SRI VENKATESWARA COLLEGE OF ENGINEERING
(An Autonomous Institution, Affiliated to Anna University, Chennai)
SRIPERUMBUDUR TK. - 602 117
DEPARTMENT OF INFORMATION TECHNOLOGY
REGULATION – 2018
M.E Computer Science and Engineering (Networks)
CURRICULUM & SYLLABUS

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Period	L	T	P	C	Pre-Requisite	F/ M
THEORY										
1	MA18185	Applied Probability and Statistics (Common to CP & NW)	FC	4	3	1	0	4	-	F
2	CP18101	Advanced Data Structures and Algorithms (Common to CP & NW)	PC	4	3	1	0	4	-	F
3	CP18102	Advanced Computer Architecture (Common to CP & NW)	PC	3	3	0	0	3	-	F
4	NW18101	Advanced OS Internals	PC	3	3	0	0	3	-	F
5	CP18104	Advanced Software Engineering (Common to CP & NW)	PC	3	3	0	0	3	-	F
6	NW18102	Network Engineering	PC	3	3	0	0	3	-	F
PRACTICALS										
7	NW18111	Advanced Data Structures and Algorithms Laboratory	PC	4	0	0	4	2	-	F
			TOTAL	24	18	2	4	22		

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Period	L	T	P	C	Pre-Requisite	F/ M
THEORY										
1	NW18201	Network Design and Programming	PC	3	3	0	0	3	-	F
2	NW18202	Network Security	PC	3	3	0	0	3	-	F
3	CP18105	Machine Learning Techniques (Common to CP & NW)	PC	3	3	0	0	3	-	F
4	NW18203	Wireless Technologies	PC	3	3	0	0	3	-	F
5	MC18081	Introduction to Research Methodology & IPR	MC	2	2	0	0	2	-	F
6		Professional Elective I	PE	3	3	0	0	3	-	M
7		Professional Elective II	PE	3	3	0	0	3	-	M
PRACTICALS										
8	NW18211	Network Design and Programming Laboratory	PC	4	0	0	4	2	-	F
9	NW18212	Term Paper Writing and Seminar	EEC	2	0	0	2	1	-	F
			TOTAL	26	20	0	6	23		

SEMESTER III

SL. No.	Course Code	Course Title	Category	Contact Period	L	T	P	C	Pre-Requisite	F/ M
THEORY										
1.		Professional Elective III	PE	3	3	0	0	3	-	M
2.		Professional Elective IV	PE	3	3	0	0	3	-	M
3.		Professional Elective V	PE	3	3	0	0	3	-	M
PRACTICALS										
4.	NW18311	Project Phase 1	EEC	12	0	0	12	6	-	F
			TOTAL	21	9	0	12	15		

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Period	L	T	P	C	Pre-Requisite	F/ M
1.	NW18411	Project Phase 2	EEC	24	0	0	24	12	Project Phase I	F
			TOTAL	24	0	0	24	12		

PROFESSIONAL ELECTIVES

Sl.No	Course Code	Course Title	Contact Period	L	T	P	C	Pre requiste	F/M
1	NW18001	Information Storage Management	3	3	0	0	3	-	M
2	NW18002	Embedded Software Development	3	3	0	0	3	-	M
3	NW18003	Parallel Programming and Paradigms	3	3	0	0	3	-	M
4	CP18002	Mobile and Pervasive Computing (Common to CP & NW)	3	3	0	0	3	-	M
5	NW18004	Theoretical Foundations of Computer Science	3	3	0	0	3	-	M
6	CP18011	Cloud Computing Technologies (Common to CP & NW)	3	3	0	0	3	-	M
7	NW18005	Digital Forensics	3	3	0	0	3	-	M
8	CP18024	High Speed Switching Architecture (Common to CP & NW)	3	3	0	0	3	-	M
9	NW18007	Advanced Infrastructure Management	3	3	0	0	3	-	M
10	NW18008	Storage Area Networks	3	3	0	0	3	-	M
11	NW18009	Data Analytics and Business Intelligence	3	3	0	0	3	-	M
12	NW18010	Network Virtualization	3	3	0	0	3	-	M
13	NW18011	Convergence Technologies	3	3	0	0	3	-	M
14	NW18012	Social Network Analysis	3	3	0	0	3	-	M

Total Credits (From Sem I to IV): 72

	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
MA18185	(Common to CP & NW)	**3**	**1**	**0**	**4**

OBJECTIVES

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors - Tests based on Normal, t,2 and F distributions for testing of mean, variance and proportions – 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

TOTAL : 60 PERIODS

OUTCOMES:

The student will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering

REFERENCES:

1. Jay L. Devore, “Probability and Statistics For Engineering and the Sciences”, Thomson and Duxbury, 2002.
2. Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineer”, Prentice Hall, Seventh Edition, 2007.
3. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, Fifth Edition, 2002.
4. Gupta S.C. and Kapoor V.K.”Fundamentals of Mathematical Statistics”, Sultan and Sons, 2001.
5. Dallas E Johnson, “Applied Multivariate Methods for Data Analysis”, Thomson and Duxbury press, 1998.

		L	T	P	C
CP18101	ADVANCED DATA STRUCTURES AND ALGORITHMS	3	1	0	4

(Common to CP & NW)

OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems. To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING 9

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

UNIT II HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree-Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III GRAPHS 9

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm;

UNIT IV ALGORITHM DESIGN TECHNIQUES 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

UNIT V NP COMPLETE AND NP HARD 9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems

TOTAL (L:45+T:15): 60PERIODS

OUTCOMES: Upon the completion of the course the student should be able to

- Design data structures and algorithms to solve computing problems.
- Design algorithms using graph structure and various string matching algorithms to solve real-life problems.
- Apply suitable design strategy for problem solving

REFERENCES:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne,"ALGORITHMS", Fourth Edition, Pearson Education.
3. S.Sridhar,"Design and Analysis of Algorithms", First Edition, Oxford University Press. 2014
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein,"Introduction to Algorithms", Third Edition, Prentice-Hall, 2011.

CP18102	ADVANCED COMPUTER ARCHITECTURE (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading

UNIT II MEMORY HIERARCHY DESIGN 9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT III MULTIPROCESSOR ISSUES 9

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT IV WAREHOUSE SCALE COMPUTERS 9

Introduction to Warehouse-scale computers- Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

TOTAL : 45PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the limitations of ILP.
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Design hierarchal memory system
- Point out how data level parallelism is exploited in architectures

TEXTBOOK:

1. John L. Hennessey and David A. Patterson,"Computer Architecture – A Quantitative Approach", Morgan Kaufmann Elsevier, 5th edition, 2012.

