E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)
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2101CP101	ADVANCED MATHEMATICS FOR SCIENTIFIC COMPUTING	L	T	P	C
		3	2	0	4

COURSE OBJECTIVE	• To apply mathematical linear programming techniques to solve constrained problems. • To appreciate the use of simulation techniques. • To enable them to estimate the value of the parameters involved in the specific distribution from a possible continuum of alternatives. • To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions. • To impart knowledge of handling random vectors which represent random variables in multi-dimensional space.

MODULE 1	**LINEAR PROGRAMMING**	**9 HOURS**
Formulation – Graphical solution – Simplex method – Two phase method –Transportation and Assignment Problems.		
MODULE 2	**SIMULATION**	**9 HOURS**
Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to real time problems.		
MODULE 3	**ESTIMATION THEORY**	**9 HOURS**
Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments.		
MODULE 4	**TESTING OF HYPOTHESIS**	**9 HOURS**
Sampling distributions – Estimation of parameters – Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion. Tests for independence of attributes and goodness of fit.		
MODULE 5	**MULTIVARIATE ANALYSIS**	**9 HOURS**
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.		

OUTCOME Employability	1. Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints. 2. Simulate appropriate application/distribution problems. 3. Obtain the value of the point estimators using the method of moments and method of maximum likelihood. 4. Apply the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples. 5. Get exposure to the principal component analysis of random vectors and matrices.

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REFERENCES	1. JayL. Devore,"Probability and Statistics for Engineering and the Sciences", Cengage Learning, 9th Edition, Boston,2016. 2. Johnson, R.A, Irwin Miller and John Freund., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, 9th Edition, NewYork, 2016. 3. Johnson, R.A., and Wichern, D.W., "Applied Multivariate Statistical Analysis", Pearson Education, Sixth Edition, New Delhi,2013. 4. Ross. S.M., "Probability Models for Computer Science", Academic Press, SanDiego,2002. 5. Taha H.A.,, "Operations Research: An Introduction", Prentice Hall of IndiaPvt.

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2102CP102	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVE	To understand the techniques for analyzing the complexity of algorithms To learn the concepts of advanced data structures To design algorithms for solving problems using appropriate data structures				
MODULE 1	**DATA STRUCTURES AND ALGORITHM ANALYSIS**				**9 HOURS**
Fundamental Data Structures- Analysis Framework-Asymptotic notations - Conditional asymptotic notation-Mathematical Analysis of Recursive - Recurrence tree method for solving recurrences –Master theorem for solving recurrences- Mathematical Analysis of and Non recursive Algorithms - P, NP and NP completeness					
MODULE 2	**HEAP STRUCTURE AND AMORTIZED ANALYSIS**				**9 HOURS**
Binary Heap : Basic heap operations-Min / Max heaps - d-heaps - Leftist heaps and property - Leftist heap Operations -Binomial queues-Binomial queue structure and operations -implementation of binomial queues- Skew heaps - Fibonacci heaps -Cutting nodes in leftist heaps-Lazy merging for binomial queues-Fibonacci heap operations.					
MODULE 3	**SEARCH STRUCTURE**				**9 HOURS**
Binary search trees- AVL trees - Single rotation-Double rotation- Splay trees- Top- down splay trees-Btrees - Red-Black trees- Bottom-up insertion-Top-down red- black trees - Top-down deletion- 2-3 trees - Insertion and deletion-2-3-4 trees - Insertion and deletion- Hashing-Hash function - Separate chaining - Hash tables without linked lists –Rehashing					
MODULE 4	**GREEDY AND DIVIDE AND CONQUER**				**9 HOURS**
Greedy method-Knapsack problem-Tree-vertex splitting-Job sequencing with deadlines - Minimum-cost spanning trees- Prim's algorithm-Kruskal's algorithm-Optimal storage on tapes - Divide-and-conquer-Merge sort-Quicksort -Strassen's matrix multiplication-Convex hull.					
MODULE 5	**DYNAMIC PROGRAMMING AND BACKTRACKING**				**9 HOURS**
Dynamic programming- Multistage graphs - All pairs shortest paths- Single-source shortest paths- 0/1 knapsack -Flow shop scheduling -Backtracking - 8-queens problem - Sum of subsets- Graph coloring-Hamiltonian cycles - Knapsack problem.					
OUTCOME EMPLOYABILITY	1. Analyze the complexity of algorithms using Asymptoticnotations 2. Design algorithms to perform operations in heap structures and analyze the algorithms forcomplexity. 3. Analyze the complexity of search tree structures and itsalgorithms 4. Design algorithms to solve problems using the greedy and divide and conquerTechniques 5. Design algorithms for problem solving using dynamic programming and backtracking methods and analyzeit.				

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REFERENCES	1. Mark Allen Weiss, Data Structures and Algorithms in C++, Fourth Edition, Pearson,2014. 2. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms / C++,University Press,2008 3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introductionto Algorithms, Third Edition, Prentice Hall of India, New Delhi, 2012 4. Adam Drozdek, Data Structures and Algorithms in C++, Fourth Edition, 2013 5. AnanyLevitin, Introduction to The Design and Analysis of Algorithms, Third Edition, Pearson,2014.

