs, Deploying Host Based IDPSs, Measuring	
	the Effectiveness of IDPSs, Intrusion Detection systems-How the IDS	
2	Watches Your Network -Packet Sniffing, Log Parsing, System Call	0
	Monitoring, Filesystem Watching, What the IDS Does When It Finds an)
	Attack Attempt, Passive Response, Active Response, Analyzing Your IDS	
	Design and Investment, False Positives versus False Negatives.	

3	IDPS Technologies-components and architecture, Network architectures, security capabilities, prevention capabilities, Network based IDPS, Networking overview, components and architecture, Security Capabilities, Information Gathering Capabilities, Logging Capabilities, Detection Capabilities, Types of Events Detected, Detection Accuracy, Tuning and Customization, Technology Limitations, Prevention Capabilities, Implementation, Wireless IDPS, WLAN Standards, WLAN Components, Threats against WLANs, Components and Architecture, Sensor Locations, Information Gathering Capabilities, Types of Events Detected, Prevention Capabilities.	9
4	 Host-Based IDPS-Components and Architecture, Typical Components, Network Architectures, Agent Locations, Host Architectures, Security Capabilities, Logging Capabilities, Detection Capabilities, Types of Events Detected, Technology Limitations, Prevention Capabilities, Other Capabilities, Implementation, The Need for Multiple IDPS Technologies, Direct IDPS Integration, Indirect IDPS Integration, Network Forensic Analysis Tool (NFAT) Software, Anti-Malware Technologies, Firewalls and Routers, Honeypots. IDPS Detection Approaches-Misuse detection-pattern matching, Rule based techniques, state based techniques, Anomaly Detection-Advanced Statistical Models, Rule based Techniques, Biological Models, Learning Models, Specification-based Detection, Hybrid Detection, Architecture and Implementation-Centralized, Distributed-Intelligent Agents,Mobile Agents, Cooperative Intrusion Detection 	11

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Comprehend the different terminologies and types related to Intrusion detection and prevention systems.	Understand
CO2	Familiarize the different control strategies and and detection systems.	Understand
CO3	Explore the different technologies and detection capabilities related to Network IDPS.	Understand
CO4	Identify the capabilities, security attacks against wireless IDPS.	Apply
CO5	Explore the different technologies and detection capabilities and approaches related to host IDPS.	Apply

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	3	2	2									2
CO3	3	2	2									2
CO4	3	2	2		2							2
CO5	3	2	2		2							2

	Text Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Principles of Information Security	Michael E. Whitman and Herbert J. Mattord	Course Technology, Cengage Learning	Fourth Edition ,2012		
2	Snort 2.1: Intrusion Detection	Brian Caswell, Mike Poor	Jay Beale's Open Source Security	second edition, 2004.		

Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Guide to Intrusion Detection and Prevention Systems (IDPS)	Karen Scarfone Peter Mell	National Institute of Standards and Technology,	First edition, 2007		
2	Network Intrusion Detection	Stephen Northcutt, Judy Novak	New Riders Publications	Third Edition,2002		

Video Links (NPTEL, SWAYAM)				
Mod ule No.	Link ID			
1	https://www.youtube.com/watch?v=jbQBve0AXzM&pp=ygUQSURQUyB0ZXJtaW5vbG9n eQ%3D%3D			
2	https://www.youtube.com/watch?v=1EPu- G09xyI&pp=ygUQIEIEUFMgRGVwbG95bWVudA%3D%3D			
3	https://www.youtube.com/watch?v=uDlqCaBnpq0&pp=ygUNV2lyZWxlc3MgSURQUw%3 D%3D			
4	https://www.youtube.com/watch?v=463zDAhN6KE&pp=ygUZSURQUyBEZXRIY3Rpb24g QXBwcm9hY2hlcw%3D%3D			
BIG DATA SECURITY

Course Code	Course Code PECCT743		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 Understanding of big Data	Course Type	Theory	

Course Objectives:

- 1. To provide an understanding of the security challenges associated with Big Data systems.
- **2.** To impart knowledge on securing Big Data environments using various techniques and frameworks.
- 3. To explore privacy-preserving mechanisms and compliance with legal regulations in Big Data.
- 4. To equip students with skills to identify and mitigate threats and vulnerabilities in Big Data.

Module No.	Syllabus Description						
	Introduction to Big Data:						
	Definition and characteristics: Volume, Velocity, Variety, Veracity, and						
	Value, Importance of Big Data in modern industries, Security Challenges in						
	Big Data:- Data breaches, privacy concerns, and compliance issues ,The CIA						
	triad in the context of Big Data.						
1	Big Data Architecture: Hadoop ecosystem: HDFS, Map Reduce, YARN,						
	Apache Spark: Resilient Distributed Datasets (RDDs) and Data Frames,						
	NoSQL databases: Cassandra, MongoDB.						
	Case Studies:						
	Real-world examples of Big Data security breaches and their implications.						
	Security Mechanisms:						
2	Authentication and Authorization: Kerberos, LDAP,	_					
	Access Control Frameworks: Apache Ranger, Apache Sentry, Data	8					
	Encryption: AES, RSA, SSL/TLS for data in transit and at rest.						

	Data Privacy Issues -Overview of data privacy in Big Data: PII, sensitive data,	
	and business data.	
	Anonymization Techniques: - Techniques like k-anonymity, l-diversity, t-	
	closeness, Differential Privacy: -Concept, mechanisms, and applications.	
	Legal and Compliance Frameworks:- Overview of GDPR, CCPA, HIPAA,	
	and their implications for Big Data,	
	Threat Landscape: - Common threats: Insider threats, APTs, ransomware, and	
	DDoS attacks in Big Data.	
3	Vulnerabilities: - Vulnerabilities in distributed frameworks: Hadoop, Spark,	10
	and NoSQL databases, Security flaws in data aggregation and integration	
	processes.	
	Case studies on compliance challenges and solutions.	
	Risk Management - Risk assessment frameworks and tools specific to Big	
	Data, Threat modelling: STRIDE, DREAD models for Big Data systems.	
4	Security Best Practices: - Data masking, tokenization, and maintaining audit	
	trails, Secure coding practices for Big Data applications.	10
	Security Monitoring and Incident Response:- Security Information and Event	
	Management (SIEM) for Big Data, Incident response strategies for Big Data	
	breaches	

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	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	• Each question carries 9 marks.		
module.	• Two questions will be given from each module, out		
• Total of 8 Questions, each	of which 1 question should be answered.		
carrying 3 marks	• Each question can have a maximum of 3 sub	60	
	divisions.		
(8x3 =24marks)	(4x9 = 36 marks)		

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand and articulate the key characteristics of Big Data and athe security challenges, including the CIA triad, within Big Data architectures like Hadoop and Apache Spark.	K2
CO2	Understand security mechanisms such as authentication, authorization, encryption, and anonymization techniques to protect sensitive data within Big Data environments	K2
СО3	Understand the implications of major legal frameworks (e.g., GDPR, CCPA, HIPAA) on Big Data, identifying common threats and vulnerabilities in distributed systems.	K2
CO4	Develop and implement risk management strategies, including threat modelling and security best practices, to safeguard Big Data systems and respond effectively to security incidents	К3

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

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcome	GO DO 16 1 7 11	a		
$-\chi_{J}$ = $-\chi_{J}$ we about the standard of χ_{J} and χ_{J} and χ_{J} and χ_{J}	('A) PA Manning Tahla	(Manning of Course	Outcomes to Program Outcome) () (
	CO-I O Mapping Labic	intapping of Course		231

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

	Text Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	Big Data: Principles and Best Practices of Scalable Real-time Data Systems	Nathan Marz and James Warren.	Manning Publications	1 st edition 2015				
2	Hadoop Security: Protecting Your Big Data Platform	Ben Spivey and Joey Echeverria	O'Reilly Media	1 st edition 2015				
3	Big Data Security	Hemalatha M, B. K. Tripathy, and L. Sudha.	CRC	1 st edition 2021				

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Security and Privacy in Big Data: Volume 1: Foundations	Shui Yu and Xiaodong Lin.	Springer	1 st edition			
2	Data-Intensive Text Processing with MapReduce	Jimmy Lin and Chris Dyer	Morgan & Claypool	1 st edition			
3	Privacy-Preserving Data Publishing: Anonymization Models, Algorithms, and Applications	Benjamin C. M. Fung, Ke Wang, Ada Wai-Chee Fu, and Philip S. Yu.	Chapman and Hall	1 st edition			
4	Computer Security: Principles and Practice	William Stallings and Lawrie Brown	Pearson	4 th edition			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	[Introduction to Big Data (NPTEL)]				
2	Cloud Computing (NPTEL)				
3	- [Information Security - V (NPTEL)]				
4	[Information Security - IV (NPTEL)] - [Network Security [NPTEL])				

SECURITY OPERATIONS ANALYSIS

Course Code	PECCT746	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)	Industrial Cyber Security , OT Threat Prevention	Course Type	Theory

Course Objectives:

- 1. Enables the learners to Understand the Role of SOC in Industrial Environments.
- 2. Enables the students to Integrate IT and OT Security Practices.
- **3.** Enables the learners to Leverage Industrial-Specific Threat Intelligence.
- 4. Enables the learners to Execute Incident Response and Forensics in OT.
- 5. Enables the learners to Apply Advanced Security Operations Techniques in OT.

Module No.	Syllabus Description				
	SOC in Industrial Environments				
	Overview of SOC Operations in OT Environments: Role of SOC in				
	industrial settings, Challenges of monitoring OT networks vs. IT networks				
1	Integration of IT and OT Security Monitoring: Convergence of IT and OT	9			
	systems, Tools and techniques for unified monitoring.				
	Incident Detection in OT Networks: Threat vectors and vulnerabilities in				
	OT environments, Detection techniques for SCADA, PLCs, and ICS				
	Threat Intelligence for Industrial Cyber Security				
	Industrial-Specific Threat Intelligence: OT-specific threat intelligence				
	sources, ISACs and proprietary feeds for industrial environments				
2	Vulnerability Management in OT: Identifying and managing OT system	10			
	vulnerabilities, Challenges in patch management for critical systems				
	Integrating Threat Intelligence with OT Systems: Correlating threat				
	intelligence with industrial protocols, Case studies of OT-targeted attacks				

	Incident Response and Forensics in Industrial Environments				
	Incident Response Strategies for OT: Responding to incidents in OT				
3	environments, Balancing operational safety with security response.				
	Forensic Analysis of OT Incidents: Techniques for forensic analysis in OT				
	systems, Data acquisition and analysis from industrial devices.	11			
	Coordination with Industrial Stakeholders: Collaborating with engineering				
	and operations teams, Best practices for communication during OT incidents.				
	Advanced Security Operations and Continuous Improvement in OT				
	Advanced Threat Detection in OT: Anomaly detection for industrial				
	protocols, Machine learning for OT-specific threat detection.				
	Proactive Security Measures in OT: Threat hunting in OT networks, Red				
	and purple teaming in industrial settings.				
4	Security Metrics and Reporting in OT: KPIs for OT security operations,	10			
	Reporting to technical and non-technical stakeholders.				
	Continuous Improvement in OT Security Operations: Post-incident				
	reviews and OT security audits, Feedback loops for enhancing SOC				
	capabilities.				

