CURRICULUM STRUCTURE

THIRD YEAR UG: B.E.

ELECTRONICS AND COMPUTER SCIENCE

REVISION: FRCRCE-2-25

Effective from Academic Year **2025-26**
Board of Studies Approval: **28/02/2025**
Academic Council Approval: **14/02/2025 to 8/3/2025**

Dr. DEEPAK BHOIR Dean Academics	Dr. SAPNA PRABHU HoD (ECS)	DR. SURENDRA RATHOD Principal

Preamble:

Greetings and congratulations to all the education partners' Fr. Conceicao Rodrigues College of Engineering for getting autonomous status to the college from the year 2024-25. University Grant Commission vide letter No. F. 2-10/2023(AC-Policy) dated 23rd Nov 2023 conferred the autonomous status to Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel Ashram, Bandstand, Bandra (West), Mumbai 400050 affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations,2023. We look towards autonomy as a great opportunity to design and implement curriculum sensitive to needs of Learner, Indian Society and Industries.

The National Education Policy (NEP), 2020 suggests that students must actively engage with the practical side of their learning as part of a holistic education to further improve their employability. ***Fr. CRCE has taken a strategic decision to implement revised assessment scheme to support more experiential learning and continuous assessment in the form of ISE-1, MSE, ISE-2 and ESE to be taken by the college.***

Honors and Minor Degree Eligibility Criteria for Students:

i. Following is the eligibility criteria for students opting the Honors/ Minor Degree program:

a. Students with no backlog in semester I, II, and III

b. The CGPI (based on semester I, II, and III) of the students must be 6.75 and above

c. For direct second year (DSE) admitted students - No backlog in semester III and CGPI must be 6.75 and above

ii) Each eligible student can opt for maximum one Honor's or one Minor Programs at any time.

iii) However, it is optional for leaners to take Honors/Minor degree program.

iv) The Honors/ Minor degree program can be opted only during regular engineering studies.

v) The student have to complete the Honors/ Minor degree program in stipulated four semesters only.

Note:

Technical support team for registration of Academic Bank of Credits (ABC), registration of elective/optional courses, registration of online courses, registration for degree options etc. under supervision of Dean Academics.

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SEMESTERWISE CURRICULUM STRUCTURE

UG Electronics and Computer Science Program:

SEM-V													
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
25PCC13EC11	PCPEC	PCC	Control Systems	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13EC12	PCPEC	PCC	Computer Networks	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13EC13	PCPEC	PCC	Artificial Intelligence	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13EC14	PCPEC	PCC	Analysis of Algorithms	PR	2	20	-	30	-	50	1	1
25PCC13EC15	PCPEC	PCC	Data Warehousing and Mining	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
25PEC13ECXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PEC13ECXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
25MDM03/ 25MDM04	MDC	MDM	1.Health, Wellness and Psychology 2. Emotional and Spiritual Intelligence	TH	2	50	-	50	-	100	2	2
25OEEC41	MDC	OE	Cloud Computing	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
25HXXXEC501	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
				Total	**TH:TU:PR 12:0:16=28**			-	-	**1000**	-	**20**

* Introduced as optional Honor's/minor degree courses

SEM-VI												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
25PCC13EC16	PCPEC	PCC	VLSI Design	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13EC17	PCPEC	PCC	Analog and Digital Communication	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PCC13EC18	PCPEC	PCC	Machine Learning	PR	2	20	-	30	-	50	1	1
25PCC13EC19	PCPEC	PCC	CAD for VLSI	PR	2	20	-	30	-	50	1	1
25PCC13EC20	PCPEC	PCC	System Security	PR	2	20	-	30	-	50	1	1
25PEC13ECXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PEC13EC1X	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
25PEC13ECXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
25PEC13ECXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
25MDM05	MDC	MDM	Public Relations and Corporate Communication	TH	2	50	-	50	-	100	2	2
25VSE13EC04	SC	VSEC	Data Acquisition and Processing	PR	2	20	-	30	-	50	1	1
25HXXXEC601	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
				Total	**TH:TU:PR 10:0:20=30**			-	-	**1000**	-	**20**

*Introduced as optional Honor's/minor degree courses

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Honors Degree Offered to ECS Students from SEM-V to SEM-VIII:

A. Name: **Internet of Things**

1. SEM-V: HIoTC501: IoT Sensor Technologies
2. SEM VI: HIoTC601: IoT System Design
3. SEM VII: HIoTC701: Dynamic Paradigm in IoT
4. SEM VII: HIoTSBL701: Interfacing & Programming with IoT Lab (SBL)
5. SEM VIII: HIoTC801: Industrial IoT

B. Name Artificial Intelligence and Machine Learning

1. SEM-V: HAIMLC501: Mathematics for AI & ML
2. SEM VI: HAIMLC601: Game Theory using AI & ML
3. SEM VII: HAIMLC701: AI & ML in Healthcare
4. SEM VII: HAIMLSBL701: AI & ML in Healthcare: Lab
5. SEM VIII: HAIMLC801: Text, Web and Social Media Analytics

C. Name: Data Science

1. SEM-V: HDSC501: Mathematics for Data Science
2. SEM VI: HDSC601: Statistical Learning for Data Science
3. SEM VII: HDSC701: Data Science for Health and Social Care
4. SEM VII: HDSSBL701: Data Science for Health and Social Care Lab
5. SEM VIII: HDSC801: Text, Web and Social Media Analytics

D. Name: Blockchain

1. SEM-V: HBCC501: Bit coin and Crypto currency
2. SEM VI: HBCC601: Blockchain Platform
3. SEM VII: HBCC701: Blockchain Development
4. SEM VII: HBCSBL701: Private Blockchain Setup Lab (SBL)
5. SEM VIII: HBCC801: DeFi (Decentralized Finance)

E. Name: Cyber Security

1. SEM-V: HCSC501: Ethical Hacking
2. SEM VI: HCSC601: Digital Forensic
3. SEM VII: HCSC701: Security Information Management
4. SEM VII: HCSSBL601: Vulnerability Assessment Penetration Testing (VAPT) Lab
5. SEM VIII: HCSC801: Application Security

List of Program Elective Courses:

Choice for Third Year:

Track-A:

SEM-V: Automation, Biomedical Instrumentation Laboratory
SEM-VI:
Any two Theory: Mobile Communication, Digital Signal Processing, Analog VLSI Design
Laboratory: IoT Laboratory, Image Processing Laboratory

Track-B:

SEM-V: Cryptography, Advanced Java programming
SEM-VI:
Any two Theory: Natural Language Processing, Big Data Analytics, Advanced Algorithms
Laboratory: Deep Learning Laboratory, Software Testing & Quality Assurance Laboratory

SEM- VII: Any two theory courses from the other track

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Open Electives offered to ECS students:

SEM-III: Database Management System
SEM-III: Software Engineering for Web Applications
SEM-IV: Operating Systems
SEM-V: Cloud Computing

List of Multi-Disciplinary Minor Courses (MDM):

1. **SEM-III:** Law for Engineers
2. **SEM-IV:** Emerging Technology and Law
3. **SEM-V:** Health, Wellness and Psychology
4. **SEM-V:** Emotional and Spiritual Intelligence
5. **SEM-VI:** Public Relations and Corporate Communication
6. **SEM-VII:** Principles of Management
7. **SEM-VIII:** From SWAYAM (To be approved by Dean Academics)

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Course Code	Course Name	Teaching Scheme (Hours/Week)			Credits Assigned			
25PCC13EC11	Control Systems	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
		Head	ISE-1	MSE	ISE-2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Basic Electrical and Electronics Engineering, Signals and Systems	
	At the end of the course, the learner should be able to:-	
Course Outcomes	CO-1	Describe elements of control systems with their types
	CO-2	Obtain transfer functions of given physical systems
	CO-3	Derive mathematical models using various modeling approaches
	CO-4	Analyze performance of control systems based on time response
	CO-5	Evaluate the stability of a given control system

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Feedback Control Systems**		02
	1.1	Overview of open loop system & closed loop system, block diagram, types, practical examples, comparison with advantages & disadvantages	1	
2		**Mathematical Modeling of Physical Systems**		06
	2.1	The transfer function – definition, advantages, disadvantages, poles & zeros in s-plane, characteristic equation, transfer function derivations of simple physical systems (electrical networks)	2,3	
	2.2	Block diagram algebra – elements of block diagram representation, block diagram reduction rules, numerical examples of the same	2,3	
3		**System Response to Transient & Steady State Conditions**		06
	3.1	Standard test signals, definition of first order systems & second order systems, time domain specifications, analysis of transient response by second order model, numerical examples	1,2,3	
	3.2	Types of systems – type 0, type 1 & type 2, steady state errors, static error constants, analysis of different system types using impulse, step, ramp & parabolic signals	2,3	
4		**Stability Analysis of Control Systems**		06
	4.1	Concept of stability, necessary conditions for stability, Routh-Hurwitz stability criterion, relative stability analysis	1,2	
	4.3	Root Locus technique for stability analysis, numerical examples	1,2	
5		**Frequency Response Analysis of Control Systems**		06
	5.1	Frequency domain specifications, importance of gain margin (GM) & phase margin (PM), correlation between the time domain response & frequency domain response	1,2,3	
	5.2	Bode plots for stability analysis, numerical examples on Bode plots	1,2,3	
	5.3	Polar & Nyquist Plots – introduction & stability criterion	1,2,3	
			Total (Hours)	26

List of Experiments:

Sr. No.	Title of Experiment	Ref.
1	Obtain time response characteristics of first order system	1, 2
2	Obtain time response characteristics of second order system	1, 2
3	Determine step & impulse response for type 0, type 1 & type 2 systems	1, 2
4	Frequency response characteristics of first order & second order systems	1, 2
5	Obtain root locus plot for given LTI system	1, 2
6	Obtain Bode plot for given LTI system	1, 2
7	Simulation of block diagram reduction techniques	1, 2, 3
8	Simulation of LTI system transfer functions	1, 2, 3

Course Assessment:

Theory:

ISE-1:
(i) Tutorial on transfer function derivation & mathematical modeling of physical systems for 10 Marks
(ii) Multiple choice quiz (MCQ) with GATE-level examination type questions for 10 Marks

ISE-2:
(i) Chart / poster preparation / model making of real-life control system & presentation for 10 Marks
(ii) Open book test on stability analysis & frequency response analysis of control systems for 10 Marks

MSE: 90 minutes written (theory) examination of 30 marks based on initial 50% syllabus

ESE: 90 minutes written (theory) examination of 30 marks based on remaining 50% syllabus after MSE

Laboratory:

(a) ISE-1:
Conducted for four experiments with continuous pre-defined rubrics-based evaluation for 20 Marks.

(b) ISE-2:
(i) Conducted for four experiments with continuous pre-defined rubrics-based evaluation for 20 Marks
(ii) Viva-voce (oral) examination based on entire syllabus for 10 Marks

Recommended Books:

1. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 5th edition.
2. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons, 2nd edition.
3. Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall India (PHI), 4th edition.
4. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, 4th edition.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC13EC12	Computer Networks	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	--	
Course Outcomes	CO1	Enumerate the layers of OSI model and TCP/IP model and describe their functions.
	CO2	Identify the characteristics of network devices and media used to design networks.
	CO3	Demonstrate the knowledge of networking protocols at various layers of TCP/IP model.
	CO4	Design and configure the networks using IP addressing and subnetting / supernetting schemes.
	CO5	Explain the functions of Application layer and Presentation layers, their paradigms and Protocols

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Data Communications and Networking**		3
	1.1	Introduction to computer networks, Layers and services, Network topologies, protocol hierarchies, design issues for the layers, connection oriented and connectionless services .	1,2	
	1.2	Reference models: Layer details of OSI, TCP/IP models. Communication between layers. Internet	1,2	
2		**Physical Layer**		3
	2.1	Guided Transmission Media: Twisted pair, Coaxial, Fiber optics.	1,2	
	2.2	Unguided media (Wireless Transmission): Radio Waves, Microwave, Bluetooth, Circuit and Packet Switching	1,2	
	2.3	Network Devices: Repeaters, Hubs, Switches, Routers and Gateways	1,2	
3		**Data Link Layer**		6
	3.1	DLL Design Issues - Services, Framing, Error Control, Flow Control, Error Detection and Correction Elementary Data Link protocols, Stop and Wait, Sliding Window - Go Back N, Selective Repeat.	1,2	
	3.2	Medium Access Control sublayer: Channel Allocation prob-lem, Multiple access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CD)	1,2	
4		**Network Layer**		6
	4.1	Network Layer design issues, Network Layer Protocols: IPv4 Datagram Format, IPv4 Addresses, IPv4 Addressing (classful and classless), Subnetting and Supernetting design problems,	1,2	

		IPv4 Protocol, IPv6 Packet Format, IPv6 Addressing, Transition from IPv4 to IPv6.		
	4.2	Routing algorithms: Intradomain Routing -Shortest Path, Distance Vector Algorithms, Link State Routing, Inter-domain Routing Protocols.	1,2	
5		**Transport Layer**		4
	5.1	The Transport Service: Transport service primitives, UDP, TCP, TCP state transition	1,2,4	
	5.2	TCP Flow control (sliding Window), TCP Congestion Con-trol: Slow Start	1,5	
6		**Application Layer**		4
	6.1	Application layer Paradigms, Standard Client Server applications: World Wide Web and HTTP, FTP, Electronic Mail, TELNET, Secure Shell (SSH), Domain Name System (DNS	1,2	
			Total	**26**

Module No.	**Sr.no**	**Suggested List of experiments**	**Ref.**
1	**1**	Network Cable connection to RJ45 connector using Cripping Tool	1
	2	Study of Network Hardware.	1
2	**3**	Network communication using Unix Commands .	1,2
	4	Use a tool (Eg. NS2) to implement a specific Network topology with respect to the given number of nodes and physical configuration and do: ● Graphical simulation of network with Routing Protocols and traffic consid-eration (TCP, UDP) ● Analysis of network performance for quality parameters such as packet-delivery-ratio, delay, and throughput	1,2
3	**5**	Socket programming using TCP and/or UDP	1,2
	6	Use basic networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route, etc) and set up a network environment with multiple IP addresses and configuration of ARP tables. Set up a network environment in Windows platform also	1,2
4	**7**	Working with routing in Linux/windows: ● View the current routing table ● Add and delete routes ● Change default gateway Perform IPTables for IP forwarding	1,2
	8	Network Simulation using Cisco Network packets.	1,2
5	**9**	Packet Sniffing using Wireshark	1,2
	10	Mini project/presentation/Group activity/ Simulation using modern tools	1,2

Course Assessment:

Theory:

ISE-1:

Activity: Quiz and assignments 20 Marks

ISE-2: Two hours 20 Marks
Activity: Article Discussion, Quiz and Assignments
Outcome: Reflective Journal

MSE: 90 Minutes 30 Marks written examination based on 50% syllabus
ESE: 90 Minutes 30 Marks written examination based on remaining syllabus after MSE

Lab:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Remaining experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Simulation using modern tools to solve the given problem statement for 10 marks

Recommended Books:

1. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education
2. Behrouz A. Forouzan, Forouzan Mosharrat, Computer Networks A Top down Approach, McGraw Hill education
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGraw Hill, Second Edition.
4. James F. Kurose, K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition, Pearson Education.
5. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
6. W. A. Shay, Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
7. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC13EC13	Artificial Intelligence	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Data structures and algorithms, Discrete mathematics, Basic Mathematics	
Course Outcomes	CO1	Identify and select suitable architectures for real-world AI problems in different environment.
	CO2	Apply appropriate search strategies to design and implement problem-solving agents
	CO3	Apply inference rules to develop intelligent agents.
	CO4	Construct Bayesian Belief Networks for decision-making.
	CO5	Develop AI applications by implementing expert system components and Prolog-based programs.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Intelligent Agents**	1	4
	1.1	Artificial Intelligence (AI), AI Perspectives: Acting and Thinking humanly, Acting and Thinking rationally History of AI, Applications of AI, The present state of AI, Ethics in AI		
	1.2	Introduction of agents, Structure of Intelligent Agent, Characteristics of Intelligent Agents, Types of Agents, Simple Reflex, Model Based, Goal Based, Utility Based Agents.		
	1.3	Environment Types, Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent		
2		**Solving Problems by Searching**	1,2	10
	2.1	Definition, State space representation, Problem as a state space search, Problem formulation, Well-defined problems		
	2.2	Solving Problems by Searching, Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality		
	2.3	Uninformed Search, Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bidirectional Search		
	2.4	Informed Search, Heuristic Function, Admissible Heuristic, Informed Search Technique, Greedy Best First Search, A* Search, Local Search, Hill Climbing Search, Simulated Annealing Search, Optimization, Genetic Algorithm		
	2.5	Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning		

3		Knowledge Representation and reasoning	1,3	6
	3.1	Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems		
	3.2	Propositional Logic (PL), Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula,		
	3.3	Predicate Logic, FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL, Forward Chaining, Backward Chaining and Resolution in FOPL		
4		**Reasoning Under Uncertainty**	1,4	2
	4.1	Handling Uncertain Knowledge, Random Variables, Prior and Posterior Probability, Inference using Full Joint Distribution		
	4.2	Bayes' Rule and its use, Bayesian Belief Networks, Reasoning in Belief		
5		**Planning and Learning**	1,4	4
	5.1	The planning problem, Partial order planning, total order planning.		
	5.2	Learning in AI, Learning Agent, Concepts of Supervised, Unsupervised, Semi Supervised Learning, Reinforcement Learning, Ensemble Learning.		
	5.3	- Expert Systems, Components of Expert System: Knowledge base, Inference engine, user interface, working memory, Development of Expert Systems		
			Total	**26**

Module No.	Sr.no	Suggested List of experiments	Ref.
1	**1**	Design of Intelligent System Using PEAS.	1
	2	Design the state space problem for given Problem statement.	
2	**3**	Implement any one of the Informed search techniques E.g. A-Star algorithm for 8 puzzle problem	1
	4	Implement any one of the Uninformed search techniques	1
	5	Implement adversarial search using min-max algorithm.	1
3	**6**	Write a program in prolog to implement simple facts and Queries	1
	7	Prove the goal sentence from the following set of statements in FOPL by applying forward, backward and resolution inference algorithms.	1,4
4	**8**	Create a Bayesian Network for the given Problem Statement and draw inferences from it. (You can use any Belief and Decision Networks Tool for modeling Bayesian Networks)	1.4
5	**9**	Implement a Planning Agent	1,4
	10	Case study of any existing successful AI system	1,4
	11	Mini project/presentation/Group activity/ Simulation using modern tools	1,4

Course Assessment:

Theory:

ISE-1: 20 Marks

Activity: Think pair Share, Case study, Quiz/assignments etc.

ISE-2: 20 Marks

Activity: Article Discussion, Quiz /Assignments, case study discussion etc

MSE: 90 Minutes for 30 Marks written examination based on 50% syllabus

ESE: 90 Minutes for 30 Marks written examination based on remaining 50% syllabus

Lab:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Mini Project for 10 marks

Recommended Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach ―Second Edition" Pearson Education.
2. Elaine Rich and Kevin Knight ―Artificial Intelligence‖ Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3. George F Luger "Artificial Intelligence" Low Price Edition, Pearson Education., Fourth edition.

Reference Books:

1. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.
2. D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
3. Saroj Kaushik "Artificial Intelligence", Cengage Learning.
4. Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
5. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley, Third Edition.
6. N. P. Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
25PCC13EC14	Analysis of Algorithms	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Courses		Data Structures
Course Outcomes	CO1	Compare the efficiency of algorithms belonging to different complexity classes (linear, quadratic, cubic, etc.).
	CO2	Apply divide and conquer strategy to design and implement algorithms.
	CO3	Apply greedy strategy to design and implement algorithms.
	CO4	Apply dynamic programming strategy to design and implement algorithms.
	CO5	Apply backtracking and branch-&-bound strategy to design and implement algorithms.
	CO6	Explore and implement string matching algorithms.

Exp. No.	Name of Experiment	Ref.
1	**Compare algorithms based on different time complexity classes such as linear, quadratic, cubic etc**	2
	• Understanding Asymptotic Notations and Analysing Algorithm Efficiency • Bubble sort and its variation • Selection sort • Insertion sort • Shell sort • Linear search • Binary search	
2	**Divide and Conquer: A Core Paradigm in Computer Science**	1,2
	• Binary search • Finding minimum and maximum from a list of elements • Merge sort • Quick sort • Randomized Quick sort • Constructing Tennis tournament	

3	**Optimizing Solutions with the Greedy Method**	**1,2**
	• Knapsack problem* • Job sequencing with deadlines • Minimum cost spanning trees-Kruskal and • Prim's algorithm* • Optimal storage on tapes • Single source shortest path	
4	**Exploration of Dynamic Programming**	**1,3**
	• Multistage graphs • All pair shortest path • Single source shortest path • Optimal binary search tree* • 0/1 knapsack • Travelling salesman problem* • Flow shop scheduling	
5	**Cracking Challenges with Backtracking**	**1,4**
	• 8 queen problem (N-queen problem) • Sum of subsets • Graph colouring • Knapsack problem	
6	**Cracking Challenges with Branch & Bound**	**1,3,5**
	• Travelling salesperson problem • 15 puzzle problem • Flow Shop Scheduling	
7	**String Matching Algorithms**	**1,5**
	• The Naïve string-matching Algorithms • The Rabin Karp algorithm • Boyer-Moore Algorithm • The Knuth-Morris-Pratt algorithm • Longest common subsequence algorithm	

**Advanced and challenging problems.*

Course Assessment:

ISE-1: Evaluates 50% of the experiments, with continuous rubric-based assessment (20 marks).

ISE-2: Evaluates the remaining experiments, with continuous rubric-based assessment (20 marks).

Final Assessment: A coding contest with problems of varying difficulty levels, conducted on any online platform / Mini Project Emphasizing Practical Implementation in Real-World Scenarios (10 marks)

Recommended Books:

1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms",PHI Publication, 2nd Edition, 2005.
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer Algorithms",2nd Edition, University Press, 2007
3. Steven S. Skiena , "Algorithm Design Manual", Springer Publication, 2nd Edition, 2008
4. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw Hill, 1st Edition, 2006
5. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI, 2nd Edition, 2013.

Online Practice Platforms:

1. Video tutorials on competitive programming (YouTube channels like Abdul Bari, CodeChef)
2. GitHub - Competitive Programming
3. **Codeforces**: For high-level algorithmic challenges
4. **LeetCode**: For interview-specific questions
5. **HackerRank**: For implementation-heavy challenges
6. **TopCoder**: For advanced contests and problems
7. **CodeChef**: For practicing competitive programming problems and contests
8. **AtCoder**: For practicing algorithmic problems with increasing difficulty
9. **SPOJ**: For a wide variety of algorithmic challenges

Online Certification Courses:

1. *Udemy - The Bible of Competitive Programming & Coding Interviews*
2. *Coursera - Data Structures and Algorithm Specialization by UC San Diego*

Additional Practice:

1. **Linked Lists**: Problems on LeetCode (Linked List), GeeksforGeeks (Linked List Practice)
2. **Stacks**: Probslems on GeeksforGeeks (Stacks), HackerRank (Stacks)
3. **Queues**: Practice on HackerRank (Queues), LeetCode (Queue Problems)
4. **Trees**: Explore Binary Tree problems on LeetCode, GeeksforGeeks (Binary Trees)
5. **Graphs**: Problems on Codeforces (Graphs), LeetCode (Graph Problems), GeeksforGeeks (Graph Algorithms)

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC13EC15	Data Warehousing and Mining	L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	15	50	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Database Managements System	
Course Outcomes	CO1	Explain Data Warehousing fundamentals and Dimensionality modelling principles
	CO2	Demonstrate the use of ETL techniques and apply OLAP operations.
	CO3	Perceive the importance of data pre-processing and basics of data mining techniques.
	CO4	Apply classification algorithms in real world dataset for classification and prediction.
	CO5	Visualize the concept of clustering and its applications.
	CO6	Explain web mining fundamentals and apply web structure mining techniques.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Data Warehousing, Dimensional Modeling and OLAP**		3
	1.1	Introduction to Data Warehouse, Characteristics of Data Warehouse	1,3	
	1.2	Fact Table, Data Warehouse Schemas; Star Schema, Snowflake Schema	1,3	
	1.3	Major steps in ETL process, OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot	2,3	
2		**Data Mining and Data Pre-processing**		3
	2.1	Introduction to data mining, KDD process	2,3	
	2.2	Data Summarization, Data Cleaning, Data Integration and Data Transformation	2,3	
	2.3	Data Reduction, Binning methods, Principal Component Analysis	2,3	
3		**Mining frequent patterns and associations**		2
	3.1	Market Basket Analysis, Frequent Item sets, Association Rule	2,3	
	3.2	Apriori Algorithm, FP growth	2,3	
4		**Classification and Clustering**		4
	4.1	Bayesian classification, Confusion matrix, Decision Tree	2,3	
	4.2	Clustering Algorithms: Partitioning- K means and K-medoids	4	
5		**Web Mining**		1
	5.1	Introduction to web mining, Web Structure mining	4	
			Total	**13**

Module No.	Sr.no	Suggested List of experiments	Ref.
1	1	Design star schema and snowflake schema using DMQL	OL4
	2	Implementation of OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot for the above problem statement	2
2	3	Implementation of Classification algorithm (Decision Tree/Naive Bayes)	2
	4	Implementation of Principle Component Analysis algorithm	2
3	5	Implementation of Apriori algorithm using data mining tool (WEKA, R tool, XL Miner, Orange etc.)	2
	6	Implementation of FP-Growth algorithm using data mining tool (WEKA, R tool, XL Miner, Orange etc.)	2
	7	Generate a Decision Tree by using J48 algorithm using data mining tool (WEKA, R tool, XL Miner, Orange etc.)	2
4	8	Implementation of K-means clustering algorithm using data mining tool (WEKA, R tool, XL Miner, Orange etc.)	2
2,3,4	9	Case study: create placement.arff file to identify students who are eligible for placements using suitable data mining algorithm	2
5	10	Apply web mining clustering algorithm on the given dataset	4

Course Assessment:

Theory:

ISE-1:
Activity: Quiz and TPS on Design of Star / Snowflake Schema for 10 Marks

ISE-2:
Activity: Quiz and TPS on problem solving using suitable data mining algorithm for 10 Marks

MSE: 60 Minutes 15 Marks written examination based on 50% syllabus
ESE: 60 Minutes 15 Marks written examination based on remaining syllabus after MSE

Lab:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
ISE-2 will be conducted for six experiments. Continuous pre-defined rubrics-based evaluation for 30 marks.

Recommended Books:

1. Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", 2nd Ed,Wiley India, 2010
2. Han, Kamber, "Data Mining Concepts and Techniques", 3rd Ed., Morgan Kaufmann, 2011
3. Reema Theraja," Data warehousing, Oxford University Press, 2011
4. Ahmed Obaid, Bharat Bhushan, Zdzislaw Polkowski, "Advanced Practical Approaches to Web Mining Techniques and Application", IGI Global, 2022

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Course Code	Course Name	Teaching Scheme (Hours/Week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
25PEC13EC11	Automation	Head	ISE-1	MSE	ISE-2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Electronic Devices, Analog Electronics	
	At the end of the course, the learner should be able to:-	
Course Outcomes	CO-1	Demonstrate the need of automation in a process control system
	CO-2	Select proper components for pneumatic & hydraulic systems
	CO-3	Choose the transmitter / controller for the given process application
	CO-4	Analyze the controller parameters for discrete or continuous type
	CO-5	Design the (electronic) controller for given process or application

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Pneumatic & Hydraulic Systems**		2
	1.1	Basic pneumatic system block diagram, pneumatic compressors (piston, vane, screw), flapper nozzle, single & double acting cylinder, rotary actuators, filter-regulator-lubricator (FRL)	3	
	1.2	Basic hydraulic system block diagram, hydraulic pumps, hydraulic valves (globe, ball, needle, butterfly, gate & diaphragm), parameters of control valves, selecting control valves for particular application	3	
2		**Design of Signal Conditioning Circuits**		6
	2.1	Principles of analog & digital signal conditioning – signal level changes & biasing changes, linearization, conversion, filtering & impedance matching, loading, comparators & converters	1	
	2.2	Design of operational amplifier-based circuits viz. voltage divider circuits, bridge circuits, R-C filters, inverting & non-inverting amplifier, instrumentation amplifier, voltage to current (V to I) converters & current to voltage (I to V) converters, integrators, differentiators	1	
	2.3	Transmitters – Introduction to telemetry & its basic block diagram, 2 wire, 3 wire & 4 wire transmitters, 4 mA to 20 mA current transmitter, electronic transmitters for temperature, level, pressure & flow, current to pressure (I to P) & pressure to current (P to I) converters	1	
3		**Principles of Process Controllers**		06
	3.1	Continuous controller – single mode (P, I & D) & composite mode (PD, PI & PID), split range, auto select, ratio & cascaded controllers, selection criterion of controller for a process model	1, 2, 4	

	3.2	Tuning of PID controller – process loop tuning, open loop transient response method, Ziegler – Nichols tuning method, frequency response methods (numerical examples on PID tuning)	1, 2, 4	
4		**Programmable Logic Controllers (PLC)**		**6**
	4.1	Discrete state process controllers – the discrete state process variables, process specifications & event sequence descriptions	1, 2, 4	
	4.2	Relay controllers & ladder diagrams – introduction to relay logic ladder diagram, ladder diagram elements & programming examples	1, 2, 4	
	4.3	PLC – relay sequencers, programmable logic controller design, PLC operation, programming the PLC, PLC software functions (application examples on relay ladder logic programming)	1, 2, 4	
5		**Digital Process Control Systems**		**4**
	5.1	Data acquisition system (DAS) – objectives, signal conditioning of inputs, single channel DAS, multi-channel DAS, computer based DAS, data logger, difference between DAS & data loggers	2, 4	
	5.2	Computer aided process control – architecture, the human machine interface (HMI), the supervisory control & data acquisition (SCADA), standard industrial interfaces (RS-232C, RS-422A & RS-485)	2, 4	
	5.3	Supervisory control system (SCS), introduction to Fieldbus & Profibus process controlled networks, overview of distributed control system (DCS), highway addressable remote transducer (HART) protocol	2, 4	
6		**Advances in Automation Systems**		**2**
	6.1	PC & microcomputer-based instrumentation, virtual instrumentation & LabVIEW introduction	4	
	6.2	Brief overview of advanced automation – additive manufacturing, digital twins, 3D printing, concept of Industry 4.0 & Society 5.0	4	
			Total (Hours)	**26**

