SRI VENKATESWARA COLLEGE OF ENGINEERING
(An Autonomous Institution, Affiliated to Anna University, Chennai)
SRIPERUMBUDUR TK. - 602 117
DEPARTMENT OF INFORMATION TECHNOLOGY
REGULATION – 2016
M.E. COMPUTER SCIENCE AND ENGINEERING
(NETWORKS)
CURRICULUM AND SYLLABUS

SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	MA16187	Applied Probability and Statistics	3	1	0	4
2	CP16101	Design and Management of Computer Networks	3	0	0	3
3	CP16102	Advanced Data Structures and Algorithms	3	0	0	3
4	CP16103	Multicore Architectures	3	0	0	3
5		Elective I	3	0	0	3
6		Elective II	3	0	0	3
PRACTICALS						
7	CP16111	Advanced Data Structures Laboratory	0	0	4	2
8	CP16112	Case Study - Network Design (Team Work)	0	0	2	1
		TOTAL	**18**	**1**	**6**	**22**

SEMESTER II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CP16201	Theoretical Foundations of Computer Science	3	1	0	4
2	NW16201	Network Programming	3	0	0	3
3	NW16202	Network and Information Security	3	0	0	3
4	CP16202	Advanced Databases	3	0	0	3
5		Elective III	3	0	0	3
6		Elective IV	3	0	0	3
PRACTICALS						
7	CP16211	Advanced Database Laboratory	0	0	4	2
8	NW16211	Case Study - Network Protocol and Security Implementation (Team Work)	0	0	2	1
		TOTAL	**18**	**1**	**6**	**22**

SEMESTER III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	NW16301	Ubiquitous Computing	3	1	0	4
2	NW16302	Network Performance Analysis	3	0	0	3
3		Elective V	3	0	0	3
4		Elective VI	3	0	0	3
PRACTICALS						
1	NW16311	Project Work (Phase I)	0	0	12	6
		TOTAL	**12**	**1**	**12**	**19**

SEMESTER IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICALS						
1	NW16411	Project Work (Phase II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

ELECTIVE I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CP16002	Performance Evaluation of Computer Systems	3	0	0	3
2	CP16004	Data Analysis and Business Intelligence	3	0	0	3
3	CP16005	Image Processing and Analysis	3	0	0	3
4	CP16007	Parallel Programming Paradigms	3	0	0	3
5	CP16009	Speech Processing and Synthesis	3	0	0	3

ELECTIVE II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	NW16001	Multimedia Communication Networks	3	0	0	3
2	NW16002	Sensing Techniques and Sensors	3	0	0	3
3	NW16003	Mobile and Pervasive Computing	3	0	0	3
4	NW16004	Web Engineering	3	0	0	3
5	NW16005	Network Protocols	3	0	0	3

ELECTIVE III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CP16008	Software Requirements Engineering	3	0	0	3
2	CP16011	Concurrency Models	3	0	0	3
3	CP16012	Real Time Systems	3	0	0	3
4	CP16013	Computer Vision	3	0	0	3
5	CP16015	Software Architectures	3	0	0	3

ELECTIVE IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	NW16006	Protocols and Architecture for Wireless Sensor Networks	3	0	0	3
2	NW16007	Simulation of Computer Systems and Networks	3	0	0	3
3	NW16008	Network Management	3	0	0	3
4	NW16009	4G Technologies	3	0	0	3
5	NW16010	High Speed Switching Architecture	3	0	0	3

ELECTIVE V

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	NW16011	Advanced Network Algorithms	3	0	0	3
2	NW16012	Next Generation Networks	3	0	0	3
3	CU16201	Wireless Communication Networks	3	0	0	3
4	NW16013	Convergence Technology	3	0	0	3

ELECTIVE VI

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	NW16014	Advanced Infrastructure Management	3	0	0	3
2	NW16023	Network Virtualization	3	0	0	3
3	NW16024	Advanced Cognitive Radio Networks	3	0	0	3
4	NW16025	Storage Area Networks	3	0	0	3

MA16187 APPLIED PROBABILITY AND STATISTICS

L	T	P	C
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 HYPOTHESES 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 problems.

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.

CP16101 DESIGN AND MANAGEMENT OF COMPUTER NETWORKS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO NETWORK MANAGEMENT **9**

Overview of Analysis, Architecture and Design Process-System Methodology, Service methodology, Service Description - Service characteristics - Performance Characteristics-Network supportability - Requirement analysis – User Requirements – Application Requirements – Device Requirements – Network Requirements – Other Requirements-Requirement specification and map.

UNIT II REQUIREMENTS ANALYSIS **9**

Requirement Analysis Process – Gathering and Listing Requirements- Developing service metrics – Characterizing behavior – Developing RMA requirements – Developing delay Requirements - Developing capacity Requirements - Developing supplemental performance Requirements – Requirements mapping – Developing the requirements specification.

UNIT III FLOW ANALYSIS **9**

Individual and Composite Flows – Critical Flows - Identifying and developing flows – Data sources and sinks – Flow models- Flow prioritization – Flow specification algorithms - Example Applications of Flow Analysis.