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

Course Outcomes (COs)

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

	Bloom's Knowledge Level (KL)	
CO1	Proficient in SOC Operations for Industrial Environments.	К2
CO2	Skilled in Integrating IT and OT Security.	K2
CO3	Capable of Utilizing Industrial-Specific Threat Intelligence.	К3
CO4	Prepared for Incident Response and Forensics in OT.	К3
CO5	Advanced in Implementing Security Operations and Continuous Improvement.	К3

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	3	2	3		3				2			2
CO3	3	3	2	2	3					2		2
CO4	3	3	3	3			2	2				2
CO5	3	3	3		3		2	2				3

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Industrial Network Security: Securing Critical Infrastructure Networks for Smart Grid, SCADA, and Other Industrial Control Systems	Eric D. Knapp and Joel Thomas Langill	Syngress	2nd edition, 2014			
2	Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS	Tyson Macaulay, Bryan L. Singer	CRC Press	I st edition, 2012			
3	Applied Cyber Security and theSmartGrid:ImplementingSecurityControlsintotheModern Power Infrastructure	Eric D. Knapp, Raj Samani	Syngress	I st edition, 2013			
4	BuildinganEffectiveCybersecurityProgram:LessonsLearnedfrom anIndustrialControlSystemsEnvironment	Tari Schreider	Rothstein Publishing	I st edition, 2017			

Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	The Industrial Control System Cyber Security: A Practitioner's Perspective	Liam M. Randall	Packt Publishing	1 st edition, 2020		
2	Practical Industrial Cybersecurity: ICS, SCADA, and PLC Security	Philip A. Craig Jr.	Packt Publishing	1 st edition, 2017		
3	The Security Analyst's Guide to Splunk	Josh Diakun, Paul R. Johnson, and Gary R. Jefress	Packt Publishing	1 st edition, 2016		

Video Links (NPTEL, SWAYAM)				
Module No.	Link ID			
1	https://archive.nptel.ac.in/courses/108/105/108105062/ https://onlinecourses.nptel.ac.in/noc23_cs127/preview			
2	https://onlinecourses.nptel.ac.in/noc24_cs85/preview			
3	https://www.udemy.com/course/incident-response-for-cyber-professionals			
4	https://nptel.ac.in/courses/108/108/108108098/ https://nptel.ac.in/courses/106/105/106105217/			

SEMESTER 7

COMPUTER VISION

Course Code	PECST745	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 Mins
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

- 1. To cover the basics of image formation, key computer vision concepts, methods, techniques, pattern recognition, and various problems in designing computer vision and object recognition systems.
- 2. To enable the learners to understand the fundamentals of computer vision and machine learning models to develop applications in computer vision.

Module No.	Syllabus Description	Contact Hours
1	Fundamentals in Computer Vision :- Camera Calibration- Pinhole camera model, Geometric Image Features - Curves, Surfaces, Analytical Image Features - Elements of Analytical Euclidean Geometry, Geometric Camera Parameters, Stereopsis - Binocular Camera Geometry, Epipolar Constraint, Binocular Reconstruction, Local Methods for Binocular Fusion, Global Methods for Binocular Fusion.	9
2	Features and Filters :- Linear Filters- Linear Filters and Convolution, Shift Invariant Linear Systems. Estimating Derivatives with Finite Differences, Noise, Edges and Gradient- based Edge Detectors Image Gradients - Computing the Image Gradient, Gradient Based Edge and Corner Detection. Filters as Templates - Normalized Correlation and Finding Patterns.	9

	Machine Learning for Computer Vision :-	
	Machine Learning - Introduction, Dataset for Machine Perception- Labelled and Unlabelled Data, Basics of Classification and Clustering, Multi-Class	
3	 Perspective. Machine Learning for Computer Vision -Machine Learning -Deep Learning Use Cases. Machine Learning Models for Vision - Image Vision-Pretrained Model, Transfer Learning, Fine-Tuning, Convolutional Networks, Convolutional Filters, Stacking Convolutional Layers, Pooling Layers - AlexNet, VGG19, , Modular architecture - ResNet, Neural Architecture Search Design - NASNet 	9
4	Segmentation and Object detection :-Segmentation Using Clustering Methods - Human vision- Grouping and Gestalt, Applications- Shot Boundary Detection, Background Subtraction, Image Segmentation by Clustering Pixels- Simple Clustering Methods, Clustering and Segmentation by K-meansObject detection - YOLO, Segmentation-Mask R-CNN and Instance 	9

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	(0
carrying 3 marks	• Each question can have a maximum of 3	00
	subdivisions.	
(8x3 =24 marks)	(4x9 = 36 marks)	

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 and terminologies like Camera Calibration, Stereopsis in computer vision	K2
CO2	Apply filters for feature extraction and for finding patterns.	K3
CO3	Build different machine learning models for computer vision	K3
CO4	Implement segmentation and object detection models	К3
CO5	Analyze different machine learning models for segmentation/object detection.	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	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3	3								3
CO5	3	3	3	3	3							3

		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, David, and Jean Ponce	Prentice hall	2011
2	Emerging topics in computer vision	Medioni, Gerard and Sing Bing Kang	PHI	2004
3	Practical Machine Learning for Computer Vision	Valliappa Lakshmanan, Martin Görner, Ryan Gillard	O'Reilly Media	2021

		Reference Books		
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer vision: algorithms and applications	Szeliski, Richard	Springer Science & Business Media	2010
2	Image Segmentation: Principles, Techniques, and Applications	Tao Lei, Asoke K. Nandi	John Wiley & Sons	2022
3	Deep Learning in Computer Vision Principles and Applications	Ali Ismail Awad, Mahmoud Hassaballah	CRC Press	2020

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	Computer Vision and Image Processing - Fundamentals and Applications by Prof. M. K. Bhuyan at IIT Guwahati https://onlinecourses.nptel.ac.in/noc23_ee39/preview				
2	Computer Vision by Prof. Jayanta Mukhopadhyay at IIT Kharagpur				
3	https://onlinecourses.nptel.ac.in/noc19_cs58/preview				
4	Deep Learning for Computer Vision by Prof. Vineeth N Balasubramanian at IIT Hyderabad https://onlinecourses.nptel.ac.in/noc21_cs93/preview				
	COVID-Net Open Source Initiative - COVIDx CT-3 Dataset				
	https://www.kaggle.com/datasets/hgunraj/covidxct				

Course Code	PECCT751	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)		Course Type	Theory

DATA & COMPUTER COMMUNICATION

Course Objectives:

- 1. Enables the learners to understand the Fundamentals of Data Communication and Networking.
- **2.** Enables the students to learn Networking Protocols and Standards.
- 3. Enables the learners to Explore Emerging Technologies and Trends in Networking.

Module	Syllabus Description	Contact
No.	Synabas Description	Hours
	Fundamentals of Data Communication	
	Introduction to Data Communication: Basic components: transmitters,	
	receivers, transmission media, Data flow types: simplex, half-duplex, full-	
	duplex.	
1	Transmission Media: Guided media: twisted pair, coaxial, fiber optics,	10
	Unguided media: radio waves, microwaves, infrared.	
	Data Encoding and Modulation: Digital-to-digital conversion, Analog-to-	
	digital conversion, Digital-to-analog modulation (ASK, FSK, PSK), Analog-	
	to-analog modulation (AM, FM, PM).	
	Network Models and Topologies	
	Network Models: OSI reference model: layers and functions, TCP/IP model:	
	layers and functions, Addressing schemes: MAC addresses, IP addresses	
2	Network Topologies: Bus, star, ring, mesh topologies: structure, advantages,	9
	disadvantages	
	Basic Networking Devices: Routers, switches, hubs, bridges, and their roles	
	in a network.	

	Data Link Layer and Network Layer Protocols	
	Data Link Layer Protocols: Error detection and correction: CRC, Hamming	
	code, Flow control mechanisms: stop-and-wait, sliding window, MAC	
3	protocols: CSMA/CD, CSMA/CA, Ethernet.	11
	Network Layer Protocols: IPv4 and IPv6 addressing, subnetting, Routing	
	algorithms: distance vector, link state Routing protocols: RIP, OSPF, BGP.	
	Transport and Application Layer Protocols	
	Transport Layer Protocols : TCP , UDP	
	Application Layer Protocols: DNS, DHCP, HTTP, FTP, SMTP, SNMP	
	Network Design: LAN and WAN planning, VLANs, wireless technologies	
4	(Wi-Fi, Bluetooth)	11
	Emerging Technologies and Future Trends in Networking: Cloud	
	Computing and Data Centers, Internet of Things (IoT), Edge computing, fog	
	computing, blockchain, quantum networking (Basic concepts only).	

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

Course Outcomes (COs)

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

	Course Outcome						
C01	CO1 Understand the basics of data communication, including transmission media and modulation techniques.						
CO2	Explain network models, topologies, and the role of networking devices.	K2					
СО3	Apply data link and network layer protocols for efficient network communication.	К3					
CO4	Analyze the use of transport and application layer protocols in network services.	К3					
C05	Explore emerging networking technologies and their future implications.	К2					

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								3
CO2	3	2	2	1								3
CO3	3	3	3	2								3
CO4	3	3	3	2								3
CO5	2	3	2	2		1	1	1	1	1	1	3

	Text Books										
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year							
1	Data and Computer	William Stallings	Pearson	10 th Edition							
	Communications										
2	Computer Networks	Andrew S. Tanenbaum and	Dearson	5 th Edition							
		David J. Wetherall	i carson	5 Edition							
3	Data Communications and	Dahrouz A Forouzon	McGraw-Hill	5 th Edition							
3	Networking	Beniouz A. Forouzan	Education	5 Edition							

	Reference Books									
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year						
1	Communication Networks: Fundamental Concepts and Key Architectures	Alberto Leon-Garcia and Indra Widjaja	McGraw-Hill	2 nd Edition						
2	Network Security Essentials: Applications and Standards	William Stallings	Pearson	6 th Edition						

Video Links (NPTEL, SWAYAM)								
Module No.	Link ID							
1	https://nptel.ac.in/courses/106/105/106105082/ https://nptel.ac.in/courses/117/104/117104117/							
2	https://nptel.ac.in/courses/106/105/106105183/ https://nptel.ac.in/courses/106/105/106105081/							
3	https://nptel.ac.in/courses/106/105/106105183/ https://nptel.ac.in/courses/106/105/106105082/ https://nptel.ac.in/courses/106/102/106102245/							
4	https://nptel.ac.in/courses/106/105/106105183/ https://nptel.ac.in/courses/106/105/106105166/ https://nptel.ac.in/courses/106/106/106106129/ https://nptel.ac.in/courses/115/106/115106086/							

Course Code	PECCT752	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 knowledge of computer networks and cybersecurity. Familiarity with ethical principles and data privacy concepts.	Course Type	Theory

SOCIAL AND ETHICAL ISSUES OF THE INTERNET

Course Objectives:

- 1. Understand the social and ethical challenges posed by the widespread use of the internet.
- 2. Analyse legal frameworks and regulations governing digital spaces.
- **3.** Assess the ethical implications of emerging technologies.
- 4. Develop strategies to address privacy, security, and ethical concerns in the digital world.