REFERENCES:

1. Darryl Gove, "Multicore Application Programming: For Windows, Linux, and Oracle Solaris", Pearson, 2011

2. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors", Morgan Kauffman, 2010

3. David E. Culler, Jaswinder Pal Singh, "Parallel computing architecture : A hardware / software approach" , Morgan Kaufmann /Elsevier Publishers, 1999

NW18101	ADVANCED OS INTERNALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To be able to read and understand sample open source programs and header files.
- To learn how the processes are implemented in linux.
- To understand the implementation of the Linux file system.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of interprocess communication.
- To understand how program execution happens in Linux.

UNIT I INTRODUCTION 9

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes -Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

UNIT II PROCESSES 9

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - - System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

UNIT III FILE SYSTEM 9

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special File systems - File sytem Type Registration - File sytem Handling - Namespaces - Mounting - Unmounting - Implementation of VFS System Calls.

UNIT IV MEMORY MANAGEMENT 9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

UNIT V PROCESS COMMUNICATION AND PROGRAM EXECUTION 9

Process Communication - Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command-Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions.

TOTAL : 45PERIODS

OUTCOMES: At the end of the course, the student should be able to:

- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the linux kernel for a different software system.

References:

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O' Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, "Structure and Interpretation of Computer Programs", Second Edition, Universities Press, 2013.
3. Maurice J. Bach, "The Design of the Unix Operating System"1st Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, "Linux Kernel Internals", 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, "Linux Kernel Development", 3rd Edition, Addison-Wesley, 2010.

CP18104	ADVANCED SOFTWARE ENGINEERING (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have a clear understanding of Software Engineering concepts.
- To gain knowledge of the Analysis and System Design concepts.
- To learn how to manage change during development.
- To learn the SOA and AOP concepts.

UNIT I INTRODUCTION **9**

System Concepts–Software Engineering Concepts-Software Life Cycle–Development Activities–Managing Software Development–Unified Modeling Language–Project Organization–Communication

UNIT II ANALYSIS **9**

Requirements Elicitation–Use Cases–Unified Modeling Language, Tools–Analysis Object Model (Domain Model)–Analysis Dynamic Models–Non-functional requirements–Analysis Patterns.

UNIT III SYSTEM DESIGN **9**

Overview of System Design–Decomposing the system-System Design Concepts–System Design Activities–Addressing Design Goals–Managing System Design.

UNIT IV IMPLEMENTATION AND MANAGING CHANGE **9**

Programming languages and coding-Human computer interaction-Reusing Pattern Solutions–Specifying Interfaces–Mapping Models to Code–Testing- Rationale Management–Configuration Management–Project Management- Real time interface design(eg: mobile design)

UNIT V ASPECT ORIENTED SOFTWARE DEVELOPMENT **9**

AO Design Principles-Separations of Concerns, Subject Oriented Decomposition, Traits,Aspect Oriented Decomposition, Theme Approach, Designing Base and Crosscutting Themes,Aspect-Oriented Programming using Aspect-J.

TOTAL : 45PERIODS

OUTCOMES: At the end of this course, the students will be able to:

- A clear understanding of Software Engineering concepts.
- Knowledge gained of Analysis and System Design concepts.
- Ability to manage change during development.
- Basic idea of the SOA and AOP concepts.

TEXT BOOKS:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd ed, Pearson Education, 2004.
2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.

References:

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.
2. AspectJ in Action, RamnivasLaddad, Manning Publications, 2003
3. Aspect-Oriented Software Development, Robert E. Filman, TzillaElrad, Siobhan Clarke, and Mehmet Aksit, October 2006.
4. Mastering AspectJ: Aspect-Oriented Programming in Java, Joseph D. Gradecki and Nicholas Lesiecki, March 2003.

NW18102	NETWORK ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide an introduction to the principles and practices of Network Engineering.
- To understand the architecture of the network devices.
- To learn QoS related methodologies.
- To explore the emerging technologies in network engineering.

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.

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 NETWORK DEVICE ARCHITECTURE **9**

Network Devices –Switch–Router–Hardware Components-Software –Configuration–Routing Concepts-Static Routing –Dynamics Routing –Routing Information Protocol –Configuration –Open Shortest Path First Protocol –Configuration –Access Control List –Standard –Extended –Named. Multiplexers, Modems and Internet Access Devices –Switching and Routing Devices-Router Structure -Configuring EGP –RIP –OSPF –IS-IS-Hub -Bridges –Routers –Link Virtualization - Multicast Architecture.

UNIT V SOFTWARE DEFINED NETWORKING **9**

Evolution of SDN -Control Plane - Control and data plane separation - Network Virtualization - Data Plane - Programming SDNs - Verification and Debugging - openflow networks.

TOTAL : 45PERIODS

OUTCOMES:

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

- Explain the of the principles of network engineering.
- Knowledge of network engineering concepts and techniques.
- Recent development in network engineering

REFERENCES:

1. James Macfarlane," Network Routing Basics: Understanding IP Routing in Cisco Systems", Wiley edition 1 2006.
2. Jean Warland and Pravin Vareya, „High Performance Networks", Morgan Kauffman Publishers, 2002
3. Larry L Peterson and Bruce S Davie, „Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufman Publishers, 2012.
4. Mahbub Hassan and Raj Jain, „High Performance TCP/IP Networking", Pearson Education/PHI, 2009.
5. Thomas Nadeau , Ken Gray, "SDN - Software Defined Networks", O'reilly Publishers, 2013.
6. Wendell Odom and Rick McDonald, "Routers and Routing Basics CCNA 2 Companion Guide (Cisco Networking Academy)", Cisco press, 2006.

NW18111	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

EXPERIMENTS:

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation
4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

TOTAL : 60 PERIODS

OUTCOMES:

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

- Design and implement basic and advanced data structures extensively.
- Design algorithms using graph structures
- Design and develop efficient algorithms with minimum complexity using design techniques.

LIST OF EQUIPMENTS:

Computers installed with Linux/Windows OS and C/Java Compiler

NW18201	NETWORK DESIGN AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic networking principles
- To explore various networking devices and protocols required for network design and management
- To study two novel networking technologies: SDN and DTN
- To learn network programming in UNIX C

UNIT I NETWORKING PRINCIPLES 9

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Collision detection and collision avoidance, Hidden and Exposed Terminals – Switched networks – Datagrams, Virtual circuits, Cell switching and Label switching – Wireless Networks – Infrastructure based, ad hoc and hybrid – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions.

