SRI SHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

(AN AUTONOMOUS INSTITUTE)

COIMBATORE – 641 062

REGULATIONS 2021- CURRICULUM AND SYLLABUS

M.E - COMPUTER SCIENCE AND ENGINEERING

SEMESTER – I

Sem	Course code	Course Title	Category	Contact Periods	L	T	P	C
I	21MS102	Applied Mathematics For Computer Science Engineers	BS	4	3	1	0	4
I	21CP101	Distributed Operating System	PC	5	3	0	2	4
I	21CP113	Distributed Operating System Laboratory	PC	2	0	0	2	1
I	21CP102	Network Management	PC	5	3	0	2	4
I	21CP114	Network Management Laboratory	PC	2	0	0	2	1
I	21CP103	Advanced Data Structures and Algorithms	PC	5	3	0	2	4
I	21CP115	Advanced Data Structures and Algorithms Laboratory	PC	2	0	0	2	1
I	21CP104	Agile Software Engineering	PC	5	3	0	2	4
I	21CP116	Agile Software Engineering Laboratory	PC	2	0	0	2	1
I	21CP111	Project I	EEC	4	2	0	2	3
I	21CP112	Technical Seminar I	EEC	2	0	0	2	1
I	21AC101	Research Paper Writing	HS	2	0	0	0	2
Total Credits (Semester)								**24**

SEMESTER – II

Sem	Course code	Course Title	Category	Contact Periods	L	T	P	C
II	21CP201	Internet of Things	PC	5	3	0	2	4
II	21CP202	Machine Learning	PC	5	3	0	2	4
II	21CP203	Database Technology	PC	5	3	0	2	4
II	21CP201	Research Methodology	PC	3	3	0	0	3
II	21PCP02	Software Quality Assurance and Testing (PE1)	PE	4	2	0	2	3
II	21CP211	Project II	EEC	4	2	0	2	3
II	21CP212	Technical Seminar II	EEC	2	0	0	2	1
II	21CP213	Internet of Things Laboratory	PC	2	0	0	2	1
II	21CP214	Machine Learning Laboratory	PC	2	0	0	2	1
II	21CP215	Database Technology Laboratory	PC	2	0	0	2	1
II	21AC201	Disaster Management	HS	2	0	0	0	0
Total Credits (Semester)								**22**

SEMESTER – III

Sem	Course code	Course Title	Category	Contact Periods	L	T	P	C
III	21PCP06	Advanced Soft Computing(PE2)	PE	4	2	0	2	3
III	21PCP11	Software Defined Networks(PE3)	PE	4	2	0	2	3
III	21PCP16	Information Security and Cyber Forensics(PE4)	PE	4	2	0	2	3
III	21CP311	Dissertation-I	EEC	12	0	0	12	6
Total Credits (Semester)								**15**

SEMESTER – IV

Sem	Course code	Course Title	Category	Contact Periods	L	T	P	C
IV	21CP411	Dissertation-II	EEC	36	0	0	24	12
Total Credits(Semester)								**12**
Total Credits)								**73**

PROFESSIONAL ELECTIVES								
S.No	**Course code**	**Course Title**	**Cate gory**	**Contact Periods**	**L**	**T**	**P**	**C**
ELECTIVE 1								
1	21PCP01	Cloud Services and Virtualization	PE	4	2	0	2	3
2	21PCP02	Software Quality Assurance and Testing	PE	4	2	0	2	3
3	21PVD16	Digital Image Processing	PE	4	2	0	2	3
4	21PCP04	Artificial Intelligence	PE	4	2	0	2	3
ELECTIVE 2								
1	21PCP05	Video Analytics	PE	4	2	0	2	3
2	21PCP06	Advanced Soft Computing	PE	4	2	0	2	3
3	21PCP07	Semantic Web Technology	PE	4	2	0	2	3
4	21PCP08	Parallel Computer Architecture	PE	4	2	0	2	3
ELECTIVE 3								
1	21PCP09	Advances in Storage Area Networks	PE	4	2	0	2	3
2	21PCP10	Natural Language Processing	PE	4	2	0	2	3
3	21PCP11	Software Defined Networks	PE	4	2	0	2	3
4	21PCP12	Embedded Computing Systems	PE	4	2	0	2	3
ELECTIVE 4								
1	21PCP13	Applied Graph Theory	PE	4	2	0	2	3
2	21PCP14	Software Architecture and Design Patterns	PE	4	2	0	2	3
3	21PCP15	NoSQL Database	PE	4	2	0	2	3
4	21PCP16	Information Security And Cyber Forensics	PC	4	2	0	2	3

21MS102	APPLIED MATHEMATICS FOR COMPUTER SCIENCE ENGINEERS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

This course is designed to enrich the knowledge in various advanced mathematical techniques such as Logic and Proofs, Graph Theory, Two Dimensional Random Variables, Testing of hypothesis, and Multivariate analysis for solving the applications of computer and information sciences.

PRE-REQUISITES:

- Basic concepts of Logics
- Basic concepts of Graphs
- Basic concepts of Random Variables & Statistics
- Basic concepts of Matrices

THEORY COMPONENT CONTENTS:

UNIT I	**LOGIC AND PROOFS**	**12**

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

UNIT II	**GRAPH THEORY**	**12**

Graph Isomorphism – Planar graphs – Hamilton paths and Cycles – Travelling Salesman Problem - Graph colouring and chromatic polynomials.

UNIT III	**TWO DIMENSIONAL RANDOM VARIABLES**	**12**

Joint Distribution - Discrete and continuous distributions - Marginal and Conditional Distributions - Covariance – Correlation – Regression.

UNIT IV	**TESTING OF HYPOTHESIS**	**12**

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on t, Chi square and F distributions for testing of mean, variance – Tests for independence of attributes and goodness of fit.

UNIT V	**MULTIVARIATE ANALYSIS**	**12**

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.

Theory:50	**Tutorial: 10**	**Practical: 0**	**Total:60 Hours**

COURSE OUTCOMES:

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

CO1 :	Apply the concepts needed to test the logic of a program.
CO2 :	Solve the various problems involving graphs.
CO3 :	Apply the concepts of Correlation and Regression
CO4 :	Identify the statistical tests in data Analysis

CO5 :	Perform exploratory analysis of multivariate data, such as multivariate normal density, Calculating descriptive statistics, testing for multivariate normality.

CO/PO MAPPING(S/M/W indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	1	2
CO2	3	2	2	1	2
CO3	3	2	2	1	2
CO4	3	2	2	1	2
CO5	3	2	2	1	2

REFERENCE BOOKS:

R1:	Kenneth H Rosen, —Discrete Mathematics and its Applications‖, Tata McGraw Hill, New Delhi, 2013.
R2 :	Grimaldi R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, Addison Wesley, 1994.
R3 :	Johnson R.A, Miller & Freund's Probability and Statistics for Engineers , Pearson Education,Delhi, 2009 .
R4 :	T.Veerarajan: “Probability, Statistics and Random Process“,3rd Edition,Tata Mc-Graw Hill Co.,2016.
R5 :	Richard A. Johnson and Dean W. Wichern, —Applied Multivariate Statistical Analysis‖,5th Edition, Pearson Education, Asia, 2002.

21CP101	DISTRIBUTED OPERATING SYSTEM	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To examine the fundamental principles of distributed operating systems
- To provide hands-on experiences in developing suitable algorithms for distributed system
- To emphasis on OS resource security and protection and database operating system

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	DISTRIBUTED OPERATING SYSTEMS	9

Overview: Synchronization Mechanisms-Architectures of Distributed Systems-Theoretical Foundations. Distributed Mutual Exclusion: Preliminaries-A Simple solution to distributed mutual exclusion-Non-Token Based Algorithm-Lamport's Algorithm-Ricart Agrawala algorithm Distributed Deadlock detection-Agreement Protocols: System Model- Classification of Agreement Problem-solution to byzantine agreement problem.

UNIT II	DISTRIBUTED RESOURCE MANAGEMENT	9

Distributed File Systems: Architecture-Mechanisms for building distributed file systems. Distributed Shared memory: Algorithms for implementing DSM-Memory Coherence- Coherence protocols. Distributed Scheduling: Issues in Load distribution-Components of load distributing algorithm-Load distributing algorithms.

UNIT III	FAULT TOLERANCE	9

Failure Recovery and Fault Tolerance-Recovery: Classification of Failures-Backward and forward error recovery-recovery in concurrent systems-Check pointing. Fault Tolerance: Commit protocols-nonblocking commit protocols-voting protocols-dynamic voting protocols- Failure resilient processes.

UNIT IV	PROTECTION AND SECURITY	9

Protection and Security-Resource Security and protection: Introduction-Preliminaries-Access Matrix Model-Implementation of Access Matrix-safety in Access matrix model. Multiprocessor Operating systems-Multiprocessor System Architectures.

UNIT V	DATABASE OPERATING SYSTEMS	9

Introduction to Database Operating systems-Concurrency Control-Theoretical Aspects- Concurrency Control Algorithms – Basic synchronization primitives-lock based algorithms- Timestamp based algorithms.

COURSE OUTCOMES:

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

CO1 :	Understand the basic foundation in the design of advanced operating systems
CO2 :	Devise algorithms for distributed file systems, distributed shared memory and distributed scheduling.
CO3 :	Assess the basis of the design of advanced operating systems such as failure recovery and fault tolerance
CO4 :	Find the solutions for the problems encountered in the design of advanced operating systems
CO5 :	Analyse algorithms for database operating systems

CO/PO MAPPING(S/M/W indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3		2		
CO2	2		2		
CO3	2	2	2		
CO4		3	2	2	2
CO5				2	2

REFERENCE BOOKS:

R1 :	Mukesh Singhal, Niranjan G.Shivaratri, Advanced Concepts in Operating Systems, "Distributed Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001. ISBN: 0-07- 047268-8.
R2 :	Pradeep K. Sinha,"Distributed Operating Systems Concepts and Design", Prentice-Hall of India, 2005, ISBN: 81-203-1380-1
R3 :	Mary Gorman, Todd Stubbs, "Introduction to Operating Systems: Advanced Course, Course Technology", 2001. ISBN: 0619059443.
R4 :	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne,"Operating System Principles", John Wiley and Sons, Seventh Edition, 2006. ISBN: 9812-53-176-9

LAB COMPONENT CONTENTS:

1.	Design and Develop a UNIX/LINUX shell program that should support at least 10 commands (Assume suitable application).
2.	Design a front-end application upon click of a button corresponding shell command should be executed.
3.	Design and develop a program to implement lazy buddy system algorithm.
4.	Write a multi-class multithreaded program that simulates multiple sleeping barbers, all in one barbershop that has a finite number of chairs in the waiting room. Each customer is instantiated from a single customer class; each barber is instantiated from a single Barber class.
5.	Create two process and demonstrate the usage of Shared segment by the above processes (use shmget, signal, fork etc. to simulate the working environment of the program).
6.	Design and develop a program to realize the virus classification, such as boot sector infector, file infector and macro.