Module No.	Syllabus Description	Contact Hours		
	Basics of Social and Ethical Issues:			
	Understanding Ethics in the Digital World - Ethics, Relationship between			
	ethics and technology. Impact of the Internet on Society - Social consequences			
	of internet expansion, digital inequality, technology access.			
1	Ethical concerns in internet conduct, online communities, and cyberbullying -			
	The significance of online identity and anonymity. Privacy and Monitoring -			
	Rights to privacy, techniques for surveillance, ethical considerations when			
	collecting and tracking data.			
	Case Studies - Ethical issues and scandals involving social media.			
	Laws and Regulations for the Internet:			
2	Internet Governance and Regulations - The worldwide and local laws that	0		
	govern the internet, comparing self-regulation and government regulation	8		

	(Overview only). Intellectual Property Rights (IPR) -copyright, patents,				
	trademarks, and their significance in the context of the internet.	l			
	Cybercrime and Cyber Law - Different types of cybercrimes, legislation	l			
	against cybercrime, digital evidence, and forensic analysis (Detailed study).	l			
	Ethical considerations of regulating content, hate speech, and censorship laws	l			
	in the debate between Freedom of Speech and Censorship (Overview only).	l			
	Case Studies of legal disputes - big companies involved in legal cases,	l			
	challenges with determining jurisdiction in cyberspace.	1			
	Data Protection and Security:				
	Principles of data protection, GDPR, and other regulations for ethical data	l			
	handling.	l			
	Ethical issues in data aggregation and the commercialization of personal data				
	in Big Data and Surveillance Capitalism.				
3	Ethical principles in cybersecurity - Proper disclosure, moral hacking,				
	technologies with both peaceful and problematic applications (Overview				
	only). User agreement and openness - Consent in gathering data, deceptive				
	practices, ethical development.				
	Case Studies - Real-life examples involving data breach and law enforcement	l			
	agencies.	1			
	Social media, AI, and Emerging Technology Ethics: Ethical Issues in				
	social media - Content moderation, biased algorithms, and misinformation	1			
	(Overview only). Algorithms and Echo Chambers - Combating	l			
	misinformation.	l			
4	Digital Identity and Online Reputation - Ethical issues in managing digital	8			
	identity and online harassment. AI and Emerging Technologies -Ethical	l			
	dilemmas in AI, deepfakes, content creation (Overview only).	l			
	Case Studies - Social media's role in election manipulation and AI in content	1			
	moderation.	l			

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

Course Outcomes (COs)

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

	Course Outcome						
CO1	Understand and analyse the ethical implications of technology and the internet	K2					
CO2	Evaluate legal and regulatory challenges associated with internet governance and cybercrimes	K4					
СО3	Critically assess ethical practices in data handling, privacy, and cybersecurity	K4					
CO4	Examine the impact of social media, AI, and algorithms on ethics and society	К3					
CO5	Discuss and propose ethical solutions for challenges posed by emerging technologies	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	-	1	-	2	-	3	-	-	-	2
CO2	3	3	1	2	2	2	1	-	-	-	-	3
CO3	3	2	3	2	-	-	-	2	-	-	-	-
CO4	2	2	2	3	1	-	-	3	2	2	-	-
CO5	3	3	2	3	2	1	-	2	1	1	2	3

	Text Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year					
1	Ethics for the Information Age	Michael J. Quinn	Pearson	7th Edition, 2017					
2	Cyber-ethics: Morality and Law in Cyberspace	Richard Spinello	Jones & Bartlett Learning	6th Edition, 2017					
3	The Ethics of Information	Luciano Floridi	Oxford University Press	2013					

Reference Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	The Ethics of Cybersecurity	Markus Christen et al.	Springer	2020				
2	Cybersecurity Ethics: An	Mary Maniikian	Routledge	1st Edition,				
	Introduction		i to unio Be	2017				
3	AI Ethics	Mark Coeckelbergh	MIT Press	2020				
4	Data and Goliath: The Hidden Battles to Collect Your Data and Control Your World	Bruce Schneier	W.W. Norton & Company	2015				
5	Internet Governance: The New Frontier of Global Institutions	John Mathiason	Routledge	2008				

Video Links (NPTEL, SWAYAM)						
Module No.	Link ID					
1	https://nptel.ac.in/courses/109106124					
2	https://nptel.ac.in/courses/106105217					
3	https://nptel.ac.in/courses/106104119)					
4	https://onlinecourses.swayam2.ac.in/cec21_ge12/preview					

INFORMATION SECURITY IN PUBLIC AND PRIVATE SECTORS

Course Code	PECCT753	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.** The goal of this course is to familiarize students with Security in computing, program security in the context of Public and private sectors.
- **2.** The topics also cover the familiarization of database security and the methods of administering security in private and public domains.

SYLLABUS

Module No.	Syllabus Description	Contact Hours	
	Security Problem in Computing:		
	The meaning of computer Security, Computer Criminals, Methods of Defense,		
1	Elementary Cryptography: Substitution Ciphers, Transpositions, Making	9	
	"Good" Encryption algorithms, The Data Encryption Standard, The AES		
	Encryption Algorithms, Public Key Encryptions, Uses of Encryption.		
	Program Security:		
	Secure Programs, Non malicious Program Errors, viruses and other malicious		
	code, Targeted Malicious code, controls Against Program Threats, Protection		
	in General- Purpose operating system protected objects and methods of	0	
2	protection memory and add mens protection, File protection Mechanisms,	9	
	User Authentication Designing Trusted O.S: Security polices, models of		
	security, trusted O.S design, Assurance in trusted O.S. Implementation		
	examples.		
	Data base Security:		
3	Security requirements, Reliability and integrity, Sensitive data, Inference,		
_	multilevel database, proposals for multilevel security. Security in Network:	9	

	Threats in Network, Network Security Controls, Firewalls, Intrusion			
	Detection Systems, Secure E-Mail.			
	Administering Security:			
	Security Planning, Risk Analysis, Organizational Security policies, Physical			
	Security. Legal Privacy and Ethical Issues in Computer Security: Protecting	0		
4	Programs and data, Information and the law, Rights of Employees and	9		
	Employers, Software failures, Computer Crime, Praia, Ethical issues in			
	Computer Security, case studies of Ethics			

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	To understand the foundation of security problems in computing	Understand
CO2	To understand and to employ methods for program security and for protecting files	Apply
СО3	To understand and to employ methods for database security and for protecting network in public and private domains	Apply
CO4	Investigate and do administration on Organizational policies and adopt ethical policies in Security.	Analyze

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	3										2
CO4	3	3										2
CO5	3	3										2

Text Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	Security in Computing	Charles P.Pfleeger, Shari Lawrence Pfleeger	РНІ	5 th Edition, 2015				
2	Cryptography and Network Analysis DVD Toolkit	A. Kahate	TMH	3 rd Edition, 2017				
3	Windows Registry Forensics: Advanced Digital Forensic Analysis of the Windows Registry	Harlan Carvey	Syngress Inc.	Edition 2,2009				
4	Practical Linux Forensics: A Guide For Digital Investigators	Bruce Nikkel		2021				

Course Code	PECCT754	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

ENGINEERING OF TRUSTWORTHY SECURE SYSTEMS

Course Objectives:

- 1. To address the major questions, challenges, and processes that Systems Security Engineers (SSE) face in evaluating the cyber risk and resiliency associated with a large-scale system.
- 2. To develop systems that are more cyber-resilient.

Module No.	Syllabus Description	Contact Hours
1	Define key concepts and principles of Systems Security Engineering. Summarize the role of policies, standards, procedures, and guidelines in securing systems. Outline the transferable (i.e. soft) and technical skills that effective Systems Security Engineers embody. Define the three system security engineering contexts - problem context, solution context, and trustworthiness context SIE 573 5 - as outlined in the System Security Engineering Framework. Identify the systems security outcomes, tasks, and activities relevant to each process outlined in the System Life Cycle - Technical, Technical Management, Organizational Project- Enabling, and Agreement.	11
2	Supervisory Control and Data Acquisition (SCADA) system. security techniques used in Supervisory Control and Data Acquisition (SCADA) systems. Classification of the 16 Critical Infrastructure (CI) Sectors. Overview and Application of the Risk Management Framework; how to use the Risk Management Framework(RMF).Risk Management Framework (RMF) activities, tasks, and outcomes. Development of a risk management assessment utilizing the Risk Management Framework.	9

3	Security and Privacy Controls: Utilize the National Institute of Standards and Technology (NIST) Security Control Catalog. Select security control baselines utilizing the guidelines established by the National Institute of Standards and Technology (NIST), Customize and create overlays of security controls, Documentation the control selection process. Overview and Application of the Cybersecurity Framework (CSF) Navigate the Cybersecurity Framework (CSF). Utilize the Cybersecurity Framework (CSF) to manage activities, tasks, and outcomes. Tailor the Cybersecurity Framework (CSF) to create a security plan.	11
4	Cyber Resiliency Considerations: Cyber Resiliency Engineering Framework. Interpret Cyber Resiliency Goals and Objectives. Describe Cyber Resiliency Goals and Objectives. Differentiate Cyber resiliency techniques, approaches and design principles. Prioritize Cyber resilience in the System Development Lifecycle (SDLC).	9

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
C01	Demonstrate the ability to develop and apply cyber-related engineering design considerations.	Analyse
CO2	Identify, formulate, and solve complex engineering problems in Systems Security Engineering and Cyber Resiliency	Apply
СО3	Recognize and address both ethical and professional responsibilities in cyber policy, standards and engineering.	Understand
CO4	identifying specific security controls for any shortcomings that may be uncovered during a security/compliance assessment as it relates to a specific critical infrastructure sector.	Analyse
CO5	Understanding how and where cyber resiliency factors should be considered throughout the SDLC.	Understand

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	3	2	2									2
CO3	3	2	2									2
CO4	3	2	2		2							2
CO5	3	2	2		2							2

Text Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Security and Privacy Controls for Information Systems and Organizations,Special Publication 800-53.	National Institute of Standards and Technology (NIST)	Special Publication 800-53	Fifth Edition ,2020			
2	Risk-Management Framework for Information Systems and Organizations – A System Life Cycle Approach for Security and Privacy.	National Institute of Standards and Technology (NIST)	Special Publication 800-37	second edition, 2018.			
3	Engineering Trustworthy Secure Systems	National Institute of Standards and Technology (NIST)	Special Publication 800-160.	First edition,2022			
4	Developing Cyber-Resilient Systems, A Systems Security Engineering Approach	National Institute of Standards and Technology (NIST)	Special Publication 800-160	First edition,2021			

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Systems Engineering Principles	Breyan Mesmer, Michael Watson	Incose Publications	First edition, 2022			
2	Principles for Trustworthy Design of Cyber-Physical Systems.	Hild D, McEvilley M, Winstead M	MITRE Technical Report	Third Edition,2021			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://www.youtube.com/watch?v=CrLRFn5O_F8&list=PLYwpaL_SFmcArHtWmbs_vXX6soTK3 WEJw				
2	https://www.youtube.com/watch?v=XbZE0Xd5Rls&pp=ygU3U3VwZXJ2aXNvcnkgQ29udHJvbCB BbmQgRGF0YSBBY3F1aXNpdGlvbiAoU0NBREEpIHN5c3RlbQ%3D%3D				
3	https://www.youtube.com/watch?v=kbwsxEGYgbs&pp=ygUdU2VjdXJpdHkgYW5kIFByaXZhY3k gQ29udHJvbHM%3D				
4	https://www.youtube.com/watch?v=3DM2FsBSJjY&pp=ygUoIEN5YmVyIFJlc2lsaWVuY3kgRW5n aW5lZXJpbmcgRnJhbWV3b3JrLg%3D%3D				

Course Code	PECCT755	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)	Nil	Course Type	Theory

CYBER THREAT INTELLIGENCE

Course Objectives:

- 1. Enables the learners to understand the basics of threat intelligence and how it helps organizations protect their data.
- **2.** Enables the learners to identify and manage different threat vectors and use scanning tools to detect vulnerabilities.
- **3.** Enables the learners to gain insights into securing applications and applying security measures throughout the development process.
- **4.** Enables the learners to explore how SIEM platforms work, utilize AI and user behavior analytics in security, and practice threat hunting techniques.

Module No.	Syllabus Description	Contact Hours
1	 Threat intelligence overview Definition, Strategy and external sources, How organisation use CTI, Role of CTI analyst, Threat intelligence platforms, Threat intelligence frameworks, Security intelligence. Data security and protection Data security challenges, common pitfalls, Industry specific data security challenges, Data protection capabilities 	11
2	Threat vectors and scanning Threat vector, types of threat vector, mitigate risk from threat vector, scanning, types of scanning, port scanning, network protocol analyser, vulnerability assessment tools.	8

	Application security and testing	
	Characteristic of security architecture, High level architectural models,	
3	security patterns, Application security overview, Application security	10
	standards and regulations, DevsecOps overview, DevsecOps Deployment,	10
	Application security Defects, Effective defenses.	
	SIEM platforms and Threat Hunting	
	SIEM concepts and Benefits, SIEM Deployment, SIEM Solutions, vendors,	
4	User behaviour analytics, AI and SIEM, Apply AI concepts, Apply user	10
	behaviour analytics, AI and Cyber security, Apply AI to SIEM, Mitigate	
	upcoming future attacks with Cyber threat Hunting.	