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2103CP007	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE	• To introduce the fundamental techniques based on parallel processing.	
	• To develop the foundations for analyzing the benefits of design options in computer architecture. • To gain knowledge about the application of the various computing techniques.	
MODULE 1	**PIPELINING AND ILP**	**9 HOURS**
Fundamentals of computer design-Basic and intermediate concepts of pipelining- Measuring and reporting performance -Instruction level parallelism and its exploitation - Concepts and challenges-Basic compiler techniques for ILP-Reducing branch costs with prediction-Overcoming data hazards with dynamic scheduling -Dynamic branch prediction.		
MODULE 2	**ADVANCED TECHNIQUES FOR EXPLOITING ILP**	**9 HOURS**
Speculation-Multiple issue processors-Compiler techniques for exposing ILP -Limitations on ILP for realizable processors - Hardware versus software speculation-Multithreading: Using ILP support to exploit thread-level parallelism -Performance of advanced multiple issue processors-Efficiency in advanced multiple issue processors		
MODULE 3	**MULTIPROCESSORS**	**9 HOURS**
A taxonomy of parallel architectures- Models for communication and memory architecture - Symmetric and distributed shared memory architectures - Cache coherence issues - Performance issues - Synchronization issues - Models of memory consistency - Interconnection networks - Buses, crossbar-Multi-stageswitches.		
MODULE 4	**MEMORY HIERARCHY**	**9 HOURS**
Introduction - Eleven advanced Optimizations of cache performance - Memory technology and optimizations - SRAM technology-DRAM technology-Protection: Virtual memory and virtual machines-Protection via virtual memory-Protection via virtual machine-Virtual machine monitor-Design of memory hierarchies		
MODULE 5	**STORAGE SYSTEMS**	**9 HOURS**
Advanced topics in disk storage -Disk power-Advanced topics in disk arrays-Definition and examples of real faults and failures- I/O performance, reliability measures and benchmarks-Throughput versus response time-Transaction processing benchmarks-A Little queuing theory.		
OUTCOME EMPLOYABILITY	1. Analyze the working principle of ILP. 2. Design the advanced techniques for exploiting ILP. 3. Compare the different multiprocessor architectures. 4. Design the cache optimizations and virtual memory. 5. Analyze the different storage systems and its performance measures.	

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2103CP002	NETWORKING TECHNOLOGIES	L	T	P	C
		3	0	0	3
COURSE OBJECTIVE	To learn about integrated and differentiated services architectures. • To understand the working of wireless networkprotocols. • To study the developments in cellularnetworks. • To get familiarized with next generationnetworks. • To know the concepts behind software definednetworks.				
MODULE 1	**NETWORK ARCHITECTURE AND QoS**				**9 HOURS**
Overview of TCP/IP Network Architecture – Integrated Services Architecture – Approach – Components – Services–QueuingDiscipline–FQ–PS–BRFQ–GPS–WFQ–RandomEarlyDetection–Differentiated Services.					
MODULE 2	**WIRELESS NETWORKS**				**9 HOURS**
IEEE 802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX – 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – LiFi – Protocol Stack – Security – Profiles					
MODULE 3	**CELLULAR NETWORKS**				**9 HOURS**
GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS–UMTS–ChannelStructureontheAirInterface–UTRAN–CoreandRadioNetworkMobility Management – UMTS Security					
MODULE 4	**4G NETWORKS**				**9 HOURS**
LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) – 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G& XG networks.					
MODULE 5	**SOFTWARE DEFINED NETWORKS**				**9 HOURS**
Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework					
OUTCOME EMPLOYABILITY	• Identify the different features of Integrated and differential services • Demonstrate various protocols of wireless networks. • Analyze the use of next generation networks • Provide solutions using SDN • Design protocols for cellular networks				

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REFERENCES	1. William Stallings, "High Speed Networks and Internets: Performance and Quality of Service", Prentice Hall, Second Edition,2002. 2. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley,2014. 3. Savo G Glisic, "Advanced Wireless Networks – 4G Technologies", John Wiley & Sons, 2007. 4. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley,2015. 5. Martin Sauter, "Beyond 3G – Bringing Networks, Terminals and the Web Together:LTE, 6. WiMAX, IMS, 4G Devices and the Mobile Web 2.0", Wiley,2009. 7. Naveen Chilamkurti, SheraliZeadally, HakimaChaouchi, "Next-Generation Wireless Technologies", Springer,2013. 8. Erik Dahlman, Stefan Parkvall, Johan Skold, "4G: LTE/LTE-Advanced for Mobile Broadband", Academic Press,2013.