List of Experiments:

Sr. No.	Title of Experiment	Ref.
1	Study of pneumatic single acting & double acting cylinder	3
2	Study of hydraulic process control valves	3
3	Design of instrumentation amplifier for variable voltage gain	1, 2
4	Design of signal conditioning circuits for LDR / thermistor / RTD / strain gauge	1, 2
5	Design of linearization circuits for transducers	1, 2
6	Tuning of P+I+D controller using MATLAB / Simulink	1, 2
7	Implementation of PLC ladder diagram for given application	1, 2
8	Simulating a simple process using LabVIEW	1, 2

Course Assessment:

Theory:

ISE-1:
(i) Tutorial on design of electronic signal conditioning circuits for 15 Marks
(ii) Multiple choice quiz (MCQ) with GATE-level examination type questions for 05 Marks

ISE-2:
(i) Review of selected technical papers based on advances in automation & presentation for 10 Marks
(ii) Open book test on tuning of P+I+D controllers for 10 Marks

MSE: 90 minutes written (theory) examination of 30 marks based on initial 50% syllabus

ESE: 90 minutes written (theory) examination of 30 marks based on remaining 50% syllabus after MSE

Laboratory:

ISE-1:
Conducted for four experiments with continuous pre-defined rubrics-based evaluation for 20 marks.
ISE-2:
i. Conducted for four experiments with continuous pre-defined rubrics-based evaluation for 20 marks
ii. Viva-voce (oral) examination based on entire syllabus for 10 marks

Recommended Books:

1. Curtis D. Johnson, "Process Control Instrumentation Technology", 7th edition, Prentice-Hall India (PHI)
2. William C. Dunn, "Fundamentals of Industrial Instrumentation & Process Control", 1st edition, McGraw Hill
3. Andrew Parr, "Pneumatics & Hydraulics", 2nd edition, Jaico Publishing Co.
4. B. G. Liptak, "Handbook of Process Control & Instrumentation", 4th edition, CRC Press

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC21	Cryptography	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses		
Course Outcomes	CO1	Apply modular arithmetic technique in cryptographic operations.
	CO2	Implement symmetric and asymmetric cryptographic algorithms
	CO3	Demonstrate authentication mechanisms using cryptographic hash functions, digital signatures, and authentication protocols
	CO4	Analyze various attacks on network security, and different security protocols.
	CO5	Apply web security measures for protection against web-based attacks.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction: Number Theory and Classical Cryptography**	1,5	4
	1.1	Security Goals, Attacks, Services and Mechanisms, Techniques. Modular Arithmetic: Euclidean Algorithm, Fermat's and Euler's theorem		
	1.2	Classical Encryption techniques, Symmetric cipher model, monoalphabetic and polyalphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers		
2		**Symmetric and Asymmetric key Cryptography**	1,5	6
	2.1	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES),		
	2.2	Public key cryptography: Principles of public key cryptosystems- The RSA Cryptosystem, The knapsack cryptosystem		
	2.3	Symmetric Key Distribution: KDC, Needham-schroeder protocol. Kerberos: Kerberos Authentication protocol, Symmetric key agreement: Diffie Hellman, Public key Distribution: Digital Certificate: X.509, PKI		
3		**Authentication using Cryptographic Hash Functions and Digital Signature**	1,5,3	6
	3.1	Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC		
	3.2	Digital signature and authentication protocols: Needham Schroeder Authentication protocol, Digital Signature Schemes – RSA, EI Gamal and Schnorr, DSS.		
4		**Network Security and System Security**	1,5	6

	4.1	Network security basics: TCP/IP vulnerabilities (Layer wise), Network Attacks: Packet Sniffing, ARP spoofing, port scanning, IP spoofing		
	4.2	Denial of Service: DOS attacks, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service		
	4.3	Internet Security Protocols: PGP, SSL, IPSEC. Network security: IDS, Firewalls, IDS		
	4.4	Buffer Overflow, malicious Programs: Worms and Viruses, SQL injection		
5		**Web Security**	1,3,5	4
	5.1	Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH,		
	5.2	Web Browser Attacks, Web Bugs, Clickjacking, CrossSite Request Forgery, Session Hijacking and Management, Phishing Technique, DNS Attack, Secure Electronic Transaction, Email Attacks, Penetration Testing		
			Total	**26**

Module No.	**Sr.no**	**Suggested List of experiments**	**Ref.**
1	**1**	Design and Implementation of a product cipher using Substitution and Transposition ciphers	1,5
2	**2**	Implementation and analysis of RSA crypto system and knapsack cryptosystem	1,5
	3	Implementation of Diffie Hellman Key exchange algorithm	1,5
3	**4**	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyze the performance of the two protocols. Use crypt APIs.	1,5
	5	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, ns lookup to gather information about networks and domain registrars.	1,5
	6	Study of packet sniffer tools: Wireshark,: 1. Download and install Wireshark and capture icmp, tcp, and http packets in promiscuous mode. 2. Explore how the packets can be traced based on different filters	1,5
4	**7**	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, xmas scan etc.	1,5
	8	Detect ARP spoofing using nmap and/or open-source tool ARPWATCH and wireshark. Use arping tool to generate gratuitous arps and monitor using wireshark	1,5
5	**9**	Simulate DOS attack using Hping, hping3 and other tools	1,5
	10	Simulate buffer overflow attack using Ollydbg, Splint, Cpp check etc	1,5
	11	Setting up personal Firewall using iptable	1,5
	12	Explore the GPG tool of Linux to implement email security	1,5

Course Assessment:

Theory:

ISE-1: 20M

Activity: Quiz/assignments/NPTEL or any other Activity

ISE-2: 20 Marks

Activity: Article Discussion, Mind map /Quiz /Assignments etc.

MSE: 90 Minutes for 30 Marks written examination based on 50% syllabus

ESE: 90 Minutes for 30 Marks written examination based on remaining syllabus after MSE

Lab:

ISE:

1. ISE-1 will be conducted for five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

2. ISE-2

a. Next five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. case study/Online course certification for 10 marks

Recommended Books

1. William Stallings, "Cryptography and Network Security, Principles and Practice", 6th Edition, Pearson Education, March 2013.
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill
3. Behrouz A. Forouzan& Debdeep Mukhopadhyay, "Cryptography and Network Security" 3rd Edition, McGraw Hill
4. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C", Second Edition, Wiley.
5. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill Education, 2003. 6. Eric Cole, "Network Security Bible", Second Edition, Wiley, 2011.

Online Resources:

1. https://github.com/cmin764/cmiN/blob/master/FII/L3/SI/book/W.Stallings%20-%20Cryptography%20and%20Network%20Security%206th%20ed.pdf
2. https://docs.google.com/file/d/0B5F6yMKYDUbrYXE4X1ZCUHpLNnc/view

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC12	Biomedical Instrumentation laboratory	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Electronic Devices	
At the end of the laboratory course, students will be able to:		
Course Outcomes	CO1	Explain the principles used in measurement of physiological parameters like blood pressure, Oxygen Saturation and Respiration rate
	CO2	Perform measurement of ECG, EEG, EMG using diagnostic equipment
	CO3	Design Instrumentation amplifiers for Biomedical applications given the specifications
	CO4	Design filters to remove power line interference in physiological measurement

Experiment No.	Title	Ref.
1.	**Blood Pressure Measurement** To measure the Systolic and diastolic blood pressure using: i. Sphygmomanometer (Manual method) ii. Automatic method	**1,2,3**
2.	**ECG measurement** To plot the ECG acquired from the subject by using the 12 Lead system	**1,2,3**
3.	**EEG Measurement** To plot and analyze the EEG acquired from the subject using plate electrodes	**1,2,3**
4.	**Measurement of Oxygen saturation (Spo2)** To measure SpO2 using Pulse Oximeter	**1,2,3**
5.	**Instrumentation Amplifier** To design and implement an Instrumentation amplifier for the given specifications	**1,2,3**
6.	**Audiometer** To measure and plot the hearing capacity (both ears) using Audiometry [with and without masking]	**1,2,3**
7.	**Respiration Rate measurement** To measure Respiration rate of the subject by displacement method	**1,2,3**
8.	**Notch Filter** To design and implement a notch filter for given specifications	**1,2,3**

Laboratory Assessment:

ISE:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
ISE-2 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
Activity: Mini- Project (10 marks)

Recommended Books:

1. Handbook of Biomedical Instrumentation: R S. Khandpur. 2004 (TMH Pub).
2. Biomedical Instrumentation and Measurements‖: Leslie Cromwell, Pearson Education, 1980.
3. Medical Instrumentation, Application and Design: J G. Webster. (John Wiley).
4. "Introduction to Biomedical Equipment Technology", Carr –Brown. (PHI Publication)

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
25PEC13EC22	Advanced Java Programming	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Courses		Object oriented Programming with JAVA
Course Outcomes	CO1	Create an event driven graphical Java application using Java Swing
	CO2	Apply Java Database Connectivity (JDBC) to access databases through Java Programs
	CO3	Build dynamic web pages, using Servlets and JSP.
	CO4	Illustrate remote methods in an application using Remote Method Invocation (RMI)
	CO5	Demonstrate Enterprise Java beans for the construction of enterprise software
	CO6	Setup and Configure Restful Web services in distributed application.

Module No.	Expt. No	List of Experiments	Ref.
1		**Swing-** Difference between AWT and Swing, Swing Components, MVC Architecture	1,2
	1	Develop an application demonstrating use of AWT and Swing Components.	1,2
2		**JDBC-** JDBC architecture, JDBC drivers, Establishing database connections, Connection pooling, Prepared Statement and Callable Statement	1,3
	2	Develop JDBC Application that use the JDBC API to connect to a database.	1,2,3
3		**Servlets** Servlet life cycle, Servlet containers, Initialization parameters, Context parameters, GET and POST methods, HTML forms and servlets.	1,2
	3	Create a Java Web Application using Servlet.	1,2
4		**Java Server Pages-** JSP life cycle, JSP expressions and declarations, Page directives, JSP actions and implicit objects, Standard and Custom Tag Libraries, Expression Language (EL), session management	1,3
	4	Create a Java Web Application using JSP using session management	1,2,3
5		Remote interface, Passing objects, RMI Process: Server Side, Client side	1,2
	5	Develop RMI Java application.	1,2
6		**Enterprise Java Beans-** Introduction to EJB, Session beans, entity beans, and message-driven beans, EJB container	1,3
	6	Develop component-based development model using EJB.	1,2,3

7		**Spring Framework-** Dependency Injection (DI) and Inversion of Control (IoC), Spring AOP (Aspect-Oriented Programming), Configuring Spring MVC, Handling web Requests	1,2
	7	Develop RESTful web service using Spring.	1,2
8		**Hibernate Framework-** Introduction to Hibernate, Object-Relational Mapping (ORM), Hibernate architecture, Mapping Java classes to database tables, HQL (Hibernate Query Language)	1,3
	8	Develop Web Content with Hibernate MVC.	1,2,3
	9	Mini Project	

Course Assessment:

Lab

ISE:

ISE-1 will be conducted for five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Mini Project -10 marks

Recommended Books

1. Herbert Schildt, "The Complete Reference: Java", McGraw Hill Education.
2. Jim Keogh, "The Complete Reference: J2EE", McGraw Hill Education.
3. Stephanie Bodoff et al, "The J2EE Tutorial", 2nd Edition, Pearson Education, 2004.

Online Resources:

1. https://docs.oracle.com/javaee/7/index.html
2. https://spring.io/guides/

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25MDM00	Health, Wellness and Psychology	L	T	P	L	T	P	Total
		2	0	0	2	0	0	2
			Examination Scheme					
			ISE-I	MSE	ISE-II	ESE		Total
		Theory	50	---	50	---		100
		Lab	---	---	---	---		---

Pre-requisite Courses		
Course Outcomes	CO1	Introduce the concept of health, wellness and psychology, and understand its effectiveness in handling stress.
	CO2	Develop human strength and life-enhancement skills through recovery and goal setting.
	CO3	Apply the holistic well-being quotient for personal and professional benefits.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Psychology, Health and Wellness**		
	1.1	Understanding holistic health- Meaning, components of holistic health- components of wellbeing, Psychology of overall health-enhancing behaviors component, Types of health-compromising behaviors, Illness Management and wellness enhancement.	1	4
	1.2	Nature and source of stress, personal and professional triggers of stress, Effects of stress, coping with stress (minimalistic yet effective exercise habits)	2	4
2		**Promoting Personal and Professional Wellness: Human Strengths & Life-Enhancement**		
	2.1	Strength: Definition, meaning; Realizing strength; Maximizing Unrealized strength Weakness: Definition, meaning; Identifying and overcoming weakness; Developing hope and optimistic approach.	2, 3	4
	2.2	Recovery and Goal Setting: analyzing trends in personality, Approaching Individual differences; Meaning of Goal setting, Types and effectiveness of Goal Setting. Motivation: Meaning, Theory of Needs, 4A's of coping with stress during or after goal setting.	2	4
	2.3	Eudaimonic Wellness: Meaning and characteristics; concept of defensive coping.	1,4	2
3		**Positive Approach and The Psychology of Living in The Present**		

	3.1	The Psychology of Living in the Present: meaning, self-registering to the flow of positive thoughts and actions; addressing positive and negative emotions; Eliminating daily hassles, creating happiness. Responding to overthinking: Sociocultural factors and self- realization.	1,2,4	4
	3.2	Resilience: Meaning and Nature; How to build resilience; Self-communication and self-care, reframe thoughts; channelize gratitude; practice resilience building: physical and mental exercises.	3, 4	4
			Total	**26**

Course Assessment:

ISE-1:
Certification: 50 marks
NPTEL/ Swayam/any other authentic portal certification
https://archive.nptel.ac.in/courses/109/103/109103182/
https://onlinecourses.nptel.ac.in/noc23_hs06/preview

ISE-2:
1. Health and Wellness: Introduce Group Happiness Project. Group work: Meet, exchange, contact, collect info, talk about why you chose this topic, brainstorm ideas, and present people's opinions in your designed PPT. **30 Marks**

2. Psychology of wellness or happiness: Case Study and Brief Report on : Chris Gardener in the Pursuit of Happiness (Group-specific interpretation) **20 Marks**

Recommended Books:

1. Emmons, R.A., & McCullough, M.E. (2003). Counting blessings versus burdens: An experimental investigation of gratitude and subjective well-being in daily life. Journal of Personality & Social Psychology, 88, 377-389
2. Carpenter, S. (2012). Awakening to sleep. Monitor on Psychology, 44 (1), 40.
3. Emmons, R. A., & Mishra, A. (2012). Why gratitude enhances well-being: What we know, What We Need to Know.
4. Carr, A. (2004). Positive Psychology: The science of happiness and human strength UK Routledge.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25MDM05	Emotional and Spiritual Intelligence	L	T	P	L	T	P	Total
		2	0	0	2	0	0	2
			Examination Scheme					
			ISE-I	MSE	ISE-II	ESE	Total	
		Theory	50	---	50	---	100	
		Lab	---	---	---	---	---	