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

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

Course Outcomes (COs)

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

	Course Outcome				
CO1	Understand Threat Intelligence.	K2			
CO2	Identify and Mitigate Threat Vectors.	K3			
CO3	Apply Application Security Measures.	K3			
CO4	Utilize SIEM Platforms.	K2			
CO5	Incorporate AI and Threat Hunting.	K3			

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

CO-PO Mapping Table (Mapping od 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								2
CO3	3	3	2	2	1							2
CO4	3	3	3	3	1		2	2				2
CO5	3	3	3		2		2	2				2

Text Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	The Threat Intelligence Handbook: A Practical Guide for Security Teams to Unlocking the Power of Threat Intelligence	Recorded Future (Company)	Recorded Future	I st Edition, 2020			
2	Network Security Essentials	William Stallings	Pearson	6 th Edition, 2019			
3	Application Security Program:APractical Guide toImplementing Secure SoftwareDevelopment Lifecycle	A. Michael Houghton	CRC Press	I st edition, 2020			
4	Security Information and Event Management(SIEM) Implementation	David Miller	Packt Publishing	I st edition, 2019			

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software	Michael Sikorski and Andrew Honig	No Starch Press	I st Edition, 2012			
2	The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws	Dafydd Stuttard and Marcus Pinto	Wiley	2 nd Edition, 2011			
3	Practical Threat Hunting: Detecting and Responding to Cyber Attacks	Aditya K. Sood	Springer	I st Edition, 2020			

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://www.coursera.org/specializations/intro-cyber-security https://www.udemy.com/course/cyber-threat-intelligence/				
2	https://www.coursera.org/learn/network-security				
3	https://www.udemy.com/topic/web-application-security-tester				
4	https://www.udemy.com/course/cyber-security-soc-analyst-training-siem-splunk-60-hrs				

SEMESTER 7

CYBER SECURITY

Course Code	OECST721	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 teach the basic attacks, threats and vulnerabilities related to cyber security
- 2. To make the learner aware of cyber crimes and cyber laws
- **3.** To give concepts of the malwares and its protection mechanisms in systems and mobile devices

Module No.	Syllabus Description	Contact Hours
1	Introduction to Cyber Security :- Basic Cyber Security Concepts, Layers of Security, Vulnerability, Threats,	
	Computer Criminals, CIA Triad, Motive of Attackers, Active attacks, Passive attacks, Software attacks, Hardware attacks, Cyber Threats and its Classifications- Malware, Social Engineering, DoS/DDoS, Insider Threats,	9
2	Advanced Persistent Threats (APTs), Data Breaches and Information Theft. Cybercrime and CyberLaw :- Cybercrime, Classification of Cybercrimes, The legal perspectives- Indian perspective, Global perspective, Categories of Cybercrime. Fundamentals of cyber law, Outline of legislative framework for cyber Law, History and emergence of cyber law, Outreach and impact of cyber law, Major amendments in various statutes.	9
3	Malwares and Protection against Malwares :- Virus, Worms, Trojans, Spyware, Adware, Key-logger, Ransomware, Common Methods of Malware Propagation- Email Attachments, Malicious Websites, Removable Media, File Sharing Networks, Malvertising, Protection against Malware- Antivirus/Antimalware Software, Regular	9

	Software Updates, Email Filtering, Web Filtering, Data Backup and Recovery, Strong Passwords and Multi-Factor Authentication (MFA).	
4	Mobile App Security :- Security Implications of Mobile Apps, Mobile App Permission Management and Best Practices, Risks of Location-Based Social Networks, Data Security on Mobile Devices- Importance of Data Security on Mobile Devices to Protect Sensitive Information, Risks of Unencrypted Data Storage and Communication on Mobile Platforms, Benefits of Device Encryption, Secure Messaging Apps, and Encrypted Storage Solutions.	9

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	Explain the attacks, security mechanisms and services to user information	K2
CO2	Identify the cybercrimes and discuss the cyber laws against the crimes	K2
CO3	Discuss the malwares and the protection mechanisms against malwares	К3
CO4	Describe the issues and solutions related with mobile applications	K2

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

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

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

Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Computer Security: Principles and Practices	William Stallings	Pearson	5/e, 2011		
2	Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Nina Godbole, Sunit Belapure	Wiley	1/e, 2011		
3	Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives	B.B.Gupta, D.P Agrawal, Haoxiang Wang.	CRC Press	1/e, 2018		
4	Cyber Security Essentials	James Graham, Richard Howard, Ryan Otson	Auerbach	1/e, 2010		

Video Links (NPTEL, SWAYAM)					
Module No.	Link ID				
1	https://archive.nptel.ac.in/courses/111/101/111101137/				
2	https://jurnal.fh.unila.ac.id/index.php/fiat/article/download/2667/1961/12044 https://www.coursera.org/learn/data-security-privacy#modules				
3	https://nptel.ac.in/courses/106105217				
4	https://archive.nptel.ac.in/courses/106/106/106106156/				
SEMESTER 7

CLOUD COMPUTING

Course Code	OECST722	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 core principles, architecture, and technologies that underpin cloud computing, including virtualization, data storage, and cloud services.
- 2. To equip students with the skills to use cloud computing tools effectively, implement cloud-based applications, and address security challenges within cloud environments.

Module No.	Syllabus Description				
1	Introduction - Cloud Computing, Types of Cloud, Working of Cloud Computing, Cloud Computing Architecture - Cloud Computing Technology, Cloud Architecture, Cloud Modelling and Design.	8			
2	Virtualization - Foundations, Grid, Cloud And Virtualization, Virtualization And Cloud Computing; Data Storage And Cloud Computing - Data Storage, Cloud Storage, Cloud Storage from LANs to WANs.	9			
3	Cloud Computing Services - Cloud Computing Elements, Understanding Services and Applications by Type, Cloud Services; Cloud Computing and Security - Risks in Cloud Computing, Data Security in Cloud, Cloud Security Services.	10			
4	Cloud Computing Tools - Tools and Technologies for Cloud, Apache Hadoop, Cloud Tools; Cloud Applications - Moving Applications to the Cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud 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 	 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
(0x3 -24 mai ks)		

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Articulate the fundamental concepts of cloud computing, its types, and how cloud computing architecture operates.	K2
CO2	Understand and describe the foundations of virtualization, its relationship with cloud computing.	К2
CO3	Describe various cloud computing services, understand the different service models, and identify potential risks.	К3
CO4	Demonstrate proficiency in using cloud computing tools such as Apache Hadoop, and deploy applications using popular cloud platforms.	К3

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

CO-PO Mapping Tal	ble (Mapping of Cou	rse Outcomes to Program	Outcomes)
--------------------------	---------------------	-------------------------	-----------

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	2	2	2									2
CO2	2	2	2	2								2
CO3	2	2	2	2								2
CO4	2	2	2	2								2

	Text Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Cloud Computing: A Practical Approach for Learning and Implementation	A.Srinivasan, J.Suresh	Pearson	1/e, 2014		

	Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Cloud Computing : Concepts, Technology, Security, and Architecture	Thomas Erl	Pearson	2/e, 2023			
2	Cloud Computing	Sandeep Bhowmik	Cambridge University Press	1/e, 2017			
3	Cloud Computing: A Hands-On Approach	Arshdeep Bahga and Vijay Madisetti	Universities Press	1/e, 2014			

	Video Links (NPTEL, SWAYAM)					
Module No.	Link ID					
1	https://onlinecourses.nptel.ac.in/noc21_cs14/preview					

SEMESTER 7

SOFTWARE ENGINEERING

Course Code	OECST723	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 fundamental knowledge in the Software Development Process including Software Development, Object Oriented Design, Project Management concepts and technology trends.
- **2.** To enable the learners to apply state of the art industry practices in Software development.

Module No.	Syllabus Description	Contact Hours
1	 Introduction to Software Engineering and Process Models - Software engineering, Software characteristics and types, Layers of Software Engineering-Process, Methods, Tools and Quality focus. Software Process models – Waterfall, Prototype, Spiral, Incremental, Agile model – Values and Principles. Requirement engineering - Functional, Non-functional, System and User requirements. Requirement elicitation techniques, Requirement validation, Feasibility analysis and its types, SRS document characteristics and its structure. <i>Case study:</i> SRS for College Library Management Software 	9
2	 Software design - Software architecture and its importance, Software architecture patterns: Component and Connector, Layered, Repository, Client-Server, Publish-Subscribe, Functional independence – Coupling and Cohesion <i>Case study:</i> Ariane launch failure Object Oriented Software Design - UML diagrams and relationships– Static and dynamic models, Class diagram, State diagram, Use case diagram, Sequence 	10

	diagram	
	Case Studies: Voice mail system, ATM Example	
	Software pattern - Model View Controller, Creational Design Pattern types -	
	Factory method, Abstract Factory method, Singleton method, Prototype method,	
	Builder method. Structural Design Pattern and its types – Adapter, Bridge, Proxy,	
	Composite, Decorator, Façade, Flyweight. Behavioral Design Pattern	
	Coding, Testing and Maintenance:	
	Coding guidelines - Code review, Code walkthrough and Code inspection, Code debugging and its methods.	
3	Testing - Unit testing, Integration testing, System testing and its types, Black box testing and White box testing, Regression testing	
	Overview of DevOps and Code Management - Code management, DevOps automation, Continuous Integration, Delivery, and Deployment (CI/CD/CD), <i>Case study</i> – Netflix.	10
	Software maintenance and its types- Adaptive, Preventive, Corrective and	
	Perfective maintenance. Boehm's maintenance models (both legacy and non-legacy)	
	Software Project Management - Project size metrics - LOC, Function points	1
	and Object points. Cost estimation using Basic COCOMO.	
	Risk management: Risk and its types, Risk monitoring and management model	
4	Software Project Management - Planning, Staffing, Organisational structures,	7
	Scheduling using Gantt chart. Software Configuration Management and its	
	phases, Software Quality Management – ISO 9000, CMM, Six Sigma for software engineering.	

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	Plan the system requirements and recommend a suitable software process model.	К3
CO2	Model various software patterns based on system requirements.	K3
CO3	Apply testing and maintenance strategies on the developed software product to enhance quality.	К3
CO4	Develop a software product based on cost, schedule and risk constraints.	К3

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

CO DO Monning	Table (Manning)	of Course Outcomes to	Duaguam (Jutaamaa)
UU-rU Madding		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
CO3	3	3	3									3
CO4	3	3	3									3

	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	McGraw-Hill	8/e, 2014			
2	Software Engineering	Ian Sommerville	Addison-Wesley	10/e, 2015			
3	Design Patterns, Elements of Reusable Object Oriented Software	Erich Gamma,Richard Helm, Ralph Johnson,John Vlissides	Pearson Education Addison-Wesley	1/e, 2009			

	Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	Pankaj Jalote's Software Engineering: With Open Source and GenAI	Pankaj Jalote	Wiley India	1/e, 2024				
2	Software Engineering: A Primer	Waman S Jawadekar	Tata McGraw-Hill	1/e, 2008				
3	Object-Oriented Modelling and Design with UML	Michael Blaha, James Rumbaugh	Pearson Education.	2/e, 2007				
4	Software Engineering Foundations : A Software Science Perspective	Yingux Wang	Auerbach Publications	1/e, 2008				
5	Object-Oriented Design and Patterns	Cay Horstmann	Wiley India	2/e, 2005				
6	Engineering Software Products: An Introduction to Modern Software Engineering	Ian Sommerville	Pearson Education	1/e, 2020				

	Video Links (NPTEL, SWAYAM)				
Module No.	Link ID				
1	https://www.youtube.com/watch?v=Z6f9ckEElsU				
2	https://www.youtube.com/watch?v=1xUz1fp23TQ				
3	http://digimat.in/nptel/courses/video/106105150/L01.html				
4	https://www.youtube.com/watch?v=v7KtPLhSMkU				
2	https://archive.nptel.ac.in/courses/106/105/106105182/				

COMPUTER NETWORKS

Course Code	OECST724	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 core concepts of computer networking.
- 2. To Explore routing protocols and their role in network communication