Theory:45	**Tutorial:0**	**Practical:30**	**Total:75 Hours**

21CP102	NETWORK MANAGEMENT	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Define parallel and distributed databases and its applications.
- Show applications of Object Oriented database
- Explain basic concepts, principles of intelligent databases.
- Utilize the advanced topics of data warehousing and mining.
- Infer emerging and advanced data models
- Extend knowledge in research topics of databases.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	FOUNDATIONS OF NETWORKING	9

Communication Networks – Network Elements – Switched Networks and Shared media Networks – Probabilistic Model and Deterministic Model – Datagrams and Virtual Circuits – Multiplexing – Switching - Error and Flow Control – Congestion Control – Layered Architecture – Network Externalities – Service Integration – Modern Applications

UNIT II	QUALITY OF SERVICE	9

Traffic Characteristics and Descriptors – Quality of Service and Metrics – Best Effort model and Guaranteed Service Model – Limitations of IP networks – Scheduling and Dropping policies for BE and GS models – Traffic Shaping algorithms – End to End solutions – Laissez Faire Approach – Possible improvements in TCP – Significance of UDP in inelastic traffic

UNIT III	HIGH PERFORMANCE NETWORKS	9

Integrated Services Architecture – Components and Services – Differentiated Services Networks – Per Hop Behavior – Admission Control – MPLS Networks – Principles and Mechanisms – Label Stacking – RSVP – RTP/RTCP

UNIT IV	HIGH SPEED NETWORKS	9

Optical links – WDM systems – Optical Cross Connects – Optical paths and Networks – Principles of ATM Networks – B-ISDN/ATM REFERENCE BOOKS Model – ATM Header Structure – ATM Adaptation Layer – Management and Control – Service Categories and Traffic descriptors in ATM networks

UNIT V	NETWORK MANAGEMENT	9

ICMP the Forerunner – Monitoring and Control – Network Management Systems – Abstract Syntax Notation – CMIP – SNMP Communication Model – SNMP MIB Group – Functional Model – Major changes in SNMPv2 and SNMPv3 – Remote monitoring – RMON SMI and MIB

COURSE OUTCOMES:

At the end of the course students should be able to	
CO1 :	Outline the various protocols and models in networks
CO2 :	Analyze the operations and features network protocols in providing QoS.
CO3 :	Interpret the operation of high performance and high speed networks and explain how they support communications.
CO4 :	Develop and Analyse simple computer networks.
CO5 :	Identify and solve network-engineering problem.

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3		2		
CO2	2		2		
CO3	2	2	2		
CO4		3	2	2	2
CO5				2	2

REFERENCE BOOKS:

R1 :	Mahbub Hassan and Raj Jain, 'High Performance TCP/IP Networking', Pearson Education, 2004.
R2 :	Larry L Peterson and Bruce S Davie, 'Computer Networks: A Systems Approach', Fourth Edition, Morgan Kaufman Publishers, 2007.
R3 :	Jean Warland and PravinVareya, 'High Performance Networks', Morgan Kauffman Publishers, 2002
R4 :	William Stallings, 'High Speed Networks: Performance and Quality of Service', 2nd Edition, Pearson Education, 2002.
R5 :	Mani Subramaniam, 'Network Management: Principles and Practices', Pearson Education, 2000
R6 :	Kasera and Seth, 'ATM Networks: Concepts and Protocols', Tata McGraw Hill, 2002.

LAB COMPONENT CONTENTS:

Implementation of	
1.	Congestion Control
2.	Traffic Shaping algorithms
3.	RSVP
4.	Case study on ATM networks
5.	Comparison study on SNMP,SNMPv2 and SNMPv3

Theory:45	**Tutorial:0**	**Practical:30**	**Total:75 Hours**

21CP115	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To extend the students' knowledge of algorithms and data structures, and to enhance their expertise in algorithmic analysis and algorithm design techniques.
- Expected to learn a variety of useful algorithms and techniques and extrapolate from them in order to then apply those algorithms and techniques to solve problems

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNI I	FUNDAMENTALS	9

Mathematical Proof Techniques: Induction, proof by contradiction-direct proofs - Asymptotic Notations – Properties of Big-oh Notation –Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis. Introduction to NP-Completeness/NP-Hard – Recurrence Equations – Solving Recurrence Equations – Time-Space Tradeoff.

UNIT II	HEAP STRUCTURES	9

Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy Binomial Heaps.

UNIT III	SEARCH STRUCTURES	9

Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries.

UNIT IV	GEOMETRIC ALGORITHMS	9

Segment Trees – 1-Dimensional Range Searching - k-d Trees – Line Segment Intersection - Convex Hulls - Computing the Overlay of Two Subdivisions - Range Trees - Voronoi Diagram.

UNIT V	PARALLEL ALGORITHMS	9

Flynn's Classifications – List Ranking – Prefix computation – Array Max – Sorting on EREW PRAM – Sorting on Mesh and Butterfly – Prefix sum on Mesh and Butterfly – Sum on mesh and butterfly – Matrix Multiplication – Data Distribution on EREW-Mesh and Butterfly.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1 :	Basic ability to analyse algorithms and to determine algorithm correctness and time efficiency class.
CO2 :	Master a variety of advanced data structures and their implementations.
CO3 :	Master different algorithm design techniques in computational geometry and in parallel algorithms.
CO4 :	Ability to apply and implement learned algorithm design techniques and data structures to solve problems
CO5 :	Ability to use and apply search strategies in real world problems.

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3		2	3	
CO2	2	2	3		
CO3	2	2	3		
CO4	2	2		2	3
CO5				2	3

REFERENCE BOOKS:

R1 :	E. Horowitz, S. Sahni and Dinesh Mehta, "Fundamentals of Data structures in C++", University Press, 2007.
R2 :	G. Brassard and P. Bratley, "Algorithmics, Theory and Practice", Printice –Hall, 1988.
R3 :	Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars,"Computational Geometry Algorithms and Applications", Third Edition, 2008.
R4 :	James A. Storer, "An Introduction to Data Structures and Algorithms", Springer, New York, 2002.
R5 :	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 2009.

LAB COMPONENT CONTENTS:

1.	Linked lists
2.	Multistacks
3.	Double Ended Queue (Deques) & Circular Queues
4.	Min Heap
5.	Deaps
6.	Leftist Heap
7.	AVL Tree
8.	B:Tree
9.	Quick Sort
10.	Greedy algorithm
11.	Knapsack using Dynamic Programming
12.	Graph coloring using backtracking

Theory:45	**Tutorial:0**	**Practical:30**	**Total:75 Hours**

21CP104	AGILE SOFTWARE ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Agile Development training course will give an understanding of what Agility means, when and why to employ Agile development, the pitfalls, issues and common mistakes to watch out for, and will cover key methodologies including Scrum and Kanban.
- We will also cover approaches, tools and scenarios to introduce Agile to your organization effectively.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	FUNDAMENTALS OF AGILE	9

The Genesis of Agile-Introduction and background-Agile Manifesto and Principles. Overview of Scrum-Extreme Programming-Feature Driven development-Lean Software Development-Agile project management-Design and development practices in Agile projects- Test Driven Development-Continuous Integration-Refactoring-Pair Programming- Simple Design-User Stories-Agile Testing-Agile Tools.

UNIT II	AGILE SCRUM FRAMEWORK	9

Introduction to Scrum-Project phases-Agile Estimation-Planning game-Product backlog- Sprint backlog-Iteration planning-User story definition-Characteristics and content of user stories-Acceptance tests and Verifying stories-Project velocity-Burn down chart. Sprint planning and retrospective: Daily scrum, Scrum roles – Product Owner-Scrum Master-Scrum Team, Scrum case study-Tools for Agile project management.

UNIT III	AGILE TESTING	9

The Agile lifecycle and its impact on testing: Test-Driven Development (TDD) -Unit framework and tools for TDD- Testing user stories - acceptance tests and scenarios. Planning and managing testing cycle: Exploratory testing-Risk based testing-Regression tests-Test Automation- Tools to support the Agile tester

UNIT IV	AGILE SOFTWARE DESIGN AND DEVELOPMENT	9

Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control

UNIT V	INDUSTRY TRENDS	9

Market scenario and adoption of Agile-Agile ALM-Roles in an Agile project-Agile applicability-Agile in Distributed teams-Business benefits-Challenges in Agile, Risks and Mitigation-Agile projects on Cloud-Balancing Agility with Discipline- Agile rapid development technologies.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1 :	Articulate the agile principles, practices, and roles of Scrum.

CO2 :	Perform Scrum Release Planning, and Scrum Sprint Planning.
CO3 :	Deconstruct user stories into tasks and ideal day estimates.
CO4 :	End a Sprint with Sprint Reviews and Sprint Retrospectives
CO5 :	Use Scrum with multiple, or distributed, project teams.

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2	2		2		
CO3			2	2	3
CO4		2		2	
CO5				2	3

REFERENCE BOOKS:

R1 :	Ken Schawber, Mike Beedle, “Agile Software Development with Scrum”, Publisher: Pearson.
R2 :	Lisa Crispin, Janet Gregory, “Agile Testing: A Practical Guide for Testers and Agile Teams”, Publisher: Addison Wesley.
R3 :	Robert C. Martin,“Agile Software Development, Principles, Patterns and Practices”, Publisher: Prentice Hall
R4 :	Alistair Cockburn, “Agile Software Development: The Cooperative Game”, Publisher: Addison Wesley.
R5 :	David J. Anderson and Eli Schragenheim,”Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results”, Prentice Hall, 2003.
R6 :	Hazza and Dubinsky,”Agile Software Engineering”, Series: Undergraduate Topics in Computer Science, Springer, 2009.