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2104CP104	**ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY**	L	T	P	C
		0	0	4	2
COURSE OBJECTIVE	To implement the different data structures in C++ To introduce mathematical aspects and implement solutions for specific problem To implement the different algorithmic design techniques				
EXPERIMENT 1	Design and Implement the concepts of linear and non-linear data structures for solving Problems				
EXPERIMENT 2	Create Min Heap and perform the operations on it				
EXPERIMENT 3	Implement operations on Leftist Heap				
EXPERIMENT 4	Implement merging of two Skew Heaps				
EXPERIMENT 5	Perform rotations on AVL Tree				
EXPERIMENT 6	Implement sorting techniques				
EXPERIMENT 7	Create convex hull using divide and conquer				
EXPERIMENT 8	Job sequencing with deadlines using greedy method				
EXPERIMENT 9	0/1 Knapsack using dynamic programming				
EXPERIMENT 10	Graph coloring using backtracking				
OUTCOME EMPLOYABILITY	Design and Implement the concepts of linear and non-linear data structures for solving Problems				
	Design and apply iterative and recursive algorithms.				
	Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques				
	Design and implement optimization algorithms for specific applications				
	Design appropriate shared objects and concurrent objects for applications				

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2104CP105	**NETWORKING TECHNOLOGIES LABORATORY**	L	T	P	C
		0	0	4	2
COURSE OBJECTIVE	Demonstrate the operation of wireless networks. Simulate and analyze the performance of GSM, CDMA, LTE and SDN. To gain knowledge and work on various protocol layers. To explore network simulators. Identify the different features of integrated and differentiated services.				
EXPERIMENT 1	Configure networks using: a) Distance Vector Routing protocol b) Link State Vector Routing protocol				
EXPERIMENT 2	Implement the congestion control using Leaky bucket algorithm.				
EXPERIMENT 3	Installation of NS3 and execution of TCL commands / scripts.				
EXPERIMENT 4	Implementation Point to Point network using duplex links between the nodes. Analyze the packet transfer by varying the queue size and bandwidth. (using simulator)				
EXPERIMENT 5	Implement the dynamic routing protocol by varying the CBR traffic for each node and use a flow monitor ( ) to monitor losses at nodes. (using simulator)				
EXPERIMENT 6	Create a wireless mobile ad-hoc network environment and implement the OLSR routing protocol. (usingsimulator)				
EXPERIMENT 7	Implement CDMA by assigning orthogonal code sequence for 5 stations, generate the CDMA code sequence and communicate between the stations using the generated code.				
EXPERIMENT 8	Create a GSM environment and implement inter and intra handover mechanisms. (using simulator)				
EXPERIMENT 9	In LTE environment implement Round Robin and Token Bank Fair Queue scheduler in MAC layer.				
EXPERIMENT 10	Write python script to create topology in Mininet and configure OpenFlow switches with POX controller to communicate between nodes.				
OUTCOME EMPLOYABLITY	**Upon completion of the course, the student will be able to** Judge the emerging wireless technology standards. Configure functionalities of router and switches. Assess the importance of wireless ad-hoc networks. Compare and contrast various wireless technologies. Explain and design the considerations for deploying wireless network infrastructure.				

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2101RMX01	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3
COURSE OBJECTIVE	• Problem formulation, analysis and solutions. • Technical paper writing / presentation without violating professional ethics • Patent drafting and filing patents.				
MODULE 1	**RESEARCH PROBLEM FORMULATION**				**9 HOURS**
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations					
MODULE 2	**LITERATURE REVIEW**				**9 HOURS**
Effective literature studies approaches, analysis, plagiarism, and research ethics.					
MODULE 3	**TECHNICALWRITING /PRESENTATION**				**9 HOURS**
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.					
MODULE 4	**INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)**				**9 HOURS**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.					
MODULE 5	**INTELLECTUAL PROPERTY RIGHTS (IPR)**				**9 HOURS**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.					
OUTCOME SKILL DEVELOPMENT	CO1 : To formulate research problem CO2 : To carry out research analysis CO3 : To follow research ethics CO4: To understand that today"s world is controlled by computer, information technology, but tomorrow world will be ruled by ideas, concept, and creativity CO5 : To understand about IPR and filing patents in R & D.				

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REFERENCES	1. Asimov, "Introduction to Design", Prentice Hall, 1962. 2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007. 3. Mayall, "Industrial Design", McGraw Hill, 1992. 4. Niebel, "Product Design", McGraw Hill, 1974. 5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

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2102CP201	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3
COURSE OBJECTIVE	To understand the concepts of Machine Learning. To appreciate supervised learning and their applications. To appreciate the concepts and algorithms of unsupervised learning. To understand the theoretical and practical aspects of Probabilistic Graphical Models. To appreciate the concepts and algorithms of advanced learning.				
MODULE 1	**INTRODUCTION**				**9 HOURS**
Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory					
MODULE 2	**SUPERVISED LEARNING**				**9 HOURS**
Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision TreeLearning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi-layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines					
MODULE 3	**UNSUPERVISED LEARNING**				**9 HOURS**
Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.					
MODULE 4	**PROBABILISTIC GRAPHICAL MODELS**				**9 HOURS**
Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models –Bayesian Networks – Conditional Independence properties– Markov Random Fields- Hidden Markov Models – Conditional Random Fields(CRFs).					
MODULE 5	**ADVANCED LEARNING**				**9 HOURS**
Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference LearningExploration.					
OUTCOME EMPLOYABILITY	Design a learning model appropriate to the application. Design a Neural Network for an application of your choice. Use a tool to implement typical Clustering algorithms for different types of applications. Design and implement an HMM for a Sequence Model type ofapplication. Identify applications suitable for different types of Machine Learning with suitable justification.				