Module No.	Syllabus Description	Contact Hours
	Introduction to Computer Networks:- Introduction, Network Components, Network Models, ISO/OSI, TCP/IP,	
1	Physical Topology, Overview of the Internet, Protocol layering; Physical Layer- Transmission media (copper, fiber, wireless), Datagram Networks, Virtual Circuit networks, Performance.	7
2	Data Link Layer:- Error Detection and Correction - Introduction, Hamming Code, CRC, Checksum; Framing-Methods, Flow Control- Noiseless Channels, Noisy Channels; Medium Access Control- Random Access, Controlled Access; Wired LANs - IEEE Standards, Ethernet, IEEE 802.11;	11
3	Network Layer:- Logical Addressing- IPv4 and IPv6 Addresses; Internet Protocol- IPV4 and IPv6; Unicast Routing Protocols- Distance Vector Routing, Link State Routing Multicast Routing Protocols.	9
4	Transport Layer:- Transport Layer Protocols- UDP, TCP; Congestion Control- Open Loop Vs Closed Loop Congestion Control, Congestion Control in TCP; Application Layer - Application Layer Paradigms, Client-server applications, World Wide Web and HTTP, FTP. Electronic Mail, DNS; Peer-to-peer paradigm - P2P Networks.	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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	6.0
carrying 3 marks	• Each question can have a maximum of 3	60
	subdivisions.	
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Comprehend the OSI and TCP/IP models, the functioning of different network layers, and the protocol stack used in computer networks.	K2
CO2	Evaluate various transmission media (copper, fiber, wireless), error detection/correction methods, and medium access control mechanisms in both wired and wireless LANs.	K2
СО3	Demonstrate a working knowledge of IPv4 and IPv6 addressing schemes, routing protocols (unicast and multicast), and apply them to network scenarios.	K3
CO4	Summarize UDP and TCP protocols, explain congestion control mechanisms, and understand client-server and peer-to-peer applications like HTTP, FTP, DNS, and P2P networks.	K3

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

	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									3
CO4	3	3	3									3

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

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Computer Networks: A Top- Down Approach	Behrouz A Forouzan	McGraw Hill	SIE, 2017			

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	L. L. Peterson and B. S. Davie	Morgan Kaufmann	5/e, 2011	
2	TCP/IP Architecture, design, and implementation in Linux	Sameer Seth M. Ajaykumar Venkatesulu	Wiley	1/e, 2008	
3	Computer Networks	Andrew Tanenbaum	Pearson	6/e, 2021	
4	Computer Networking: A Top- Down Approach Featuring Internet	J. F. Kurose and K. W. Ross	Pearson Education	8/e, 2022	

Video Links (NPTEL, SWAYAM)				
Sl.No.	Link ID			
1	https://nptel.ac.in/courses/106/105/106105183/			

SEMESTER 7

MOBILE APPLICATION DEVELOPMENT

(Common to CS/CA/CM/CD/CR/AI/AM/AD)

Course Code	OECST725	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	0	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	GXEST204 OR OECST615	Course Type	Theory

Course Objectives:

- 1. To impart a Comprehensive Mobile Development Knowledge
- 2. To give Proficiency in Flutter and Dart, UI/UX Design Skills
- 3. To present the Industry Practices and Deployment such as app security, testing.

Module No.	Syllabus Description	Contact Hours
	Fundamentals of Mobile Application Development:	
	Introduction to Mobile Application Development, Overview of Mobile	
	Platforms: iOS and Android, Introduction to Flutter: History, Features, and	
1	Benefits, Setting Up the Flutter Development Environment*, Mobile App	9
	Architectures (MVC, MVVM, and BLoC), Basics of Dart Programming	
	Language.	
	User Interface Design and User Experience:	
	Principles of Mobile UI/UX Design, Designing Responsive UIs with Flutter,	
2	Using Flutter Widgets: StatelessWidget and StatefulWidget, Layouts in Flutter:	9
	Container, Column, Row, Stack, Navigation and Routing in Flutter, Customizing	
	UI with Themes and Styles.	
	Advanced Flutter Development:	
3	State Management in Flutter: Provider, Riverpod, and BLoC	9

	Networking in Flutter: HTTP Requests, JSON Parsing, RESTful APIs Data Persistence: SQLite, SharedPreferences, Hive Asynchronous Programming with Dart: Futures, async/await, and Streams	
4	Industry Practices and App Deployment: Advanced UI Components and Animations, App Security Best Practices, Testing and Debugging Flutter Applications, Publishing Apps to Google Play Store and Apple App Store, Industry Trends and Future of Mobile Development with Flutter	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 	 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. 	60
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

		Bloom's
	Course Outcome	Knowledge
		Level (KL)
CO1	Explain the basics of mobile application development and different mobile platforms and the environment setup.	K2
CO2	Apply principles of effective mobile UI/UX design, develop responsive user interfaces using Flutter widgets.	K3
СОЗ	Experiment effectively with state in Flutter applications. networking and data persistence in Flutter apps.	К3
CO4	Apply security best practices in mobile app development and debug Flutter applications effectively.	К3

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	3	3	3							3

	Text Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year					
1	Flutter Cookbook	Simone Alessandria	Packt	2/e, 2023					
2	Flutter for Beginners	Alessandro Biessek	Packt	1/e, 2019					

Reference Books									
Sl. No	Title of the Book	Title of the BookName of the Author/s		Edition and Year					
1	Flutter in Action	Eric Windmill	Manning	1/e, 2019					
2	Flutter and Dart: Up and Running	Deepti Chopra, Roopal Khurana	BPB	1/e, 2023					

	Video Links (NPTEL, SWAYAM)				
Sl.No.	Link ID				
1	https://www.youtube.com/watch?v=VPvVD8t02U8				

SEMESTER 8

COMPUTER SCIENCE AND ENGINEERING (CYBER SECURITY)

IPR AND CYBER LAWS

Course Code	PECCT861	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. A comprehensive understanding of the fundamental concepts of cyberspace and cyber law, enabling them to analyse and address the challenges of regulating and securing the digital world.
- **2.** To understand cybercrime, cyber ethics, and ethical issues in emerging technologies, enabling them to tackle related challenges effectively.
- **3.** To equip students with a clear understanding of information security policies, legal frameworks like the IT Act, and intellectual property rights related to technology.

Module	Syllabus Description					
No.	Synabus Description					
	Fundamentals of Cyber Law and Cyber Space					
	Introduction to cyber law, Contract Aspects in Cyber Law, Security					
	Aspects of Cyber Law, Intellectual Property aspect in Cyber Law and					
	Evidence aspect in Cyber Law, The criminal aspects in Cyber Law, Need					
1	for Indian Cyber Law.	12				
	Cyberspace- Web space, Web hosting and web Development agreement,					
	Legal and Technological Significance of domain Names, Internet as a					
	tool for global access.					
	Cybercrime and Cyber Ethics					
2	Introduction to cyber crime- Defintion and Origins of Cyber crime- Classifications of Cybercrime, Cyber Offences- Strategic Attacks, Types of					

	Attacks, Security Challenges Faced by Mobile Devices. Organizational	
	Measures for Handling Mobile Phones.	
	Ethics in the Information Society- Principles, Participation, People, Profession, Privacy, Piracy, Protection, Power, Policy	
	Security Policies and Information Technology Act	
3	Need for an Information Security policy, Information Security Standards- ISO, Introducing various security policies and their review process,Information Technology Act, 2000, Penalities, Adjudication and appeals under the IT Act,2000, Offences under IT Act, 2000, Right to Information Act, 2005, IT Act,2008 and its amentments.	9
	Introduction to IPR	
4	Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights -Copyright in Internet - Multimedia and Copyright issues, Software Piracy, Patents- Understanding Patents, European Position on Computer related Patents, Legal position of U.S.on Computer related Patents, Indian Position on Computer related Patents, Trademarks -Trademarks in Internet, Domain name registration - Domain Name Disputes & WIPO, Databases in Information Technology - Protection of databases, Position in USA, EU and India.	10

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

Continuous Internal Evaluation Marks (CIE):

	Assignment/	Internal	Internal	
Attendance	Microproject	Examination-1 (Written)	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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

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 cyber law and the various components and challenges associated with cyberspace.	K2
CO2	Understand cybercrime classifications, mobile security challenges, and key ethical principles in information society.	K2
CO3	Understand the need for information security policies, key ISO standards, and the legal framework of the IT Act, including penalties, appeals, and amendments.	K2
CO4	Describe copyright and patent issues in IT, including software piracy, trademarks, domain name disputes, and database protection, with a focus on legal perspectives in the U.S., EU, and India.	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	2										2
CO3	2	2										2
CO4	2	2										2

Reference Books								
Sl. No	Title of the Book	le of the Book Name of the Author/s		Edition and Year				
1	Cyber Security and Cyber Laws	Nilakshi Jain, Ramesh Menon	Wiley	2020				
2	Introduction to Information Security and Cyber Laws	Surya Prakash Tripathi, Ritendra Goel, Praveen Kumar Shukla	Dreamtech Press	2014				
3	Cyber Laws	Justice Yatindra Singh	Universal Law Publishing	2016.				
4	Cyber Ethics 4.0: Serving Humanity with Values	Christoph Stückelberger , Pavan Duggal	Springer	2020				
5	Cyber Laws: Intellectual property & E Commerce, Security	K. Kumar	Dominant Publisher	First Edition,2011				

Video Links (NPTEL, SWAYAM)						
Module						
No.						
1	https://www.wbnsou.ac.in/NSOU-MOOC/mooc_cyber_security.shtml					
2	https://onlinecourses.swayam2.ac.in/cec22_lw07/preview					
3	https://www.coursera.org/learn/data-security-privacy#modules					
4	https://jurnal.fh.unila.ac.id/index.php/fiat/article/download/2667/1961/12044					

SECURITY IN WIRELESS NETWORKS

Course Code	PECCT862	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. This course covers the overview of wireless network
- 2. Also give the ideas about security WLANs and wireless networks

Module No.	Syllabus Description				
	Overview of Wireless Networks				
1	Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer-MAC Management SublayerWireless ATM - HIPERLAN - HIPERLAN 2, WiMax, Wireless Local Loop (WLL). Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, CDMA2000 overview- Radio and Network components, Network structure. 4G features and challenges, Technology path, IMS Architecture, Convergent Devices, 4G technologies, Advanced Broadband Wireless Access and Services.	11			
2	Foundation Introduction to security of existing and emerging wireless networks, Introduction to cryptographic algorithms and protocols, Introduction to game theory, Case studies: cellular, WiFi, Bluetooth, MANET, VANET et	9			
3	Security in Wireless LANs Authentication methods, Cross Domain Mobility Adaptive Authentication, AAA Architecture and Authentication for wireless LAN Roaming, Experimental Study on Security Protocols in WLANs	5			

	Security of wireless networks	
4	GSM, UMTS, WEP, IEEE 802.11i, Public Wifi hotspots, Bluetooth; Vehicular Ad-hoc Networks: vulnerabilities, challenges, Security architecture	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
٠	2 Questions from each	• Each question carries 9 marks.	
	module.	• Two questions will be given from each module, out	
•	Total of 8 Questions, each	of which 1 question should be answered.	
	carrying 3 marks	• Each question can have a maximum of 3 sub	
		divisions.	
	(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome				
CO1	Understand the wireless network	K2			
CO2	Demonstrate fundamental techniques of secure wireless systems	K3			
CO3	Examine security threats in wireless networks and design strategies to manage network security	K4			
CO4	Understand the Security of wireless networks	K2			
CO5	Understand the vulnerabilities of vehicular Ad-hoc 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	1				1	1			2		2
CO2	2	3				2		1				2
CO3	2	1	2		2	1						1
CO4	2	2	2		1	1						2
CO5	2		1									1

Text Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Wireless Communications and Networks	William Stallings	Prentice Hall	1st Edition, 2004			
2	Security and Cooperation in Wireless Networks	Levente Buttyan (BME) and Jean- Pierre Hubaux (EPFL)	Cambridge University	1st Edition, 2007			
3	Security and Cooperation in Wireless Networks: Thwarting Malicious and Selfish Behavior in the Age of Ubiquitous Computing	Butty L. &Hubaux J. P	Cambridge University	1st Edition, 2007			
4	Mobile and Wireless Network Security and Privacy	K Makki, P Reiher,et. all.	Springer	1st Edition, 2007			

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	3G Wireless Networks	Clint Smith. P.E., and Daniel Collins	Tata McGraw Hill	2nd Edition, 2007			
2	Wireless and Mobile Network Security	Pallapa Venkataram, Satish Babu	Tata McGraw Hill	1st Edition, 2010			
3	WirelessSecurity-Models,Threats and Solutions	Nichols and Lekka	Tata McGraw – Hill, New Delhi	1st Edition, 2006			
4 Security in Computing		Charles P. Fleeger	Prentice Hall, New Delhi	1st Edition, 2009			

Video Links (NPTEL, SWAYAM)						
Module	Link ID					
No.						
1	https://youtu.be/pnunzdvezto?feature=shared					
2	https://youtu.be/jSsehESW37c?feature=shared					
3	https://youtu.be/YNmLYQWjYUY?feature=shared					
4	https://youtu.be/bur9hq_abog?feature=shared					

Course Code	PECCT863	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)	A sound knowledge in Java.	Course Type	Theory

SECURE MOBILE APPLICATION DEVELOPMENT

Course Objectives:

- 1. To understand mobile systems, interfaces, and the Android framework for app development.
- **2.** To understand implementation of 2D graphics and multimedia techniques in Android applications.
- 3. To explore mobile embedded system architecture and scheduling algorithms.
- **4.** To understand application of data storage techniques and leverage mobile cloud computing in app deployment.