Pre-requisite Courses		--
Course Outcomes	CO1	Introduce the concept of emotional intelligence, its models, components and measures of emotional intelligence
	CO2	Understand the significance of emotional intelligence in self-growth and building effective relationships, Understand the professional impact of emotional intelligence
	CO3	Develop a wide range of work and life skills.
	CO4	Display spiritual intelligence in different roles.
	CO5	Apply the spiritual quotient for corporate benefits.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Fundamentals of Emotional Intelligence**		
	1.1	Emotion- Meaning, characteristics of emotion, components of emotion- cognitive component, physiological component, Behavioral component. Types of emotions, exposing the myths about emotion, physiological or bodily changes accompanying emotions, how emotions affect our thinking and actions	1	3
	1.2	Nature and Significance of EI, Models of emotional intelligence: Ability, Trait and Mixed, Building blocks of emotional intelligence: self-awareness, self- management, social awareness, and relationship management	2	3
2		**Personal and Social Competence**		
	2.1	Self-Awareness: Observing and recognizing one's own feelings, Knowing one's strengths and areas of development Self-Management: Managing emotions, anxiety, fear, and anger	2	3
	2.2	Social Awareness: Others' Perspectives, Empathy and Compassion Relationship Management: Effective communication, Collaboration, Teamwork, and Conflict management (professional impact)	2	3
	2.3	Strategies to develop and enhance emotional intelligence and using them effectively in professional life	1	2
3		**Background and Approach: Spiritual Intelligence and Karma Yoga**		

	3.1	• Spiritual Intelligence- Definition, need, state of presence, psychological element, Intuitive intelligence. • Foundation of Spiritual Intelligence • Types of spiritual actions • Models- SQ and SI-Growth model • Yoga of Action and Spirituality: Professionalism	6,8	3
	3.2	• Types of spiritual actions • Models- SQ and SI-Growth model • Readiness for spiritual intelligence: self-leadership, synthesize high performance, spiritual awareness, neuropsychology, and state of conscious identity.	5, 7	3
4		**Opposite Polarity in SI and Overall Impact on Personality**		
	4.1	• Twin poles of attention- subject and the object pole • Benefits of Spiritual Intelligence- personal, social and corporate • Dimensions of Spiritual Intelligence- SI and Self Esteem, SI and Restoration of confidence • SI and clarity of thoughts and speech, Personality moulding and SI.	8	4
5	**5.1**	**Spiritual Ecology and Environmental Grassroots Activism**		
		• Spiritual Stewardship and Ecology: Case studies based on making a difference in ecology through environmental grassroots activism	4	2
			Total	**26**

Course Assessment:

ISE-1:

Certification: 50 marks

NPTEL/ Swayam/ Farmer space Certification

https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

https://www.framerspace.com/course/-Mx9gV_of5-self-directed-emotional-learning-for-empathy-and-kindness-short-course?cid=64815e6241de0ce10ee9c717

ISE-2:

1.Emotional Intelligence: Identifying emotions and applying it to personal and professional situations 20 marks

2. Spiritual Intelligence: Performing solutions based on given problems **30 Marks**

Recommended Books:

1. Bar-On, R., & Parker, J.D.A.(Eds.) (2000). The handbook of emotional intelligence, San Francisco, California: Jossey Bros.
2. Goleman, D. (2005). Emotional Intelligence. New York: Bantam Book.
3. Sternberg, R. J. (Ed.). (2000). Handbook of intelligence. Cambridge University Press.
4. Thich Nhat Hanh, V. S. (2016). *Spiritual Ecology: The Cry of the Earth.* Golden Sufi Center.
5. Vivekananda, S. (2015). *The Complete Book of Yoga.* Solar Books.
6. Yogananda, P. (1946). *Autobiography of a Yogi.* Thomas Press Ltd.
7. Krishnaswami, O. (2006). *Karma Yoga: Yoga of Action.* Dev Publishers.
8. Buzan, T. (2001). *Power of Spiritual Intelligence: 10 Ways to Tap into Your Spiritual Genius.* Thorsons

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25OEEC41	Cloud Computing	L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	15	50	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Database Management System, Operating System	
Course Outcomes	CO1	Understand the key concepts, service models, and deployment types of cloud computing and their practical applications.
	CO2	Implement and compare virtualization types, including hosted, bare-metal, and containerized approaches, using tools like Docker and Kubernetes.
	CO3	Configure and manage compute, storage, database, and networking services across platforms like AWS and Azure.
	CO4	Apply security principles such as IAM, encryption, and compliance standards to secure and monitor cloud environments effectively.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Cloud Computing**		
	1.1	**Cloud Computing Fundamentals** • Definition and Evolution of Cloud Computing • Benefits and Challenges of Cloud Adoption • NIST Definition of Cloud Computing: Essential Characteristics, Service Models, and Deployment Models • Cloud Service and Deployment Models (IaaS, PaaS, SaaS, Public, Private, Hybrid, Multi-cloud)	1, 2	2
	1.2	**Cloud Ecosystem Overview** • Major Cloud Providers: AWS, Azure, GCP • Private Clouds: Introduction to OpenStack • Cloud Cube Model: Dimensions and its Relevance in Decision-Making	1,2	1
2	Virtualization			
	2.1	**Introduction to Virtualization** • Virtualization and its Role in Cloud Computing • Characteristics of virtualized environment, Understanding the importance of Hypervisors, Type I & Type II Hypervisors,	1	2

		• Types of Virtualization: Hardware, Software, Network, CPU, I/O and Storage		
	2.2	• Virtualization Reference model, implementation levels of virtualization • Types of Virtualization**:**Full Virtualization, Binary, Translation, Para-Virtualization, Hardware-Assisted Virtualization	1	2
	2.3	**Virtual Machines and Containers** • Comparison of VMs and Containers • Containerization Technologies: Docker, Kubernetes	1	1
3	**Cloud Services and Implementation**			
	3.1	**Compute Services** • Setting up Virtual Machines (AWS EC2, Azure VMs) • Serverless Functions (AWS Lambda, Azure Functions)	2	1
	3.2	**Storage Services** • Block Storage (EBS, Managed Disks) • Object Storage (Amazon S3, Azure Blob Storage)	2	1
	3.3	**Database Services** • Relational Databases (AWS RDS, Azure SQL Database) • NoSQL Databases (DynamoDB, Cosmos DB	2	1
	3.4	**Networking Services** • Virtual Private Clouds (VPCs) • Load Balancers and Content Delivery Networks (CDNs)	2	1
4	**Cloud Security and Compliance**			
	4.1	**Cloud Security Basics** • Shared Responsibility Model • Identity and Access Management (IAM)	1,2	1
	4.2	**Data Protection and Encryption** • Data at Rest and In-Transit Encryption • Cloud Key Management Services (AWS KMS, Azure Key Vault)	1,2	1
	4.3	**Compliance and Governance** • Cloud Compliance Standards (ISO 27001, GDPR, HIPAA) • Cost Management and Monitoring Tools	1,2	1
			Total	**15**

Module No.	Sr.no	Suggested List of experiments	Ref.	Hrs.
1	1	Understand the basics of cloud computing, its evolution, service models, and deployment models (Case studies of various Cloud expected)	2	2
2	2	**Hosted Virtualization Implementation:** Set up and configure hosted virtualization using VirtualBox and KVM.	2	2
2	3	**Bare-Metal Virtualization Implementation:** Study and implement bare-metal virtualization using Xen Hypervisor.	1,2	2
1	4	**Infrastructure as a Service (IaaS) Implementation:** Deploy virtual machines on AWS as an IaaS solution.	1,2	2
1	5	**Platform as a Service (PaaS) Implementation:** Develop and deploy applications using AWS Elastic Beanstalk.	1,2	2
1	6	**AWS Lightsail Implementation (SaaS):** Set up and deploy VPS, applications, and storage using AWS Lightsail.	1,2,3	2
3	7	**Storage as a Service Implementation:** Configure and manage AWS S3 and Glacier storage services.	1,2,3	2
4	8	**Identity and Access Management on AWS:** Learn to manage access control and secure AWS resources using IAM users, groups, roles, and policies.	3	2
4	9	**Securing Networks and Applications on AWS:** Secure cloud networks and applications Such as VPC, WAF, Shield, and AWS monitoring tools.	3	2
3	10	**Database Services Implementation:** Set up and manage relational databases using AWS RDS.	3,4,5	2
2	11	**Containerization with Docker:** Study and implement containerized applications using Docker.	3,4,5	2
2	12	**Orchestration with Kubernetes:** Deploy and manage containerized applications using Kubernetes.	3,4,5	2
3	13	**Cloud Messaging Implementation:** Implement messaging systems using AWS SQS and SNS.	4,5,6	2
3	14	**Serverless Event Handling with AWS Lambda:** Create and deploy serverless functions for event handling.	4,5,6	2
		Mini project		
			Total	**26**

Course Assessment:

Theory:

ISE-1: Activity: Quiz and assignments 15 Marks/ One hour Test 10 Marks

ISE-2: One hours 10 Marks
Activity: Article Discussion, Quiz and Assignments
Outcome: Reflective Journal

MSE: Two hours 15 Marks written examination based on 50% syllabus
ESE: Two hours 60 Marks (30% weightage) written examination based on entire syllabus

Lab:

ISE:
1. ISE-1 will be conducted for four or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
2. ISE-2
a. Remaining Four experiments or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Simulation using modern tools to solve the given problem statement for 10 marks/Mini project

Recommended Books:

1. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah," Cloud Computing Black Book", Dreamtech Press.
2. Mastering Cloud Computing, Rajkumar Buyya, MGH publication
3. John Paul Mueller, "AWS for Admins for Developers", John Wiley & Sons, Inc
4. Ken Cochrane, Jeeva S. Chelladhurai, NeependraKhare , "Docker Cookbook – Second 9. Edition", Packt publication
5. Jonathan Baier, "Getting Started with Kubernetes-Second Edition", Packt Publication
6. Michael Collier, Robin Shahan, "Fundamentals of Azure, Microsoft Azure Essentials", Microsoft Press.

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC13EC16	VLSI Design	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	**MSE**	**ISE2**	**ESE**	**Total**	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Electronic Devices, Analog Electronics	
Course Outcomes	CO1	Demonstrate a clear understanding of choice of technology and
	CO2	Analyze CMOS based circuits
	CO3	Realize logic circuits with different MOS circuit design styles
	CO4	Demonstrate the understanding of system level design issues in
	CO5	Compare different approaches for memory implementation
	CO6	Simulate MOS based circuits

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Technology Trend**		5
	1.1	Technology Comparison**:** Comparison of BJT, NMOS and CMOS technology	1,2	
	1.2	MOSFET Scaling**:** Types of scaling, Level 1 and Level 2 MOSFET Models.	1,2	
	1.3	MOSFET capacitances	1,2	
2		**Direct realization methods**		8
	2.1	Circuit Analysis**:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load and CMOS inverter, comparison of all types of MOS inverters, design of CMOS inverters, CMOS Latch-up	1,2	
	2.2	Logic Circuit Design**:** Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter	1,2	
	2.3	Implementation of any complex function	1,2	
3		**MOS Circuit Design Styles**		6
	3.1	Design Styles: Static CMOS, pass transistor logic, transmission gate, Pseudo NMOS, Domino, NORA, Zipper, C2MOS, sizing using logical effort	1,2,3	
	3.2	Circuit Realization: SR Latch, JK FF, D FF, 1 Bit Shift Register, MUX, decoder using above design styles	1,2,3	
	3.3	Data Path Design:	1,2,3	

		Adder: Bit adder circuits, ripple carry adder, CLA adder Multipliers and shifter**:** Partial-product generation, partial-product accumulation, final addition, barrel shifter		
4		**Semiconductor Memories**		5
	4.1	SRAM: ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits),	2,3	
	4.2	DRAM (Operation 3T, 1T, operation modes, leakage currents, refresh operation, Input-Output circuits), Flash (mechanism, NOR flash, NAND flash)	2,3	
	4.3	Peripheral Circuits**:** Sense amplifier, decoder	2,3	
5		**VLSI Clocking and System Design**		5
	5.1	Clocking: CMOS clocking styles, Clock generation, stabilization, and distribution	2,4	
	5.2	Low Power CMOS Circuits: Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling	2,4	
	5.3	IO pads and Power Distribution and Interconnect: ESD protection, input circuits, output circuits, simultaneous switching noise, power distribution scheme: Interconnect delay model, interconnect scaling and crosstalk	2,4	
			Total	26

List of Experiments:

Experiment No.	**Experiment Title**
1	Output and Transfer characteristics of NMOS and PMOS
2.	COMPARATIVE ANALYSIS OF VARIOUS LOAD INVERTER
3.	Design and analysis of NAND and NOR Circuit
4.	Estimation of Power Dissipation
5.	Layout and Extraction for VLSI Circuits
6.	2:1 Multiplexer using transmission gate
7.	Pass transistor Implementation
8.	Different Design Style
9.	6-T RAM Cell
10.	DFF implementation
11.	Novel Devices

Course Assessment:

Theory:

ISE-1: Model making and presentation: 20 marks

ISE-2: Article Discussion and report writing: 20 Marks

MSE: 90 minutes 30 Marks written examination based on 50% syllabus

ESE: 90 minutes 30 Marks written examination based on remaining syllabus after MSE

Lab:

ISE-1: Minimum six experiments performance for 20 Marks (List 1-5)

ISE-2: Minimum six experiments performance for 30 Marks (List 5-11)

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC13EC17	Analog and Digital Communication	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Practical	20	--	30	--	50	

Pre-requisite Courses	Digital Electronics, Signals and Systems, Electronic Devices	
Course Outcomes	CO1	Explain types and parameters of noise and the need for modulation.
	CO2	Analyze various amplitude and angle modulation techniques.
	CO3	Discuss the operation of radio receivers and demodulators.
	CO4	Generate and detect pulse modulation techniques.
	CO5	Derive performance parameters of Digital modulation methods
	CO6	Simulate/implement various analog and digital modulation techniques.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Communication**	2,6	3
	1.1	Types of Noise, Signal-to-noise ratio, Noise factor, Noise Figure, Noise Temperature		
	1.2	Need for modulation		
2		**Amplitude Modulation**	1,2, 3,6	6
	2.1	Amplitude Modulation: Representation of AM wave (Mathematical & Graphical), Frequency spectrum of AM wave, AM Power Distribution, AM for a Complex Modulating Signal: modulation index, power distribution, and Current Distribution		
	2.2	Types of AM: Generation of DSB-SC using diode based balanced modulator, Generation of SSB using phase shift method		
3		**Angle modulation**	1,2, 3,6	6
	3.1	Theory of Frequency Modulation (FM) & Phase Modulation (PM) - Basic Concepts, Spectrum Analysis of FM Wave, Noise triangle, Pre-emphasis, De-emphasis, Comparison of AM, FM and PM		
	3.2	Radio receivers: Super-heterodyne Receiver, Receiver Characteristics: Sensitivity, Selectivity, Fidelity and Image frequency rejection ratio, choice of Intermediate frequency, Diode detector for AM, Frequency discriminator and Phase discriminator methods for FM		

4		**Pulse Modulation**	1,2, 3,6	6
	4.1	Sampling theorem, aperture effect and aliasing		
	4.2	Generation and Detection of Pulse Amplitude Modulation (PAM)		
	4.3	Pulse Code Modulation (PCM), Delta Modulation (DM), Advanced Delta Modulation (ADM)		
	4.4	Multiplexing Techniques: Time Division Multiplexing (TDM): T1 carrier system, Frequency Division Multiplexing (FDM)		
5		**Digital Modulation Techniques**	1,3, 4,5, 6	5
	5.1	Generation, detection, Constellation diagram, Power spectral density and bandwidth of: Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), M-ary PSK, Binary Amplitude Shift Keying (BASK), Quadrature Amplitude Modulation (QAM), Binary Frequency Shift Keying (BFSK), Minimum Shift Keying (MSK).		
			Total	**26**

Module No.	**Sr. no**	**Suggested List of experiments**	**Ref.**
2	**1**	Hardware/software simulation of AM modulation and demodulation and analysis of the AM wave.	Online 1
	2	Hardware/software simulation of SSB and DSB-SC modulation and demodulation.	
3	**3**	Hardware/software simulation of pre-emphasis and de-emphasis circuits.	
	4	Simulation and comparison of generation of FM and PM waves.	Online 2
4	**5**	Proof of sampling theorem through software/hardware simulation.	
	6	Implementation of pulse modulation techniques.	
	7	Implementation of TDM and FDM.	
5	**8**	Hardware/software implementation of amplitude shift keying techniques.	Online 3
	9	Hardware/software implementation of phase shift keying techniques.	Online 3
	10	Hardware/software implementation of frequency shift keying techniques.	Online 3
	11	Hardware/software implementation of constellation diagram of digital modulation techniques.	