LAB COMPONENT CONTENTS

1.	Team Work- Implementation of Mini project using agile model.

Theory:45	**Tutorial:0**	**Practical:30**	**Total:75 Hours**

21CP201	INTERNET OF THINGS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- The purpose of this course is to impart knowledge on IoT Architecture and various protocols, study their implementations

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	OVERVIEW	9

IoT-An Architectural Overview: Building an architecture-Main design principles and needed capabilities-An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals: Devices and gateways-Local and wide area networking-Data management. Arduino vs Raspberry Pi vs Electric Imp – Key features and comparisons Arduino Interfaces – Arduino IDE - Programming

UNIT II	REFERENCE ARCHITECTURE	9

IoT Architecture: State of the Art-Introduction-State of the art-Reference Model and architecture-IoT reference Model: IoT Reference Architecture- Introduction-Functional View- Information View-Deployment and Operational View-Other Relevant architectural views. Real-World Design Constraints: Introduction-Technical Design constraints-hardware-Data representation and visualization-Interaction and remote control.

UNIT III	IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS	9

PHY/MACLayer: 3GPP-MTC-IEEE 802.11-IEEE 802.15- Wireless HART-ZWave-Bluetooth-Zigbee Smart Energy-DASH7.Network Layer: IPv4-IPv6-6LoWPAN- 6TiSCH-DHCP-ICMP-RPL-CORPL-CARP.

UNIT IV	TRANSPORT & SESSION LAYER PROTOCOLS	9

Transport Layer:TCP-MPTCP-UDP-DCCP-SCTP-TLS-DTLS.Session Layer:CoAP- XMPP-AMQP- MQTT

UNIT V	SERVICE LAYER PROTOCOLS & SECURITY	9

Service Layer -oneM2M-ETSI M2M-OMA-BBF – Security in IoT Protocols :MAC 802.15.4 , 6LoWPAN.Application Layer.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1:	To Understand the Architectural Overview of IoT
CO2:	To Understand the IoT Reference Architecture and Real World Design Constraints
CO3:	To understand a design of different layers.
CO4:	To choose and apply protocol for real world scenarios.
CO5:	Apply the security mechanism on IoT real time applications

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2		2		
CO2				2	2
CO3	2		2		
CO4		2		2	2
CO5					3

REFERENCE BOOKS	
R1:	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
R2:	Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
R3:	Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
R4:	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
R5:	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", 1st Edition, VPT, 2014.

LAB COMPONENT CONTENTS :	
Arduino/Raspberry Pi Programming	
1.	Basic Arduino Programming
2.	Controlling LED with Arduino
3.	Working with sensors and actuators
4.	Serial Port Programming
5.	Interfacing Arduino with modules and Shields
6.	Interfacing with Camera, SMTP, HTTP

Theory:45	**Tutorial:0**	**Practical:30**	**Total:75 Hours**

21CP202	MACHINE LEARNING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the concepts of machine learning
- To appreciate supervised and unsupervised learning and their applications
- To understand the theoretical and practical aspects of Probabilistic Graphical Models
- To appreciate the concepts and algorithms of reinforcement learning
- To learn aspects of computational learning theory

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	SUPERVISED LEARNING	9

Definition of Machine Learning - Examples of Machine Learning Applications. SUPERVISED LEARNING:Learning a Class from Examples - VC Dimension - PAC Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization - Dimensions of a Supervised Machine Learning Algorithm. Dimensionality Reduction: Introduction - Subset Selection - PCA - FA - MDS - LDA - Isomap - Locally linear Embedding.

UNIT II	MULTILAYER PERCEPTRONS	9

Introduction - The Perceptron - Training a Perceptron - Learning Boolean Functions - Multilayer Perceptrons - MLP as a Universal Approximator - Backpropagation Algorithm - Training Procedures - Tuning the Network Size - Dimensionality Reduction - Learning Time.

UNIT III	KERNEL MACHINES	9

Separating Hyperplane - Soft Margin Hyperplane – v-SVM - Kernel Trick - Vectorial Kernels - Defining Kernels - Multiple Kernel Learning - Multiclass Kernel Machines - One class Kernel Machines - Kernel Dimensionality Reduction.

UNIT IV	HIDDEN MARKOV MODELS	9

Introduction - Discrete Markov Processes - HMM - Basic Problems of HMMs - Evaluation Problem - Finding the State Sequence - Learning Model Parameters - Continuous Observations - The HMM with Input - Model Selection in HMM.

UNIT V	REINFORCEMENT LEARNING	9

Introduction - Single State Case-Elements of Reinforcement Learning - Model-Based Learning - Temporal Difference Learning - Generalization - Partially Observable States. Design of Machine Learning Experiments: Introduction - Factors, Response, and Strategy of Experimentation - Response Surface Design - Randomization, Replication, and Blocking - Guidelines for Machine Learning Experiments.

COURSE OUTCOMES:

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

CO1:	To implement a neural network for an application using an available tool
CO2:	To implement and analyse probabilistic discriminative and generative algorithms for real time applications.
CO3:	To use a tool to implement typical clustering algorithms for different types of applications
CO4:	To design and implement an HMM for a sequence model type of application
CO5:	To identify applications for different types of machine learning with suitable justification

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2		2		
CO2				2	2
CO3		2	2		
CO4		2	2		
CO5		2	2		

REFERENCE BOOKS:	
R1:	Etham Alpaydin, "Introduction to Machine Learning", The MIT Press, Cambridge, 2010.
R2:	Drew Conway and John Myles White, "Machine Learning for Hackers", O"Reilly, USA, 2012.
R3:	Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, Heidelberg, 2006.
R4:	Tom M Mitchell, "Machine Learning", Mc-Graw Hill, New York, 1997.
R5:	Kevin P Murphy, "Machine Learning A Probabilistic Perspective", The MIT Press, Cambridge, 2012

LAB COMPONENT CONTENTS:	
1.	Naive Bayes learner.
2.	Decision Tree learners.
3.	Perform 5-fold cross-validation. (You need to choose the appropriate options for missing values).
4.	Estimate the precision, recall, accuracy, and F-measure of the decision tree classifier on the text classification task for each of the 10 categories using 10-fold cross-validation.
5.	Develop the prediction Model for movies rating,
6.	Develop the prediction Model using K-means algorithm
7.	Develop the Reinforcement Learning

Theory:45	**Tutorial:0**	**Practical:30**	**Total:75 Hours**

21CP203	DATABASE TECHNOLOGY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Define parallel and distributed databases and its applications.
- Show applications of Object Oriented database
- Explain basic concepts, principles of intelligent databases.
- Utilize the advanced topics of data warehousing and mining.
- Infer emerging and advanced data models
- Extend knowledge in research topics of databases.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	REVIEW OF RELATIONAL DATA MODEL AND RELATIONAL DATABASE CONSTRAINTS	9

Relational model concepts: Relational model constraints and relational database schemas- Update operations-anomalies, dealing with constraint violations-Types and violations. Overview of Object Oriented Concepts: Objects-Basic properties-Advantages-Abstract data types-Encapsulation-class hierarchies-polymorphism-examples.

UNIT II	OBJECT AND OBJECT-RELATIONAL DATABASES	9

Overview of OOP:Object model of ODMG. Object definition Language ODL: Object Query Language OQL-Conceptual design of Object database. Overview of object relational features of SQL: Object-relational features of Oracle-Implementation and related issues for extended type systems-syntax and demo examples-the nested relational model. Overview of C++ language binding;

UNIT III	PARALLEL AND DISTRIBUTED DATABASES: ARCHITECTURES FOR PARALLEL DATABASES	9

Parallel query evaluation-Parallelizing individual operations-Parallel query optimizations. Introduction to distributed databases-Distributed DBMS architectures-Storing data in a Distributed DBMS-Distributed catalog management-Distributed Query processing- Updating distributed data-Distributed transactions-Distributed Concurrency control and Recovery.

UNIT IV	DATA WAREHOUSING, DECISION SUPPORT AND DATA MINING	9

Introduction to decision support-OLAP-multidimensional model-Window queries in SQL- Finding answers quickly-Implementation techniques for OLAP-Data Warehousing. Views and Decision support: View materialization-Maintaining materialized views. Introduction to Data Mining-Counting co-occurrences-Mining for rules-Tree-structured rules-ROC and CMC Curves-Clustering-Similarity search over sequences-Incremental mining and data streams-Additional data mining tasks.

UNIT V	ENHANCED DATA MODELS FOR SOME ADVANCED APPLICATIONS	9

Active database concepts and triggers-Temporal-Spatial and Deductive-More Recent Applications: Mobile databases-Multimedia databases-Geographical Information Systems: Genome data management.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1 :	Evaluate the high performance database like parallel and distributed database
CO2 :	Infer and represent the real world data using object oriented database
CO3 :	Interpret rule set in the database to implement data warehousing in mining
CO4 :	Discover and design database for recent applications database for better interoperability
CO5 :	Extend knowledge in research topics of databases.

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2			2	2	3
CO3	2	3			
CO4			2	2	3
CO5		3	2		

REFERENCE BOOKS:

R1 :	Elmasri and Navathe,"Fundamentals of Database Systems", Pearson Education, 2013.
R2 :	Raghu Ramakrishnan and Johannes Gehrke,"Database Management Systems", 3rd Edition, McGraw-Hill, 2013.
R3 :	Abraham Silberschatz, Henry F. Korth, S. Sudarshan,"Database System Concepts", 6th Edition, McGraw Hill, 2010.
R4 :	Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.
R5 :	C.J.Date, A.Kannan and S.Swamynathan,"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
R6 :	V.S.Subramanian, "Principles of Multimedia Database Systems", Harcourt India Pvt. Ltd., 2001.

LAB COMPONENT CONTENTS:

Database Design and Implementation

1.	Object-relational features of Oracle
2.	Mobile databases

3.	Multimedia databases		
4.	Geographical Information Systems		
5.	Genome data management		
Theory:45	**Tutorial:0**	**Practical:30**	**Total:75 Hours**

21CP201	RESEARCH METHODOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Ability to critically evaluate current research and propose possible alternate methods for furtherwork.
- Ability to develop hypothesis / Problem Statement and methodology forresearch.
- Ability to comprehend and deal with complex research issues in order to communicate their scientific results clearly for peerreview.

PRE-REQUISITES:

- NIL

THEORY COMPONENT CONTENTS:

UNIT I	INTRODUCTION TO RESEARCH METHODOLOGY	9

Meaning of Research-Types of Research-Research Process-Problem definition-Objectives of Research-Research Questions- Research design- Approaches to Research- Quantitative vs. Qualitative Approach-Understanding Theory-Building and Validating Theoretical Models- Exploratory vs. Confirmatory Research-Experimental vs Theoretical Research- Importance of reasoning in research.