UNIT II PHYSICAL NETWORK DESIGN 9

LAN cabling topologies – Ethernet Switches – High speed and Gigabit and 10Gbps – Building cabling topologies and Campus cabling topologies – Routers, Firewalls and L3 switches –Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP - WAN Design and Enterprise Networks – Core networks, distribution networks and access networks

UNIT III LOGICAL DESIGN AND MANAGEMENT 9

IPv4 and IPv6 Dynamic Addressing –Hierarchical routing – VLSMand CIDR – Transition from IPv4 to IPv6 – NAT and DHCP – Static and Dynamic routes – RIP, OSPF and BGP – VPN –RMON and SNMP

UNIT IV INNOVATIVE NETWORKS 9

Software Defined Networks – Evolution of switches and control planes – Centralized and distributed data and control planes – OpenFlow and SDN Controllers – Network Function Virtualization – Needs of the Data Centres – SDN solutions for data centres - Delay Tolerant Networks – Overlay architecture – Bundle Protocol – Opportunistic routing and Epidemic routing

UNIT V NETWORK PROGRAMMING IN UNIX C 9

Socket address structures – Byte ordering and byte manipulation functions – Elementary TCP sockets – socket, connect, bind, listen, accept and close functions – TCP client and server – Elementary UDP sockets –recvfrom and sendto functions , connect function with UDP – Raw sockets – Client-server design alternatives – Iterative and Concurrent servers.

TOTAL: 45PERIODS

OUTCOMES:

After studying this course, the student should be able to:

- Apply the networking principles to design a network
- Apply SDN in computing paradigms like Cloud Computing and Internet of Things
- Configure the networking devices and protocols
- Develop network applications in various platforms

REFERENCES:

1. Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", 5th edition, Morgan Kauffman, 2011
2. ParitoshPuri, M.P.Singh,"Asurvey paper on routing in delay tolerant networks", International Conference on Information and Computer Networks (ISCON), 2013, DOI:10.1109/ICISCON 2013.6524206
3. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kauffman, 2014
4. W.Richard Stevens, Bill Fenner and Andrew M Rudoff, "Unix Network Programming: The Sockets Networking API: Volume 1", 3rd Edition, Addison Wesley, 2003
5. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2011

NW18202	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of network security
- 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 10

Services, Mechanisms and attacks-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

UNIT II BLOCK CIPHERS & PUBLIC KEY ENCRYPTION 10

Data Encryption Standard-Block cipher design principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key encryption: Principles of public key cryptosystems-The RSA algorithm – Key Management - Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT III HASH FUNCTIONS AND DIGITAL SIGNATURES 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC - Digital signature and authentication protocols – DSS – EI Gamal – Schnorr.

UNIT IV E-MAIL, IP & WEB SECURITY 8

E-mail Security: Pretty Good Privacy-S/MIME. IPSecurity: Overview of IPSec - IP security policy-Encapsulation Security Payload (ESP)-Combining Security Associations-Internet Key Exchange. Web Security: Web Security Considerations-Secure Socket Layer(SSL)-Transport Layer Security(TLS)- -Secure Electronic Transaction (SET).

UNIT V SYSTEM SECURITY 8

Authentication applications – Kerberos – X.509 Authentication services - Firewalls – Types of Firewalls- Firewall design principles- Trusted System. Intruders – Intrusion detection – Viruses and related threats – Virus Countermeasures.

TOTAL : 45PERIODS

OUTCOMES:

- Compare various Security Techniques Design Secure applications Inject secure coding in the developed applications
- Implement basic security algorithms required by any computing system.
- Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
- Analyze the possible security attacks in complex real time systems and their effective countermeasures
- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical derivation, modeling, and simulations
- Formulate research problems in the computer security field

REFERENCES:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007.
2. Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
3. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.
4. Charlie Kaufman and Radia Perlman, Mike Speciner, "Network Security", Second Edition, Private Communication in Public World, PHI 2002.
5. Douglas R Simson ,"Cryptography – Theory and practice", First Edition, CRC Press, 1995. . http://nptel.ac.in/.
6. Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003.
7. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 2000.
8. William Stallings," Cryptography and Network Security", 6th Edition, Pearson Education, March 2013.

CP18105	MACHINE LEARNING TECHNIQUES (Common to CP & NW)	L 3	T 0	P 0	C 3

OBJECTIVES

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques.
- To study the various probability based learning techniques.
- To understand graphical models of machine learning algorithms.

UNIT I INTRODUCTION **9**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II LINEAR MODELS **9**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

UNIT III TREE AND PROBABILISTIC MODELS **9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS **9**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

UNIT V GRAPHICAL MODELS **9**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

TOTAL: 45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the apt machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

TEXT BOOK:

1. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014

REFERENCES:

2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
4. Stephen Marsland,"Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall, CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.

NW18203 **L T P C**

WIRELESS TECHNOLOGIES **3 0 0 3**

OBJECTIVES

- To understand the concepts of various wireless technologies
- To review the concepts of wireless networks
- To explore the emerging wireless technologies and their potential impact

UNIT I WIRELESS LAN AND PAN **9**

Introduction, fundamentals of WLAN –technical issues, network architecture, IEEE 802.11- physical layer, Mac layer mechanism, CSMA/CA,RTS/CTS, Polling, Bluetooth- User scenarios, Architecture, Radio layer, Baseband layer, Link manager protocol, L2CAP, Security, SDP, IEEE 802.15.3. 19

UNIT II WIRELESS INTERNET **9**

Introduction –wireless internet, address mobility, inefficiency of transport layer and Application layer protocol, mobile IP – simultaneous binding, route optimization, mobile IP variations, handoffs, IPv6 advancements, IP for wireless domain, security in mobile IP, TCP in wireless domain – TCP over wireless , TCPs -traditional, snoop, indirect, mobile, transaction- oriented, impact of mobility.

UNIT III AD-HOC SENSOR NETWORK **9**

Wireless Sensor Network – Applications, design Challenges, Protocol stack, comparisons with MANET node architecture, network architecture, MAC protocols-requirements, IEEE 802.15.4 MAC protocol, Routing Protocol –energy aware routing, Location based routing, clustering, aggregation, QoS, security protocol, Zigbee standard.

UNIT IV 3G NETWORKS **9**

Evolution from GSM, 3G Services and Applications - UMTS network structure - Core network - UMTS Radio access - HSPA – HSUPA- HSDPA- CDMA 1X - EVDO Rev -0, Rev-A, Rev-B, Rev-C Architecture- Protocol stack, Cognitive Radio network, Spectrum Sensing.

UNIT V 4G - LTE **9**

Overview of LTE Networks - Need for LTE- From LTE to LTE-Advanced SAE :- LTE Architecture, Radio Protocol stack , Interfaces, Concept of HetNET, Quality of Service and Bandwidth Reservation - QoS metrics, Signaling for Bandwidth Requests and Grants, Bandwidth Allocation and Traffic Handling, Mobility Management, Security Protocols.