Course Assessment:

Theory:

ISE-1:
Activity: Quiz and assignments 20 Marks
Practical assignment
ISE-2: Two hours 20 Marks
Activity: Article Discussion, Quiz and Assignments
Outcome: Reflective Journal

MSE: 90 minutes 30 Marks written examination based on 50% syllabus
ESE: 90 minutes 30 Marks written examination based on the remaining syllabus after MSE

Lab:

ISE:

1. **ISE-1** will be conducted for four or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
2. **ISE-2**
   a. Remaining Four experiments or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
   b. Simulation using modern tools to solve the given problem statement for 10 marks/Mini project

Recommended Books:

1. Principles of Communication Systems, Taub Schilling & Saha, Tata Mc-Graw Hill, Third Ed
2. Electronics Communication System, George Kennedy, Bernard Davis and Prasanna, Tata McGraw Hill, 6th Ed, 2018
3. Analog and Digital Communication, T. L. Singal, Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
4. Digital Communication: Fundamentals and Applications, Sklar B. & Ray P. K., Pearson, Dorling Kindersley (India), 2nd edition, 2006
5. Digital communication, Simon Haykin, John Wiley and sons, 2010
6. Electronics Communication Systems, Wayne Tomasi, Pearson Education, Third Edition, 2001.

Online Resources:

1. https://www.mathworks.com/help/comm/ug/analog-baseband-examples.html
2. https://www.mathworks.com/help/comm/ug/analog-passband-modulation-examples.html
3. https://github.com/Nikeshbajaj/ASK_PSK_FSK

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
25PCC13EC18	Machine Learning	0	0	2	0	0	1	1
		Examination Scheme						
		ISE		MSE	ISE	ESE		Total
		20		---	30	---		50

Pre-requisite Courses	Programming Fundamentals	
	On successful completion of the course learner will be able to	
Course Outcomes	CO1	Apply and analyze data handling techniques by loading, preprocessing, and visualizing datasets using Pandas, Matplotlib, and Seaborn.
	CO2	Implement and evaluate supervised learning models, including Decision Trees, Linear Regression, Logistic Regression, and Naïve Bayes, using Scikit-learn.
	CO3	Develop and compare machine learning models using appropriate evaluation metrics such as accuracy, precision-recall, confusion matrices, and ROC curves
	CO4	Explore and implement neural network-based models, including Artificial Neural Networks (ANN) and K-Nearest Neighbors (KNN), for classification tasks.
	CO5	Apply and assess clustering techniques such as K-Means and Expectation-Maximization (EM) for unsupervised learning, comparing their effectiveness on real-world datasets.

Exp. No.	Name of the experiment	Ref
	Introduction	
1	**Data Handling and Analysis:** 1. Load datasets from CSV, Excel, and JSON files using Pandas. 2. Perform data exploration (checking missing values, data types, and summary statistics). 3. Implement data cleaning techniques (handling missing values, duplicates, and type conversions). 4. Apply filtering, sorting, and grouping operations on datasets. 5. Perform data visualization using Matplotlib and Seaborn	1, 2

Supervised Learning		
2	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. 1. Load and preprocess a dataset. 2. Implement a Decision Tree Classifier using Scikit-learn. 3. Evaluate the impact of Entropy, Information Gain, and Gini Index on decision-making. 4. Prevent overfitting using pruning techniques (pre-pruning and post-pruning). 5. Compare Decision Tree performance with Random Forest (Bagging & Boosting). 6. Evaluate model accuracy using confusion matrix, precision-recall, and ROC curves..	1,2
Linear Models for Regression		
3	Write a program to implement linear regression for a sample dataset. 1. Load and preprocess dataset containing property details and prices. 2. Implement Simple Linear Regression to analyze the relationship between variables. 3. Extend the model to Multiple Linear Regression by incorporating additional features. 4. Evaluate model performance using Mean Absolute Error (MAE), Mean Squared Error (MSE), and R^2 Score. 5. Visualize regression results using scatter plots and regression lines. 6. Understand the impact of feature scaling and multicollinearity on model accuracy.	1,3
4	Write a program to implement logistic regression for a sample dataset. Example: Diabetes is a common chronic disease that can be predicted based on factors such as age, blood pressure, glucose level, BMI, and family history. The objective of this practical is to build a Logistic Regression model using Python to classify patients as diabetic or non-diabetic based on given health indicators. 1. Load and preprocess a diabetes dataset containing patient health records. 2. Implement Binary Classification using Logistic Regression from Scikit-learn. 3. Split the dataset into training and testing sets for evaluation. 4. Evaluate the model using accuracy, precision-recall, confusion matrix, and ROC curve. 5. Understand decision boundary and interpret model coefficients.	1,3

	6. Apply feature scaling (Standardization/Normalization) to improve model performance.	
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets. Example: Email service providers need to classify incoming emails as spam or not spam to protect users from unwanted messages. The objective of this practical is to implement a Naïve Bayes Classifier using Python to automatically classify emails based on their content. 1. Load and preprocess a dataset containing email text and spam labels. 2. Perform text preprocessing (removing stopwords, tokenization, and vectorization using TF-IDF or CountVectorizer). 3. Implement Multinomial Naïve Bayes for text classification. 4. Evaluate model performance using accuracy, precision-recall, F1-score, and confusion matrix. 5. Compare Naïve Bayes with other classification models such as Logistic Regression or Decision Trees. 6. Interpret model predictions and understand prior and likelihood probabilities.	1,3
Neural Networks		
6	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	1,3
7	Handwritten digit recognition is a common application of machine learning, used in postal services, banking, and OCR systems. The objective of this practical is to implement the K-Nearest Neighbors (KNN) algorithm using Python to classify handwritten digits from the MNIST dataset. 1. Load and preprocess the MNIST dataset, which consists of images of digits (0-9). 2. Convert images into numerical feature vectors using pixel intensities. 3. Implement KNN classification using Scikit-learn's KNeighborsClassifier. 4. Tune the hyperparameter k (number of neighbours) to improve classification accuracy. 5. Evaluate model performance using accuracy, confusion matrix, and classification report. 6. Compare KNN with other classifiers such as Logistic Regression or Decision Trees.	1,3

8	Early diagnosis of cancer, especially breast cancer, can significantly improve treatment outcomes. The objective of this practical is to implement a Support Vector Machine (SVM) classifier using Python to predict whether a tumor is malignant or benign based on cellular features from the Breast Cancer Wisconsin dataset. 1. Load and preprocess the Breast Cancer Wisconsin dataset. 2. Implement SVM classification using Scikit-learn's SVC class. 3. Experiment with different kernels (Linear, Polynomial, RBF) to improve performance. 4. Tune hyperparameters such as C (regularization) and gamma (kernel coefficient). 5. Evaluate the model using accuracy, precision-recall, F1-score, and ROC curve. 6. Visualize decision boundaries and understand the impact of the margin and support vectors.	1,3
Un-supervised Learning		
9	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.	1,3
10	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.	1,3
Mini Project		
11	Students are expected to form a group of maximum 3 students and complete mini project.	1,3

Course Assessment:

ISE-1

a. For first five experiments, Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Remaining Five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Mini Project for 10 marks

Recommended Books:

1. Christopher Bishop: Pattern Recognition and Machine Learning, Springer-Verlag New York Inc., 2006.
2. Tom M. Mitchell: Machine Learning, The McGraw-Hill, Indian Edition, 2017.
3. Kevin Murphy: Machine Learning: A Probabilistic Perspective, MIT Press, 2012

4. Shai Shalev-Shwartz and Shai Ben-David: Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014
5. Ethem Alpaydin: Introduction to Machine Learning, 3rd Edition, MIT Press, 2014
6. Aurelien Geron: Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2019.

Online Resources:

1. Google Machine Learning crash course: https://developers.google.com/machine-learning/crash-course
2. NPTEL course on Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc23_cs18/preview
3. IBM course on Machine Learning with Python: https://www.coursera.org/learn/machine-learning-with-python

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PCC13EC19	CAD for VLSI	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Courses		
Course Outcomes	CO1	Analyze given VLSI Circuit for key performance metrics using Simulation tool
	CO2	Draw optimized layout for VLSI Circuit using Layout Simulation tool
	CO3	Write HDL code and simulate using HDL simulator
	CO4	Implement Verilog code for complex engineering problem on FPGA

Exp. No.	Topics	Max Marks
1 & 2	CAD Tools for VLSI Circuit Simulation	10
3 & 4	CAD Tools for VLSI Layout Simulation	10
5 & 6	CAD Tools for VLSI HDL Simulation	10
7 & 8	CAD Tools for FPGA Implementation	10
9	Complex Problem Solving using FPGA	10
	Total	**50**

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned		
		L	T	P	L	T	P	Total
25PCC13EC20	System Security Lab	0	0	2	0	0	1	1
		Examination Scheme					
		ISE	MSE	ISE	ESE	Total		
		20	------	30	------	50		

Pre-requisite Courses	C programming	
	On successful completion of the course learner will be able to	
Course Outcomes	CO1	Implement Secure Authentication and Access Control Mechanisms
	CO2	Analyze and Mitigate Security Threats and Attacks
	CO3	Develop Secure Data Storage and Communication Techniques.
	CO4	Conduct Digital Forensics and Intrusion Detection.
	CO5	Apply Security Best Practices in System and Application Development.

Exp. No.	Name of the experiment	Ref
1	Implement a secure user authentication system using multi-factor authentication (MFA). • The system should include password-based authentication, OTP verification (email/SMS). • Ensure that passwords are stored securely using bcrypt hashing and include brute-force attack prevention. • Explain cracking by John the ripper attack.	1, 2
2.	Develop a **network-based intrusion detection system (NIDS)**. • System should detect malicious network activities such as port scanning, DoS attacks, and unauthorized access attempts.	1, 5
3	Design and implement a **secure cloud storage system.** • Users should encrypt and upload their files. • The system should ensure confidentiality (AES encryption), integrity (SHA-256 hashing), and access control (role-based permissions).	1, 3
4	Simulate a **ransom ware attack** in a controlled environment and implement **a detection and recovery mechanism.** The system should detect abnormal file encryption patterns and block the process before it spreads.	1, 3
5	Perform penetration testing on a web application. • Use tools like Burp Suite, OWASP ZAP, or manual SQL injection/XSS testing.	1, 5

	• Identify security vulnerabilities and propose countermeasures.	
6	Develop a **secure REST API** that prevents common web attacks. • SQL injection, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), and API key leaks. • Use OAuth 2.0 for authentication and implement rate limiting for protection.	1, 6
7	Simulate a **cybercrime investigation** scenario where students must analyze a compromised system**.** • Perform disk forensics (recover deleted files), memory forensics (extract running processes), and network forensics (trace malicious activity using Wireshark).	1, 5
8	Set up a sandbox environment to analyze the behavior of malicious executables. • Extract features like file system changes, network activity. • Registry modifications using tools like Cuckoo Sandbox or Sysinternals Suite.	1, 2
9	Design a zero-trust security framework. • Users and devices must continuously verify their identity before accessing network resources. • Implement least privilege access control, micro-segmentation, and multi-factor authentication in a simulated enterprise network.	2,1,5
10	Develop a **secure communication system** where messages are encrypted and embedded into an image using **steganography**. The recipient should be able to extract and decrypt the hidden message.	2,1

Course /Lab Assessment:

ISE:

1. **ISE-1(20M)**
   Continuous assessment of 50% experiments.

2. **ISE-2(30M)**

   Continuous assessment of remaining experiments. (20M)
   Quiz/Case studies discussion (10M)

Recommended Books:

1. William Stallings, "Cryptography and Network Security, Principles and Practice", 6th Edition, Pearson Education, March 2013.
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill

3. Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security"3rd Edition, McGraw Hill
4. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C",Second Edition.
5. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C", Second Edition, Wiley.

Online Resources:

1. https://github.com/cmin764/cmiN/blob/master/FII/L3/SI/book/W.Stallings%20-%20Cryptography%20and%20Network%20Security%206th%20ed.pdf
2. https://docs.google.com/file/d/0B5F6yMKYDUbrYXE4X1ZCUHpLNnc/view

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC13	Mobile Communication	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Practical	20	–	30	–	50	

Pre-requisite Courses	Computer Networks	
Course Outcomes (CO):	At the End of the course students will be able to :	
Course Outcomes	CO1	Apply the fundamentals of cellular systems to estimate the coverage area and capacity of a cellular network considering factors like frequency reuse, interference, and traffic demand. (BL3)
	CO2	Demonstrate knowledge of GSM signaling, call setup processes, and the role of channels in GSM communication.
	CO3	Explain the architecture and components of the LTE network
	CO4	Explain the evolution and key features of 4G technologies, including LTE-Advanced, and their role in modern communication systems
	CO5	Explore the requirements and challenges of 5G networks.