UNIT IV NETWORK ARCHITECTURE **9**

Architecture and design – Component Architectures – Reference Architecture – Architecture Models – System and Network Architecture – Addressing and Routing Architecture – Addressing and Routing Fundamentals – Addressing Mechanisms – Addressing Strategies – Routing Strategies – Network Management Architecture – Network Management Mechanisms Performance Architecture – Performance Mechanisms – Security and Privacy Architecture – Planning security and privacy Mechanisms.

UNIT V NETWORK DESIGN **9**

Design Concepts – Design Process - Network Layout – Design Traceability – Design Metrics – Logical Network Design – Topology Design – Bridging, Switching and Routing Protocols- Physical Network Design – Selecting Technologies and Devices for Campus and Enterprise Networks – Optimizing Network Design.

TOTAL: 45 PERIODS

REFERENCES:

1. Network Analysis, Architecture, and Design By James D. McCabe, Morgan Kaufmann, Third Edition, 2007.ISBN-13: 978-0123704801
2. Computer Networks: A Systems Approach by Larry L. Peterson, Bruce S. Davie - 2007, Elsevier Inc.
3. Top-down Network Design: [a Systems Analysis Approach to Enterprise Network Design] By Priscilla Oppenheimer, Cisco Press , 3rd Edition, ISBN-13: 978-1-58720- 283-4 ISBN-10: 1-58720-283-2

4. Integrated Management of Networked Systems: Concepts, Architectures, and Their Operational Application (The Morgan Kaufmann Series in Networking), Heinz-Gerd Hegering, Sebastian Abeck, and Bernhard Neumair, 1999.
5. "Network Design and Management" – by Steven T.Karris, Orchard publications, Second edition, Copyright 2009, ISBN 978-1-934404-15-7
6. "Network Design, Management and Technical Perspective", Teresa C. Mann-Rubinson and Kornel Terplan, CRC Press, 1999
7. "Ethernet Networks-Design, Implementation, Operation and Management by Gilbert Held, John Wiley and sons, Fourth Edition.
8. James Kurose and Keith Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 1999.

CP16102 ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the principles of iterative and recursive algorithms.
- To learn the graph search algorithms.
- To study network flow and linear programming problems.
- To learn the hill climbing and dynamic programming design techniques.
- To develop recursive backtracking algorithms.
- To get an awareness of NP completeness and randomized algorithms.
- To learn the principles of shared and concurrent objects.
- To learn concurrent data structures.

UNIT I ITERATIVE AND RECURSIVE ALGORITHMS

Iterative Algorithms: Measures of Progress and Loop Invariants-Paradigm Shift: Sequence of Actions versus Sequence of Assertions- Steps to Develop an Iterative Algorithm-Different Types of Iterative Algorithms-Typical Errors-Recursion-Forward versus Backward- Towers of Hanoi-Checklist for Recursive Algorithms-The Stack Frame-Proving Correctness with Strong Induction-Examples of Recursive Algorithms-Sorting and Selecting Algorithms-Operations on Integers-Ackermann‘s Function- Recursion on Trees-Tree Traversals- Examples- Generalizing the Problem - Heap Sort and Priority Queues-Representing Expressions.

UNIT II OPTIMISATION ALGORITHMS

Optimization Problems-Graph Search Algorithms-Generic Search-Breadth-First Search-Dijkstra‘s Shortest Weighted-Path -Depth-First Search-Recursive Depth-First Search-Linear Ordering of a Partial Order- Network Flows and Linear Programming-Hill Climbing-Primal Dual Hill Climbing-Steepest Ascent Hill Climbing-Linear Programming-Recursive Backtracking-Developing Recursive Backtracking Algorithm- Pruning Branches-
Satisfiability.

UNIT III DYNAMIC PROGRAMMING ALGORITHMS

Developing a Dynamic Programming Algorithm-Subtle Points- Question for the Little Bird-Subinstances and Subsolutions-Set of Subinstances-Decreasing Time and Space-Number of Solutions-Code. Reductions and NP Completeness-Satisfiability-Proving NP-Completeness- 3-Coloring- Bipartite Matching. Randomized Algorithms-Randomness to Hide Worst Cases-Optimization Problems with a Random Structure.

UNIT IV SHARED OBJECTS AND CONCURRENT OBJECTS

Shared Objects and Synchronization -Properties of Mutual Exclusion-The Moral -The Producer–Consumer Problem -The Readers–Writers Problem-Realities of Parallelization-Parallel Programming- Principles- Mutual Exclusion-Time- Critical Sections--Thread Solutions-The Filter Lock-Fairness-Lamport‘s Bakery Algorithm Bounded Timestamps-Lower Bounds on the Number of Locations-Concurrent Objects- Concurrency and Correctness-Sequential Objects-Quiescent Consistency- Sequential Consistency-Linearizability- Formal Definitions- Progress Conditions-The Java Memory Model.