TOTAL : 45PERIODS

OUTCOMES: Upon successful completion of this course, a student will be able to:

- To design the various wireless networks.
- To be able to design the 4G and LTE networks
- To design application sensor networks.
- To design Heterogeneous networks

REFERENCES:

1. Abd-Elhamid M. Taha and Hossam S. Hassanein and Najah Abu Ali, "LTE, LTE-Advanced and Wimax towards IMT-advanced networks" John Wiley &Sons , 2012.
2. HarriHolma and Antti Toskala, "HSDPA/HSUPA for UMTS", John Wiley & Sons, 2006.
3. Holger Karl and Andreas Willing,"Protocols and Architecture for Wireless Sensor Network", John Wiley & Sons, 2007.
4. Jochen Schiller, "Mobile Communication", Pearson education, 2nd edition 2005.
5. JuhaKorhonen, "Introduction to 3G Mobile Communication", Artech House, 2003.
6. Larry J. Greenstein, Andrea J. Goldsmith, "Principles of Cognitive Radio", Cambridge University press, 2013.
7. Vijay. K. Garg,"Wireless Communication and Networking", Morgan Kaufmann Publishers, 2007.

MC18081 INTRODUCTION TO RESEARCH METHODOLOGY AND IPR **L T P C**
2 0 0 2

OBJECTIVES:

- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection.

UNIT I RESEARCH METHODOLOGY **6**

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, Plagiarism, Research ethics

UNIT II RESULTS AND ANALYSIS **6**

Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.

UNIT III TECHNICAL WRITING **6**

Effective technical writing, how to write a manuscript/ responses to reviewers comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment by a review committee

UNIT IV INTELLECTUAL PROPERTY RIGHTS **6**

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT.

UNIT V PATENT RIGTS AND NEW DEVELOPMENTS IN IPR **6**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, students will be able to

- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understand research problem formulation & Analyze research related information and Follow research ethics
- Correlate the results of any research article with other published results. Write a review article in the field of engineering.
- Appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

TEXT BOOKS:

1. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005.
2. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.
3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

REFERENCES:

1. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.
2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students', Juta & Company, 1996.
3. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.
4 Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5 Mayall , "Industrial Design", McGraw Hill, 1992.
6 Niebel , "Product Design", McGraw Hill, 1974.
7 Asimov , "Introduction to Design", Prentice Hall, 1962.

NW18211	NETWORK DESIGN AND PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To practice LAN and WAN design
- To learn network programming in UNIX C and Python
- Establish a LAN with a switch/hub with 3 PCs and check the connectivity and configuration
- Establish a internetwork with 2 routers and two or more LANs using static routes and check the connectivity and configuration
- Establish a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration
- In the internetwork created in experiment number 4, analyze the performance of various TCP variants using an FTP application

NETWORK PROGRAMMING

- Develop a C program that demonstrates inter process communication
- Develop a TCP client/server application
- Develop a UDP client/server application
- Develop an Iterative UDP server with 2 or 3 clients
- Develop a concurrent TCP server with 2 or 3 clients
- Develop a multiprotocol server with TCP and UDP and 2 clients
- Develop simple Python programs that use frequently used syntactic constructs
- Develop a Socket based application in Python
- Build client applications for major APIs (Amazon S3, Twitter etc) in Python
- Develop an application that interacts with e-mail servers in python
- Develop applications that work with remote servers using SSH, FTP etc in Python

TOTAL :60 PERIODS

OUTCOMES:

After completing this course the student should be able to

- Design and implement LANs and internetworks
- Develop network based applications in UNIX C and Python

LIST OF EQUIPMENTS:

Computers with Linux/Windows OS, C/Java/Python

NW18001	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the storage architecture and available technologies
- To learn to establish & manage datacenter
- To learn security aspects of storage & data center

UNIT I STORAGE TECHNOLOGY 9

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities

UNIT II STORAGE SYSTEMS ARCHITECTURE 9

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS 9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identifysingle points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

TOTAL : 45PERIODS

REFERENCES:

1.EMC Corporation, Information Storage and Management, Wiley, India.
2. Robert Spalding, “Storage Networks: The Complete Reference“, Tata McGraw Hill , Osborne, 2003.
3. Marc Farley, “Building Storage Networks”, Tata McGraw Hill ,Osborne, 2001.
4. Additional resource material on www.emc.com/resource-library/resource-library.esp.

NW18002	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.
- To study, analyze and design applications on embedded systems.

UNIT I EMBEDDED PROCESSORS **9**

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioural Description - ARM Processor - Intel ATOM Processor.

UNIT II EMBEDDED COMPUTING PLATFORM **9**

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT III EMBEDDED NETWORK ENIVIRONMENT **9**

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT IV REAL-TIME CHARACTERISTICS **9**

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT V SYSTEM DESIGN TECHNIQUES **9**

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

TOTAL : 45PERIODS

OUTCOMES:

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

- Understand different architectures of embedded processor, microcontroller and peripheral devices. Interface memory and peripherals with embedded systems.
- Work with embedded network environment.
- Understand challenges in Real time operating systems.
- Design and analyze applications on embedded systems.

REFERENCES:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013
2. Andrew N Sloss, D. Symes, C. Wright, "Arm system developers guide", Morgan Kauffman/ Elsevier, 2006.
3. ArshdeepBahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach" VPT First Edition, 2014
4. C. M. Krishna and K. G. Shin, "Real-Time Systems" , McGraw-Hill, 1997
5. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley & Sons.
7. Jane.W.S. Liu, "Real-Time systems", Pearson Education Asia.
8. Michael J. Pont, "Embedded C", Pearson Education , 2007.
9. Muhammad Ali Mazidi , SarmadNaimi , SepehrNaimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C" Pearson Education, First edition, 2014
10. Steve Heath, "Embedded System Design" , Elsevier, 2005
11. Wayne Wolf,"Computers as Components:Principles of Embedded Computer System Design", Elsevier, 2006.

NW18003 PARALLEL PROGRAMMING PARADIGMS

L	T	P	C
3	0	0	3

OBJECTIVES

- To familiarize the issues in parallel computing.
- To describe distributed memory programming using MPI.
- To understand shared memory paradigm with Pthreads and with OpenMP.
- To learn the GPU based parallel programming using OpenCL.

UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING 9

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats- coordinating processes/ threads- hybrid model – shared memory model and distributed memory model -I/O – performance of parallel programs-– parallel program design.

UNIT II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD-programs– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm

UNIT III SHARED MEMORY PARADIGM WITH PTHREADS 9

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety-Pthreads case study.