Module No.	Unit No.	Contents	Ref.	Hrs
1 Fundamentals of Mobile Communication	**1.1**	**The Cellular System Design Fundamentals:** Frequency Reuse, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems.	1,3	6
	1.2	**Large scale fading:** Free space propagation model, the three basic propagation mechanisms. **Small scale fading:** small scale multipath propagation, parameters of mobile multipath channels.		
	1.3	**Multiple access techniques:** Frequency division multiple access (FDMA), Time division multiple access (TDMA), space division multiple access (SDMA), Code division multiple access (CDMA)		
2 2G, 2.5G	**2.1**	**GSM:** GSM Network architecture, GSM channels, frame structure for GSM, GSM speech coding, authentication and security in GSM, GSM call procedures, GSM hand-off procedures.	1,2	6
	2.2	GSM evolution: GPRS and EDGE- architecture, radio specifications.		
3G	**3.1**	**3G UMTS Networks:** UMTS Architecture, Protocol structure, channel and frame structure.	1	4

	3.2	**CDMA 2000 Cellular Technologies: F**orward and reverse channels, Handoff and Power control.		
3 **3G & 4G**	**3.2**	LTE Architecture, LTE Physical layer: Frames, slots, and symbols, modulation, coding. Multi-antenna Techniques: Smart antennas, multiple input multiple output systems. Cognitive radio: Architecture, spectrum sensing. Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals SDR: Architecture, limitations, advantages, disadvantages.	1	5
4 **5G**	**4.1**	10 Pillars of 5G, small Cells for 5G mobile Network, small cell challenges, overview of cognitive radio technology in 5G wireless, key requirements and challenges for 5G Cognitive terminals,Security Issues and Challenges in 5G Communications Systems.	7	5
			Total	**26**

Recommended Books:

1. Theodore S. Rappaport ―Wireless Communications - Principles and Practice, PEARSON, Second edition
2. T L Singal ―Wireless Communications, McGraw Hill Education
3. Andreas F. Molisch ― Wireless Communications Wiley India Pvt Ltd., Second Edition
4. Raj Pandya- Mobile and Personal Communication Services and Systems (IEEE Series on Mobile & Digital Communications)
5. Upena Dalal ―Wireless and Mobile Communications‖, Oxford University Press.
6. Vijay K. Garg ―Wireless Communications and Networking‖, Morgan–Kaufmann series in Networking-Elsevier
7. Rodriguez, Jonathan & Al-Yasir, Yasir. (2015). Fundamentals of 5G Mobile Networks. 10.1002/9781118867464.

Course Assessment:

Theory:

ISE-1:
Activity: Quiz /crossword10 Marks
Assignment 10 Marks

ISE-2:
Activity: Seminar on Research paper (IEEE) 10 Marks
Assignment 10 Marks

MSE: Two hours 30 Marks written examination based on 50% syllabus**.**
ESE: Three hours 100 Marks written examination (with 30% weightage) based on the entire syllabus.

Suggested Laboratory Experiments:

S.N.	Title of experiment	References
1	Analyse network performance parameters (Netsim)	2,3,6
2	Simulation of frequency reuse in cellular system	2,3
3	To study the effect of handover threshold and margin on SINR and call drop Probability and handover probability (IIT Vlab)	1
4	Simulation of CDMA	2,3
5	Design and analysis a Multipath fading Channel model	1,3
6	Throughput and Bottleneck Server Analysis (NetSim)	1,2
7	Implementation of GSM security algorithm	2
8	Design, analyze and test Wireless standards and evaluate the performance measurements such as BER, PER, BLER, throughput, capacity, ACLR, EVM for 4G and 5G using Matlab.	2
9	Analysis of TCP Congestion Control Algorithm Behavior and Performance (NetSim)	

***Tools to be used:** *MATLAB, NS3, NetSim, OMnet++*

Course Assessment:

Lab:

ISE-1 Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Activity: case studies (10 marks)

Online Resources:

1. IITs Vlabs: http://vlabs.iitkgp.ac.in/fcmc/
2. Lecture Series by Dr. Aditya Jagannath, IIT Kanpur : https://www.youtube.com/watch?v=8CKZ_icPea0
3. NPTEL course on Wireless Communication by Dr. Ranjan Bose, IIT Delhi https://archive.nptel.ac.in/courses/117/102/117102062
4. NS3 Manual: https://www.nsnam.org/docs/manual/html/index.html
5. Omnet++ Manual: https://doc.omnetpp.org/omnetpp/manual/
6. NetSim User Manual: https://www.tetcos.com/downloads/v12/NetSim_User_Manual.pdf

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC14	Digital Signal Processing	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses		
Course Outcomes	CO1	Illustrate the concepts of Discrete Fourier transform, Fast Fourier transform and apply in system analysis.
	CO2	Design digital IIR and FIR filters to satisfy the given specifications and evaluate the frequency response.
	CO3	Interpret Finite word length Effect in Digital filter.
	CO4	Derive and analyze the frequency-domain characteristics of Multirate systems.
	CO5	Apply signal processing concepts, algorithms in applications related to the field of biomedical and speech signal processing.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Filter Design**		
	1.1	A typical real-time DSP system, Classification of discrete time signals, DFT, its computation, DIT & DIF algorithms, Radix 2 FFT.	1,2	8
	1.2	FIR filter design– Window & frequency sampling method		
	1.3	IIR filter design – Impulse invariant & Bilinear Z-transform method		
	1.4	Realization structures for FIR & IIR filters.		
2		**Finite word length effect**		
	2.1	Introduction, DSP arithmetic	1,2	8
	2.2	ADC quantization error & signal quality		
	2.3	Finite word length effects in IIR & FIR digital filter.		
3		**Multirate DSP**		
	3.1	Introduction & concept of multirate processing.	1,2	8
	3.2	Decimation, interpolation, resampling by rational fractions, Multi rate identities, Polyphase representations.		
4		**Applications of Digital Signal Processing**		
	4.1	Application of DSP for ECG signals analysis.	1,2	2
	4.2	Application of DSP for Dual Tone Multi Frequency signal.		
	4.3	Application of DSP for Radar Signal Processing.		
			Total	**26**

Sr.no	Suggested List of experiments	Ref.
1	Generation of standard test signals in signal processing	1,3
2	To calculate DFT and IDFT of a sequence.	1,3
3	Verify linearity and multiplication property of DFT	1,3
4	Design FIR filter to meet the given specification	1,3
5	Design IIR filter to meet the given specification	1,3
6	Develop IIR realization structure in DF-I, DF-II, Cascade, Parallel	1,3
7	Decimation-in-time FFT algorithm Decimation-in-Frequency FFT algorithm	1,3
8	Analysis of ECG/EEG signals	1,3
9	Add and remove ECHO from the signal.	1,3

Course Assessment:

Theory:

ISE-1:

Activity: Quiz /crossword10 Marks
Assignment 10 Marks

ISE-2:

Activity: Seminar on Research paper (IEEE) 10 Marks
DSP Innovation Idea Pitch 10 Marks

MSE: 90 minutes 30 Marks written examination based on 50% syllabus.
ESE: 90 minutes 30 Marks written examination based on remaining 50% syllabus.

Lab:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Simulation using modern tools to solve the given problem statement for 10 marks

Recommended Books:

1. J. Proakis and D. Manolakis, Digital Signal Processing, 4th Edn, Pearson Education.
2. Sanjit K Mitra "Digital Signal Processing" TMH.
3. Oppenheim A V and Sehafer R W, "Discrete Time Signal Processing",Prentice Hall (1989).
4. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, Digital Signal Processing" TataMcgraw Hill Publication First edition (2010). ISBN 978-0-07-066924-6.

5. A Nagoor Kani ―Digital Signal Processing‖, 2nd Edition. Tata Mc Graw Hill Education Private Limited.
6. Ashok Ambardar, Digital Signal Processing", Cengage Learning, 2007, ISBN: 978-81-315-0179-5.

Online Resources:

1. NPTEL link - https://onlinecourses.nptel.ac.in/noc25_ee26/preview
2. NPTEL link - https://onlinecourses.nptel.ac.in/noc25_ee77/preview

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Course Code	Course Name	Teaching Scheme (Hrs./week)			Credits Assigned			
25PEC13EC15	Analog VLSI Design	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Electronic Devices, Analog Electronics, VLSI Design	
Course Outcomes	CO1	Discuss trade-offs involved in analog VLSI Circuits.
	CO2	Demonstrate working of single stage amplifier, differential amplifier.
	CO3	Analyze the differential amplifier with active load.
	CO4	Understand the noise consideration in case of differential Amplifier
	CO5	Analyze the performance of operational Amplifier with stability and frequency response.

Module No.	Unit No.	Topics	Ref.	Hrs.
	Analog building blocks			
1	**1.1**	Need for CMOS analog and mixed signal designs, MOS Transistor as sampling switch, active resistances, current source and sinks, current mirror.	1,2	5
	1.2	Voltage References: Band Gap References, General Considerations, Supply-independent biasing,	1,2	
	1.3	Temperature independent references, PTAT current generation and Constant Gm biasing	1,2	
2	**Amplifier Fundamentals**			
	2.1	Single Stage Amplifiers: Basic concepts, Gain Bandwidth (GBW)	1,2	5
	2.2	Common-source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration)	1,2	
	2.3	Source follower, common-gate stage, cascode stage, folded cascade stage.	1,2	
3	**Differential Amplifiers**			
	3.1	Single ended and differential operation, Basic differential pair	1,2,3	6
	3.2	large signal and small signal behavior	1,2,3	
	3.3	Common-mode response, Differential pair with MOS loads.	1,2,3	
4	**Noise Consideration**			
	4.1	Statistical Characteristics of Noise, Types of Noise	2,3	5

	4.2	Representation of Noise in circuits, Noise in Single stage amplifiers (CS, CD, CG stages)	2,3	
	4.3	Noise in differential pairs, noise bandwidth, noise figure, noise temperature	2,3	
5	**MOS Operational Amplifiers**			
	5.1	Stability and Frequency Compensation: General Considerations, Multipole systems, Phase margin, Frequency compensation, compensation of two stage op- amps	1, 2	5
	5.2	Op-amp Design: General Considerations, performance parameters, One-stage op- amps, Two-stage op-amps, Gain Boosting, Common-mode feedback, Input range limitations (ICMR), Slew Rate, Power supply rejection, Noise in op-amps.	2,3	
	5.3	Design of single ended and double ended two stage Op-Amps, Data Converter Fundamentals	2,4	
			Total	**26**

Module No.	**Sr.no**	**Suggested List of experiments**	**Ref.**	**Hrs.**
1	**1**	Study analog VLSI circuits	1,2	2
	2	Analysis of MOSFETs for analog performance		2
	3	Design and simulate various types of current mirror circuits		2
	3	Design and simulate various common source amplifier circuits		2
	4	Design and simulate various types of single stage amplifiers		2
2	**5**	Design and simulate differential amplifier	1,2,3	2
	6	Design and simulate operational transconductance amplifier		2
	7	Design and simulate switch capacitor circuits		2
	8	Design and simulate various types of oscillators		2
3	**9**	Design and simulate mixed mode circuit	2,3	2
	10	Study analog VLSI circuits (Transmission Gate as Analog Switch)		2
	11	Analysis of MOSFETs for analog performance		2
	9	Design and simulate various types of current mirror circuits		2
4	**10**	Design and simulate various common source amplifier circuits	2,3	2
	11	Generate layout for the simple and cascode current mirror		2
	12	Generate layout for common source amplifier		2
5	**13**	Generate layout for the differential amplifier		2
	14	Design of One-stage op- amps		2
	15	Single Ended op-amp		2
			Total	**26**

Course Assessment:

Theory:

ISE-1:

Activity: Quiz and assignments 20 Marks

ISE-2: Two hours 20 Marks
Activity: Article Discussion, Quiz and Assignments
Outcome: Reflective Journal

MSE: 90 minutes 30 Marks written examination based on 50% syllabus
ESE: 90 minutes 30 Marks written examination based on remaining 50% syllabus

Lab:

ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
b. Simulation using modern tools to solve the given problem statement for 10 marks

Recommended Books:

1. .B Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 1st Edition.
2. .R. Jacaob Baker, Harry W. Li, David E. Boyce, "CMOS Circuit Design, Layout, and Simulation", Wiley, Student Edition
3. P. E. Allen and D. R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 3rd Edition.
4. Gray, Meyer, Lewis, Hurst, "Analysis and design of Analog Integrated Circuits", Willey,5th Edition

Online Resources:

1. Website link

   https://nptel.ac.in/courses/117/101/117101105/

   https://www.coursera.org/lecture/vlsi-cad-layout/basics-1MtuT

2. NPTEL link: https://www.google.com/search?client=firefox-b-d&q=h

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC23	Natural Language Processing	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Integral Calculus and Probability Theory, Creative coding with python, Machine Learning	
Course Outcomes	CO1	Describe the mathematical and linguistic preliminaries necessary for various processes in NLP
	CO2	Perform Word-Level analysis on a natural language
	CO3	Perform Syntax-Level analysis on a natural language
	CO4	Analyze the natural language at Semantic Level
	CO5	Explain Pragmatics in NLP
	CO6	Apply NLP techniques to design real-world NLP applications

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Natural Language Processing**	1,3	4
	1.1	The need of NLP, Levels of NLP		
	1.2	Stages in building a Natural Language Processing System		
	1.3	Challenges and ambiguities in NLP Design		
	1.4	Mathematical preliminaries required for NLP: Probability Theory, Conditional Probability and Independence, Bayes Rule, Probability Distributions, Statistics: Counting, Frequency, Mean and Variance		
2		**Word Level Analysis**	1,3	5
	2.1	Tokenization, Segmentation, Lemmatization, Edit Distance, Collocations, Porter Stemmer		
	2.2	N-gram Language Model, Evaluating N-gram Model: Perplexity, Smoothing		
	2.3	Morphological Analysis, Derivational and Reflectional Morphology		

3		**Syntax Analysis**	3,4	5
	3.1	ag set for English (Penn Tree bank), Introduction to Parts of Speech Tagging (POST), Types of POS tagging: Rule –based, stochastic and Transform based.		
	3.2	Markov Processes, Hidden Markov Models (HMM), Parts of Speech Tagging using Hidden Markov Models, Viterbi Algorithm		
4		**Semantic Analysis**	3,4	4
	4.1	Lexical Semantics, ambiguous words, word senses, Relations between senses: synonym, antonym, reversives, hyponym, hypernym, meronym, structured polysemy, metonymy, zeugma		
	4.2	Study of Various language dictionaries: WordNet (gloss, synset, sense relations in WordNet), Babelnet.		
	4.3	Cosine distance between documents.		
	4.4	Word sense disambiguation: Knowledge based approach (Lesk's Algorithm), Supervised (Naïve Bayes, Decision List), Introduction to Semi-supervised method (Yarowsky) Unsupervised (Hyperlex)		
5		**Pragmatics & Discourse Processing and Applications of NLP**	5,6	4
	5.1	Reference resolution: Discourse model, Reference Phenomenon, Syntactic and Semantic Constraints on co reference.		
6		**Applications of NLP**	1,3	4
	6.1	Applications of NLP: Machine Translation, Text Summarization, Sentiment Analysis, Named Entity Recognition, Information Retrieval, Question Answer System		
			Total	**26**

Module No.	**Sr.no**	**Suggested List of experiments**	**Ref.**
2	**1**	Preprocessing of text (Tokenization, Filtration, Lower casing, Stop Word Removal etc.)	1,2,6
2	**2**	Perform Stemming and Lemmatization on a given Text	1,2,6
3	**3**	Study different POS taggers and Perform POS tagging on the given text.	1,2,6
3	**4**	Implement N-Gram model for the given text input.	1,2,6
3	**5**	Implement Chunking and Named Entity Recognition	1,2,6
3	**6**	Implement POS tagging using HMM	1,2,6
4	**7**	To extract word senses in a given sentence using WordNet	1,2,6
4	**8**	Implement Text Similarity Recognizer for the chosen text documents (TF-IDF)	1,2,6

All Modules	**9**	Mini project implementation for real-world problems	1,2,6
	10	Mini project presentation/Group activity/ Simulation using modern tools	

Course Assessment:

Theory:

ISE-1 (20M)

a. Quiz (10M)

b. Activity based assignments (Concept map) (10 Marks)

ISE-2 (20M)

a. Activity: Article Discussion (10M)

b. Assignments (10M)