UNIT V CONCURRENT DATA STRUCTURES

Practice-Linked Lists-The Role of Locking-List-Based Sets-Concurrent Reasoning- Coarse-Gra Synchronization-Fine-Grained Synchronization-Optimistic Synchronization- Lazy Synchronization-NonBlocking Synchronization-Concurrent Queues and the ABA Problem-Queues-A Bounded Partial Queue-An Unbounded Total Queue-An Unbounded Lock-Free Queue-Memory Reclamation and the ABA Problem- Dual Data Structures- Concurrent Stacks and Elimination- An Unbounded Lock -Free Stack- Elimination-The Elimination Backoff Stack.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design and apply iterative and recursive algorithms.
- Design and implement optimisation algorithms in specific applications.
- Design appropriate shared objects and concurrent objects for applications.
- Implement and apply concurrent linked lists, stacks, and queues.

REFERENCES:

1. Jeff Edmonds, "How to Think about Algorithms", Cambridge University Press, 2008.

2. M. Herlihy and N. Shavit, "The Art of Multiprocessor Programming", Morgan Kaufmann, 2008.

3. Steven S. Skiena, "The Algorithm Design Manual", Springer, 2008.

4. Peter Brass, "Advanced Data Structures", Cambridge University Press, 2008.

5. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, "Algorithms" , McGrawHill, 2008.

6. J. Kleinberg and E. Tardos, "Algorithm Design", Pearson Education, 2006.

7. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithms ",PHI Learning Private Limited, 2012.

8. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, 1995.

9. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, "The Design and Analysis of Computer Algorithms**",** AddisonWesley, 1975.

10. A. V. Aho, J. E. Hopcroft, and J. D. Ullman,"Data Structures and Algorithms", Pearson,2006.

CP16103 MULTICORE ARCHITECTURES L T P C
3 0 0 3

OBJECTIVES:

- To understand the recent trends in the field of Computer Architecture and identify performance related parameters.
- To appreciate the need for parallel processing.
- To expose the students to the problems related to multiprocessing.
- To understand the different types of multicore architectures.
- To expose the students to warehouse-scale and embedded architectures.

UNIT I FUNDAMENTALS OF QUANTITATIVE DESIGN AND ANALYSIS 9

Classes of Computers – Trends in Technology, Power, Energy and Cost – Dependability – Measuring, Reporting and Summarizing Performance – Quantitative Principles of Computer Design – Classes of Parallelism - ILP, DLP, TLP and RLP - Multithreading - SMT and CMP Architectures – Limitations of Single Core Processors - The Multicore era – Case Studies of Multicore Architectures.

UNIT II DLP IN VECTOR, SIMD AND GPU ARCHITECTURES 9

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

UNIT III TLP AND MULTIPROCESSORS 9

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

UNIT IV RLP AND DLP IN WAREHOUSE-SCALE ARCHITECTURES 9

Programming Models and Workloads for Warehouse-Scale Computers – Architectures for Warehouse-Scale Computing – Physical Infrastructure and Costs – Cloud Computing – Case Studies.

UNIT V ARCHITECTURES FOR EMBEDDED SYSTEMS 9

Features and Requirements of Embedded Systems – Signal Processing and Embedded Applications – The Digital Signal Processor – Embedded Multiprocessors - Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the limitations of ILP and the need for multicore architectures.
- Discuss the issues related to multiprocessing and suggest solutions.
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Critically analyze the different types of inter connection networks.
- Discuss the architecture of GPUs, warehouse-scale computers and embedded processors.

REFERENCES:

1. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier, 5th. edition, 2012.
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill Education, 2003.
3. Richard Y. Kain, "Advanced Computer Architecture a Systems Design Approach", PHI, 2011.
4. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture : A Hardware/ Software Approach" , Morgan Kaufmann / Elsevier, 1997.

CP16111 ADVANCED DATA STRUCTURES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To learn to implement iterative and recursive algorithms.
- To learn to design and implement algorithms using hill climbing and dynamic programming techniques.
- To learn to implement shared and concurrent objects.
- To learn to implement concurrent data structures.

LAB EXERCISES:

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:

- Implementation of graph search algorithms.
- Implementation and application of network flow and linear programming problems.
- Implementation of algorithms using the hill climbing and dynamic programming design techniques.
- Implementation of recursive backtracking algorithms.
- Implementation of randomized algorithms.
- Implementation of various locking and synchronization mechanisms for concurrent linked lists, concurrent queues, and concurrent stacks.
- Developing applications involving concurrency.

TOTAL: 45 PERIODS

OUTCOMES:

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

- 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 optimisation algorithms for specific applications.
- Design and implement randomized algorithms.
- Design appropriate shared objects and concurrent objects for applications.
- Implement and apply concurrent linked lists, stacks, and queues.