UNIT IV SHARED MEMORY PARADIGM: OPENMP 9

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search

UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA 9

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object - case study. Introduction to CUDA programming.

TOTAL : 45PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify issues in parallel programming.
- Develop distributed memory programs using MPI framework.
- Design and develop shared memory parallel programs using Pthreads and using OpenMP.
- Implement Graphical Processing OpenCL programs.

REFERENCES:

1. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, "OpenCL programming guide", Addison Wesley, 2011
2. M. J. Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
3. Peter S. Pacheco, "An introduction to parallel programming", Morgan Kaufmann, 2011.
4. Rob Farber, "CUDA application design and development", Morgan Haufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, "Using MPI: Portable parallel programming with the message passing interface", Second Edition, MIT Press, 1999

CP18002	MOBILE AND PERVASIVE COMPUTING (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the characteristics, basic concepts and systems issues in mobile and pervasive computing
- To familiar with the network protocol stack.
- To learn the latest mobile telecommunication system.
- To introduce the characteristic features of Ad-hoc wireless networks and their applications to the students.
- To introduce the pervasive computing device technology

UNIT I INTRODUCTION **9**

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile Computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues- Pervasive computing- Basics and Vision- Principle of pervasive computing

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER **9**

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – Route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP performance

UNIT III MOBILE TELECOMMUNICATION SYSTEM **9**

Migration to 3G network- IMT 2000 and UMTS- UMTS Architecture- USer Equipment- Radio Network system-UTRAN- NodeB- RNC Function-USIM- 4G- LTE- Control Plane- NAS and RRC

UNIT IV MOBILE AD-HOC NETWORKS **9**

Ad-Hoc Basic Concepts – Characteristics – ApplicationsDesign Issues of Routing Protocols for Ad Hoc Networks- Classification of Routing Protocols- Proactive Routing- WRP, DSDV, OLSR Protocol- Reactive Routing- AODV, DSR, TORA, CBRP Protocol- Hybrid Routing.- ZRP, ZHLS

UNIT V PERVASIVE COMPUTING **9**

Pervasive computing infrastructure-applications- Device Technology - Hardware, Human-machine Interfaces, Biometrics, and Operating systems– Device Connectivity –Protocols, Security, and Device Management- Pervasive Web Application architecture-Access from PCs and PDAs - Access via WAP

TOTAL : 45PERIODS

OUTCOMES:

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

- To introduce the characteristics, basic concepts and systems issues in mobile and pervasive computing
- To learn the latest mobile telecommunication system.
- To introduce the characteristic features of Ad-hoc wireless networks and their applications to the students.
- To introduce the pervasive computing device technology

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, PHI, Second Edition, 2003.
2. Jochen Burthardt et al , “Pervasive computing: Technology and Architecture of mobile Internet application ", pearson educaiton, 2003.

REFERENCES:

1. Asoke K Talukder, hasan Ahmed, Roopa R Yavagal, "Mobile Computing: Technology, Applicaitons and service creations", 2nd edition , Tata MCGraw Hill, 2010.
2. Frank Adeistein, “Fundamentals of mobile and pervasive computing”, Tata MCGraw Hill, 2005.

NW18004	THEORETICAL FOUNDATIONS OF COMPUTER SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To review sets, relations, functions, and other foundations
- To understand propositional and predicate logics and their applications
- To understand lambda calculus and functional programming
- To understand graph structures and their applications
- To understand formal models of computation, computability, and decidability

UNIT I FOUNDATIONS **9**

Sets – relations – equivalence relations – partial orders – functions – recursive functions – sequences – induction principle – structural induction – recursive algorithms – counting – pigeonhole principle – permutations and combinations – recurrence relations

UNIT II LOGIC AND LOGIC PROGRAMMING **9**

Propositional logic – syntax – interpretations and models – deduction theorems – normal forms
– inference rules – SAT solvers – Davis Putnam procedure – binary decision diagrams – predicate logic – syntax – proof theory – semantics of predicate logic – Normal form – unification – inferences in first-order logic – logic programming – definite programs – SLD resolution – normal programs – SLDNF resolution – introduction to Prolog

UNIT III LAMBDA CALCULUS AND FUNCTIONAL PROGRAMMING **9**

Lambda notation for functions – syntax – curried functions – parametric polymorphism – lambda reduction – alpha reduction – beta reduction – beta abstraction – extensionality theorem – delta reduction – reduction strategies – normal forms – Church-Rosser Theorems – pure lambda calculus – constants – arithmetic – conditionals – Iteration – recursion – introduction to functional programming

UNIT IV GRAPH STRUCTURES **9**

Tree Structures – Graph structures – graph representations – regular graph structures – random graphs – Connectivity – Cycles – Graph Coloring – Cliques, Vertex Covers, Independent sets – Spanning Trees – network flows – matching

UNIT V STATE MACHINES **9**

Languages and Grammars – Finite State Machines – State machines and languages – Turing Machines – Computational Complexity – computability – Decidability – Church's Thesis

TOTAL: 45PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able

- To explain sets, relations, functions
- To conduct proofs using induction, pigeonhole principle, and logic
- To apply counting, permutations, combinations, and recurrence relations
- To apply recursive functions and lambda calculus
- To explain logic programming and functional programming principles
- To apply sequential structures, tree structures, and graph structures
- To explain computational models, computability, and complexity

REFERENCES:

1. Uwe Schoning, “Logic for Computer Scientists”, Birkhauser, 2008.
2. M. Ben-Ari, “Mathematical logic for computer science”, Second Edition, Springer, 2003.
3. John Harrison, “Handbook of Practical Logic and Automated Reasoning”, Cambridge University Press, 2009.
4. Greg Michaelson, “An introduction to functional programming through lambda calculus”, Dover Publications, 2011.
5. Kenneth Slonneger and Barry Kurtz, “Formal syntax and semantics of programming languages”, Addison Wesley, 1995.
6. Kenneth H. Rosen, “Discrete Mathematics and its applications”, Seventh Edition, Tata McGraw Hill, 2011.
7. Sriram Pemmaraju and Steven Skiena, “Computational Discrete Mathematics”, Cambridge University Press, 2003.
8. M. Huth and M. Ryan, “Logic in Computer Science – Modeling and Reasoning about systems”, Second Edition, Cambridge University Press, 2004.
9. Norman L. Biggs, “Discrete Mathematics”, Second Edition, Oxford University Press, 2002.
10. Juraj Hromkovic, “Theoretical Computer Science”, Springer, 1998.
11. J. E. Hopcroft, Rajeev Motwani, and J. D. Ullman, “Introduction to Automata Theory, Languages, and Computation”, Third Edition, Pearson, 2008.