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2102CP202	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE	To understand different forms of intermediate languages and analyzing programs. To understand optimizations techniques for single program blocks. To apply optimizations on procedures and low level code. To explore and enhance inter procedural optimizations. To enhance resource utilization.

MODULE 1	**INTERMEDIATE REPRESENTATION OF PROGRAMS AND ANALYSIS**	**9 HOURS**

Structure of an Optimizing Compiler – Compiler Construction tools – LIR, MIR, HIR, DAG, Syntax Tree and Postfix. Analysis: Control Flow Analysis, Iterative Data Flow Analysis, Static Single Assignment–A Linear Time Algorithm for Placing -Nodes, BasicBlock Dependence, Alias Analysis. Introduction to LLVM – Compiling a language

MODULE 2	**LOCAL AND LOOP OPTIMIZATIONS**	**9 HOURS**

Early Optimizations: Constant-Expression Evaluation – Scalar Replacement of Aggregates – Algebraic Simplifications and Re-association – Value Numbering – Copy Propagation – Sparse Conditional Constant Propagation. Redundancy Elimination: Common – Sub expression Elimination – Loop-Invariant Code Motion – Partial-Redundancy Elimination – Redundancy Elimination and Association – Code Hoisting. Loop Optimizations: Induction Variable Optimizations – Unnecessary Bounds Checking Elimination. LLVM pass –LLVM Test Infrastructure.

MODULE 3	**PROCEDURE OPTIMIZATION AND SCHEDULING**	**9 HOURS**

Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination – Procedure Integration – In-Line Expansion – Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling – Speculative Loads and Boosting – Speculative Scheduling – Software Pipelining – Trace Scheduling – Percolation Scheduling. Control-Flow and Low-Level Optimizations: Unreachable-Code Elimination – Straightening – If Simplifications – Loop Simplifications –Loop Inversion Un-switching – Branch Optimizations – Tail Merging or Cross Jumping – Conditional Moves – Dead-Code Elimination – Branch Prediction – Machine Idioms and Instruction Combining. LLVM API procedure optimization

MODULE 4	**INTER PROCEDURAL OPTIMIZATION**	**9 HOURS**

Symbol table Runtime Support – Inter procedural Analysis and Optimization: Inter procedural Control- Flow Analysis – The Call Graph – Inter procedural Data-Flow Analysis – Inter procedural Constant Propagation – Inter procedural Alias Analysis – Inter procedural Optimizations – Inter procedural Register Allocation – Aggregation of Global References. LLVM– Interprocedural Analyses.

MODULE 5	**OPTIMIZING FOR MEMORY**	**9 HOURS**

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Register Allocation: Register Allocation and Assignment – Local Methods – Graph Coloring Priority Based Graph Coloring. Computations on Iteration Spaces- Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches – Instruction-Cache Optimization – Scalar Replacement of Array Elements – Data-Cache Optimization – Scalar vs. Memory-Oriented Optimizations. Software Prefetching – Parallelization – Instruction Level Parallelism– Automatic Parallelization.	
OUTCOME EMPLOYABILITY	Identify the different optimization techniques that are possible for a sequence of code. Design performance enhancing optimization techniques. Manage procedures with optimal overheads. Understand modern programming language features and constructs. Learn to work on a larger software project.
REFERENCES	1. Steven.S. Muchnick, Advanced Compiler Design and Implementation, MorganKaufman Publishers, 1997. 2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition,2007. 3. Y.N.Srikant, Priti Shankar, "The Compiler Design Handbook – Optimizations andMachine Code Generation", CRC Press, Second Edition, 2008. 4. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java",Cambridge University Press, Second Edition, 2002. 5. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann,Second Edition, 2011. Randy Allen and Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufman,2001.

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2102CP203	SOFTWARE PROJECT MANAGEMENT AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE	1. To provide a strong foundation on the concept of software project development 2. To learn the concepts on project management and evaluation. 3. To study the various test design strategies. 4. To understand the levels of testing and defect classes.

MODULE 1	**PROJECT EVALUATION AND PROJECT LIFE CYCLE**	**9 HOURS**
Understanding software projects –Project management vs. product management –stages of project management –Software project life cycle -Managerial issues.		

MODULE 2	**ACTIVITY PLANNING AND RISK MANAGEMENT**	**9 HOURS**
Project initiation –Identifying project –Developing project character –Identifying stack holders –Requirement analysis –Gathering requirements –Requirements types –Project scope planning –Resource breakdown structure (RBS) –Manpower planning –Quality planning – Time and Cost estimates –Risk management planning –Procurements for the project.		

MODULE 3	**COST ESTIMATION TECHNIQUES**	**9 HOURS**
Software effort estimation techniques: KLOC/SLOC estimation, expert opinion, top-down and bottom-up approach, use-case point estimates, object point estimates, Delphi technique – Project test plan –Software quality assurance (SQA) –Software quality control (SQC) –cost of quality –Software quality Metrics –SEI-CMMi model.		

MODULE 4	**INTRODUCTION - SOFTWARE TESTING**	**9 HOURS**
Software testing fundamentals–Minimizing Risks –Writing a policy –Building a structuredapproach–Developing a test strategy –Building the software testing process– Software testing guidelines –Customizing the software testing process.		