REFERENCES:

1. Jeff Edmonds, “How to Think about Algorithms”, Cambridge University Press, 2008.
2. M. Herlihy and N. Shavit, “The Art of Multiprocessor Programming”, Morgan Kaufmann, 2008.
3. Steven S. Skiena, “The Algorithm Design Manual”, Springer, 2008.
4. Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008.
5. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, “Algorithms” , McGrawHill, 2008.
6. J. Kleinberg and E. Tardos, "Algorithm Design”, Pearson Education, 2006.
7. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, “Introduction to Algorithms”, PHI Learning Private Limited, 2012.
8. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, Cambridge University Press, 1995.
9. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, “The Design and Analysis of Computer Algorithms**”,** AddisonWesley, 1975.
10. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures and Algorithms”, Pearson,2006.

CP16112	CASE STUDY: NETWORK DESIGN (Team Work)	L	T	P	C
		0	0	4	2

CASE STUDY: 1

Analyzing the performance of various configurations and protocols in LAN.

1.1. Establishing a Local Area Network (LAN):

The main objective is to set up a Local Area Network, concepts involved in this network are IP addressing and the Address Resolution Protocol (ARP). The required equipments are192.168.1.1 ,192.168.1.2, 192.168.1.3, Host A Host B Host C, Switch/HUB, three PC`s equipped with at least one NIC, one HUB or Switch and the necessary cables. Once the physical LAN is set up the hosts need to be configured using the if config command. To verify communication among the machines the ping command is used. Next, to manipulate the routing tables at the hosts to understand how machines know where to send packets. Since the if config command places a default route into the routing tables this route must be deleted. to ´blindfoldˇ the machine. The ping command is used again to show that communication is no longer available. To re-establish communication the routes are put back into the routing table one host at a time. Communication is once again verified using the ping command.

1.2. Connecting two LANs using multi-router topology with static routes:

The main objective is to extend routing connection by using multiple routers. The concepts include IP addressing and basic network routing principles. Connect two LANs topology. During router configuration attention is paid to the types of interfaces as additional issues are involved with setup. For example, the serial interfaces require clocking mechanisms to be set correctly. Once the interfaces are working the ping command is used to check for communication between LANs. The failure of communication illustrates the need for routes to be established inside the routing infrastructure. Static routes are used to show how packets can be transported through any reasonable route. It is run trace route on two different configurations to demonstrate the implementation of different routes.

1.3. Analyzing the performance of various configurations and protocols:

Original TCP versus the above modified one: To compare the performance between the operation of TCP with congestion control and the operation of TCP as implemented. The main objective is for students to examine how TCP responds to a congested network. The concepts involved in the lab include network congestion and the host responsibilities for communicating over a network. This lab requires three PC's connected to a switch. One PC is designated as the target host and the other two PC's will transfer a file from the target host using FTP. A load is placed on the network to simulate congestion and the file is transferred, first by the host using the normal TCP and then by the host using the modified version. This procedure is performed multiple times to determine average statistics. The students are then asked to summarize the results and draw conclusions about the performance differences and the underlying implications for hosts operating n a network environment.

Case Study 2:

RIP and OSPF Redistribution:

This case study addresses the issue of integrating Routing Information Protocol (RIP) networks

with Open Shortest Path First (OSPF) networks. Most OSPF networks also use RIP to communicate with hosts or to communicate with portions of the internetwork that do not use OSPF. This case study should provide examples of how to complete the following phases in redistributing information between RIP and OSPF networks, including the following topics:

- Configuring a RIP Network
- Adding OSPF to the Center of a RIP Network
- Adding OSPF Areas
- Setting Up Mutual Redistribution.

Case Study 3:

Dial-on-Demand Routing:

This case study should describe the use of DDR to connect a worldwide network that consists of a central site located in Mumbai and remote sites located in Chennai, Bangalore, and Hyderabad.
The following scenarios should be considered:

- Having the Central Site Dial Out
  Describe the central and remote site configurations for three setups: a central site with one interface per remote site, a single interface for multiple remote sites, and multiple interfaces for multiple remote sites. Include examples of the usage of rotary groups and access lists.
- Having the Central and Remote Sites Dial In and Dial Out
  Describe the central and remote site configurations for three setups: central site with one inter face per remote site, a single interface for multiple remote sites, and multiple interfaces for multiple remote sites. Also describes the usage of Point-to-Point Protocol (PPP) encapsulation and the Challenge Handshake Authentication Protocol (CHAP).
- Having Remote Sites Dial Out
  A common configuration is one in which the remote sites place calls to the central site but the central site does not dial out. In a "star" topology, it is possible for all of the remote routers to have their serial interfaces on the same subnet as the central site serial interface.
- Using DDR as a Backup to Leased Lines
  Describes the use of DDR as a backup method to leased lines and provides examples of how to use floating static routes on single and shared interfaces.
- Using Leased Lines and Dial Backup
  Describes the use of Data Terminal Ready (DTR) dialing and V.25bis dialing with leased lines.

Case Study 4:

Network Security:

This case study should provide the specific actions you can take to improve the security of your network. Before going into specifics, however, you should understand the following basic concepts that are essential to any security system:

- Know your enemy
  This case study refers to attackers or intruders. Consider who might want to circumvent your security measures and identify their motivations. Determine what they might want to do and the damage that they could cause to your network. Security measures can never

make it impossible for a user to perform unauthorized tasks with a computer system. They can only make it harder. The goal is to make sure the network security controls are beyond the attacker's ability or motivation.