UNIT II	LITERATURE REVIEW	9

Problem Formulation-Understanding Modeling & Simulation-Conducting Literature Review- Referencing-Information Sources-Information Retrieval-Role of libraries in Information Retrieval- Tools for identifying literatures-Indexing and abstracting services-Citation indexes.

UNIT III	DATA COLLECTION AND SAMPLING DESIGN	9

Experimental Research: Cause effect relationship-Development of Hypothesis-Measurement Systems Analysis-Error Propagation-Validity of experiments-Statistical Design of Experiments- Field Experiments-Data/Variable Types & Classification-Data collection. Numerical and Graphical Data Analysis: Sampling-Observation-Surveys-Inferential Statistics-and Interpretation of Results.

UNIT IV	RESEARCH REPORTS	9

Preparation of Dissertation and Research Papers-Tables and illustrations-Guidelines for writing the abstract-introduction- methodology-results and discussion- conclusion sections of a manuscript- References-Citation and listing system of documents.

UNIT V	INTELLECTUAL PROPERTY RIGHTS (IPR) AND PATENTS	9

Intellectual property rights (IPR) - patents-copyrights-Trademarks-Industrial design geographical indication. Ethics of Research- Scientific Misconduct- Forms of Scientific Misconduct. Plagiarism-Unscientific practices in thesis work. Ethics in science.

Theory:45	Tutorial: 0	Practical: 0	Total:45 Hours

COURSE OUTCOMES

At the end of the course students should be able to

CO1:	Recognize the importance of literature review.
CO2:	Identify the different types of research.
CO3:	Formulate problem statement and develop mathematical models for different problems.
CO4:	Formulate methodology of research and experimental analysis.
CO5:	Analyze the results using statistical methods, interpretation of results with reference to similar research outcomes.

CO6:	Prepare technical reports and research papers.

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

REFERENCE BOOKS

R1:	C.R. Kothari, "Research Methodology Methods & Techniques",New Age international Publishers, Reprint 2008.
R2:	R. Panneerselvam, "Research Methodology", PHI 2004.
R3:	Deepak Chawla, NeenaSodhi "Research Methodology concepts and cases " 2nd edition, Vikas Publishing house pvt ltd.
R4:	Michael Quinn Patton "Qualitative Research & Evaluation Methods" 3rd edition, Sage Publications.
R5:	Paul D. Leedy, Jeanne Ellis Ormrod "Practical Research: Planning and Design", Prentice Hall

Theory: 45	**Tutorial: 0**	**Practical:0**	**Total:45 Hours**

21PCP01	CLOUD SERVICES AND VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explore the legacy OSs on virtual machines.
- How the intricacies of server, storage, network, desktop and application virtualizations of working
- To understand and differentiate full and para virtualization.
- To create cloud applications in virtual machine platforms.

PRE-REQUISITES:

NIL

UNIT I	INTRODUCTION	6

Introduction - Essentials - Benefits - Business and IT Perspective - Cloud and Virtualization - Cloud Services Requirements - Cloud and Dynamic Infrastructure - Cloud Computing Characteristics - Cloud Adoption - Cloud Models - Cloud Characteristics - Measured Service - Cloud Models - Security in a Public Cloud - Public versus Private Clouds - Cloud Infrastructure Self Service.

UNIT II	CLOUD SERVICES AND SOLUTIONS	6

Principal Technologies - Cloud Strategy - Cloud Design and Implementation using SOA - Conceptual Cloud Model - Cloud Service Defined. Cloud Solutions: Introduction - Cloud Ecosystem - Cloud Business Process Management - Cloud Service Management - Cloud Stack - Computing on Demand (CoD) – Cloud Sourcing.

UNIT III	CLOUD OFFERINGS AND CLOUD MANAGEMENT	6

Cloud Offerings: Information Storage - Retrieval - Archive and Protection - Cloud Analytics - Testing under Cloud - Information Security - Virtual Desktop Infrastructure - Storage Cloud. Cloud Management: Resiliency - Provisioning - Asset Management - Cloud Governance - High Availability and Disaster Recovery - Charging Models - Usage Reporting - Billing and Metering.

UNIT IV	CLOUD ENABLIBNG TECHNOLOGIES	6

Data Center Technology - Virtualization Technology - Web Technology - Multitenant Technology - Service Technology - Case Study in AWS.

UNIT V	CLOUD VIRTUALIZATION	6

Virtualization Defined - Virtualization Benefits - Server Virtualization - Virtualization for x86 Architecture - Hypervisor Management Software - Logical Partitioning (LPAR) - VIO Server - Virtual Infrastructure Requirements - Storage virtualization - Storage Area Networks - Network- Attached storage - Cloud Server Virtualization - Virtualized Data Center.

Theory: 30	Tutorial: 0	Practical: 0	Total: 30 Hours

COURSE OUTCOMES:

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

CO1:	Deploy legacy OSs on virtual machines.
CO2:	Distinguish the intricacies of server, storage, network, desktop and application virtualizations.
CO3:	Compare full and Para virtualization.
CO4:	Producing cloud applications in virtual machine platforms.
CO5:	Understand the basic idea of AWS.

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2			2	2	
CO3				2	2
CO4		2		2	2
CO5	2		2		

REFERENCE BOOKS:

R1:	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes" Elsevier/Morgan Kaufmann, 2005.
R2:	David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center" Auerbach Publications, 2006.
R3:	Kumar Reddy, Victor Moreno, "Network virtualization" Cisco Press, July, 2006.
R4:	Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", Apress 2005.
R5:	Danielle Ruest, Nelson Ruest" Virtualization: A Beginner‟s Guide", TMH, 2009
R6:	Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology and Architecture", Prentice Hall Service Technology Series, 2013
R7:	Kenneth Hess, Amy Newman: "Practical Virtualization Solutions: Virtualization from the Trenches" Prentice Hall 2010
R8:	John Rittinghouse, James Ransome," Cloud Computing, Implementation, Management and Strategy", CRC Press, 2010
R9:	Anthony T. Volte, Toby J. Volte, Robert Elsenpeter "Cloud Computing: A Practical Approach",TMH, 2010
R10:	Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas – "Cloud Computing Synopsis and Recommendations ",NIST, May 2011
R11:	Tom White ," Hadoop: The Definitive Guide Storage and Analysis at Internet Scale", O'Reilly Media Press May 2012
R12:	Dave Shackleford ,"Virtualization security- Protecting Virtualized Environments", Sybex Publishers, First Edition, 2012

LAB COMPONENT CONTENTS:

1.	Deployment of private cloud
2.	Launch your VM in the EC2 Cloud

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Total: 30 Hours**

21PCP02	SOFTWARE QUALITY ASSURANCE AND TESTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the concepts of software quality assurance framework
- To Understand the process of software testing throughout the software development process
- To Analyze software quality assurance metrics, difficulties and limitations
- To interpret the knowledge of testing tools.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	SOFTWARE QUALITY ASSURANCE FRAMEWORK AND PLAN	6

Software Quality Assurance Framework and Standards SQA Framework: What is Quality? - Components of Software Quality Assurance - Software Quality Assurance Plan - Steps to develop and implement a Software Quality Assurance Plan. Quality Standards: ISO 9000 and Companion ISO Standards.

UNIT II	SOFTWARE QUALITYASSURANCE METRICS AND MEASUREMENT SOFTWARE QUALITY METRICS	6

Product Quality metrics - In-Process Quality Metrics - Metrics for Software Maintenance - Examples of Metric Programs.

UNIT III	SOFTWARE QUALITY METRICS	6

Software Quality Metrics Methodology: Establish quality requirements - Identify Software quality metrics - Implement the Software Quality Metrics - Analyze Software Metrics Results - Validate the Software Quality Metrics - Software Quality Indicators -Fundamentals in Measurement Theory.

UNIT IV	SOFTWARE TESTING TECHNIQUES	6

Black-Box - Boundary value - Bottom-up - Branch coverage - Cause-Effect Graphing - CRUD - Database - Exception - Gray-Box - Histograms - Inspections - JADs - Pareto Analysis - Prototyping - Random Testing - Risk-based Testing - Regression Testing - Structured Walkthroughs - Thread Testing - Performance Testing - White-Box Testing.

UNIT V	SOFTWARE TESTING TOOLS	6

Taxonomy of Testing Tools - Methodology to Evaluate Automated Testing Tools - Load Runner - Win runner and Rational Testing Tools - Java Testing Tools – Jmetra - JUNIT and Cactus.

Theory: 30	Tutorial: 0	Practical: 0	Total: 30 Hours

COURSE OUTCOMES:

At the end of the course students should be able to

CO1:	Understand the effective strategies, methods and technologies of software testing
CO2:	Design test plan and test cases to perform automatic testing
CO3:	Apply effective software testing techniques in software development
CO4:	Report clear and correct software defectives
CO5:	To select distinguished tool for software testing

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2		2	2		
CO3			2	2	
CO4				2	2
CO5			2		2

REFERENCE BOOKS:

R1:	Effective Methods for Software Testing, 2nd Edition, William E. Perry, Second Edition, Wiley India, 2006.
R2:	Software Quality, Mordechai Ben-Menachem/Garry S. Marliss, Thomson Learning publication, 1997.
R3:	Testing and Quality Assurance for Component-based Software, by Gao, Tsao and Wu, Artech House Publishers
R4:	Software Testing Techniques, by Bories Beizer, Second Edition, Dreamtech Press
R5:	Handbook of Software Quality Assurance, by G. Gordon Schulmeyer, James I.McManus, Second Edition, International Thomson Computer Press
R6:	Metrics and Models for Software Quality Engineering, by Stephen H. Kan, by Pearson Education Publication.
R7:	Software Testing Tools, K.V.K.K. Prasad, Dream tech press, 2008.

LAB COMPONENT CONTENTS:

1.	Write a test cases for any known applications
2.	Track the bug in bug tracking tool
3.	Execute the test case in selenium automation tool.

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Total: 30 Hours**

21PVD16	DIGITAL IMAGE PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

This course will enable students to

- Understand fundamentals of digital image
- Learn different image transforms
- Study concept of segmentation

THEORY COMPONENT CONTENTS

UNIT I	DIGITAL IMAGE FUNDAMENTALS	9

A simple image model, Sampling and Quantization, Imaging Geometry, Digital Geometry, Image Acquisition Systems, Different types of digital images. Basic concepts of digital distances, distance transform, medial axis transform, component labeling, thinning, morphological processing, extension to gray scale morphology

UNIT II	IMAGE TRANSFORMS	9

1D DFT, 2D transforms - DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet transform

UNIT III	SEGMENTATION OF GRAY LEVEL IMAGES	9

Histogram of gray level images, multilevel thresholding, Optimal thresholding using Bayesian classification, Watershed and Dam Construction algorithms for segmenting gray level image. Detection of edges and lines: First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking.