Module	Syllabus Description				
No.	Synabus Description				
	Overview of Mobile App and Mobile Interface Mobile Systems Overview, Mobile Interface and Application Optimizations,				
1	Mobile Embedded System Basics, Mobile Cloud Computing Concepts, Big Data Applications in Mobile Systems, Data Security and Privacy Protection in Mobile Systems, Introduction to Mobile Apps (Android Focus), Android Framework Setup, Key Concepts of Android: App Components, Resources, Manifest	9			
	Case Study : <i>Snapchat Data Breach (2014)</i> - Analysing the vulnerabilities in mobile systems that led to privacy violations, focusing on how improper data security and privacy protection practices contributed to the breach.				

	2D Graphics and Multimedia in Android Introduction to 2D Graphics	
	Techniques in Android, Advanced UI Design, Multimedia in Android: Audio	
	and Video Implementation	
	Mobile Embedded System Architecture	
2	Embedded Systems Architecture, Scheduling Algorithms: FCFS, SJF, Multiprocessor, Priority Scheduling, Memory Technology in Mobile Systems, Messaging and Communication Mechanisms	9
	Case Study : <i>Stagefright Vulnerability in Android (2015)</i> - Examination of how multimedia components, particularly Android's handling of video, opened vulnerabilities for remote code execution attacks.	
	Data storage and SQLite Operations	
3	Internal and External Storage in Android, Secure File Management: Saving, Deleting,Deleting,andQueryingSpaceSQLite Database: Table Structure and CRUD Operations, Secure SQLite Operations, Content Provider and Secure Data AccessSecure SQLiteCase Study: Evernote Security Breach (2013) - Focus on how weak data storage security led to breaches in a popular note-taking app, and how secure SQLite operations could have mitigated the attack.	9
	Mobile Cloud Computing in Mobile Applications Deployment	
4	Mobile Cloud Computing Concepts, Differences Between Cloud and Mobile Cloud Computing Mobile Computing Architecture: Wireless LAN, WAN, Cellular Networks Techniques for Mobile Cloud: Virtualization, Parallel Programming, Distributed Storage, Mobile Cloud Computing Architecture, Security Challenges in Mobile Cloud, Best Practices for Secure Mobile App Deployment Case Study : <i>iCloud Hack (2014)</i> - Analysis of how mobile cloud security vulnerabilities exposed user data and what strategies could be used to prevent such breaches in mobile cloud environments.	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 	 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. 	60
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

		Bloom's
	Course Outcome	Knowledge
		Level (KL)
COL	Describe the concepts, security challenges in mobile system and mobile	K2
COI	applications	
CO2	Understand the implementation of 2D graphics, Graphical User	K2
02	Interface and incorporation of multimedia in Android applications	
	Explain the concepts of general and Android based mobile embedded	K2
CO3	systems and its application, processor technology and scheduling	
	algorithms	
CO4	Illustrate the storage of data from mobile applications to a mobile device	К2
CO5	Describe the techniques employed in mobile cloud	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						
CO2	3	1	2		2							
CO3	3	2	2									
CO4	3	1			2							
CO5	3	2			2	1						

	Text Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Mobile Applications Development with Android Technologies and Algorithms	Meikang Qiu, Wenyun Dai, and Keke Gai,	Taylor and Francis				
2	Mobile Application Security	Himanshu Dwivedi, David Thiel, and Chris Clark	McGraw-Hill Education				

	Reference Books						
Sl. No	Title of the Book	Title of the Book Name of the Author/s		Edition and Year			
1	Mobile Applications: Design,Development,andOptimization	Tejinder S. Randhawa	Springer	2022			
2	Android Boot Camp for Developers using Java, a Beginner's Guide to Creating Your First Android Apps	Corinne Hoisington	Course Technology Inc	2017			
3	Android Application Development for Java Programmers	James C. Sheusi	Cengage	2013			

Video Links (NPTEL, SWAYAM)				
Module	Link ID			
No.				
1	https://youtu.be/rjcpzn7ty0o			
2	https://youtu.be/-j1wISEOXYc			
3	https://youtu.be/b1AgSvtl03g			
4	https://youtu.be/LcAPj95KeSA			

NETWORK FORENSICS

Course Code	PECCT864	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:

- 5. Identify the significance and principles underlying networking concepts and protocols
- **6.** Explain Network Forensics and its importance and understand Security issues of network communications.
- 7. Understand network forensics tools and techniques and evaluate procedure for network forensics investigation.
- 8. Comprehend wireless basics, authentication types, and attacks on wireless networks.

|--|

Module	Syllabus Description			
No.	Synabus Description	Hours		
	Basics of Computer Networks- Definition of Network, Need of Networks,			
	Protocol, Types of Networks- LAN, MAN, WAN. Network Components-			
	Twisted Pair Cable, Coaxial cable, Fiber Optic Cables, Network Interface			
1	Card, HUB, Switch, Router. OSI model and TCP/IP protocol suite,			
	Introduction Network Protocols- IP, TCP, UDP, DHCP, DNS. Types of	9		
	Topologies- RING, STAR, BUS, MESH (features, advantages,			
	disadvantages). Classification by Component: Peer to Peer, Client/ Server.			
	Overview of Network Forensics: Definition, Process of Network Forensics,			
	Importance, Advantages and Disadvantages, Application of Network			
2	Forensics. Network threats and vulnerabilities:			
	Types of network attacks- eavesdropping, spoofing, modification, Cross-site	9		
	scripting, DNS Spoofing, Routing Table Page Poisoning, ARP Poisoning,			

	Web Jacking. Social Engineering Attacks and its types. Types of network	
	forensics investigations: Incident Response and Proactive Investigations	
	Identifying sources of evidence- Digital devices, Network traffic, Cloud	
	environments, Steps for handling evidence. Data acquisition methods-	
	Network traffic capture, Log file analysis, Memory acquisition, List Packet	
	capture tools. Introduction to Data Preservation Technique- Write-blocking,	
	Data encryption, Data hashing, Metadata preservation.	
2	Network Traffic Analysis Methods- Flow analysis, Packet analysis, Deep	0
3	packet inspection (DPI), and Network behavior analysis.	9
	Identifying sources of evidence, learning to handle the evidence, collecting	
	network traffic using tcpdump, Collecting network traffic using Wireshark,	
	Collecting network logs, Acquiring memory using FTK Imager, Tapping into	
	network traffic: Packet sniffing and analysis using Wireshark, Packet sniffing	
	and analysis using NetworkMiner.	
	Introduction to Wireless Networks: Basics of wireless (IEEE 802.11)	
	communication and security challenges.	
	Types of Authentications: WEP, WPA and WPA-2 Encryption. Attacks on	
	Wireless networks: Man-in-the middle (MITM), Brute-Force, Evil Twin,	
4	Rogue access points, Phishing, Wireless Jamming (Denial-of-Service	
4	Attacks), Wireless Eavesdropping.	9
	Legal challenges in network forensics: Authorization, Privacy, Data	
	Preservation, Disclosure, Cross-Border Investigations. Digital Personal Data	
	Protection Act, 2023: Introduction, Data, Data Fiduciary, Data Principal, Data	
	Processor, Personal Data Breach, Need of DPDP, Key Features of DPDP	

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3 sub	00
	divisions.	
(8x3 =24marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome					
		Level (KL)				
CO1	Illustrate the Basics of Networking Concepts and Protocols	Understand				
CO2	Describe the significance of network forensics and the security concerns associated with network communications.	Understand				
CO3	Describe the process of evidence handling, data acquisition methods, and Network Traffic Analysis methods	Analyse				
CO4	Comprehend wireless basics, authentication types, and attacks on wireless networks	Understand				

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
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

Text Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Learning Network Forensics	Samir Datt	PACKT Publications	, ISBN: 9781782174905			
2	Tools and techniques for network forensics	Meghanathan, N., Allam, S. R., & Moore, L. A.	arXiv preprint arXiv:1004.0570.	2010			
3	Network Forensics	Ric Messier	Wiley	ISBN: 9781119328285			
4	Network forensics: tracking hackers through cyberspace	Davidoff, S., & Ham, J.	Pearson	(2012)(Vol. 2014). ISBN: 9780132565110 Upper Saddle River: Prentice Hall.			

Reference Books							
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year			
1	Introduction to Security and Network Forensics	William J. Buchanan	CRC press publications.	2011			
2	Hands-On Network Forensics	Nipun Jaswa	PACKT Publications	March 2019 ,ISBN 9781789344523			
3	Network Forensics	Anchit Bijalwan	CRC press publications.	December 2021 978- 0367493615			

Video Links (NPTEL, SWAYAM)					
Module	Link ID				
No.					
1	https://youtu.be/VwN91x5i25g?feature=shared				
2	https://youtu.be/VklrX2IfCNk				
3	https://youtu.be/VklrX2IfCNk?feature=shared				
4	https://youtu.be/U_cl7QqCF3c?feature=shared				

WINDOWS AND LINUX FORENSICS

Course Code	PECCT866	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. The goal of this course is to familiarize students with Windows and Linux OS forensic analysis in the context of Disk Forensics.
- 2. The topics also covers the familiarization of different tools which may explore new
- 3. ways to approach problems in the fields of digital forensic analysis.

Module	Syllabus Description	Contact			
No.	Synabus Description				
1	Digital investigation foundation: Digital investigations and evidence, Digital crime scene investigation process, Data analysis, overview of toolkits. Computer foundations- Data organizations-booting process-Hard disk technology- Hard disk data acquisition-introduction- reading the source data-writing the output data.	9			
2	Live Response: Data Collection Introduction, Live Response- Locard's Exchange Principle, Order of Volatility, When to Perform Live Response, What Data to Collect, System Time, Logged-on Users, Open Files, Network Information, Network Connections Process Information-, Process-to-Port Mapping, Process Memory, Network Status, Nonvolatile Information, Live Response Methodologies.	7			

3	Collecting Process Memory, Dumping Physical Memory, Analyzing a Physical Memory Dump File Metadata, File Signature Analysis, NTFS Alternate Data Streams, Executable File Analysis: Static Analysis, Dynamic Analysis.	
	Registry Analysis: System Information, Auto Start Locations, USB Removable Storage Devices, Mounted Devices, Portable Devices. Finding Users, Tracking User Activity.	9
4	Linux Overview, Modern Linux Systems, Forensic Analysis of Linux Systems, Linux File Types and Identification. Linux File Analysis, Crash and Core Dumps, Investigating Evidences From Linux Logs, Network Configuration Analysis, Network Security Artifacts.	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			
• 2 Questions from each	• Each question carries 9 marks.			
module.	• Two questions will be given from each module, out			
• Total of 8 Questions, each	of which 1 question should be answered.			
carrying 3 marks	• Each question can have a maximum of 3 sub			
	divisions.			
(8x3 =24marks)	(4x9 = 36 marks)			

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	To understand the foundation of digital investigation and methods of data analysis.	Understand
CO2	Tools and utilities can be used to collect and analyze live response data from questionable machines.	Analyse
CO3	Conduct research and investigation in the disk forensic sector.	Create
CO4	investigate and do research on Linux systems in order to create forensic tools.	Create

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
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

Text Books								
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year				
1	Windows Forensic Analysis DVD Toolkit	Harlan Carvey	Syngress Inc.	Edition 2,2009				
2	Windows Registry Forensics: Advanced Digital Forensic Analysis of the Windows Registry	Harlan Carvey	Syngress Inc.	Edition 2,2009				
3	Practical Linux Forensics: A Guide For Digital Investigators	Bruce Nikkel		2021				
NEXT GENERATION INTERACTION DESIGN

(Common to CS/CR/CM/CA/CD/AM/AD/CN/CC/CI/CG)

Course Code	PECST865	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)	None	Course Type	Theory

Course Objectives:

- 1. To provide a comprehensive understanding of the principles of interaction design and their application in augmented reality (AR) and virtual reality (VR) environments.
- 2. To equip learners with practical skills in developing, prototyping, and evaluating AR/VR applications, focusing on user-centered design and advanced interaction techniques.