- Count the cost
  Security measures almost always reduce convenience, especially for sophisticated users. Security can delay work and create expensive administrative and educational overhead. It can use significant computing resources and require dedicated hardware. When you design your security measures, understand their costs and weigh those costs against the potential benefits. To do that, you must understand the costs of the measures themselves and the costs and likelihoods of security breaches. If you incur security costs out of proportion to the actual dangers, you have done yourself a disservice.
- Identify your assumptions
  Every security system has underlying assumptions. For example, you might assume that your network is not tapped, or that attackers know less than you do, that they are using standard software, or that a locked room is safe. Be sure to examine and justify your assumptions. Any hidden assumption is a potential security hole.
- Control your secrets
  Most security is based on secrets. Passwords and encryption keys, for example, are secrets. Too often, though, the secrets are not really all that secret. The most important part of keeping secrets is knowing the areas you need to protect. What knowledge would enable someone to circumvent your system? You should jealously guard that knowledge and assume that everything else is known to your adversaries. The more secrets you have, the harder it will be to keep all of them. Security systems should be designed so that only a limited number of secrets need to be kept.
- Know your weaknesses
  Every security system has vulnerabilities. You should understand your system's weak points and know how they could be exploited. You should also know the areas that present the largest danger and prevent access to them immediately. Understanding the weak points is the first step toward turning them into secure areas.
- Limit the scope of access
  You should create appropriate barriers inside your system so that if intruders access one part of the system, they do not automatically have access to the rest of the system. The security of a system is only as good as the weakest security level of any single host in the system.
- Remember physical security
  Physical access to a computer (or a router) usually gives as sufficiently sophisticated user total control over that computer. Physical access to a network link usually allows a person to tap that link, jam it, or inject traffic into it. It makes no sense to install complicated software security measures when access to the hardware is not controlled.

Case Study 5:

Controlling Traffic Flow:

In this case study, the firewall router allows incoming new connections to one or more communication servers or hosts. Having a designated router act as a firewall is desirable because it

clearly identifies the router's purpose as the external gateway and avoids encumbering other routers with this task. In the event that the internal network needs to isolate itself, the fire wall router provides the point of isolation so that the rest of the internal network structure is not affected. Connections to the hosts are restricted to incoming file transfer protocol (FTP) requests and email services. The incoming Telnet, or modem connections to the communication server are screened by the communication server running TACACS username authentication.

Case Study 6:

Defining Access Lists:

Access lists define the actual traffic that will be permitted or denied, whereas an access group applies an access list definition to an interface. Access lists can be used to deny connections that are known to be a security risk and then permit all other connections, or to permit those connections that are considered acceptable and deny all the rest. For firewall implementation, the latter is the more secure method. In this case study, incoming email and news are permitted for a few hosts, but FTP, Telnet, and rlogin services are permitted only to hosts on the firewall subnet. IP extended access lists (range 100 to 199) and transmission control protocol (TCP) or user datagram protocol (UDP) port numbers are used to filter traffic. When a connection is to be established for email, Telnet, FTP, and so forth, the connection will attempt to open a service on a specified port number. You can, therefore, filter out selected types of connections by denying packets that are attempting to use that service. An access list is invoked after a routing decision has been made but before the packet is sent out on an interface. The best place to define an access list is on a preferred host using your favorite text editor. You can create a file that contains the access-list commands, place the file (marked readable) in the default TFTP directory, and then network load the file onto the router.

Case Study 7:

Configuring a fire wall

Consider a Fire wall communication server with single inbound modem. Configure the modem to ensure security for LAN

Case Study 8:

Integrating EIGRP (Enhanced Interior Gateway Routing Protocol) into Existing Networks:

The case study should provide the benefits and considerations involved in integrating Enhanced IGRP into the following types of internetworks:

- IP—The existing IP network is running IGRP
- Novell IPX—The existing IPX network is running RIP and SAP
- AppleTalk—The existing AppleTalk network is running the Routing Table Maintenance Protocol (RTMP).

When integrating Enhanced IGRP into existing networks, plan a phased implementation. Add Enhanced IGRP at the periphery of the network by configuring Enhanced IGRP on a boundary router on the backbone off the core network. Then integrate Enhanced IGRP into the core network.

CP16201 THEORETICAL FOUNDATIONS OF COMPUTER SCIENCE

L	T	P	C
3	1	0	4

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 **12**

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 **12**

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 firstorder logic – logic programming – definite programs – SLD resolution – normal programs – SLDNF resolution – introduction to Prolog.

UNIT III LAMBDA CALCULUS AND FUNCTIONAL PROGRAMMING **12**

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 **12**

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 **12**

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

TOTAL: 45 PERIODS

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.

NW16201 NETWORK PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand interprocess and inter-system communication.
- To understand socket programming in its entirety.
- To understand usage of TCP/UDP / Raw sockets.
- To understand how to build network applications.