MSE: 90 Minutes 30 Marks written examination based on 50% syllabus

ESE: 90 Minutes 30 Marks written examination based on remaining syllabus after MSE

Lab:

ISE-1 (20M) will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2 (30M)

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Mini project for 10 marks

Recommended Books:

1. Daniel Jurafsky, James H. and Martin, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
2. Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
3. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
4. Daniel M Bikel and Imed Zitouni ― Multilingual natural language processing applications: from theory to practice, IBM Press, 2013.
5. Alexander Clark, Chris Fox, Shalom Lappin ― The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
6. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
7. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly, 2009

Online resources:

1. Course: Natural Language Processing By Prof. Pawan Goyal, IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc21_cs102/preview
2. Course: Applied Natural Language Processing By Prof. Ramaseshan R, CMI
   https://onlinecourses.nptel.ac.in/noc20_cs87/preview

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC24	Big Data Analytics	L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
		Examination Scheme						
			ISE1	**MSE**	**ISE2**	**ESE**	**Total**	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Basic Mathematics, Discrete mathematics, Data structures	
Course Outcomes	CO1	Apply fundamental Big Data techniques, to develop problem-solving and critical-thinking skills.
	CO2	Classify different forms of Big Data and demonstrate efficient methods for collection, storage, querying, and analysis
	CO3	Apply Hadoop, MapReduce, and NoSQL for intelligent business and scientific computing applications..
	CO4	Implement Big Data analytics techniques in real-world applications.
	CO5	Analyze business models and scientific computing paradigms while utilizing software tools for Big Data analytics.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Big Data Analytics**	1	2
	1.1	Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data a business approach		
	1.2	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.		
2		**Hadoop and NoSQL**	1	8
	2.1	Introduction to Hadoop. Core Hadoop Components, Hadoop Ecosystem-Apache HBase, Hive, HCatalog, Pig, Mahout, Oozie, Zookeeper, Sqoop, Physical Architecture, Hadoop limitations.		
	2.2	Introduction to NoSQL, NoSQL business drivers, NoSQL database case studies.		
	2.3	NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns		
	2.4	Using NoSQL to manage big data: Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems, Managing MongoDB database with CRUD operations.		
3		**MapReduce**	1 , 2	6

	3.1	MapReduce and The New Software Stack: Distributed File Systems, Physical Organization of Compute Nodes, Large Scale File-System Organization.		
	3.2	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures		
	3.3	Algorithms Using MapReduce: MapReduceWordCount Program, Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations by MapReduce, Matrix Operations, Matrix Multiplication by MapReduce.		
4		**Techniques in Big Data Analytics**	1 , 2	4
	4.1	Finding Similar Item: Nearest Neighbor Search, Similarity of Documents, Distance Measures: Euclidean, Jaccard , Cosine , Edit and Hamming Distance with its Examples		
	4.2	Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis Filtering streams: The Blooms filter.		
	4.3	Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in asearch engine, Efficient computation of Page Rank: Page Rank Implementation Using MapReduce.		
	4.4	Frequent Itemset Mining: Market-Basket Model, Apriori Algorithm, Algorithm of Park Chen-Yu.		
5		**Big Data Analytics Applications**	1,4	6
	5.1	Recommendation Systems: Introduction, A Model for Recommendation Systems: Collaborative-Filtering System, Content based system and its Examples.		
	5.2	Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs: Applying Standard Clustering Techniques, Counting triangles using MapReduce.		
			Total	**26**

Module No.	**Sr.no**	**Suggested List of experiments**	**Ref.**
1	**1**	Hadoop HDFS Practical: -HDFS Basics, Hadoop Ecosystem Tools Overview. -Installing Hadoop. -Copying File to Hadoop. -Copy from Hadoop File system and deleting file. -Moving and displaying files in HDFS.	1,5
2	**2**	To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands.	1
	3	Perform CRUD operations in MongoDB	1
3	**4**	Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc.	1

	5	Write a program to implement word count program using Map Reduce.	1,5
	6	Implement PageRank using Map-Reduce.	1,5
4	**7**	Implementing any one Clustering algorithm (K-Means/CURE) using Map-Reduce.	1,5
	8	Implement Bloom Filter using any programming language	1
5	**9**	To demonstrate use of recommendation system for movie rating prediction	1
	10	To find common friends in social network graph using Map-Reduce.	1
	11	Mini project/presentation/Group activity/ case study using modern tools	
			Total

Course Assessment:

Theory:

ISE-1: 20M

Activity: Quiz (difficulty level should be maintained)/assignments/Article discussion/Mind map

ISE-2: 20 Marks

Activity: Technical paper discussion/Debate activity/Think pair share activity etc.

MSE: 90 Minutes for 30 Marks written examination based on 50% syllabus

ESE: 90 Minutes for 30 Marks written examination based on remaining syllabus after MSE

Lab:

ISE-1 will be conducted for five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Next five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Mini Project/case study/Online course certification for 10 marks

Recommended Books

1. Radha Shankarmani and M Vijayalakshmi —Big Data Analytics‖, Wiley
2. Alex Holmes —Hadoop in Practice‖, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.

Reference Books:

4. Bill Franks, —Taming The Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley
5. Chuck Lam, —Hadoop in Action‖, Dreamtech Press

Online Resources:

1. https://www.analyticsvidhya.com/blog/2014/05/hadoop-simplified
2. https://www.analyticsvidhya.com/blog/2014/05/introduction-mapreduce/
3. https://www.pdfdrive.com/big-data-analytics-a-hands-on-approach-e158549112.html
4. https://www.pdfdrive.com/data-science-and-big-data-analytics-e58447171.html

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC25	Advanced Algorithms	L	T	P	L	T	P	**Total**
		2	--	1	2	--	1	**3**
		Examination Scheme						
			ISE1	**MSE**	**ISE2**	**ESE**	**Total**	
		Theory	20	30	20	30	100	
		Lab	20	--	30	--	50	

Pre-requisite Courses	Data structures, Discrete structures	
	At the End of the course students will be able to :	
Course Outcomes	CO1	Analyze the performance of different algorithms time and space complexity.
	CO2	Implement advanced data structures to optimize data organization and retrieval.
	CO3	Identify the appropriate data structures and design strategies to optimize a given set of problem
	CO4	Apply network algorithms to solve shortest path and max flow problems.
	CO5	Analyze NP-completeness and approximation algorithms to address NP hard problems.

Module No.	Unit No.	Topics	Ref.	Hrs
1		**Introduction to analysis of algorithm**	1,2	6
	1.1	Mathematical background for algorithm analysis, Growth of function – Big – Oh, Omega, Theta notation, Complexity derivations.		
	1.2	Solving recurrences using Substitution Method, Recursion tree method and Master method		
	1.3	Complexity Classes: P, NP, NP Hard, NP Complete		
	1.4	Amortized Analysis -Aggregate Method, Accounting Method, Potential Method		
2.		**Advanced Data structures**	1,2,3	4
	2.1	Skip Lists		
	2.2	Trees: AVL Tree, Red-Black Tree, B-tree, B+ Tree		
	2.3	Heaps: Fibonacci heaps, Binomial heap, Min Heap, Max Heap		
3.		**Divide and conquer Algorithms**	1,2	4

	3.1	Min-max algorithm Integer Multiplication. Matrix Multiplication (Strassen's algorithm) Maximal Subsequence.		
4.		**Optimization Algorithms: Greedy approach and Dynamic programming approach**	1,2	6
	4.1	Using Greedy Approach: Huffman's Codes, Activity selection problem coin change problem, Job sequencing problem		
	4.2	Using Dynamic programming approach: Activity selection problem coin change problem, Job sequencing problem, Matric chain multiplication		
5.		**Network Algorithms**	2, 4	4
	5.1	Shortest path algorithms: Bell man Ford algorithm, Floyd-Warshall algorithm.		
	5.2	Max flow : Introduction to Flow networks, Ford Fulkerson method, Max bipartite matching, Edmond-Karp maximum-flow algorithm		
6.		**NP-Completeness and Approximation Algorithms**	1, 4 ,5	2
	6.1	Polynomial time, polynomial time verification, NP-Completeness and reducibility.		
	6.2	NP-Complete problems. Approximation Algorithms – Hamiltonian cycle, Vertex cover.		
				26

List of Experiments:

Module. No	**Sr. No.**	**Suggested List of experiments**	**Ref.**
1	1	**Growth of Functions and Complexity Analysis** Problem Statement: Implement a program to compare the growth rates of different functions (e.g., constant, logarithmic, linear, quadratic, cubic, exponential) and visualize them.	**1,2**
2	2	**Skip Lists** Problem Statement: Design an efficient real-time search system for a stock market application using skip lists.	**1,2**
2	3	**AVL Tree:** Problem statement: Implement an AVL tree for efficient indexing of medical records in a hospital database system.	**1,2**
2	4	**B-Trees in Database Indexing**	**1,2**

		Problem Statement: Implement a B-tree structure to optimize database search operations in an online banking system.	
2	5	**Fibonacci Heap for Task Scheduling** Problem Statement: Implement a Fibonacci heap to optimize job scheduling for cloud-based data centers.	**1,2**
3	6	**Min-Max Algorithm in AI Game Development** Problem Statement: Implement the Min-Max algorithm for an AI-driven chess game.	**2,4**
3	7	**Strassen's Matrix Multiplication in Image Processing** Problem Statement: Use Strassen's Matrix Multiplication algorithm for fast image transformations in medical imaging.	**1,2**
3	8	**Maximum Subsequence Sum in Financial Forecasting** Problem Statement: Implement a divide-and-conquer approach to find the best stock-buying period for maximizing profit.	**1,2**
4	9	**Huffman Encoding in Data Compression** Problem Statement: Implement Huffman coding to compress text files in a file storage system.	**2,6**
4	10	**Activity Selection Problem in Event Scheduling** Problem Statement: Optimize event scheduling for an online meeting platform.	**2,6**
5	11	**Max Flow in Internet Traffic Optimization** Problem Statement: Implement Ford-Fulkerson's algorithm to optimize bandwidth allocation in cloud networks.	**4, 5**
6	12	**NP-Completeness and Approximation Algorithms** Problem Statement: Implement the Vertex Cover problem and show how it belongs to NP-complete problems.	**4,5**

Course Assessment:

Theory:

ISE-1:

Activity: Quiz - 10 Marks

Assignment on Online coding challenge on hackerrank rank - 10 Marks

ISE-2:

Activity: Article discussion /Research paper analysis - 10 Marks

Assignment - 10 Marks

MSE: 90 minutes 30 Marks written examination based on 50% syllabus

ESE: 90 Minutes 30 Marks written examination based on remaining syllabus after MSE

Recommended Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, The MIT Press, 2009.
2. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", John Wiley and Sons, 2002.
3. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill, 2009
4. R. K. Ahuja, TL Magnanti and JB Orlin, "Network flows: Theory, Algorithms, and Applications", Prentice Hall Englewood Cliffs, NJ 1993.
5. M. R. Garey and D.S. Johnson, Computers and Intractability: A Guide to the Theory of NP- Completeness, Freeman, 1979.
6. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Computer Science Press,1978.

Online References:

1. NPTEL course: https://nptel.ac.in/courses/106105164
2. Coursera link: https://www.coursera.org/specializations/algorithms
3. https://www.youtube.com/watch?v=iEm1NRyEe5c

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13E16	Internet of Things Laboratory	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes	Microcontrollers, Embedded systems	
At the end of the laboratory course, students will be able to:		
Course Outcomes	CO1	Interface various sensors to any IoT device and push data onto cloud.
	CO2	Remotely control various devices using Blynk App and Node-red environment.
	CO3	Implement IoT protocols to control devices remotely.
	CO4	Implement services like Google Assistance, Adafruit I/O, IFTTT, Firebase etc in IoT.

Experiment No.	Title	Ref.
1.	**Title: Arduino programming** Task: Interface a Sensor (temperature/proximity/optical) using Arduino board	**7,8**
2.	**Title: Porting Sensor Data to the Cloud** Task: Interfacing DHT 11 sensor to the cloud using Thingspeak	**7, O1**
3.	**Title: Controlling a device using Blynk** Task: Blinking an LED connected to NodeMCU using Blynk	**7, O2**
4.	**Title: Interfacing of a Flex Sensor to monitor the bend angle** Task: Reading data from a Flex Sensor connected to Arduino	**7,8**
5.	**Title: Understanding the Node-Red environment for IoT applications** Task: Controlling IoT devices/sensors remotely using Node-Red and Raspberry PI	**O3**
6.	**Title: Using Voice commands to control IoT devices** Task: ESP8266 Voice Control with Google Assistant (Adafruit IO and IFTTT)	**O4**
7.	**Title: Implementation of MQTT protocol** Task: Implementing Publish-Subscribe model using MQTT protocol and DHT11 sensor	**1,2**
8.	**Title: AWS IoT** Publishing sensor data from ESP32 to AWS IoT Cloud	**O5**
9.	**Title: Google Firebase**	**O6**

	Controlling LED using Android App	
10.	**Title: DIY experiment** Design and implement an IoT experiment	

Laboratory Assessment:

ISE:

1. **ISE-1** will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

2. **ISE-2**

a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Activity: Mini- Project (10 marks)

Reference Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach, Universities Press.
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw Hill Education, First Edition
3. David Hanes, Gonzalos Algueiro, "IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, Kindle 2017 Edition
4. Andrew Minteer, "Analytics for the Internet of Things (IoT)", Kindle Edition
5. Adrian McEwen, Hakim Cassimally: Designing the Internet of Things", Paperback, First Edition
6. Yashavant Kanetkar, Shrirang Korde: Paperback "21 Internet of Things (IOT) Experiments", BPB Publications
7. M.A.Mazidi, J.C.Mazidi, Rolin D. McKinlay,"The 8051 Microcontroller and Embedded Systems
8. Using Assembly and C", Pearson Education, Second Edition, 2007.
9. https://www.arduino.cc

Online Links:

1. https://thingspeak.mathworks.com
2. https://blynk.io/
3. https://nodered.org/
4. https://www.instructables.com/Home-Automation-Using-Google-Assistant-and-Adafrui/
5. https://aws.amazon.com/iot-core/features/
6. https://www.instructables.com/IoT-Using-Firebase-and-NodeMCU-and-Custom-Android-/

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned		
		L	T	P	L	T	P	Total
25PEC13EC17	Image Processing Lab	0	0	2	0	0	1	1
		Examination Scheme						
		ISE		MSE	ISE	ESE		Total
		20		--	30	--		50

Pre-requisite Course Codes	C programming	
	On successful completion of the course learner will be able to	
Course Outcomes	CO1	Implement basic image processing techniques using programming.
	CO2	Develop programs for image enhancement in spatial and frequency domains.
	CO3	Apply image compression and segmentation techniques.
	CO4	Analyze and implement morphological operations and feature extraction methods.
	CO5	Develop mini-projects on real-world applications using image processing concepts.