Module No.	Syllabus Description			
1	Introduction to Interaction Design and AR/VR :- Fundamentals of Interaction Design - Principles of interaction design, Human-computer interaction (HCI) basics, User experience (UX) design principles; Introduction to AR and VR - Overview of AR and VR technologies (Key differences and Application), Overview of AR/VR hardware (headsets, controllers, sensors), Software tools and platforms for AR/VR development.	10		
2	User-Centered Design and Prototyping :- Understanding User Needs and Context - User research methods, Personas and user journey mapping, Contextual inquiry for AR/VR, Designing for AR/VR Environments, Spatial design principles, Immersion and presence in AR/VR, User interface (UI) design for AR/VR; Prototyping and Testing - Rapid prototyping technique, Usability testing methods, Iterative design and feedback loops.	10		
3	Advanced Interaction Techniques :-	13		

	Gesture - Designing for gesture-based interaction, Implementing gesture	
	controls in AR/VR applications; Voice - Voice recognition technologies,	
	Integrating voice commands in AR/VR; Haptic Feedback and Sensory	
	Augmentation - Understanding haptic feedback and tactile interactions; Eye	
	Gaze - Designing and integrating Eye Gaze in VR; Spatial Audio;	
	Microinteraction; Motion capture and tracking technologies; Natural	
	Language Interaction and conversational interfaces; Type of IoT sensors and	
	uses.	
	Implementation, Evaluation, and Future Trends :-	
	Developing AR/VR Projects - Project planning and management.	
	Collaborative design and development. Case studies of successful A R/VR	
4	Conaborative design and development, case studies of successful ARVIK	11
4	projects; Evaluating AR/VR Experiences - Evaluation methods and metrics,	11
	Analyzing user feedback, Refining and improving AR/VR applications; Future	
	Trends and Ethical Considerations- Emerging technologies in AR/VR. Ethical	
	implications of AK/VK, Future directions in interaction design for AR/VR.	

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

- The students must be directed to measure the quality of the interfaces / GUI based on various techniques such as user testing.
- The students may be assessed based on their ability to analyze various performance of the interfaces /GUIs.

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

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Apply fundamental interaction design principles and human-computer interaction (HCI) concepts to create effective and intuitive user experiences in AR/VR applications.	K3
CO2	Demonstrate proficiency in using AR/VR hardware and software tools for the development and prototyping of immersive environments.	К3
CO3	Conduct user research and apply user-centered design methodologies to tailor AR/VR experiences that meet specific user needs and contexts.	K4
CO4	Implement advanced interaction techniques such as gesture controls, voice commands, haptic feedback, and eye gaze in AR/VR applications to enhance user engagement and immersion.	К3
C05	Evaluate AR/VR projects, utilizing appropriate evaluation methods and metrics, and propose improvements based on user feedback and emerging trends in the field.	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	3								3
CO2	3	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

Reference Books						
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Augmented Reality - Theory, Design and Development	Chetankumar G Shetty	McGraw Hill	1/e, 2023		
2	Virtual Reality and Augmented Reality: Myths and Realities	Ralf Doerner, Wolfgang Broll, Paul Grimm, and Bernhard Jung	Wiley	1/e, 2018		
3	Augmented Reality: Principles and Practice	Dieter Schmalstieg and Tobias Hollerer	Pearson	1/e, 2016		
4	Human–Computer Interaction	Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale	Pearson	3/e, 2004		
5	Evaluating User Experience in Games: Concepts and Methods	Regina Bernhaupt	Springer	1/e, 2010		
6	Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics	Bill Albert, Tom Tullis	Morgan Kaufman	2/e, 2013		
7	The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything	Robert Scoble and Shel Israel	Patrick Brewster	1/e, 2016		
8	Augmented Reality and Virtual Reality: The Power of AR and VR for Business	M. Claudia tom Dieck and Timothy Jung	Springer	1/e, 2019		

Video Links (NPTEL, SWAYAM)				
Sl.No.	Link ID			
1	Interaction Design https://archive.nptel.ac.in/courses/107/103/107103083/			
2	Virtual Reality https://archive.nptel.ac.in/courses/106/106/106106138/			
3	Augmented Reality https://www.youtube.com/watch?v=WzfDo2Wpxks			

INTRODUCTION TO ALGORITHMS

(Common to CS/CA/CM/CD/CR/AD/AM)

Course Code	OECST831	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 give proficiency in analysing algorithm efficiency and solve a variety of computational problems, including sorting, graph algorithms.
- 2. To provide an understanding in algorithmic problem-solving techniques, including Divide and Conquer, Greedy Strategy, Dynamic Programming, Backtracking, and Branch & Bound algorithms.

Module No.	Syllabus Description			
1	Introduction to Algorithm Analysis Time and Space Complexity- Asymptotic notation, Elementary operations and Computation of Time Complexity-Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms Recurrence Equations: Solution of Recurrence Equations – Iteration Method and Recursion Tree Methods	9		
2	Trees - Binary Trees – level and height of the tree, complete-binary tree representation using array, tree traversals (Recursive and non- recursive), applications. Binary search tree – creation, insertion and deletion and search operations, applications; Graphs – representation of graphs, BFS and DFS (analysis not required), Topological Sorting.	9		

3	Divide and Conquer - Control Abstraction, Finding Maximum and Minimum, Costs associated element comparisons and index comparisons, Binary Search, Quick Sort, Merge Sort - Refinements; Greedy Strategy - Control Abstraction, Fractional Knapsack Problem, Minimum Cost Spanning Trees – PRIM's Algorithm, Kruskal's Algorithm, Single Source Shortest Path Algorithm - Dijkstra's Algorithm.	9
4	Dynamic Programming - The Control Abstraction- The Optimality Principle - Matrix Chain Multiplication, Analysis; All Pairs Shortest Path Algorithm - Floyd-Warshall Algorithm; The Control Abstraction of Backtracking – The N-Queens Problem. Branch and Bound Algorithm for Travelling Salesman Problem.	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 	 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
(8x3 =24 marks)		

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Identify algorithm efficiency using asymptotic notation, compute complexities, and solve recurrence equations	К3
CO2	Use binary trees and search trees, and apply graph representations, BFS, DFS, and topological sorting	К3
CO3	Use divide and conquer to solve problems like finding maximum/minimum, binary search, quick sort, and merge sort	К3
CO4	Apply greedy strategies to solve the fractional knapsack problem, minimum cost spanning trees using Prim's and Kruskal's algorithms, and shortest paths with Dijkstra's algorithm.	K3
CO5	Understand the concepts of Dynamic Programming, Backtracking and Branch & Bound	К2

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

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

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

	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	4/e, 2022					
2	Fundamentals of Computer Algorithms	Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran	Universities Press	2/e, 2008					

	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, Eva Tardos	Pearson	1/e, 2005					
2	Algorithms	Robert Sedgewick, Kevin Wayne	Pearson	4/e, 2011					
3	The Algorithm Design Manual	Steven S. Skiena	Springer	2/e, 2008					

Video Links (NPTEL, SWAYAM)					
Sl.No.	Link ID				
1	https://archive.nptel.ac.in/courses/106/105/106105164/				

WEB PROGRAMMING

Course Code	OECST832	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)	GXEST203	Course Type	Theory

Course Objectives:

- 1. To equip students with the knowledge and skills required to create, style, and script web pages using HTML5, CSS, JavaScript, and related technologies.
- 2. To provide hands-on experience with modern web development tools and frameworks such as React, Node.js, JQuery, and databases, enabling students to design and build dynamic, responsive, and interactive web applications.

Module No.	Syllabus Description	Contact Hours		
	Creating Web Page using HTML5 - Introduction, First HTML5 example,			
	Headings, Linking, Images, Special Characters and Horizontal Rules, Lists,			
	Tables, Forms, Internal Linking, meta Elements, HTML5 Form input Types,			
	Input and datalist Elements and autocomplete Attribute, Page-Structure			
	Elements; Styling Web Page using CSS - Introduction, Inline Styles,			
1	Embedded Style Sheets, Linking External Style Sheets, Positioning	9		
	Elements:, Absolute Positioning, z-index, Positioning Elements: Relative			
	Positioning, span, Backgrounds, Element Dimensions, Box Model and Text			
	Flow, Media Types and Media Queries, Drop-Down Menus; Extensible			
	Markup Language - Introduction, XML Basics, Structuring Data, XML			
	Namespaces, Document Type Definitions (DTDs), XML Vocabularies			
	Scripting language - Client-Side Scripting, Data Types, Conditionals,			
	Loops, Arrays, Objects, Function Declarations vs. Function Expressions,			
2	Nested Functions , The Document Object Model (DOM) - Nodes and	9		
	NodeLists, Document Object, Selection Methods, Element Node Object,			
	Event Types			

	Asynchronous JavaScript and XML - AJAX : Making Asynchronous		
	Requests, Complete Control over AJAX, Cross-Origin Resource Sharing		
	JavaScript library - jQuery - jQuery Foundations - Including jQuery,		
	jQuery Selectors, Common Element Manipulations in jQuery, Event		
	Handling in jQuery		
	JavaScript runtime environment : Node.js - The Architecture of Node.js,		
	Working with Node.js, Adding Express to Node.js; Server-side		
	programming language : PHP - What Is Server-Side Development? Quick		
	tour of PHP, Program Control, Functions, Arrays, Classes and Objects in		
3	PHP, Object-Oriented Design; Rendering HTML: React - ReactJS	9	
	Foundations : The Philosophy of React, What is a component? Built- in		
	components, User- defined components - Types of components, Function		
	Components, Differences between Function and Class Components		
	SPA – Basics, Angular JS; Working with databases - Databases and Web		
	Development, SQL, Database APIs, Accessing MySQL in PHP; Web		
	Application Design - Real World Web Software Design, Principle of		
4	Layering, Software Design Patterns in the Web Context, Testing; Web	9	
	services - Overview of Web Services - SOAP Services, REST Services, An		
	Example Web Service, Web server - hosting options		
		l	

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 	 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. 	60
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Develop structured web pages with HTML5 and style them using CSS techniques, including positioning, media queries, and the box model.	K3
CO2	Write client-side scripts using JavaScript and utilize jQuery for DOM manipulation, event handling, and AJAX requests to create responsive and interactive user interfaces.	K3
CO3	Build and deploy server-side applications using Node.js, Express, and PHP, and integrate databases using SQL to store and retrieve data for dynamic content generation.	K3
CO4	Utilize React for building component-based single-page applications (SPAs), understanding the fundamental principles of component architecture, and leveraging AngularJS for web application development.	K3

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

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	3		3							3

	Text Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Fundamentals of Web Development	Randy Connolly, Ricardo Hoar	Pearson	1/e, 2017		
2	Building User Interfaces with ReactJS - An Approachable Guide	Chris Minnick	Wiley	1/e, 2022		
3	Internet & World Wide Web - How to Program	Paul J. Deitel, Harvey M. Deitel, Abbey Deitel	Pearson	1/e, 2011		
4	SPA Design and Architecture: Understanding Single Page Web Applications	Emmit Scott	Manning Publications	1/e, 2015		

	Reference Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	A Hand Book On Web Development : From Basics of HTML to JavaScript and PHP	Pritma Jashnani	Notion press	1/e, 2022		
2	Advanced Web Development with React	Mohan Mehul	BPB	1/e, 2020		
3	JavaScript Frameworks for Modern Web Development	Tim Ambler, Sufyan bin Uzayr, Nicholas Cloud	Apress	1/e, 2019		

	Video Links (NPTEL, SWAYAM)				
Module No.	Link ID				
1	https://archive.nptel.ac.in/courses/106/106/106106222/				
2	https://archive.nptel.ac.in/courses/106/106/106106156/				

SOFTWARE TESTING

Course Code	OECST833	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 Cultivate proficiency in software testing methodologies and techniques.
- 2. To Foster expertise in software testing tools and technologies.