UNIT I INTRODUCTION **9**

Overview of UNIX OS - Environment of a UNIX process - Process control – Process relationships Signals – Interprocess Communication- overview of TCP/IP protocols.

UNIT II ELEMENTARY TCP SOCKETS **9**

Introduction to Socket Programming –Introduction to Sockets – Socket address Structures – Byte ordering functions – address conversion functions – Elementary TCP Sockets – socket, connect, bind, listen, accept, read, write , close functions – Iterative Server – Concurrent Server.

UNIT III APPLICATION DEVELOPMENT **9**

TCP Echo Server – TCP Echo Client – Posix Signal handling – Server with multiple clients – boundary conditions: Server process Crashes, Server host Crashes, Server Crashes and reboots, Server Shutdown – I/O multiplexing – I/O Models – select function – shutdown function– TCP echo Server (with multiplexing) – poll function – TCP echo Client (with Multiplexing).

UNIT IV SOCKET OPTIONS, ELEMENTARY UDP SOCKETS **9**

Socket options – getsocket and setsocket functions – generic socket options – IP socket options – ICMP socket options – TCP socket options – Elementary UDP sockets – UDP echo Server – UDP echo Client – Multiplexing TCP and UDP sockets – Domain name system – gethostbyname function – Ipv6 support in DNS – gethostbyadr function – getservbyname and getservbyport functions.

UNIT V ADVANCED SOCKETS **9**

Ipv6 interoperability – threaded servers – thread creation and termination –TCP echo server using threads – Mutexes – condition variables – raw sockets – raw socket creation – raw socket output – raw socket input – ping program – trace route program.

TOTAL: 45 PERIODS

OUTCOMES:

- To write socket API based programs.
- To design and implement client-server applications using TCP and UDP sockets.
- To analyze network programs.

REFERENCES:

1. W. Richard Stevens, B. Fenner, A.M. Rudoff, "Unix Network Programming – The Sockets Networking API", 3rd edition, Pearson, 2004.
2. W. Richard Stevens, S.A Rago, "Programming in the Unix environment", 2nd edition, Pearson, 2005.

NW16202 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:

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

- 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. 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.
4. Jonathan Katz, and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press, 2007.
5. Douglas R. Stinson, "Cryptography Theory and Practice", Third Edition, Chapman & Hall/CRC, 2006.
6. Wenbo Mao, "Modern Cryptography – Theory and Practice", Pearson Education, First Edition, 2006.
7. Network Security and Cryptography, Menezes Bernard, Cengage Learning, New Delhi, 2011.
8. Man Young Rhee, Internet Security, Wiley, 2003.
9. OWASP top ten security vulnerabilities: http://xml.coverpages.org/OWASP-TopTen.pdf.

CP16202	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the modelling and design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented database.
- To understand the principles of intelligent databases.
- To understand the usage of advanced data models.
- To learn emerging databases such as XML, Cloud and Big Data.
- To acquire inquisitive attitude towards research topics in databases.

UNIT I PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies.

UNIT II OBJECT AND OBJECT RELATIONAL DATABASES 9

Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle – Case Studies.

UNIT III INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- TSQL2- Deductive Databases: Logic of Query Languages – Datalog- Recursive Rules-Syntax and Semantics of Datalog Languages- Implementation of Rules and Recursion- Recursive Queries in SQL- Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures- Spatial Access Methods- Spatial DB Implementation.

UNIT IV ADVANCED DATA MODELS 9

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models -Concurrency Control - Transaction Commit Protocols- Multimedia Databases- Information Retrieval- Data Warehousing- Data Mining- Text Mining.

UNIT V EMERGING TECHNOLOGIES **9**

XML Databases: XML-Related Technologies-XML Schema- XML Query Languages- Storing XML in Databases-XML and SQL- Native XML Databases- Web Databases- Geographic Information Systems- Biological Data Management- Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models- Query Languages- Introduction to Big Data-Storage-Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Select the appropriate high performance database like parallel and distributed database.
- Model and represent the real world data using object oriented database.
- Design a semantic based database to meaningful data access.
- Embed the rule set in the database to implement intelligent databases.
- Represent the data using XML database for better interoperability.
- Handle Big data and store in a transparent manner in the cloud.
- To solve the issues related to the data storage and retrieval.

REFERENCES:

1. R. Elmasri, S. B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education / Addison Wesley, 2007.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Fifth Edition, McGraw Hill, 2006.
4. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
5. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition 2004.

CP16211	ADVANCED DATABASE LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. Implement parallel sorting and aggregates.
2. Implement parallel joins and Hash joins.
3. Implement semi join and bloom join in distributed DBMS.
4. Implement two phase commit in distributed DBMS.
5. Implementation of cube operator in OLAP queries in data warehousing and decision support system.
6. Implement decision tree of data mining problem.
7. Implement a priori algorithm in data mining.
8. Simulation of a search engine.
9. Implement view modification and materialization in data warehousing and decision support systems.
10. Implementation of data log queries for deductive databases (Negation, Aggregate, Recursive etc.).
11. Implement R Trees in spatial databases.
12. Implementation of spatial database queries.