MODULE 5	**ORGANIZATION AND DEVELOPMENT OF TESTING APPROACH**	**9 HOURS**
Overview of the software testing process –Organizing for testing –Developing Test plan – Profile the software project –Understand project risk –Testing technique –Unit testing and analysis –Build and Inspect Test Plan.		

OUTCOME	
EMPLOYABILITY	1. Explain the concept of software project lifecycle 2. Describe planning and Risk management 3. Explore cost estimation techniques 4. Explain various types of testing

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REFERENCES	1. William E Perry, Effective Methods for Software Testing, John Wiley & Sons, USA,2008 2. Watts S. Humphrey, Managing the software process, Addison Wesley, 2011 3. Ian Somerville, Software Engineering,,Addison-Wesley,8thedition, 2006. 4. Steve McConnell, Code Complete, Second Edition, Microsoft Press. 5.Richard E. Fairley, Software Engineering Concepts, McGraw-Hill,1985

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2103CP010	ADVANCED DATABASE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE	Exemplify the data models and to conceptualize a database system using ER diagrams. Interpret the concepts of parallel and distributed databases. Understand the emerging database technologies

MODULE 1	**DATABASE SYSTEM CONCEPTS**	**9 HOURS**
Purpose of Database systems - Data Storage and Querying - Database architecture - Data models: Relational model - Entity relationship model: Constraints - Removing redundant attributes in entity sets- Entity-relationship diagrams - Reduction to relational schemas - Entity relationship design issue- Extended E-R features - Alternative notations for modeling Data - Normalization and database design: First normal form, second normal form, third normal form- Boyce coddnormalform		

MODULE 2	**PARALLEL AND DISTRIBUTED DATABASES**	**9 HOURS**
Parallel databases: I/O parallelism - Inter and intra query parallelism - Inter and intra operation parallelism -Distributed databases: Homogeneous and Heterogeneous databases - Distributed data storage - Distributed transactions - Commit protocols - Concurrencycontrol- Distributed query processing		

MODULE 3	**OBJECT AND OBJECT RELATIONAL DATABASES**	**9 HOURS**
Concepts for object databases: Object identity - Object structure- Type constructors- Encapsulation of operations -Methods - Persistence- Type and class hierarchies-Inheritance-Complex objects- Object databasestandards,languagesanddesign:ODMGmodel-ODL-OQL-Objectrelationaland extended - Relational systems: Object relational features in SQL / Oracle		

MODULE 4	**INTELLIGENT DATABASES**	**9 HOURS**
Active database concepts and triggers-Temporal databases -Spatial databases- Multimedia databases- Deductive databases- XML databases structure of XML data - XML Document Schema - Querying and Transformation - Geographic information systems-Genome data management		

MODULE 5	**EMERGING DATABASE TECHNOLOGIES**	**9 HOURS**
Cloud based databases- Mobile Database system - Location and handoff management - Effect of mobility on data management- Location dependent data distribution- Execution Model based on ACID Transaction Framework - Pre-write transaction execution model-Mobile transaction models - Concurrency control - Information retrieval		

OUTCOME	
EMPLOYABILITY	1. Analyze the basic database system concepts 2. Implement parallel and distributed databases in database technology 3. Apply the object oriented concepts and relations in databases 4. Compare and Implement the active, temporal and deductive databases 5. Analyze the emerging database technology such as cloud and mobile databases

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2103CP015	CLOUD COMPUTING	L	T	P	C
		3	0	0	3
COURSE OBJECTIVE	To understand the concept of cloud and utility computing. To understand the various issues in cloud computing. To familiarize themselves with the lead players in cloud. To appreciate the emergence of cloud as the next generation computing paradigm. To be able to set up a private cloud.				
MODULE 1	**INTRODUCTION**				**9 HOURS**
Introduction- Historical Development – Cloud Computing Architecture – The Cloud ReferenceModel – Cloud Characteristics –Cloud Deployment Models: Public, Private, Community, Hybrid Clouds- Cloud Delivery Models: IaaS, PaaS, SaaS – Open Source Private Cloud Software: Eucalyptus, Open Nebula,Open Stack.					
MODULE 2	**VIRTUALIZATION**				**9 HOURS**
Data Center Technology – Virtualization – Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques – Virtualization and Cloud Computing –Pros and Cons of Virtualization – Implementation Levels of Virtualization – Tools and Mechanisms: Xen, VMWare, Microsoft Hyper-V,KVM, Virtual Box					
MODULE 3	**CLOUD COMPUTING MECHANISM**				**9 HOURS**
Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database – Cloud Management Mechanism: Remote Administration System, Resource Management System, SLA Management System, Billing Management System					
MODULE 4	**HADOOP AND MAP REDUCE**				**9 HOURS**
Apache Hadoop – Hadoop Map Reduce –Hadoop Distributed File System- Hadoop I/O- Developing a Map Reduce Application – Map Reduce Types and Formats – Map Reduce Features– Hadoop Cluster Setup – Administering Hadoop.					
MODULE 5	**SECURITY IN THE CLOUD**				**9 HOURS**
Basic Terms and Concepts – Threat Agents – Cloud Security Threats –Cloud Security Mechanism: Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-on, Cloud Based Security Groups Hardened Virtual Server Images.					
OUTCOME EMPLOYABILITY	1. Articulate the main concepts, key technologies, strengths and limitations of cloud computing. 2. Identify the architecture, infrastructure and delivery models of cloud computing. 3. Explain the core issues of cloud computing such as security, privacy and interoperability. 4. Choose the appropriate technologies, algorithms and approaches for the related issues. 5. Facilitate Service Level Agreements (SLA).				