Module No.	Syllabus Description	Contact Hours
1	Introduction to Software Testing & Automation:- Introduction to Software Testing - Concepts, importance of testing, software quality, and real-world failures (e.g., Ariane 5, Therac 25); Software Testing Processes - Levels of thinking in testing; Testing Terminologies - Verification, validation, fault, error, bug, test cases, and coverage criteria; Types of Testing - Unit, Integration, System, Acceptance, Performance (stress, usability, regression), and Security Testing; Industry Trends - AI in test case automation, Introduction to GenAI in testing; Testing Methods - Black-Box, White-Box, and Grey- Box Testing; Automation in Testing - Introduction to automation tools (e.g., Selenium, Cypress, JUnit); Case Study- Automation of Unit Testing and Mutation Testing using JUnit.	8
2	Unit Testing, Mutation Testing & AI-Driven Automation:- Unit Testing- Static and Dynamic Unit Testing, control flow testing, data flow testing, domain testing; Mutation Testing- Mutation operators, mutants, mutation score, and modern mutation testing tools (e.g.,	8

	Muclipse); JUnit Framework - Automation of unit testing, frameworks for testing in real-world projects; AI in Testing - GenAI for test case generation and optimization, impact on automation; Industry Tools - Application of AI-driven testing tools in automation and predictive testing; Case Study - Mutation testing using JUnit, AI-enhanced test case automation.	
3	Advanced White Box Testing & Security Testing:- Graph Coverage Criteria - Node, edge, and path coverage; prime path and round trip coverage; Data Flow Criteria - du paths, du pairs, subsumption relationships; Graph Coverage for Code - Control flow graphs (CFGs) for complex structures (e.g., loops, exceptions); Graph Coverage for Design Elements - Call graphs, class inheritance testing, and coupling data-flow pairs; Security Testing - Fundamentals, tools (OWASP, Burp Suite), and their role in protecting modern applications; Case Study - Application of graph based testing and security testing using industry standard tools.	10
4	Black Box Testing, Grey Box Testing, and Responsive Testing:- Black Box Testing - Input space partitioning, domain testing, functional testing (equivalence class partitioning, boundary value analysis, decision tables, random testing); Grey Box Testing - Introduction, advantages, and methodologies (matrix testing, regression testing, orthogonal array testing); Performance Testing - Network latency testing, browser compatibility, responsive testing across multiple devices (e.g., BrowserStack, LambdaTest); Introduction to PEX - Symbolic execution, parameterized unit testing, symbolic execution trees, and their application; GenAI in Testing - Advanced use cases for predictive and responsive testing across devices and environments; Case Study- Implementation of black-box, grey-box, and responsive testing using PEX and AI-driven tools.	10

Continuous In	ternal 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 	 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. 	60
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Bloom's Knowledge Level (KL)	
CO1	Demonstrate the ability to apply a range of software testing techniques, including unit testing using JUnit and automation tools.	K2
CO2	Illustrate using appropriate tools the mutation testing method for a given piece of code to identify hidden defects that can't be detected using other testing methods.	К3
CO3	Explain and apply graph coverage criteria in terms of control flow and data flow graphs to improve code quality.	К2
CO4	Demonstrate the importance of black-box approaches in terms of Domain and Functional Testing	К3
CO5	Illustrate the importance of security, compatibility, and performance testing across devices.	К3
CO6	Use advanced tools like PEX to perform symbolic execution and optimize test case generation and also leverage AI tools for automated test case prediction and symbolic execution with PEX.	К3

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3	3							3
CO3	3	3	3									3
CO4	3	3	3	3								3
CO5	3	3	3		3							3
CO6	3	3	3	3	3							3

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

	Text Books									
Sl. No	Title of the Book	of the Book Name of the Author/s		Edition and Year						
1	Introduction to Software Testing.	Paul Ammann, Jeff Offutt	Cambridge University Press	2/e, 2016						
2	Software Testing and Quality Assurance: Theory and Practice	Kshirasagar Naik, Priyadarshi Tripathy	Wiley	1/e, 2008						

	Reference Books									
SI. No	Title of the Book Name of the Author/s		Title of the BookName of the Author/s		Title of the Book Name of the Author/s		Name of the Publisher	Edition and Year		
1	Software Testing	Ron Patten	Pearson	2/e, 2005						
2	Software Testing: A Craftsman's Approach	Paul C. Jorgensen	CRC Press	4/e, 2017						
3	Foundations of Software Testing	Dorothy Graham, Rex Black, Erik van Veenendaal	Cengage	4/e, 2021						
4	he Art of Software Testing Glenford J. Myers, Tom Badgett, Corey Sandler		Wiley	3/e, 2011						

	Video Links (NPTEL, SWAYAM)						
Module No.	Link ID						
1	https://archive.nptel.ac.in/courses/106/101/106101163/						
2	https://archive.nptel.ac.in/courses/106/101/106101163/						
3	https://archive.nptel.ac.in/courses/106/101/106101163/						
4	https://archive.nptel.ac.in/courses/106/101/106101163/						

INTERNET OF THINGS

Course Code	OECST834	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)	NA	Course Type	Theory

Course Objectives:

- 1. To give an understanding in the Internet of Things, including the components, tools, and analysis through its fundamentals and real-world applications.
- 2. To enable the students to develop IoT solutions including the softwares and programming of Raspberry Pi hardware.

Module	S-llabor Description	Contact		
No.	Synabus Description			
1	Introduction to IoT - Physical Design of IoT, Logical Design of IoT, IoT levels and Deployment templates, Domain Specific IoT- Home automation, Energy, Agriculture, Health and lifestyle.	9		
2	IoT and M2M-M2M, Difference between IoT and M2M, Software Defined Networking, Network Function virtualization, Need for IoT System Management, Simple Network Management Protocol(SNMP), NETCONF, YANG; LPWAN - LPWAN applications, LPWAN technologies, Cellular (3GPP) and Non 3GPP standards, Comparison of various protocols like Sigfox, LoRA, LoRAWAN, Weightless, NB-IoT, LTE-M.	9		
3	Developing IoT - IoT design methodology, Case study on IoT system for weather monitoring, Motivations for using python, IoT-system Logical design using python, Python Packages of Interest for IoT - JSON, XML, HTTPlib & URLLib, SMTPLib	9		
4	Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi, Interfacing an LED and switch with Raspberry Pi, Other IoT devices- PcDino, Beagle bone Black, Cubieboard, Data Analytics for IoT	9		

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 	 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. 	60
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

Course Outcome					
CO1	Understand domain-specific applications and apply the principles of IoT, including physical and logical design and deployment templates	K2			
CO2	Use the principles of IoT and M2M, their differences, and key concepts like SDN, NFV, and essential management protocols.	К3			
CO3	Develop and apply IoT design methodology, utilize Python for logical system design, and leverage key Python packages through practical case studies.	К3			
CO4	Experiment using Raspberry Pi with Python to control LEDs and switches, interface with other IoT devices.	К3			

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

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

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

	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	1/e, 2016						

	Reference Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Internet of Things : Architecture and Design Principles	Rajkamal	McGraw Hill	2/e, 2022		
2	The Internet of Things –Key applications and Protocols	Olivier Hersent, David Boswarthick, Omar Elloumi	Wiley	1/e, 2012		
3	IoT fundamentals : Networking technologies, Protocols and use cases for the Internet of things	David Hanes Gonzalo. Salgueiro, Grossetete, Robert Barton	Cisco Press	1/e, 2017		

Video Links (NPTEL, SWAYAM)			
Sl.No.	Link ID		
1	https://archive.nptel.ac.in/courses/106/105/106105166/		
2	https://archive.nptel.ac.in/courses/108/108/108108179/		

SEMESTER 8

COMPUTER GRAPHICS

Course Code	OECST835	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 Objective:

1. To provide strong technological concepts in computer graphics including the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications.

Module No.	Syllabus Description	Contact Hours		
	Basics of Computer graphics - Basics of Computer Graphics and its			
	applications. Video Display devices - LED, OLED, LCD, PDP and FED and			
	reflective displays. Random and Raster scan displays and systems.			
1	Line and Circle drawing Algorithms - Line drawing algorithms-	10		
	Bresenham's algorithm, Liang-Barsky Algorithm, Circle drawing algorithms			
	- Midpoint Circle generation algorithm, Bresenham's Circle drawing			
	algorithm.			
	Geometric transformations - 2D and 3D basic transformations - Translation,			
	Rotation, Scaling, Reflection and Shearing, Matrix representations and			
	homogeneous coordinates.			
2	Filled Area Primitives - Scan line polygon filling, Boundary filling and flood filling.	10		
	Transformations and Clipping Algorithms - Window to viewport	-		
3	transformation. Cohen Sutherland and Midpoint subdivision line clipping	8		

	algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping	
	algorithms.	
	Three dimensional graphics - Three dimensional viewing pipeline.	
	Projections- Parallel and Perspective projections. Visible surface detection	
4	algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm,	8
	A buffer algorithm.	

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	• Each question carries 9 marks.	
module.	• Two questions will be given from each module, out	
• Total of 8 Questions, each	of which 1 question should be answered.	60
carrying 3 marks	• Each question can have a maximum of 3	00
	subdivisions.	
(8x3 =24 marks)	(4x9 = 36 marks)	

Course Outcomes (COs)

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

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the principles of computer graphics and displays	K2
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms	K3
CO3	Illustrate 2D and 3D basic transformations and matrix representation	K3
CO4	Demonstrate different clipping algorithms and 3D viewing pipeline.	K3

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

	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
CO4	3	3	3	3								3

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

	Text Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year		
1	Computer Graphics : Algorithms and Implementations	D. P. Mukherjee, Debasish Jana	PHI	1/e, 2010		
2	Computer Graphics with OpenGL	Donald Hearn, M. Pauline Baker and Warren Carithers	PHI	4/e, 2013		

Reference Books					
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year	
1	Introduction to Flat Panel Displays	Jiun-Haw Lee, I-Chun Cheng, Hong Hua, Shin- Tson Wu	Wiley	1/e, 2020	
2	Computer Graphics and Multimedia	ITL ESL	Pearson	1/e, 2013	
3	Computer Graphics	Zhigang Xiang and Roy Plastock	McGraw Hill	2/e, 2000	
4	Principles of Interactive Computer Graphics	William M. Newman and Robert F. Sproull	McGraw Hill	1/e, 2001	
5	Procedural Elements for Computer Graphics	David F. Rogers	McGraw Hill	1/e, 2017	
6	Computer Graphics	Donald D Hearn, M Pauline Baker	Pearson	2/e, 2002	

Video Links (NPTEL, SWAYAM)				
Sl.No.	Link ID			
1.	Computer Graphics By Prof. Samit Bhattacharya at IIT Guwahati https://onlinecourses.nptel.ac.in/noc20_cs90/preview			