UNIT IV	IMAGE ENHANCEMENT AND COLOR IMAGE PROCESSING	9

Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration. Color Representation, Laws of color matching, chromaticity diagram, color enhancement, color image segmentation, color edge detection, color demosaicing

UNIT V	IMAGE COMPRESSION	9

Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Periods

COURSE OUTCOMES

At the end of the course students should be able to

CO1 :	Discuss image enhancement techniques
CO2 :	Explain color image processing
CO3 :	Compare image compression schemes

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2			2	2	
CO3				2	2
CO4		2		2	2
CO5	2		2		

REFERENCE BOOKS	
R1	A.K. Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, Addison-Wesley, 1989.
R2	Bovik (ed.), “Handbook of Image and Video Processing”, Academic Press, 2000

LAB COMPONENT CONTENTS	
1.	Implement a function in MATLAB for image segmentation
2.	Implement a function in MATLAB for image morphology that analyze the form and shape detail of image structures.
3.	Implement a function in MATLAB for Image Restoration.
4.	Models for representing the color and methods of processing the color plane.
5.	Implement Smoothing and Sharpening of an eight bit color image.

Theory:0	**Tutorial:0**	**Practical:30**	**Project:0**	**Total:30 periods**

21PCP04	ARTIFICIAL INTELLIGENCE	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

This course will enable students to

- Understand the fundamentals of Artificial Intelligence
- Learn the basics of problem spaces and search techniques
- Learn game playing techniques associated with artificial intelligence
- Understand knowledge representation and reasoning techniques
- Develop simple programs in PROLOG

THEORY COMPONENT CONTENTS

UNIT I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**9**
The AI problems, AI technique, philosophy and development of Artificial intelligence		
UNIT II	**PROBLEM SPACES AND SEARCH**	**9**
State space search, Uninformed and informed search techniques:BFS, A*, variations of A*. Local search and optimization: hill climbing, simulated annealing		
UNIT III	**ADVERSARIAL SEARCH AND GAME PLAYING**	**9**
Minimax algorithm, alpha-beta pruning, stochastic games, Constraint-satisfaction problems		
UNIT IV	**KNOWLEDGE AND REASONING**	**9**
Logical agents, Propositional logic, First-order logic, Inference in FoL: forward chaining, backward chaining, resolution, Knowledge representation: Frames, Ontologies, Semantic web and RDF		
UNIT V	**UNCERTAIN KNOWLEDGE, REASONING AND PROLOG**	**9**
Probabilistic reasoning, Bayesian networks, Fuzzy logic Facts and predicates, data types, goal finding, backtracking, simple object, compound objects, use of cut and fail predicates, recursion, lists, simple input/output, dynamic database		

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Periods

COURSE OUTCOMES

At the end of the course students should be able to

CO1 :	Understand Artificial Intelligence, its foundation and principles.
CO2 :	Examine the useful search techniques; learn their advantages, disadvantages and comparison.
CO3 :	Learn the basics of game playing
CO4 :	Understand knowledge and reasoning
CO5 :	Apply PROLOG to solve basic AI problems

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	2	2			
CO2			2	2	
CO3				2	2
CO4		2		2	2
CO5	2		2		

TEXT BOOKS				
T1	Artificial Intelligence, Elaine Rich & Kevin Knight, TMH Publication			
REFERENCE BOOKS				
R1	Introduction to Turbo PROLOG, Carl Townsend, BPB Publication			
R2	Introduction to AI & Expert Systems, Dan W. Patterson, PHI Publication			
LAB COMPONENT CONTENTS				
1.	Study of facts, objects, predicates and variables in PROLOG			
2.	Study of Rules and Unification in PROLOG.			
3.	Study of “cut” and “fail” predicate in PROLOG.			
4.	Study of arithmetic operators, simple input/output and compound goals in PROLOG.			
5.	Study of recursion in PROLOG.			
6.	Study of Lists in PROLOG.			
7.	Study of dynamic database in PROLOG			
8.	Study of string operations in PROLOG. Implement string operations like substring, string position, palindrome etc.)			
9.	Write a prolog program to maintain family tree.			
10.	Write a prolog program to implement all set operations (Union, intersection, complement etc.)			
11	Write a prolog program to implement Library Management system.			
12.	Write a prolog program to solve “Water Jug Problem”.			
Theory:0	**Tutorial:0**	**Practical:30**	**Project:0**	**Total:30 periods**

P19CSPE004	VIDEO ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the fundamentals of digital image processing, image and video analysis.
- To understand the real time, use of image and video analytics.
- To demonstrate real time image and video analytics applications and others.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	DIGITAL IMAGE REPRESENTATION	6

Visual Perception- Sampling and Quantization- Basic Relations between Pixels. Mathematical Tools Used in Digital Image Processing: Fundamental Operations –Vector and Matrix Operations- Image Transforms (DFT, DCT, DWT, Hadamard).

UNIT II	FUNDAMENTALS OF SPATIAL FILTERING	6

Spatial correlation and convolution-smoothing blurring- sharpening- edge detection. Basics of filtering in the frequency domain: smoothing-blurring- sharpening -Histograms and basic statistical models of image.

UNIT III	COLOUR MODELS AND TRANSFORMATIONS	6

Image and Video segmentation-Image and video demonising- Image and Video enhancement- Image and Video compression.

UNIT IV	OBJECT DETECTION AND RECOGNITION IN IMAGE AND VIDEO	6

Texture models Image and Video 25 classification models- Object tracking in Video.

UNIT V	APPLICATIONS AND CASE STUDIES	6

Industrial- Retail- Transportation & Travel- Remote sensing. Video Analytics in WSN: IoT Video Analytics Architectures.

Theory:30	Tutorial: 0	Practical: 0	Total:30 Hours

COURSE OUTCOMES:

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

CO1:	Understand the fundamental concepts of image and video analysis.
CO2:	Ability to identify the colour models and images in the video and image patterns.
CO3:	Apply image and video analysis in real world problems.
CO4:	Apply the object recognition technique in appropriate area.
CO5:	Understanding the image and video analytics in real world applications.

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1		2	2		
CO2			2	2	
CO3				2	2
CO4			2	2	
CO5				2	2

REFERENCE BOOKS:

R1:	R.C. Gonzalez and R.E. Woods.” Digital Image Processing”. 3rd Edition. Addison Wesley, 2007.

R2:	W. Härdle, M. Müller, S. Sperlich, A. Werwatz, “Nonparametric and Semi parametric Models”, Springer, 2004.
R3:	Rick Szelisk, “Computer Vision: Algorithms and Applications”, Springer 2011.
R4:	Jean-Yves Dufour, “Intelligent Video Surveillance Systems”, Wiley, 2013.
R5:	Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
R6:	AsierPerallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola, “Intelligent Transport Systems: Technologies and Applications”, Wiley, 2015.
R7:	Basudeb Bhatta, “Analysis of Urban Growth and Sprawl from Remote Sensing Data”, Springer, 2010.

LAB COMPONENT CONTENTS:			
1.	Study on An Open-Source Platform for Underwater Image and Video Analytics.		
2.	Study on Video analytics for surveillance camera networks.		
3.	Study on Motion detection, tracking and classification for automated Video Surveillance.		
Theory: 0	**Tutorial: 0**	**Practical:30**	**Total:30 Hours**

21PCP06	ADVANCED SOFT COMPUTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To familiarize various soft computing techniques.
- To relate various soft computing techniques in practical scenario.
- To understand hybrid approach for application development.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	**INTRODUCTION**	**6**

Differentiate Hard and Soft Computing- Soft Computing Constituents- Neuro Fuzzy and Soft Computing Characteristics.

UNIT II	**FUZZY LOGIC & ROUGH SET THEORY**	**6**

Fuzzy Relations and Fuzzy Rules - Generalized Moderns Ponens - Defuzzification and its Types Fuzzy Inference Systems- Design of Fuzzy Controller- Introduction to Rough Sets.

UNIT III	**SUPERVISED AND UNSUPERVISED NETWORKS**	**6**

Error Back Propagation Training Algorithm- Radial Basis Function- Kohenon Self Organizing Maps- Basic Learning Vector Quantization- Basic Adaptive Resonance Theory.

UNIT IV	**HYBRID SYSTEMS AND INTRODUCTION TO DEEP LEARNING**	**6**

Fuzzy-Neural Systems- Neuro-Genetic Systems Fuzzy- Genetic Systems- Deep Learning: Definition & background- historical context of deep learning- Three classes of deep learning network.

UNIT V	**APPLICATIONS AND CASE STUDY**	**6**

Automobile Fuel Efficiency using ANFI- Colour Recipe prediction using CANFIS.

Theory:30	**Tutorial: 0**	**Practical: 0**	**Total:30 Hours**

COURSE OUTCOMES:

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

CO1:	To demonstrate various soft computing techniques.
CO2:	To apply and analyse different soft computing techniques for solving practical applications.
CO3:	To design an intelligent system for social and technical problems.
CO4:	Handle multi objective optimization problems.
CO5:	Apply rough set theory and granular computing to solve process control application.

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	PO2	PO3	PO4	PO5
CO1	2	2			
CO2			2		2
CO3		2		2	
CO4	2		2		
CO5		2	2		

REFERENCE BOOKS:

R1:	J.S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.