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REFERENCES	1. Thomas Erl, ZaighamMahood, Ricardo Puttini, "Cloud Computing, Concept, Technology & Architecture", Prentice Hall,2013. 2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", TataMcGraw-Hill,2013. 3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach",Tata McGraw-Hill Edition,2010. 4. ArshdeepBahga,VijayMadisetti,"CloudComputing:AHands-OnApproach", Universities Press(India) Private Limited, 2014. 5. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition,2015. 6. John Rittinghouse& James Ransome, "Cloud Computing, Implementation, Management and Strategy", CRC Press,2010.

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2104CP204	MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C
		0	0	4	2
COURSE OBJECTIVE	To apply the concepts of Machine Learning to solve real-world problems To implement basic algorithms in clustering & classification applied to text & numeric data To implement algorithms emphasizing the importance of bagging & boosting in classification & regression To implement algorithms related to dimensionality reduction To apply machine learning algorithms for Natural Language Processing applications				
EXPERIMENT 1	Solving Regression & Classification using Decision Trees				
EXPERIMENT 2	Root Node Attribute Selection for Decision Trees using Information Gain				
EXPERIMENT 3	Bayesian Inference in Gene Expression Analysis				
EXPERIMENT 4	Pattern Recognition Application using Bayesian Inference				
EXPERIMENT 5	Bagging in Classification				
EXPERIMENT 6	Bagging, Boosting applications using Regression Trees				
EXPERIMENT 7	Data & Text Classification using Neural Networks				
EXPERIMENT 8	Using Weka tool for SVM classification for chosen domain application				
EXPERIMENT 9	Data & Text Clustering using K-means algorithm				
EXPERIMENT 10	Data & Text Clustering using Gaussian Mixture Models				
EXPERIMENT 11	Dimensionality Reduction Algorithms in Image Processing applications				
EXPERIMENT 12	Application of CRFs in Natural Language Processing				
OUTCOME EMPLOYABILITY	To learn to use Weka tool for implementing machine learning algorithms related to numeric data To learn the application of machine learning algorithms for text data To use dimensionality reduction algorithms for image processing applications To apply CRFs in text processing applications To use fundamental and advanced neural network algorithms for solving real-world data				

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2104CP205	DATABASE TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2
COURSE OBJECTIVE	To study and implement the basic SQL commands To implement the database design in PL/SQL To implement distributed database, active databases and parallel databases				
EXPERIMENT 1	Working basic SQL commands (DDL, DML, DCL, and TCL)				
EXPERIMENT 2	Executing Single Row and Group Functions				
EXPERIMENT 3	Running SQL queries on Join and Integrity constraints				
EXPERIMENT 4	Implement Simple programs using PL/SQL blocks				
EXPERIMENT 5	Apply the concepts of Exception handling in PL/SQL block				
EXPERIMENT 6	Create Cursors and package in PL/SQL block				
EXPERIMENT 7	Use the concept of Procedures and Function in PL/SQL block				
EXPERIMENT 8	Implement Distributed Database for Bookstore				
EXPERIMENT 9	Active Database -Implementation of Triggers and Assertions for Bank Database				
EXPERIMENT 10	Implement Parallel Database of University Counseling for Engineering colleges				
OUTCOME EMPLOY ABILITY	Execute the basic SQL commands in ORACLE Develop PL/SQL programs in ORACE Implement intelligent databases in MYSQL and ORACLE				

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2104CP206	Mini Project with Seminar	L	T	P	C
		0	0	4	2
Course Objective	1.To develop knowledge to formulate a real world problem and project's goals 2.To identify the various tasks of the project to determine standard procedures 3.To identify and learn new tools, algorithms and techniques 4.To understand the various procedures for validation of the product and analysis the cost effectiveness 5.To understand the guideline to Prepare report for oral demonstrations				
Guidelines	A Mini Project shall be undertaken by the students individually in consultation with the respective faculty and Head of the Department, as specified in the curriculum. Periodically four reviews are conducted and are evaluated by the faculty in charge. A student is expected to make a presentation about the mini-project during the final evaluation and submit the project report.				
Course Outcome EMPLOYABILITY/ ENTERPRENEUR SHIP	After completion of the course, Student will be able to 1. Self-learning various topics. 2. Survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research. 3. Write technical reports. 4. Develop oral and written communication skills to present and defend their work in-front of technically qualified audience.				

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1703CP004 **CLOUD COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the broad perceptive of cloud architecture and model
- To understand the concept of Virtualization
- To be familiar with the lead players in cloud.
- To understand the features of cloud simulator
- To apply different cloud programming model as per need.
- To be able to set up a private cloud.
- To understand the design of cloud Services.
- To learn to design the trusted cloud Computing system

UNIT I CLOUD ARCHITECTURE AND MODEL **9**

Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture. Cloud Models:- Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

UNIT II VIRTUALIZATION **9**

Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data-center Automation.