CP18011	CLOUD COMPUTING TECHNOLOGIES (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of virtualization and virtual machines
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

UNIT I VIRTUALIZATION **9**

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation –Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

UNIT II VIRTUALIZATION INFRASTRUCTURE **9**

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT III CLOUD PLATFORM ARCHITECTURE **9**

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

UNIT IV PROGRAMMING MODEL **9**

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT V CLOUD SECURITY **9**

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management

TOTAL : 45PERIODS

OUTCOMES:

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

- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing

- Develop services using Cloud computing
- Apply the security models in the cloud environment

TEXT BOOKS:

1. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner‟s Guide", McGraw-Hill Osborne Media, 2009.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

REFERENCES:

4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O'Reilly Media, Inc.,2009.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
7. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

NW18005	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Have an understanding of the fundamental concepts of forensic science.
- Have a basic understanding of the application of forensic science principles to digital evidence examinations.
- Be able to articulate the steps of the forensic process as applied to digital evidence.
- Be able to draft a Standard Operating Procedure.
- Conduct rudimentary digital forensic examinations.

UNIT I INTRODUCTION **9**

Introduction - Digital Forensics - Digital Evidence - Increasing Awareness of Digital Evidence - Digital Forensics: Past, Present, and Future – Principles - Challenging Aspects of Digital Evidence – Cyber trail - Language of Computer Crime Investigation - Role of Computers in Crime

UNIT II EVIDENCE AND INVESTIGATIONS **9**

Evidence in the Courtroom - Duty of Experts – Admissibility - Levels of Certainty in Digital Forensics - Direct versus circumstantial evidence - Scientific Evidence - Presenting Digital Evidence - Conducting Digital Investigations - Digital Investigation Process Models - Scaffolding for Digital Investigations - Applying the Scientific Method in Digital Investigations - Investigative Scenario: Security Breach

UNIT III OPEN SOURCE EXAMINATION PLATFORM **9**

Open Source Examination Platform - Using Linux and Windows as the Host, Disk and File System Analysis, Media Analysis Concepts , Sleuth Kit, Partitioning and Disk Layouts, Special Containers, Hashing

UNIT IV DISK AND FILE SYSTEM ANALYSIS **9**

Imaging, Internet Artifacts, Browser & Mail Artifacts, File Analysis, Image, Audio, Video, Archives, Documents, Graphical Investigation Environments, PyFLAG, Fiwalk, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition.

UNIT V LAWS AND ACTS **9**

Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.

TOTAL : 45PERIODS

OUTCOMES:

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

- Have an idea regarding the fundamental concepts of forensic science.
- Can apply the concepts and will be able to collect digital evidence.
- Able to Implement the forensic concepts in open platform.
- Able to apply the Standard Operating Procedure.
- Present the forensic evidence in terms of Legal procedure.

References:

1. Cory Altheide and Harlan Carvey, "Digital Forensics with Open Source Tools", Elsevier publication, 3rd Edition, April 2011

2. Eoghan Casey , "Digital Evidence and Computer Crime, Forensic Science, Computers, and the Internet", Elsevier, 3rd Edition, 2011

3. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics ", TataMcGraw - Hill, New Delhi, 2006

4. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.

5. Robert M Slade," Software Forensics", Tata McGraw - Hill, New Delhi, 2005.

CP18024	HIGH SPEED SWITCHING ARCHITECTURES (Common To CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of switching
- To explore the various space division switches
- To evaluate the performance of various switching architectures
- To study the architecture of IP routers
- To study about MPLS switches

UNIT I SWITCHING BASICS **9**

Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals

UNIT II SWITCHING ARCHITECTURES **9**

Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks –Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches

UNIT III PACKET QUEUES AND DELAY ANALYSIS **9**

Littles theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – PollaczekKhinchine formula –M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burkes theorem and Jackson theorem.

UNIT IV P ROUTER ARCHITECTURE **9**

Bus based router architecture with single processor and multiple processors – Architecture with multiple parallel forwarding engines – Switch based router architecture with multiple processors – Switch based router architecture with multiple processors – Switch based architecture with fully distributed processors – Critical and non critical data path processing – fast and slow path.

UNIT V MPLS ROUTERS **9**

MPLS – Layer 2.5 - Labels – Switching and Distribution –Label Switched Path – Label Forwarding Instance Base – Label Stacking - IP Lookup vs Label lookup – Label Distribution Protocol – MPLS based VPNs– Label switching – Label switched path – Comparison with ATM technology.

TOTAL : 45PERIODS

OUTCOMES:

At the end of this course one should be able to:

- Apply switching concepts to build networks.
- Deploy the network with appropriate type of switches.
- Select and configure the appropriate type of IP router.
- Design and implement MPLS networks.

TEXT BOOKS:

1. Damitri P Bertsekas and Gallager, "Data Networks", 2nd edition, PHI, 1992
2. Elhanany, Itamar, Hamdi and Mounir, "High Performance Packet Switching Architectures", Springer 2007

REFERENCES:

1. H.Jonathan Chao and Bin Liu, "High Performance Switches and Routers", John Wiley and Sons, 2007
2. Howard C Berkowitz, "Designing Routing and Switching Architectures for Enterprise Networks", Sams, 1999
3. Luc De Ghein, "MPLS Fundamentals", Cisco Press 2014.

NW18007	ADVANCED INFRASTRUCTURE MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT I INFRASTRUCTURE MANAGEMENT OVERVIEW 9

Infrastructure management activities, Preparing for Infrastructure Management Factors to consider in designing IT organizations and IT infrastructure, Determining customer's Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems, Models, Information Technology Infrastructure Library (ITIL).

UNIT II DIFFERENT STORAGE TECHNOLOGIES AND VIRTUALIZATION 9

Challenges in Data Storage and Management, Data Storage Infrastructure. Components of a Storage System Environment,Intelligent Storage System (ISS) and its components, Implementation of ISS as high-end and midrange storage arrays. Introduction to Networked Storage: Evolution of networked storage, Architecture, Overview of FC-SAN, NAS, and IP-SAN. Network-Attached Storage (NAS): Benefits of NAS, Components, Implementations, File Sharing, I/O operations, Performance and Availability. Content Addressed Storage (CAS): features and Benefits of a CAS. CAS Architecture, Storage and Retrieval, Examples. Storage Virtualization: Forms, Taxonomy, Configuration, Challenges, Types of Storage Virtualizations. Overview of emerging technologies such as Cloud storage, Virtual provisioning, Unified Storage, FCOE, FAST.