Minimum 8 to 10 experiments based on the syllabus and above experiment list should be implemented using ORACLE / MSSQL SERVER / JAVA.

TOTAL: 45 PERIODS

NW16211	CASE STUDY: NETWORK PROTOCOL AND SECURITY IMPLEMENTATION (Team Work)	L	T	P	C
		0	0	2	1

1. **A real-time, confidential, bulk amount of data is to be transferred across a network. Write programs to transfer the data applying the following conditions** :

The data is to be transferred in real time, so the data packet should be given higher priority among others. Since it is more confidential, implement some security algorithm so that the hackers never hack the data.It is a bulk amount of data. So, there should not be any data loss.Apply suitable networking protocols and implement the above scenario. Give examples and explanations for the other protocols which are not appropriate.

2. **Consider the following scenario and answer the questions below.**

A network administrator receives an alert from the central virus console reporting that approximately 5 percent of the machines in a local area network have been infected with the latest virus. In addition to the alert message it also lists the IP addresses of the infected machines.

1. As a lab administrator, what will be your immediate action after the threat alert? Develop corrective and preventive measures for the threat mentioned above. Perform an analysis which measures the percentage of loss the threat may create in network system when the threat goes undetected for a week, a month and a year.
2. Build a security system which detects the following threat in a computer system and measures the tolerance of every system in the network against the threat. Software which when installed in a computer of a Local Area Network slowly migrates to every other computer in the network in few months or year.

TOTAL: 30 PERIODS

NW16301	UBIQUITOUS COMPUTING	L	T	P	C
		3	1	0	4

UNIT I INTRODUCTION **9**

Ubiquitous computing Properties, Environment Interaction, Architectural design for Ubicom systems, Application and Requirements - Smart Devices - CCI, CPI, iHCI and HPI, Smart Environments - CCI and CPI- Applications in Virtual, Human and Physical world.

UNIT II CONTEXT AWARE SYSTEM **9**

Modelling Context Aware system, Mobility Awareness, Spatial Awareness, Temporal Awareness.

UNIT III INTELLIGENT SYSTEM **9**

Introduction, Types of IS, Types of environment for IS,IS Architectures, Semantic KB IS, Classical Logic IS, Soft computing IS Models ,IS system operation ,Interaction Multiplicity ,Generic Interaction Application, Autonomous System and Artificial Life.

UNIT IV UBIQUITOUS COMMUNICATION **9**

Introduction, Audio networks, Data Networks, Wireless Data networks, Ubiquitous Networks, Network design issues, Management of Smart Devices.

UNIT V CASE STUDY **9**

A Centroid - GPS Model to Improving Positioning Accuracy for a sensitive location based system, Network Assisted Teaching System, Automatic adjustment of Outdoor LED Display Brightness, Security in Cloud Environment.

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

REFERENCES:

1. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions", Wiley, 2009.
2. Frank Adelstein Sandeep K. S. Gupta Golden G. Richard III Loren Schwiebert "Fundamentals of Mobile and Pervasive Computing, ", McGraw-Hill, 2005.
3. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing: Technology, Applications and Service Creation", 2nd ed, Tata McGraw Hill, 2010.
4. James J. Jong Hyuk Park, Yi Pan, Han-Chieh Chao, Gangman Yi Ubiquitous Computing Application and Wireless Sensor: UCAWSN-14 ,Springer 2014.

NW16302 NETWORK PERFORMANCE ANALYSIS

L	T	P	C
3	0	0	3

UNIT I QUEUING PARADIGM **9**

Introduction to Queuing theory- Queuing Models-Case Study I : Performance Model of Distributed File Service- Case Study II: Single bus multiprocessor modelling- Case Study III: TeraNet, A Light wave Network- Case Study IV: Performance Model of a shared medium packet switch.

UNIT II NETWORK OF QUEUES **9**

Product Form Solution – Open Networks- Local Balance- Closed Queuing networks- The BCMP generalization- Algebraic Topological Interpretation-Recursive Solution of Non Product form Networks- Queuing networks with Negative Customers.

UNIT III ADAPTIVE BANDWIDTH SHARING FOR ELASTIC TRAFFIC **9**

Elastic Transfers in a Network- Network parameters and Performance Objectives- Sharing a single link- Rate based Control- Window based control- TCP: The Internet's Adaptive window protocol.

UNIT IV PERFORMANCE AND ARCHITECTURAL ISSUES **9**

Performance measures: packet switches- Circuit switches- Architectural issues- Queuing in packet switches-FIFO queuing at input and output- Combined input output queuing-delay analysis-Variable length packet switches- Non-FIFO input Queued switches- Emulating output queuing with input queuing.