R2:	S. Rajasekaran and G.A. Vijaylakshmi Pai “Neural Networks Fuzzy Logic, and Genetic Algorithms”, Prentice Hall of India.
R3:	Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill, 2004.
R4:	S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
R5:	Samir Roy, Udit Chakraborty "Introduction to Soft Computing" Pearson Education India,2013
R6:	Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley, 2010.
R7:	Fakhreddine O. Karry, Clarence De Silva," Soft Computing and Intelligent Systems Design Theory, Tools and Applications" Pearson 2009.
R8:	Li Deng and Dong Yu, “Deep Learning Methods and Applications” now Publishers Inc. 2014

LAB COMPONENT CONTENTS			
1.	Implementation of Fuzzy Relations (Max-min Composition).		
2.	Implementation of Fuzzy Controller (Washing Machine).		
3.	Implementation of Unsupervised Learning Algorithm.		
4.	Implementation of Perceptron Learning Algorithm.		
5.	Study of research paper on Soft Computing.		
Theory: 0	**Tutorial: 0**	**Practical:30**	**Total:30 Hours**

21PCP07	SEMANTIC WEB TECHNOLOGY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Student will understand how this technology revolutionizes the World Wide Web and its uses. Ontology languages (RDF, RDF-S and OWL) and technologies (explicit metadata, ontologies, logic, and inference) will be covered.
- In addition, students will be exposed to; ontology engineering, application scenarios, Semantic Web Query Languages, Description Logic and state of the art Semantic Web applications, such as linked data development.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	SEMANTIC WEB VISION	6

Transition to the Semantic Web: Transition Examples-Semantic Web Technologies - Recommended Layered Architectures. Structured web documents: The XML Language: Structuring - Namespaces - Addressing and Querying XML Documents - Processing.

UNIT II	RESOURCE DESCRIPTION	6

RDF: RDF Schema-Axiomatic Semantics for RDF and RDF Schema - Direct Inference System for RDF and RDFS-Querying in SPARQL.

UNIT III	WEB ONTOLOGY LANGUAGE	6

OWL Language: Ontology Examples - OWL in OWL - Future Extensions to OWL. Ontology engineering: Constructing Ontologies Manually - Reusing Existing Ontologies - Using Semiautomatic Methods - On-To-Knowledge-Semantic Web Architecture.

UNIT IV	LOGIC AND INFERENCE	6

Rules: Monotonic Rules- Syntax - Semantics - Representing Family Relationships. Nonmonotonic Rules: Syntax - Brokered Trade as an Example - Monotonic and Nonmonotonic Rule Markup.

UNIT V	APPLICATIONS	6

Horizontal Information Products at Elsevier - Data Integration at Audi - Skill Finding at Swiss Life - Think Tank Portal at EnerSearch - e-Learning - Web Services.

Theory:45	Tutorial: 0	Practical: 0	Total:30 Hours

COURSE OUTCOMES

At the end of the course students should be able to

CO1:	Understand the structure of Semantic Web technology
CO2:	Analyse Semantic Web technology revolutionizes to World Wide Web and its uses.
CO3:	Understand the concepts of metadata, semantics of knowledge and resource, ontology, and their descriptions in XML-based syntax and web ontology language (OWL).
CO4:	Describe logic semantics and inference with OWL.
CO5:	Understand Semantic Web query languages (SPARQL) and ontology in semantic web.

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1			2	2	
CO2		2			2
CO3	2	2			
CO4	2		2		
CO5			2	2	

REFERENCE BOOKS	
R1:	Antoniou G and Van Harmelen F, "Semantic Web Primer", MIT press, USA, 2008.
R2:	Daconta, M C, J Obrst L and Smit K T, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Wiley, USA, 2003.
R3:	Davies J, Studer R and Warren P, "Semantic Web Technologies: Trends and Research in Ontology-based Systems", Wiley, USA, 2006.
R4:	Ducharme B, "Learning SPARQL", O"Reilly Media, USA, 2011

LAB COMPONENT CONTENTS	
1.	Creation of Structured web documents using XML.
2.	Processing of XML Document
3.	Creation of Ontology using OWL.
4.	Representing ontology using XML and RDF.
5.	Querying an Ontology using SPARQL.
6.	Representation of Monotonic and Non Monotonic Rule Markup.
7.	Extending ontology using OWL.

Theory: 0	**Tutorial: 0**	**Practical:30**	**Total:30 Hours**

21PCP09	ADVANCES IN STORAGE AREA NETWORKS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand Storage Area Networks characteristics and components.
- To become familiar with the SAN vendors and their products
- To learn Fibre Channel protocols and how SAN components use them to communicate with each other
- To become familiar with Cisco MDS 9000 Multilayer Directors and Fabric Switches Thoroughly learn Cisco SAN-OS features.
- To understand the use of all SAN-OS commands. Practice variations of SANOS features

PRE-REQUISITES

1. Computer Networks
2. Cloud Computing

THEORY COMPONENT CONTENTS

UNIT I	INTRODUCTION TO INFORMATION STORAGE:	9

Information Storage - Data - Big Data - Evolution of Storage Architecture-Data Center Infrastructure - Virtualization and Cloud Computing; Data Center Environment – Application- Host – Connectivity - Storage-Disk Drive Components - Disk Drive Performance - Direct-Attached Storage-Storage Design Based on Application- Requirements and Disk Performance -Introduction to Flash Drives -Components and Architecture of Flash Drives- Features of Enterprise Flash Drives -Concept in Practice: VMware ESXi

UNIT II	INTELLIGENT STORAGE SYSTEMS	9

Components of an Intelligent Storage System-Storage Provisioning - Types of Intelligent Storage Systems - Concepts in Practice: EMC Symmetrix and VNX; Data Protection: RAID - RAID Implementation Methods-Software RAID-Hardware RAID-RAID Array Components-RAID Techniques -RAID Levels-RAID 0 -RAID 1-Nested RAID-RAID 3 -RAID 4 -RAID 5 -RAID 6-RAID Impact on Disk Performance - RAID Comparison - Hot Spares ; Understanding SANOS

UNIT III	STORAGE NETWORKING TECHNOLOGIES	9

Fibre Channel Storage Area Networks - Fibre Channel: Overview -The SAN and Its Evolution - Components of FC SAN- Fibre Channel Architecture - FC SAN Topologies- Virtualization in SAN- NAS – Components and implementation of NAS- IP-SAN- Content-Addressed Storage - CAS Use cases.

UNIT IV	BACKUP, ARCHIVE, AND REPLICATION	9

Introduction to Business Continuity – Failure Analysis - Backup and Archive- Backup Purpose - Disaster Recovery - Operational Recovery – Archival - Backup Topologies- Backup in NAS Environments - Backup in Virtualized Environments- Local and remote replication

UNIT V	SECURING AND MANAGING STORAGE INFRASTRUCTURE	9

Information Security Framework - Storage Security Domains - Security Implementations in Storage Networking- Monitoring the Storage Infrastructure - Storage Infrastructure Management Activities - Storage Infrastructure Management Challenges

Theory:45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

COURSE OUTCOMES

At the end of the course students should be able to

CO1 :	Implement data storage in cloud environment
CO2 :	Gain knowledge of RAID and SANOS commands
CO3 :	Clearly discern the networking technologies for storage
CO4 :	Analyze the failure condition and recovery of data
CO5 :	Understand techniques involved in securing the storage structure

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2		2	2	
CO2		2			
CO3		2			2
CO4			2		
CO5	2		2	2	

TEXT BOOKS

1.	EMC Corporation, Information Storage and Management, Wiley.

REFERENCE BOOKS

1.	Robert Spalding, “Storage Networks: The Complete Reference“, Tata McGraw Hill, Osborne, 2003.
2.	Marc Farley, “Building Storage Networks”, Tata McGraw Hill ,Osborne, 2001.
3.	Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002.

LABORATORY CONTENTS

1.	Installation and execution of Virtual environment (VMWare)
2.	Execution of SAN OS Commands and Cisco MDS 9000 NX-OS commands
3.	Applications and Case studies of SAN implementation in educational Institutions
4.	Design and Configure a SAN with its components and fabrications for an Indian Bank.

21PCP10	NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the fundamentals of Language processing from the algorithmic viewpoint.
- To discuss various issues those make natural language processing a hard task.
- To discuss some applications of Natural Language Processing (NLP).

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	INTRODUCTION TO NATURAL LANGUAGE	6

Understanding- Levels of language analysis- Syntax, Semantics, Pragmatics. Linguistic Background- An Outline of English Syntax.

UNIT II	GRAMMARS	6

Lexicons, POS Tagging, Word Senses. Grammars and Parsing- Features, Agreement and Augmented Grammars.

UNIT III	PARSING AND AMBIGUITY RESOLUTION	6

Grammars for Natural Language, Parsing methods and Efficient Parsing. Ambiguity Resolution- Statistical Methods. Probabilistic Context Free Grammar.

UNIT IV	SEMANTIC AND LOGICAL FORM	6

Semantics and Logical Form: Linking Syntax and Semantics Ambiguity Resolution- other Strategies for Semantic Interpretation Scoping and the Interpretation of Noun Phrases

UNIT V	KNOWLEDGE REPRESENTATION AND REASONING	6

Knowledge Representation and Reasoning- Local Discourse, Context and Reference- Using World Knowledge- Discourse Structure- Defining a Conversational Agent. Text Categorization and Summarization.

Theory:45	Tutorial: 0	Practical: 0	Total:30 Hours

COURSE OUTCOMES

At the end of the course students should be able to

CO1:	Appreciate the fundamental concepts of Natural Language Processing.
CO2:	Design algorithms for NLP tasks.
CO3:	Implement a rule based system to tackle morphology/syntax of a language.
CO4:	Design a tag set to be used for statistical processing for real-time applications.
CO5:	Develop useful systems for language processing and related tasks involving text processing.