UNIT III NETWORK INFRASTRUCTURE 9

Implementing, Managing and Maintaining IP Addressing; Configure TCP/IP addressing on a server computer using DHCP; Implementing, Managing and Maintaining Name Resolution using DNS Server; Implementing, Managing and Maintaining Routing and Remote Access; Configure remote access authentication protocols; Implement secure access between private networks; Manage Routing and Remote Access routing interfaces; Maintaining a Network Infrastructure.

UNIT IV 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. Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards.

UNIT V CASE STUDY 9

Devops Infrastructure Management, Container Infrastructure Management, Engine yard PaaS,Docker Infrastructure Management.

TOTAL (L:45): 45PERIODS

REFERENCES:

1.G. Somasundaram, Alok Shrivastava, EMC Educational Services, Information Storage and Management, Wiley India.

2.Robert Spalding, “Storage Networks: The Complete Reference“, Tata McGraw Hill, Osborne, 2003. 3. Marc Farley, “Building Storage Networks”, Tata McGraw Hill, Osborne, 2001.

3.Jan Van Bon, “Foundations of IT Service Management: based on ITIL”, Van Haren Publishing, 2nd edition 2005.

NW18008	STORAGE AREA NETWORKS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **9**

Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle Components of Storage System Environment, Disk Drive Components, Disk Drive Performance, Fundamental Laws Governing Disk Performance, Logical Components of the Host, Application Requirements and Disk Performance.

UNIT II INTELLIGENT STORAGE SYSTEM **9**

Hot Spares Components of an Intelligent Storage System, Intelligent Storage Array, Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, Overview of Fibre Channel, The SAN and Its Evolution, Components of SAN, FC Connectivity, Fibre Channel Ports, Fibre Channel Architecture, Zoning, Fibre Channel Login Types, FC Topologies.

UNIT III NETWORK ATTACHED STORAGE **9**

Purpose Service vs. NAS Devices, Benefits of NAS, NAS File I / O, Components of NAS, NAS Implementations, NAS File-Sharing Protocols, NAS I/O Operations, Factors Affecting NAS Performance and Availability. iSCSI, FCIP.

UNIT IV CONTENT-ADDRESSED STORAGE AND STORAGE VIRTUALIZATION **9**

Fixed Content and Archives, Types of Archive, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples Forms of Virtualization, SNIA Storage Virtualization Taxonomy, Storage Virtualizations Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.

UNIT V SECURING AND MANAGING THE STORAGE INFRASTRUCTURE **9**

Storage Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking Monitoring the Storage Infrastructure, Storage Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution.

TOTAL: 45PERIODS

REFERENCES:

1. G. Somasundaram, A. Shrivastava, EMC Corporation : Information Storage and Management, 1st Edition, wiley publishing, 2009.
2. Robert Spalding, Storage Networks : The Complete Reference, 1st Edition, TMH, 2003.
3. Marc Farley : Building Storage Networks, 2nd Edition, Tata McGraw Hill, Osborne, 2001.
4. Meeta Gupta : Storage Area Network Fundamentals, 2nd Edition, Pearson Education Limited, 2002.
5. Barker, R., & Massiglia, P. (2002) Storage Area Network Essentials (2nd ed.) New York, NY: John Wiley & Sons, Inc. ISBN: 0-471- 03445-5.
6. Clark, T. (2001) IP SANs: A Guide to iSCSI, and FCIP Protocols for torage Area Networks Boston, MA: Addison Wesley (Pearson Education) ©2002 ISBN: 0-201-75277-8.

NW18009 DATA ANALYTICS AND BUSINESS INTELLIGENCE

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand linear regression models
- To understand logistic regression models
- To understand generalized linear models
- To understand simulation using regression models
- To understand causal inference
- To understand multilevel regression
- To understand data collection and model understanding

UNIT I LINEAR REGRESSION 9

Introduction to data analysis – Statistical processes – statistical models – statistical inference – review of random variables and probability distributions – linear regression – one predictor – multiple predictors – prediction and validation – linear transformations – centering and standardizing – correlation – logarithmic transformations – other transformations – building regression models – fitting a series of regressions

UNIT II LOGISTIC AND GENERALIZED LINEAR MODELS 9

Logistic regression – logistic regression coefficients – latent-data formulation – building a logistic regression model – logistic regression with interactions – evaluating, checking, and comparing fitted logistic regressions – identifiability and separation – Poisson regression – logistic-binomial model – Probit regression – multinomial regression – robust regression using *t* model – building complex generalized linear models – constructive choice models

UNIT III SIMULATION AND CAUSAL INFERENCE 9

Simulation of probability models – summarizing linear regressions – simulation of non-linear predictions – predictive simulation for generalized linear models – fake-data simulation – simulating and comparing to actual data – predictive simulation to check the fit of a time-series model – causal inference – randomized experiments – observational studies – causal inference using advanced models – matching – instrumental variables

UNIT IV MULTILEVEL REGRESSION 9

Multilevel structures – clustered data – multilevel linear models – partial pooling – group-level predictors – model building and statistical significance – varying intercepts and slopes – scaled inverse-Wishart distribution – non-nested models – multi-level logistic regression – multi-level generalized linear models

UNIT V DATA COLLECTION AND MODEL UNDERSTANDING 9

Design of data collection – classical power calculations – multilevel power calculations – power calculation using fake-data simulation – understanding and summarizing fitted models – uncertainty and variability – variances – R2 and explained variance – multiple comparisons and statistical significance – analysis of variance – ANOVA and multilevel linear and general linear models – missing data imputation

TOTAL : 45PERIODS

OUTCOMES:

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

- Build and apply linear regression models
- Build and apply logistic regression models
- Build and apply generalized linear models
- Perform simulation using regression models
- Perform casual inference from data
- Build and apply multilevel regression models
- Perform data collection and variance analysis

REFERENCES:

1. Andrew Gelman and Jennifer Hill, "Data Analysis using Regression and multilevel/Hierarchical Models", Cambridge University Press, 2006.
2. Philipp K. Janert, "Data Analysis with Open Source Tools", O'Reilley, 2010.
3. Wes McKinney, "Python for Data Analysis", O'Reilley, 2012.
4. Davinderjit Sivia and John Skilling, "Data Analysis: A Bayesian Tutorial, Second Edition, Oxford University Press, 2006.
5. Robert Nisbelt, John Elder, and Gary Miner, "Handbook of statistical analysis and data mining applications", Academic Press, 2009.
6. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
7. John Maindonald and W. John Braun, "Data Analysis and Graphics Using R: An Examplebased Approach", Third Edition, Cambridge University Press, 2010.
8. David Ruppert, "Statistics and Data Analysis for Financial Engineering", Springer, 2011.