UNIT III CLOUD INFRASTRUCTURE **9**

Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

UNIT IV PROGRAMMING MODEL **9**

Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments - Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

UNIT V SECURITY IN THE CLOUD **9**

Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

TOTAL: 45 PERIODS

OUTCOMES: EMPLOYABILITY
Upon Completion of the course, the students will be able to
CO1 Compare the strengths and limitations of cloud computing

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CO2	Identify the architecture, infrastructure and delivery models of cloud computing
CO3	Apply suitable virtualization concept.
CO4	Write programming paradigms
CO5	Handle cloud resource management

REFERENCES:

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2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
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8. Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley – India, 2010.
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1703CP016-ADHOC MOBILE WIRELESS NETWORKS

L T P C
3 0 0 3

OBJECTIVES:

- To learn about the issues in the design of ad hoc and wireless sensor networks
- To understand the working of protocols in different layers of ad hoc and sensor networks
- To expose the students to different aspects in ad hoc and sensor networks
- To understand various standards and applications in ad hoc and sensor networks

UNIT I FUNDAMENTALS 9

Introduction to ad hoc networks- Differences between cellular and ad hoc wireless networks- Challenges and issues in ad hoc networks-Introduction to WSN-Single node architecture-Network architecture-Localization and positioning-Operating systems for WSN.

UNIT II MAC AND LINK MANAGEMENT 9

Fundamentals of wireless MAC protocols- Classification of MAC protocols for ad hoc networks-MAC for WSN-Low duty cycle protocols and wakeup concepts-Contention and schedule based protocols-WSN link layer-Error control-Framing-Link management.

UNIT III ROUTING 9

Design issues of routing protocols for ad hoc networks- Classification of routing protocols-Proactive, Reactive and Hybrid routing protocols-Routing in WSN-Naming and addressing-Gossiping and agentbased unicast forwarding- Energy efficient unicast- Broadcast and multicast- Geographic routing-Data-centric and content-based networking.

UNIT IV TRANSPORT LAYER AND QoS 9

Challenges of transport layer protocol in wireless environments- TCP"s challenges and design issues in ad hoc networks-Transport protocols for ad hoc networks-Transport control protocols for WSNs-Issues and challenges in providing QoS in ad hoc networks-Network layer QoS solutions- QoS Model-QoS in wireless sensor networks-Congestion control in network processing.

UNIT V STANDARDS AND APPLICATIONS 9

Wireless sensor network standards-Standards on wireless mesh networks-Applications of ad hoc and WSNs-Case study: Building military border area surveillance system, Forest fire detection system and tsunami early warning system with wireless sensor networks.

TOTAL : 45 PERIODS

OUTCOMES: EMPLOYABILITY

Upon completion of this course students should be able to

CO1 Identify different issues in wireless ad hoc and sensor networks
CO2 Analyze the protocols developed for ad hoc and sensor networks
CO3 Analyse different routing protocols and its applications

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CO4 Determine and analyse different QoS techniques in communication
CO5 Identify and discuss the standards and applications of ad hoc and sensor networks

REFERENCES:

1. SubirKumarSarkar, TGBasavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.
2. C.Siva Ram Murthy, B.S.Manoj, "Ad Hoc Wireless Networks- Architectures and Protocols", Pearson Education, 2004.
3. KazemSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley & Sons, 2007.
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1703CP010-NETWORK AND INFORMATION SECURITY

L T P C
3 0 0 3

OBJECTIVES:

To understand the fundamentals of Cryptography

- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks
- To design security applications in the field of Information technology

UNIT I INTRODUCTION 9

An Overview of Computer Security-Security Services-Security Mechanisms-Security Attacks- Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies.

UNIT II CRYPTOSYSTEMS & AUTHENTICATION 9

Classical Cryptography-Substitution Ciphers-permutation Ciphers-Block Ciphers-DES- Modes of Operation- AES-Linear Cryptanalysis, Differential Cryptanalysis- Hash Function - SHA 512- Message Authentication Codes-HMAC - Authentication Protocols -

UNIT III PUBLIC KEY CRYPTOSYSTEMS 9

Introduction to Public key Cryptography- Number theory- The RSA Cryptosystem and Factoring Integer-Attacks on RSA-The ELGamal Cryptosystem- Digital Signature Algorithm-Finite Fields- Elliptic Curves Cryptography- Key management – Session and Interchange keys, Key exchange and generation-PKI

UNIT IV SYSTEM IMPLEMENTATION 9

Design Principles, Representing Identity, Access Control Mechanisms, Information Flow and Confinement Problem

Secure Software Development: Secured Coding - OWASP/SANS Top Vulnerabilities – Buffer Overflows - Incomplete mediation - XSS - Anti Cross Site Scripting Libraries - Canonical Data Format - Command Injection - Redirection - Inference – Application Controls

UNIT V NETWORK SECURITY 9

Secret Sharing Schemes-Kerberos- Pretty Good Privacy (PGP)-Secure Socket Layer (SSL)- Intruders – HIDS- NIDS - Firewalls - Viruses