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2		2	2	
CO2		2			
CO3		2	2	2	2
CO4				2	2
CO5	2		2	2	

REFERENCE BOOKS	
R1:	D. Jurafsky and J. H. Martin, Speech and Language Processing, Prentice Hall India, 2000
R2:	James Allen, Natural Language Understanding, 2e, The Benjamin/Cummings Publishing Company Inc., Redwood City, CA.
R3:	Charniak, Eugene, Introduction to Artificial intelligence, Addison-Wesley, 1985
R4:	Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley,1999.
R5:	U. S. Tiwary and Tanveer Siddiqui, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

LAB COMPONENT CONTENTS	
1.	Text Classification
2.	Text Matching / Similarity
3.	Sentiment Analysis
4.	Speech Recognition
5.	Chat Bot Development

Theory: 0	**Tutorial: 0**	**Practical:30**	**Total:30 Hours**

21PCP11	SOFTWARE DEFINED NETWORKS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- This course introduces software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behaviour of an entire networ

PRE-REQUISITIE

NIL

THEORY COMPONENT CONTENTS

UNIT I	INTRODUCING SDN	6

SDN Origins and Evolution – Introduction – Why SDN? - Centralized and Distributed Control and Data Planes - The Genesis of SDN

UNIT II	SDN ABSTRACTIONS	6

How SDN Works - The Openflow Protocol - SDN Controllers: Introduction - General Concepts - VMware - Nicira - VMware/Nicira - OpenFlow-Related - Mininet - NOX/POX - Trema - Ryu - Big Switch Networks/Floodlight - Layer 3 Centric - Plexxi - Cisco OnePK

UNIT III	PROGRAMMING SDN'S	6

Network Programmability - Network Function Virtualization - NetApp Development, Network Slicing

UNIT IV	SDN APPLICATIONS AND USE CASES	6

SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases - The Open Network Operating System 3

UNIT V	SDN'S FUTURE AND PERSPECTIVES	6

SDN Open Source - SDN Futures - Final Thoughts and Conclusions

Theory: 30	Tutorial: 0	Practical: 0	Project: 0	Total: 30 Hours

COURSE OUTCOMES

At the end of the course students should be able to

CO1 :	Differentiate between traditional networks and software defined networks
CO2 :	Understand advanced and emerging networking technologies
CO3 :	Obtain skills to do advanced networking research and programming
CO4 :	Learn how to use software programs to perform varying and complex networking tasks
CO5 :	Expand upon the knowledge learned and apply it to solve real world problems

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2		2		
CO2		2		2	
CO3		2	2		
CO4				2	2
CO5				2	2

REFERENCE BOOKS

1.	Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014
2.	SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013.
3.	Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 2014.
4.	Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1, 2015.
5.	Lantz, Bob, Brandon Heller, and Nick McKeown. "A network in a laptop: rapid prototyping for software-defined networks." Proceedings of the 9th ACM SIGCOMM Workshop on Hot Topics in Networks. ACM, 2010.
6.	Monsanto, Christopher, et al. "Composing software defined networks." Presented as part of the 10th USENIX Symposium on Networked Systems Design and Implementation (NSDI 13). 2013
7.	Nunes, Bruno AA, et al. "A survey of software-defined networking: Past, present, and future of programmable networks." Communications Surveys & Tutorials, IEEE 16.3, 2014.
8.	Software Defined Networking with OpenFlow By Siamak Azodolmolky, Packt Publishing, 2013

LAB COMPONENT CONTENTS

1.	Study of Amazon elastic file system to understand the implementation of • Scalable file systems • Dynamic elasticity • Management of workloads • Budget estimation • Security features • Compliance of standards		
Theory: 0	**Tutorial: 0**	**Practical:30**	**Total:30 Hours**

21PCP12	EMBEDDED COMPUTING SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Explain a general overview of Embedded Systems
- Show current statistics of Embedded Systems
- Examine a complete microprocessor-based hardware system
- Design, code, compile, and test real-time software
- Integrate a fully functional system including hardware and software
- Make intelligent choices between hardware/software tradeoffs

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS:

UNIT I	INTRODUCTION TO EMBEDDED SYSTEMS	6

Embedded systems: Processor embedded into a system- Embedded hardware units and device in system- Embedded software in a system- Examples of embedded systems- Design process in embedded system- Formalization of system design- Design process and design examples- Classification of embedded systems- skills required for an embedded system designer.

UNIT II	DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK	6

IO types and example: Serial communication devices- Parallel device ports- Sophisticated interfacing features in device ports- Wireless devices- Timer and counting devices- Watchdog timer- Real time clock- Networked embedded systems- Serial bus communication protocols- Parallel bus device protocols- parallel communication internet using ISA, PCI, PCI-X and advanced buses- Internet enabled systems- network protocols- Wireless and mobile system protocols.

UNIT III	DEVICE DRIVERS AND INTERRUPTS AND SERVICE MECHANISM	6

Programming-I/O busy-wait approach without interrupt service mechanism- ISR concept- Interrupt sources- Interrupt servicing (Handling) Mechanism- Multiple interrupts- Context and the periods for context switching- interrupt latency and deadline- Classification of processors interrupt service mechanism from Context-saving angle- Direct memory access- Device driver programming.

UNIT IV	INTER PROCESS COMMUNICATION AND SYNCHRONIZATION OF PROCESSES, THREADS AND TASKS	6

Multiple processes in an application: Multiple threads in an application- Tasks- Task states- Task and Data- Clear-cut distinction between functions. ISRS and tasks by their characteristics- concept and semaphores- Shared data- Inter-process communication- Signal function- Semaphore functions- Message Queue functions- Mailbox functions- Pipe functions- Socket functions- RPC functions.

UNIT V	REAL-TIME OPERATING SYSTEMS	6

OS Services: Process management- Timer functions- Memory management: Device- file and IO subsystems management- Interrupt routines in RTOS environment and handling of interrupt source calls- Real-time operating systems- Basic design using an RTOS, RTOS task scheduling models- interrupt latency and response of the tasks as performance metrics- OS security issues. Introduction to embedded software development process and tools- Host and target machines- Linking and location software.

Theory:30	Tutorial: 0	Practical: 0	Total:30 Hours

COURSE OUTCOMES:

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

CO1:	Distinguish the characteristics of embedded computer systems.

CO2:	Examine the various vulnerabilities of embedded computer systems.
CO3:	Design an embedded system.
CO4:	Design and develop modules using RTOS.
CO5:	Implement RPC, threads and tasks.

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2		2		
CO2		2		2	
CO3		2	2		
CO4				2	2
CO5				2	2

REFERENCE BOOKS:	
R1:	Raj Kamal, "Embedded Systems: Architecture, Programming, and Design" 2nd edition, Tata McGraw hill-2013.
R2:	Marilyn Wolf, "Computer as Components, Principles of Embedded Computing System Design" 3rd edition, Elsevier-2014.
LAB COMPONENT CONTENTS:	
1.	Study on how to secure embedded system in real time environment.
2.	Study on web connectivity and security in embedded systems.
3.	Study on inter process communication.

Theory: 0	**Tutorial: 0**	**Practical:30**	**Total:30 Hours**

21PCP13	APPLIED GRAPH THEORY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

This course will enable students to

- · Have knowledge of the basic concepts of graph
- · Have a knowledge classes of graphs and its algorithm
- · Be exposed to constrained and unconstrained optimization techniques

PRE-REQUISITES

- Data structures
- Design and analysis of Algorithm

THEORY COMPONENT CONTENTS

UNIT I	INTRODUCTION	9

Discovery of graphs – Definitions – Sub graphs **-** Isomorphic graphs - Matrix representations of graphs - Degree of a vertex - Directed walks, paths and cycles - Connectivity in digraphs - Eulerian and Hamilton digraphs - Eulerian digraphs - Hamilton digraphs - Special graphs - Complements - Larger graphs from smaller graphs – Union – Sum - Cartesian Product - Composition - Graphic sequences - Graph theoretic model of the LAN problem - Havel-Hakimi criterion - Realization of a graphic sequence.

UNIT II	CONNECTED GRAPHS AND SHORTEST PATHS	9

Walks – trails – paths – cycles – Connected graphs – Distance – Cut-vertices and cut-edges – Blocks – Connectivity – Weighted graphs and shortest paths – Weighted graphs – Dijkstra's shortest path algorithm – Floyd – Warshall shortest path algorithm.

UNIT III	TREES	9

Definitions and characterizations – Number of trees –Cayley's formula – Kircho-matrix-tree theorem – Minimum spanning trees – Kruskal's algorithm – Prim's algorithm – Special classes of graphs – Bipartite Graphs – Line Graphs – Chordal Graphs – Eulerian Graphs – Fleury's algorithm – Chinese Postman problem – Hamilton Graphs – Introduction – Necessary conditions and sufficient conditions.

UNIT IV	INDEPENDENT SETS COVERINGS AND MATCHINGS	9

Introduction – Independent sets and coverings – basic equations – Matching's in bipartite graphs – Hall's Theorem – K¨onig's Theorem – Perfect matching's in graphs – Greedy and approximation algorithms.

UNIT V	VERTEX COLORINGS	9

Basic definitions – Cliques and chromatic number – Mycielski's theorem – Greedy coloring algorithm – Coloring of chordal graphs – Brooks theorem – Edge Colorings – Introduction and Basics – Gupta-Vizing theorem – Class-1 and Class-2 graphs – Edge-coloring of bipartite graphs – Class-2 graphs – Hajos union and Class-2 graphs – A scheduling problem and equitable edge-coloring.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Periods

COURSE OUTCOMES

At the end of the course students should be able to

CO1 :	Understand the basics of software architecture
CO2 :	Critically analyse the quality measures of architecture

CO3 :	Understand architecture life cycle for a given project
CO4 :	Design software with creational and structure patterns
CO5 :	Design software with behavioural patterns

TEXT BOOKS

T1	Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides : Design Patterns: Elements of Reusable Object-Oriented Software, Addison – Wesley, 1994
T2	Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice (2nd Ed.), Pearson

CO/PO MAPPING (1/2/3 indicates strength of correlation)
3-Strong, 2-Moderate, 1-Fair

COs	PROGRAMME OUTCOMES (POs)				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2		2		
CO2		2		2	
CO3		2	2		
CO4				2	2
CO5				2	2

REFERENCE BOOKS

R1	Clark J. and Holton D.A, "A First Look at Graph Theory", Allied Publishers, 1995.
R2	D..B.West: Introduction to Graph Theory,Prentice-Hall of India/Pearson, 2009

LAB COMPONENT CONTENTS

1.	Implement Dijkstra's Algorithm.
2.	Implement Floyd Warshall's Algorithm.
3.	Implement Bellman Ford's Algorithm.
4.	Konigs theorem implementation
5.	Implement prims and kruskals algorithm
6.	Implement Chinese postman problem using Hamilton graph
7.	Brooks theorem implementation
8.	Mycielski's theorem implementation

Theory:0	**Tutorial:0**	**Practical:30**	**Project:0**	**Total:30 periods**

21PCP14	SOFTWARE ARCHITECTURE AND DESIGN PATTERNS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

This course will enable students to

- Understand the software architecture concept
- Learn the different quality measures of a good software architecture
- Understand the architectural life cycle
- Learn the various design patterns used in software architecture

PRE-REQUISITES

Nil

THEORY COMPONENT CONTENTS

UNIT I	INTRODUCTION TO SOFTWARE ARCHITECTURE	9

Basics of software architecture – Architectural structures – views – patterns –The features of good software architecture

UNIT II	QUALITY ATTRIBUTES	9

Understanding Quality Attributes – Availability – Interoperability – modifiability – Performance – Security – Testability – Usability – Tactics and patterns

UNIT III	ARCHITECTURE IN THE LIFE CYCLE	9

Architecture in agile projects – requirements – designing and documenting software architecture – implementation – testing – reconstruction – conformance – evaluation – management and governance