NW18010	NETWORK VIRTUALIZATION	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **12**

Virtualization-need, Virtualization Technologies :Server Virtualization, Hardware emulation, Storage Virtualization, Network-attached storage, Storage area networks, I/O Virtualization, Network Virtualization, Client Virtualization, Application virtualization, Desktop virtualization, Case study: Studying Server Consolidation, Development and Test Environments , Quality of Service, Simple failover High availability, Clustering ,Data mirroring, Data replication, IT Operational Flexibility, Load balancing, Server pooling, Helping with Disaster Recovery, Rethinking Virtualization in Business Terms : Rethinking Infrastructure Virtualization, Rethinking Applications and IT Operations Management, Rethinking Client Virtualization, Benefits of Virtualization.

UNIT II INTRODUCTION TO VMWARE VIRTUALIZATION **9**

Introduce virtualization, virtual machines, and vSphere components, server, network, and storage virtualization, vSphere . Create Virtual Machine VMware vCenter Server: Introduction to vCenter Server architecture and appliance , Virtual Machine Management :Deploy virtual machines using templates and cloning, Modify and manage virtual machines, Create and manage virtual machine snapshots, Perform VMware vSphere® vMotion® and Storage vMotion migrations, Create a vSpherevApp.

UNIT III ACCESS AND AUTHENTICATION CONTROL **6**

Control user access through roles and permissions, Configure and manage the ESXi firewall, Configure ESXi lockdown mode, Integrate ESXi with Active Directory, Introduce VMware vShield Zones.

UNIT IV INSTALLING VMWARE COMPONENTS **7**

Introduce ESXi installation, Describe boot from SAN requirements, Introduce vCenter Server deployment options, Describe vCenter Server hardware, software, and database requirements, Install vCenter Server (Windows based).

UNIT V IMPLEMENT AND CONFIGURE WINDOW SERVER 2008 HYPER V **11**

Configure Hyper V Virtual Networking, Configure and use Hyper V remote administration, Create and configure Virtual Hard Drives, Use Virtual Machine snapshots, Describe considerations for configuring Hyper-V servers for high availability, Monitor the performance of a Hyper-V server, use existing virtual machines with Hyper-V server, understand issues with migrating existing virtual machines to Hyper-V, Understand system center Virtual Machine Manager (VMM) features and use VMM to manage virtual machines, Manage a VMM Library, Manage VMM checkpoint.

TOTAL: 45PERIODS

REFERENCES:

1. Virtualization: a beginner's guide - Danielle Ruest, Nelson Ruest , McGraw-Hill Prof Med, 2010.
2. Windows Server 2008 Hyper-V: Insiders Guide to Microsoft's Hypervisor By John Kelbley, Mike Sterling, Allen Stewart, Sybex; 1 edition (April 20, 2009).
3. Virtualization for Dummies - Bernard Golden, For Dummies; 1 edition (December 5, 2007).
4. Mastering Microsoft Virtualization - Tim Cerling, Jeffrey Buller, Jeffrey L. Buller, Sybex; 1 edition (December 21, 2009).

NW18011	CONVERGENCE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of Convergence Technologies, its standards and protocols
- To appreciate the concepts of multimedia convergence and network convergence
- To understand the insight on the application of convergence technologies in real time scenario.

UNIT I INTRODUCTION **9**

Convergence Technologies Overview of convergence, Benefits of Converged network, Challenges, Types of convergence, OSI layered perspective: Possible convergence at each layer and protocol modifications, Switching Networks ATM, Packet Switched Networks, Circuit Switched Networks, Frame Relays.

UNIT II CONVERGENCE STANDARDS AND PROTOCOLS **9**

Voice Compression, VOIP Convergence, H.323 protocol, SIP, Media Gateway Control, Protocol (MGCP), MEGACO.

UNIT III MULTIMEDIA CONVERGENCE **9**

Coding Standards, Compression Techniques, Lossy and Lossless, MPEG,H.264 Compression, Voice and Video Coding and Speech Processing , Benefits by convergence of broadcasting and telecommunications, IPCablecom, Interoperability among broadcasting systems, Media Networking, Multi Services over MPLS, Multimedia Security, Multimedia Quality of Service, IP TV.

UNIT IV WIRELESS TECHNOLOGY AND NETWORK CONVERGENCE **9**

Wireless Standards, IEEE 802.11, HYPERLAN, IEEE 802.15.4, Wireless ATM , Wireless Internet, Wireless Convergence, Broadband Wireless Access, Sensor Networks, Zigbee and Protocol stack, RFID.

UNIT V CONVERGENCE CASE STUDIES **9**

Home Integration Technologies, IP Convergence, Convergence for NGN , Smart City, Smart e-Mall, Fixed mobile convergence, The Walt Disney Company, The Tribune Company, Viacom Inc., AOL Time Warner.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Build a convergence network in real time scenarios.
- Identify the different components of convergence technologies.

REFERENCES:

1. Multimedia Communications Directions and Innovations By Jerry Gibson Academic Press.
2. ATM Networks Concepts and Protocols by Sumeet Kasera and Pankaj Sethi Tata McGraw.
3. Ad Hoc Wireless Network: Architectures and Protocols, by C. Siva Ram Murthy B.S. Manoj. Pearson.

NW18012	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of Social networks and Web Social Networks
- To appreciate the modeling and visualizing techniques associated with Social Networks
- To understand the different techniques used to mine communities from Web Social Networks
- To appreciate concepts of evolution and prediction in Social Networks
- To understand the application of text mining techniques for Content and Opinion mining

UNIT I INTRODUCTION **9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis – Development of Social Network Analysis - Key concepts and measures in network analysis – Discussion networks - Blogs and online communities - Web-based networks.

UNIT II MODELING AND VISUALIZATION **9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data - RandomWalks and their Applications –Use of Hadoop and MapReduce - Ontological representation of social individuals and relationships.

UNIT III MINING COMMUNITIES **9**

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT IV EVOLUTION **9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities – Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models

UNIT V V TEXT AND OPINION MINING **9**

Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering -Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time.

TOTAL (L:45): 45PERIODS

OUTCOMES:

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

- Build a social network data set from existing social networking sites
- Identify the different components of a web social network that can be used for analyzing and mining
- Identify the different data structures and graph algorithms that can be used for web social network mining
- Implement a community detection algorithm
- Design an application that uses various aspects of Social Network Mining to improve its functionality and to harvest information available on the web to build recommender systems
- Analyze social media data using appropriate data/web mining techniques

REFERENCES:

1. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011
2. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition 2007.
3. Borko Furht, "Handbook of Social Network Technologies and Applications",Springer, 1st edition, 2010**.**
4. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2011.
5. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis",Springer, 2010.
6. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.
7. Toby Segaran, "Programming Collective Intelligence", O'Reilly, 2012