Exp. No.	Name of the experiment	Ref
	LIST OF SUGGESTED EXPERIMENTS	
1	Write a program to read and display images using a library (e.g., OpenCV/Matplotlib).	1, 2
2.	Perform basic operations: grayscale conversion, cropping, resizing, and flipping images.	1, 2
3	Implement histogram equalization for image enhancement.	1, 2
4	Apply spatial filters: smoothing (average filter) and sharpening (Laplacian filter).	1, 2
5	Perform Fourier Transform to enhance images in the frequency domain.	1, 2
6	Implement edge detection algorithms: Sobel, Prewitt, and Canny.	1, 2
7	Apply thresholding techniques for image segmentation (global and adaptive thresholding).	1, 2
8	Perform morphological operations: erosion, dilation, opening, and closing.	1, 2
9	Write a program to compress an image using a standard technique (e.g., Run-Length Encoding).	1, 2
10.	Perform color image processing: separate and manipulate RGB channels.	1, 2
11	Extract features from an image using edge and corner detection methods.	1, 2
12	Design and implement an application (e.g., license plate detection or face recognition).	1, 2
Mini Project: (Suggested list of Mini Project Topics)		
13	a. Develop a photo editor application with basic operations.	1,2

	b. Implement an OCR (Optical Character Recognition) system. c. Design a real-time face detection application. d. Create a histogram-based image matching application. e. Implement a medical imaging system for noise reduction and enhancement.	

Course Assessment:

Lab:

ISE:

1. ISE-1 will be conducted for four or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

2. ISE-2

a. Remaining Four experiments or 50% of experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Simulation using modern tools to solve the given problem statement for 10 marks/Mini project

Recommended Books:

1. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Digital Image Processing and Analysis: Application with MATLAB and CVIP tools, SE Umbaugh, 3rd Edition, Taylor & Francis/CRC Press, 2018

Online Resources:

1. Image Processing Tutorials: https://scikit-image.org/
2. MATLAB Image Processing Toolbox: https://www.mathworks.com/

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
25PEC13EC26	Deep Learning Laboratory	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		Creative coding with python, Machine Learning
Course Outcomes	CO1	Design and Train deep learning models for supervised learning task.
	CO2	Design and Train deep learning models for unsupervised learning task
	CO3	Design, train, and optimize deep learning models by tuning hyperparameters to improve model performance.
	CO4	Select and implement appropriate deep learning model to solve real world problem.

Exp. No.	Topic	Ref.
1	**Introduction to Python Libraries for Deep Learning:** **Objectives:** To introduce various python libraries used for DL models. **Task:** Explore python libraries for deep learning e.g. Theano, TensorFlow, pytorch etc.	**1,2**
2	**Optimization algorithms:** **Objectives:** Implementing Optimization algorithms **Task:** Apply any of the following learning algorithms to learn the parameters of the supervised single layer feed forward neural network. a. Stochastic Gradient Descent b. Mini Batch Gradient Descent c. Momentum GD d. Nestorev GD e. Adagrad GD f. Adam Learning GD	**1,2,3**
3	**Fully Connected Neural Network:** **Objectives:** To design and train Fully connected Neural networks for Image classification. **Task:** Design and implement a fully connected deep neural network for **digit classification**. Use appropriate Learning Algorithm, output function and loss function.	**1,2,3**
4	**Convolutional Neural Networks (CNNs) for Image Classification:** **Objective**: Apply CNNs for image classification tasks. **Task:** Design and implement a CNN model for image classification. Use **CIFAR-10** (images of 10 classes: airplanes, cats, etc.). Build a CNN model with: • Convolutional layers (with filters, e.g., 32 filters of size 3x3)	**1,2,3**

	• Pooling layers (max pooling) • Fully connected layers at the end • Softmax output layer **Optimization:** Use Adam optimizer and categorical cross-entropy loss function. **Evaluation:** Monitor accuracy and loss during training, and test on the validation dataset. **Experimentation:** Change the architecture of CNN for example change the number of filters and kernel sizes, the number of layers. And observe the model performance.	
5	**Transfer Learning with Pre-Trained Models:** **Objectives**: Learn how to use pertained models for transfer learning. **Task:** Use a smaller dataset (e.g., Flowers dataset with 5 classes). Classify flower species using a pre-trained models such as **VGG16, ResNet50**, or **InceptionV3** from Keras. Remove the final fully connected layers. Add a custom fully connected layer suited for your task. **Optimization:** Use fine-tuning on the last layers and train the modified model. **Evaluation:** Track accuracy on the validation dataset. **Experiment Variations**: • Freeze earlier layers and fine-tune later layers. • Compare performance with and without transfer learning.	**3,4**
6	**Time-Series Forecasting with Recurrent Neural Networks (RNNs):** **Objective**: Introduce sequence modeling with RNNs and use them for time-series forecasting. **Task:** Use Stock price data, temperature data, or any time-series dataset. Build and train an RNN/LSTM/GRU to predict future values based on historical data.	**3,4,5**
7	**Auto encoders for Dimensionality Reduction and Anomaly Detection:** **Objective**: Learn how auto encoders can be used for unsupervised tasks like anomaly detection and dimensionality reduction. **Task:** The **MNIST dataset** (or a custom dataset with normal and anomalous data). **Task**: Detect anomalous data points (e.g., outlier detection). Build an autoencoder with: • Encoder: A few convolutional or dense layers to reduce dimensionality. • Decoder: Reconstructs the input data. **Optimization**: Use **Mean Squared Error (MSE)** as the loss function. **Evaluation**: Evaluate reconstruction error. Data points with high reconstruction error can be considered anomalies. **Experiment Variations**: • Use a bottleneck layer with varying sizes. • Implement Variational Autoencoders (VAE) for generative capabilities.	**3,4,5**
8	**Generative Adversarial Networks (GANs) for Image Generation:** **Objective**: Introduce generative models, focusing on GANs, to generate new images.	**6,7**

	Task: Use the **CelebA** dataset (celebrity faces). Generate realistic-looking faces from random noise. Implement a GAN with: • A **generator** network to generate fake images from random noise. • A **discriminator** network to distinguish real vs. fake images. **Training**: Use adversarial training where both networks compete and improve simultaneously. **Evaluation**: Evaluate the quality of generated images using visual inspection or Inception Score/FID. **Experiment Variations**: • Modify the architecture of the generator and discriminator. • Try conditional GANs where the generation is conditioned on certain labels (e.g., age, gender).	
9	**Hyperparameter Tuning and Model Optimization:** **Objective**: Learn how to tune hyperparameters for better model performance. **Task:** Use **CIFAR-10** dataset. Build a neural network (MLP or CNN). 1. **Hyperparameters to tune**: o Learning rate, batch size, number of epochs. o Number of layers, units per layer, activation functions. 2. **Method**: Use **Grid Search** or **Random Search** for hyperparameter optimization. 3. **Evaluation**: Track training and validation accuracy. 4. **Experiment Variations**: o Use early stopping or learning rate decay. o Try more advanced methods like **Bayesian Optimization** or **Hyperband**.	**6,7**
10	**Attention Mechanisms and Transformer Models:** **Objective**: Explore transformer-based models and attention mechanisms in NLP tasks. **Task:** Use a **text dataset** (e.g., sentiment analysis with IMDB dataset). Classify movie reviews as positive or negative. Implement a transformer model using attention mechanisms (For example BERT). **Optimization**: Use **cross-entropy loss** and **Adam optimizer**. **Evaluation**: Evaluate accuracy, precision, recall, and F1-score. **Experiment Variations**: • Try pre-trained transformer models (like BERT or GPT). • Fine-tune a pre-trained model on your specific task.	**7,8**
11	**Mini Project:** **Task:** Defining the problem statement and objectives. Select, implement and train a suitable deep learning model to solve the real world problem. Evaluate the model based on suitable evaluation metrics. Interpret the results to understand how well the model addresses the problem. **Mini Project based on the content of the syllabus (Group of 2-3 students)**	

Course Assessment:

ISE-1 (20M)

will be evaluated based on (40-50%) experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2 (30M)

- will be evaluated for remaining experiments. Continuous pre-defined rubrics-based evaluation for 20 marks,
- Mini project for 10 marks

Recommended Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. ―Deep Learning, MIT Press Ltd, 2016
2. Li Deng and Dong Yu, ―Deep Learning Methods and Applications, Publishers Inc.,2013.
3. Satish Kumar "Neural Networks A Classroom Approach", Tata McGraw-Hill, 2nd Edition.
4. Deep Learning from Scratch: Building with Python from First Principles- Seth Weidman by O`Reilley
5. François Chollet. ―Deep learning with Python ―(Vol. 361). 2018 New York: Manning.
6. Douwe Osinga. ―Deep Learning Cookbook, O'REILLY, SPD Publishers, Delhi.
7. M. J. Kochenderfer, Tim A. Wheeler. ―Algorithms for Optimization, MIT Press.
8. Learning Deep Learning: Theory and Practice of Neural Networks, Computer Vision, NLP, and Transformers using TensorFlow, Magnus Ekman, Released August 2021, Addison-Wesley Professional

Online Repository:

1. DeepLearning.AI Coursera: https://www.coursera.org/specializations/deep-learning
2. NPTEL course on Deep Learning: https://onlinecourses.nptel.ac.in/noc20_cs62/preview
3. https://keras.io/
4. https://stanford.edu/~shervine/teaching/cs-230/cheatsheet-recurrent-neuralnetworks
5. https://keras.io/examples/vision/autoencoder/
6. https://stanford.edu/~shervine/teaching/cs-230/cheatsheet-convolutional-neuralnetworks

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
25PEC13EC27	Software Testing and Quality Assurance Lab	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes	Software Engineering	
At the end of the laboratory course, students will be able to:		
Course Outcomes	CO1	Demonstrate an understanding of fundamental software testing concepts, differentiate between effective and exhaustive testing strategies.
	CO2	Analyze software requirements to find testable components and create effective test strategies.
	CO3	Identify and formulate test scenarios based on software requirements, use cases, and risk analysis to ensure comprehensive test coverage.
	CO4	Apply white box and black box testing techniques for structural and functional testing
	CO5	Apply Quality Assurance principles, processes, and methodologies to ensure software reliability.

Experiment No	Title	Ref.
1	Concepts of software testing, Exhaustive testing	1,2
2	Requirement analysis for testing	1,2
3	Identifying test scenarios	1,2
4	Black box techniques – Equivalence partitioning	1,2
5	Black box techniques – Boundary value analysis	1,2
6	Black box techniques – Decision table	1,2
7	Black box techniques – Cause effect graphing	1,2
8	Black box techniques – Error guessing	1,2
9	White box techniques – Statement and decision coverage	1,2
10	White box techniques – Basis path testing	1,2
11	White box techniques – Loop testing	1,2
12	STLC – perform all activities in STLC	1,2
13	Quality Assurance – activities for QA review, checklist, training	1,2

Laboratory Assessment:

ISE1: ISE-1 will be conducted for 6 experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2: ISE2 will be conducted for 6 experiments. Continuous pre-defined rubrics-based evaluation for 30 marks.

Recommended Books:

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher Education

2. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy, Wiley Publication

3. Effective Methods for Software Testing, third edition by Willam E. Perry, Wiley Publication

4. Software Testing Concepts and Tools by Nageswara Rao Pusuluri, Dreamtech press

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050

(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
MDM04	Public Relations and Corporate Communication (Semester-VI)	2	--	--	2	--	--	2
		Examination Scheme						
		ISE1	ISE2		ESE		Total	
		50	50		----		100	

Pre-requisite Course Codes	SLRW Skills	
Course Outcomes	CO1	Develop professional communication skills through training and practice
	CO2	Draft professional documents with precision
	COs3	Develop effective communication strategies for diverse, cultural and global business environment

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Professional Communication Skills**	1,3	8
	1.1	Resume Writing & Cover Letter for Employment		
	1.2	Group Discussion		
	1.3	Formal dressing		
	1.4	Communication – language and articulation		
	1.5	Interview Techniques		
	1.6	Formal email writing		
2		**Synergy Communication**	4	6
	2.1	Presentation Skills – creating and delivering presentations		
	2.2	Report Writing- Importance, Objective, type – versioning and storage		
	2.3	Meetings and Documentation: Notice, Agenda, Minutes		
	2.4	Phone and video communication		
3		**Cross-Cultural Communication**	2,4	6
	3.1	Cultural awareness		
	3.2	Language barriers		
	3.3	Global communication strategies		
	3.4	Corporate etiquettes		
4		**Corporate Identity and Branding**	5	6
	4.1	Corporate image and reputation		
	4.2	Branding strategies		
	4.3	Visual identity		
	4.4	Messaging and tone		
	4/5	Cultural context of branding		
			Total	**26**

Assessment:

Sr. No.	List of Written and Oral Assignments	ISE	Marks
1	Resume/ Cover Letter	ISE1	10
2	GD Practices		10
3	Mock Interview HR Question		10
4	Team Building Activity		10
5	Notice & Agenda and Minutes of the Meeting		10
6	Formal presentation	ISE2	10
7	GD Practices		20
8	Mock Interview HR Question		20
	Total (Average)		100

Recommended Textbooks:

1. Dr. K.Alex, Soft Skills- Know Yourself & know the World, S.Chand
2. John Hayes, Interpersonal Skills at Work, McGraw Hill Education
3. Ankur Malhotra,Campus Placement: A Comprehensive Guide, McGraw Hill Education
4. Meenakshi Raman,Sangeeta Sharma, Communication Skills, Oxford, India
5. Courtland L. Bovee, Business Communication Today, Pearson

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned		
		L	T	P	L	T	P	Total
25VSE13EC04	Data Acquisition and Processing	0	0	2	0	0	1	1
		Examination Scheme						
		ISE 1		MSE	ISE 2	ESE		Total
		20		--	30	--		50

Pre-requisite Course Codes	Control Systems	
	On successful completion of the course learner will be able to	
Course Outcomes	CO1	Understanding the characteristics of Sensors and Transducer characteristics.
	CO2	Design and Implement signal conditioning circuit.
	CO3	Demonstrate the working of Sample and Hold Circuit and Data Converters.
	CO4	Differentiate among various types of Data Acquisition Systems.
	CO5	Understand the significance of Virtual Instrumentation in DAS.

Exp. No.	Name of the experiment	Ref
	Sensors and Transducers	
1.	Draw the characteristics of the Linear Transducer (Thermistor/ RTD/ Strain Gauge etc.)	1,2,3
2.	Digital Transducer working (Speed measurement, Shaft Encoder)	1,2,3
	Signal Conditioning Circuits	
3.	Design of Instrumentation Amplifier	1,2,3
4.	Design of 4-20 mA current loop in measurement.	1,2,3
	Data Converters	
5.	Dual Slope A/D converter working	1,2,3
6.	SAR Type 3-bit A/D Converters	1,2,3
7.	2-bit Flash type A/D Converter.	1,2,3
8	D/A converter: 3-bit Weightage and R/2R type	1,2,3
	Data Acquisition Systems	
9	Single Channel DAS	1,2,3
10.	Multiple Channel DAS system	1,2,3
11	Data Logger	1,2,3
	LabVIEW based DAS system	
12	VISA Demonstration to handle Analog inputs	1,2,3
13	DAQ demonstration	1,2,3

Course Assessment:

ISE-1

b. For first Eight experiments, Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2

a. Remaining 5 experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

b. Mini project for 10 marks.

Recommended Books:

1. Process Instrumentation By A/ K Shawney
2. Instrumentation by W. D. Cooper
3. Instrumentation by Rangan Sharma

Online Resources:

3. www.ni.com
4. NPTEL link

Further Reading:

1. Instrumentation Handbook Vol. 1 and 2 By Liptak

2. Virtual Instrumentation Manual