TOTAL: 45 PERIODS

OUTCOMES: EMPLOYABILITY

Upon Completion of the course, the students will be able to

CO1 Implement basic security algorithms required by any computing system.
CO2 Analyze the vulnerabilities in any computing system and hence be able to design a security solution
CO3 Analyze the possible security attacks in complex real time systems and their effective countermeasures
CO4 Identify the security issues in the network and resolve it.
CO5 Formulate research problems in the computer security field

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REFERENCES:

1. William Stallings, "Cryptography and Network Security: Principles and Practices", Third Edition, Pearson Education, 2006.
2. Matt Bishop ,"Computer Security art and science ", Second Edition, Pearson Education, 2002
3. Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with Coding Theory" Second Edition, Pearson Education, 2007
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1703CO036	NETWORK ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Wireless Networks
2. Ad hoc and Sensors Networks

COURSE OBJECTIVES:

1. To understand the need for interoperable network management
2. To learn to the concepts and architecture behind standards based network management
3. To understand the concepts and terminology associated with SNMP and TMN
4. To understand network management as a typical distributed application
5. To study the current trends in network management technologies

UNIT I FUNDAMENTALS OF COMPUTER NETWORK TECHNOLOGY **9 Hours**

Network Topology, LAN, Network node components- Hubs, Bridges, Routers, Gateways, Switches, WAN, ISDN Transmission Technology, Communications protocols and standards. Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network

UNIT II OSI NETWORK MANAGEMENT **9 Hours**

OSI Network management model-Organizational model-Information model, communication model. Abstract Syntax Notation - Encoding structure, Macros Functional model CMIP/CMIS.

UNIT III INTERNET MANAGEMENT(SNMP) **9 Hours**

SNMP(V1 and V2)-Organizational model-System Overview, The information model, communication model-Functional model, SNMP proxy server, Management information, protocol remote monitoring- , RMON SMI and MIB, RMON1,RMON2 - A Case Study of Internet Traffic Using RMON.

UNIT IV BROADBAND NETWORK MANAGEMENT **9 Hours**

Broadband networks and services, ATM Technology-VP,VC, ATM Packet, Integrated service, ATMLAN emulation, Virtual LAN. ATM Network Management-ATM Network reference model, integrated local management Interface.ATM Management Information base, Role of SNMD and ILMI in ATM Management, M1, M2, M3, M4Interface. ATM Digital Exchange Interface Management- , TMN conceptual Model - TM Architecture, TMN Management Service Architecture

UNIT V NETWORK MANAGEMENT APPLICATIONS **9 Hours**

Configuration management, Fault management, performance management, Event Correlation Techniques security Management, Accounting management, Report Management, Policy Based Management Service Level Management- Network Management Tools, Network Statistics Measurement Systems – Web Based Management, XML Based Network Management - : Future Directions.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Broadband implementing technologies
2. Communication networks

COURSE OUTCOMES: EMPLOYABILITY

On the successful completion of the course, students will be able to

CO1 Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
CO2 Apply network management standards to manage practical networks.
CO3 Formulate possible approaches for managing OSI network model.
CO4 Use on SNMP for managing the network
CO5 Use RMON for monitoring the behavior of the network

REFERENCES:

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1704CP301 Project Work Phase-I	L T P C 0 0 12 6

OBJECTIVES:

- To identify and describe the problem and scope of project
- To collect, analyze and present data into meaningful information using relevant tools
- To select, plan and execute a proper methodology in problem solving, work independently and ethically
- To present the results in written and oral format effectively and identify basic entrepreneurship skills in project management.

GUIDELINES TO BE FOLLOWED:

A student should work under a project supervisor, a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES: EMPLOYABILITY / ENTREPRENEURSHIP

1. Problem Identification 1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree) 2. List of possible solutions including alternatives and constraints 3. Cost benefit analysis 4. Timeline of activities
2. A report highlighting the design finalization [based on functional requirements and standards (if any)]
3. A presentation including the following: 1. Implementation Phase (Hardware / Software / both) 2. Testing and Validation of the developed system 3. Learning in the Project
4. Consolidated report preparation

TOTAL: 90 PERIODS

ATTESTED
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1704CP401 Project Work Phase-II	L T P C 0 0 24 12

OBJECTIVES:

- To create and describe the problem and scope of project
- To analyze, design and present data into meaningful information using relevant tools
- To select, plan and execute a proper methodology in problem solving, work independently and ethically
- To implement and present the results in written and oral format effectively and identify basic entrepreneurship skills in project management.

GUIDELINES TO BE FOLLOWED:

A student should work under a project supervisor, a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES: EMPLOYABILITY / ENTERPRENEURSHIP

1. Problem Identification 1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree) 2. List of possible solutions including alternatives and constraints 3. Cost benefit analysis 4. Timeline of activities
2. A report highlighting the design finalization [based on functional requirements and standards (if any)]
3. A presentation including the following: 1. Implementation Phase (Hardware / Software / both) 2. Testing and Validation of the developed system 3. Learning in the Project
4. Consolidated report preparation

TOTAL: 120 PERIODS

ATTESTED
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