UNIT IV	CREATIONAL AND STRUCTURAL PATTERNS	9

Abstract factory – builder – factory method – prototype – singleton – adapter – bridge – composite – decorator – facade – flyweight – proxy

UNIT V	BEHAVIOURAL PATTERNS	9

Chain of responsibility – command – interpreter – iterator – mediator patterns – case study – design a document editor

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Periods

COURSE OUTCOMES

At the end of the course students should be able to

CO1 :	Understand the basics of software architecture
CO2 :	Critically analyse the quality measures of architecture
CO3 :	Understand architecture life cycle for a given project
CO4 :	Design software with creational and structure patterns
CO5 :	Design software with behavioural patterns

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2			2	2	
CO3			2	2	
CO4		2		2	2
CO5				2	2

TEXT BOOKS	
T1	Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides : Design Patterns: Elements of Reusable Object-Oriented Software, Addison – Wesley, 1994
T2	Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice (2nd Ed.), Pearson
REFERENCE BOOKS	
R1	Eric J. Braude , Software Design, John Wiley and Sons.
R2	Mary Shaw & David Garlan, Software Architecture – Perspectives on an emerging discipline, Pearson, 1996
LAB COMPONENT CONTENTS	
1.	Java class implementation with singleton pattern
2.	Abstract factory and factory method implementation
3.	Adapter pattern implementation
4.	Decorator pattern implementation
5.	Facade pattern implementation
6.	Implementation of chain of responsibility
7.	Iterator pattern implementation
8.	Mediator pattern implementation

Theory:0	**Tutorial:0**	**Practical:30**	**Project:0**	**Total:30 periods**

21PCP15	NOSQL DATABASE	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Demonstrate competency in designing NoSQL database management systems
- Demonstrate competency in describing how NoSQL databases differ from relational databases.
- Demonstrate competency in selecting a particular NoSQL database for specific use cases.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS

UNIT I	INTRODUCTION	6

Introduction to Databases - Three Database Revolutions - Different Databases for Different Requirements - Variety of NoSQL Databases : Data Management with Distributed Databases - ACID and BASE - Four Types of NoSQL Databases : Key-Value Pair Databases, Document Databases, Column Family Databases, Graph Databases

UNIT II	KEY-VALUE DATABASES	6

Introduction to Key-Value Databases : From Arrays to Key-Value Databases - Essential Features of Key-Value Databases - Keys: More Than Meaningless Identifiers - Values: Storing any data - Key-Value Database Terminology : Key-Value Database Data Modeling Terms - Key-Value Architecture Terms - Key-Value Implementation Terms - Designing for Key-Value Databases : Key Design and Partitioning - Designing Structured Values - Limitations of Key-Value Databases - Design Patterns for Key-Value Databases

UNIT III	DOCUMENT DATABASES	6

Introduction to Document Databases : Basic Operations on Document Databases - Document Database Terminology : Document and Collection Terms - Types of Partitions - Data Modeling and Query Processing - Designing for Document Databases : Normalization, denormalization and search for proper balance - Planning for Mutable Documents - The Goldilock zone of Indexes - Modeling Common Relations

UNIT IV	COLUMN FAMILY DATABASES	6

Introduction to Column Family Databases : Differences and Similarities to Key-Value and Document Databases - Architectures Used in Column Family Databases - Column Family Database Terminology : Basic Components of Column Family Databases - Structures and Processes: Implementing Column Family Databases - Processes and Protocols - Designing for Column Family Databases : Guidelines for Designing Tables - Guidelines for Indexing

UNIT V	GRAPH DATABASES AND THE DATABASE LANDSCAPE	6

Introduction to Graph Databases : What Is a Graph - Graphs and Network Modeling - Advantages of Graph Databases - Graph Database Terminology : Elements of Graphs - Operations on Graphs - Properties of Graphs and Nodes - Types of Graphs - Designing for Graph Databases : Querying a Graph - Tips and Traps of Graph Database Design - Choosing a NoSQL Database

Theory:30	Tutorial: 0	Practical: 0	Total:30 Hours

COURSE OUTCOMES:

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

CO1:	Understand competency in designing NoSQL database management systems
CO2:	Understand the Key-Value Databases
CO3:	Understand the Document Databases
CO4:	Understand the Column Family and Graph Databases
CO5:	Identified how to choose a NoSQL Database for our application

CO/PO MAPPING (1/2/3 indicates strength of correlation) 3-Strong, 2-Moderate, 1-Fair					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2			2	2	
CO3			2	2	
CO4		2		2	2
CO5				2	2

REFERENCE BOOKS:	
R1:	Dan Sullivan. NoSQL for Mere Mortals. Addison-Wesley Professional. 2015. ISBN: 0134023218
R2:	Guy Harrison. Next-Generation Databases. Apress. 2016. ISBN: 9781484213292

LAB COMPONENT CONTENTS:	
1.	Key-Value Databases for Mobile Application Configuration
2.	Document Database for Customer Manifests
3.	Column Family Database for Customer Data Analysis
4.	Graph Databases for Optimizing Transportation Routes

Theory: 0	**Tutorial: 0**	**Practical:30**	**Total:30 Hours**

21PCP16	INFORMATION SECURITY AND CYBER FORENSICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the classic & public key cryptosystems, hash functions.
- Learn and understand the next generation Internet protocol.
- Acquire fundamental knowledge on the concepts of securing operating systems.
- Become knowledgeable in various methods and protocols to maintain E-mail security, and web security.
- Plan and prepare for all stages of a Cyber & Forensic Incidents and Network Forensics.

PRE-REQUISITES:

NIL

THEORY COMPONENT CONTENTS

UNIT I	INTRODUCTION	6

Services, Mechanisms and attacks-the OSI security architecture-Network security model classical Encryption techniques: Data Encryption Standard- Block cipher principles, Advanced Encryption Standard (AES)- Principles of public key cryptosystems- The RSA algorithm- Key management- Diffie Hellman Key exchange- Authentication functions-Message authentication codes- Hash functions- Hash Algorithms (Secure Hash Algorithm).

UNIT II	NEXT GENERATION INTERNET PROTOCOL	6

Introduction to IPv6 – IPv6 Advanced Features –V4 and V6 header comparison – V6 Address types –Stateless auto configuration – IPv6 routing protocols – IPv4-V6 Tunnelling and Translation Techniques.

UNIT III	OPERATING SYSTEM SECURITY	6

Security in Windows and LINUX/Unix: Protection system- authorization- security analysis and vulnerabilities- The security kernel- Secure communications processor– Retrofitting security into operating systems.

UNIT IV	WEB SECURITY SSL/TLS	6

Basic Protocol Plan and prepare for all stages of a Forensic Incidents and Network Forensic sol- computing the keys- client authentication- PKI as deployed by SSL Attacks fixed in v3-Exportability- Encoding- Secure Electronic Transaction (SET)- Kerberos- Security Services for E-mail-attacks: E-mail- Pretty Good Privacy- S/MIME.

UNIT V	CYBER & FORENSICS	6

Cyber Security and its Problem- Intervention Strategies: Redundancy- Diversity and Autarchy- Cyber security in Society- Security in cyber laws. Forensics Incident - Incident Response Methodology- Forensic duplication- Forensic Analysis of File System. Network Forensics: Network Protocols- Email Tracing- Internet Fraud- Ethical Issues: Cybercrime.

Theory:30	Tutorial:0	Practical:0	Total:30 Hours

COURSE OUTCOMES:

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

CO1:	Understand the classic & public key cryptosystems, hash functions.
CO2:	Identify & compare the next generation Internet protocol.
CO3:	Able to apply the security concepts on operating systems
CO4:	Choose various methods and protocols to maintain E-mail security, and web security.
CO5:	Illustrate for all the stages of Cyber & Forensic Incidents and Network Forensics.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak					
COs	**PROGRAMME OUTCOMES (POs)**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2			
CO2			2	2	
CO3			2	2	
CO4		2		2	2
CO5				2	2

REFERENCE BOOKS:	
R1:	William Stallings, "Cryptography and Network Security", Pearson Education, 6th Edition, 2013, ISBN10: 0133354695.
R2:	Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGraw-Hill, 2006.
R3:	Trent Jaeger, Operating Systems Security, Morgan & Claypool Publishers, 2008
R4:	Michael J.Palmer, Guide to Operating Systems Security, Thomson/Course Technology, 2004.
R5:	Jonathan Rosenoer,"Cyber Law: The law of the Internet", Springer-Verlag, 1997.
LAB COMPONENT CONTENTS:	
1.	Study on Cyber Forensics in a Military Operations Perspective.
2.	Study on Cyber Forensics in a health care field.

Theory:0	**Tutorial:0**	**Practical:30**	**Total:30 Hours**

21CS111 **PROJECT I**

L	**T**	**P**	**C**
0	**0**	**6**	**3**

Course Objectives

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to

CO1 identify technically and economically feasible problems of social relevance

CO2 plan and build the project team with assigned responsibilities

CO3 identify and survey the relevant literature for getting exposed to related solutions

CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 implement and test solutions to trace against the user requirements

CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix : 3 High, 2 Medium, 3 Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
CO2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

21CS211 **PROJECT I I**

L	T	P	C
0	0	6	3

Course Objectives

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.

• To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to

CO1 identify technically and economically feasible problems of social relevance

CO2 plan and build the project team with assigned responsibilities

CO3 identify and survey the relevant literature for getting exposed to related solutions

CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 implement and test solutions to trace against the user requirements

CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix : 3 High, 2 Medium, 3 Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
CO2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

		L	T	P	C
21CS311	**Dissertation-I**	**0**	**0**	**12**	**6**

Course Objectives

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to

CO1 identify technically and economically feasible problems of social relevance

CO2 plan and build the project team with assigned responsibilities

CO3 identify and survey the relevant literature for getting exposed to related solutions

CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 implement and test solutions to trace against the user requirements

CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix : 3 High, 2 Medium, 3 Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
CO2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is

required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

		L	T	P	C
21CS411	**DISSERTATION-II**	**0**	**0**	**24**	**12**

Course Objectives

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to

CO1 identify technically and economically feasible problems of social relevance

CO2 plan and build the project team with assigned responsibilities

CO3 identify and survey the relevant literature for getting exposed to related solutions

CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 implement and test solutions to trace against the user requirements

CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix : 3 High, 2 Medium, 3 Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
CO2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

CO5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
CO6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2