UNIT V MULTIPLE ACCESS WIRELESS NETWORK **9**

Bits over a wireless link: Principles, Issues, and Trades-off .Bits over a wireless network-TCP performance over wireless Links- Adaptive and Cross layer techniques-Random Access: Aloha, S-Aloha and CSMA/CA-Wireless Local Area Networks- Wireless ad-hoc networks- Link Scheduling and Network capacity-Wireless Sensor network –An overview.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Robertazzi T G, Computer Networks and Systems: Queuing Theory and Performance Evaluation, 2nd, Edition, Springer-Verlag, 1994. *(Unit 1,2)*
2. Anurag Kumar, D. Manjunath, Joy Kuri, Communication Networking: An analytical Approach, Elsevier, 2004. *Unit(3,4,5)*

REFERENCES:

1. Schwartz M, Telecommunication Networks: Protocols, Modelling and Analysis, Addison-Wesley, 1987.
2. Ng C H, Queuing Modelling Fundamentals, John Wiley, 1996.
3. Bertsekas D and Gallager R, Data Networks, 2nd Edition, Prentice-Hall, 1992.
4. Harrison P G and Patel N M, Performance Modelling of Communication Networks and Computer Architectures, Addison-Wesley, 1993.

CP16002 PERFORMANCE EVALUATION OF COMPUTER SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems.
- To understand the metrics used for performance evaluation To understand the analytical modeling of computer systems.
- To enable the students to develop new queueing analysis for both simple and complex systems.
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies.

UNIT I OVERVIEW OF PERFORMANCE EVALUATION **9**

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queueing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little‘s Law and other Operational Laws – Modification for Closed Systems.

UNIT II MARKOV CHAINS AND SIMPLE QUEUES **9**

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1 and PASTA.

UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS **9**

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke‘s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV REAL-WORLD WORKLOADS **9**

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

UNIT V SMART SCHEDULING IN THE M/G/1 **9**

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the need for performance evaluation and the metrics used for it.
- Discuss open and closed queueing networks.
- Define Little‘e law and other operational laws.
- Apply the operational laws to open and closed systems.
- Use discrete-time and continuous-time Markov chains to model real world systems.
- Develop analytical techniques for evaluating scheduling policies.

REFERENCES:

1. Mor Harchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action", Cambridge University Press, 2013.
2. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling", Wiley-Interscience, 1991.
3. Lieven Eeckhout, "Computer Architecture Performance Evaluation Methods", Morgan and Claypool Publishers, 2010.
4. Paul J. Fortier and Howard E. Michel, "Computer Systems Performance Evaluation and Prediction", Elsevier, 2003.
5. David J. Lilja, "Measuring Computer Performance: A Practitioner's Guide", Cambridge University Press, 2000.
6. Krishna Kant, "Introduction to Computer System Performance Evaluation", McGraw-Hill, 1992.
7. K. S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2001.

CP16004 DATA ANALYSIS 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 – R^2 and explained variance – multiple comparisons and statistical significance – an alysis of variance – ANOVA and multilevel linear and general linear models – missing data imputation.

TOTAL: 45 PERIODS

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 Example-based Approach", Third Edition, Cambridge University Press, 2010.
8. David Ruppert, "Statistics and Data Analysis for Financial Engineering", Springer, 2011.

CP16005 IMAGE PROCESSING AND ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of digital images
- To understand noise models.
- To understand spatial domain filters.
- To understand frequency domain filters.
- To learn basic image analysis --- segmentation, edge detection, and corner detection.
- To learn morphological operations and texture analysis.
- To understand processing of color images.
- To understand image compression techniques.

UNIT I SPATIAL DOMAIN PROCESSING **9**

Introduction to image processing – imaging modalities – image file formats – image sensing and acquisition – image sampling and quantization – noise models – spatial filtering operations – histograms – smoothing filters – sharpening filters – fuzzy techniques for spatial filtering – spatial filters for noise removal.

UNIT II FREQUENCY DOMAIN PROCESSING **9**

Frequency domain – Review of Fourier Transform (FT), Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT) – filtering in frequency domain – image smoothing – image sharpening – selective filtering – frequency domain noise filters – wavelets – Haar Transform – multiresolution expansions – wavelet transforms – wavelets based image processing.

UNIT III SEGMENTATION AND EDGE DETECTION **9**

Thresholding techniques – region growing methods – region splitting and merging – adaptive thresholding – threshold selection – global valley – histogram concavity – edge detection – template matching – gradient operators – circular operators – differential edge operators – hysteresis thresholding – Canny operator – Laplacian operator – active contours – object segmentation.

UNIT IV INTEREST POINTS, MORPHOLOGY, AND TEXTURE **9**

Corner and interest point detection – template matching – second order derivatives – median filter based detection – Harris interest point operator – corner orientation – local invariant feature detectors and descriptors – morphology – dilation and erosion – morphological operators – grayscale morphology – noise and morphology – texture – texture analysis – co-occurrence matrices – Laws' texture energy approach – Ade's eigen filter approach.

UNIT V COLOR IMAGES AND IMAGE COMPRESSION **9**

Color models – pseudo colors – full-color image processing – color transformations – smoothing and sharpening of color images – image segmentation based on color – noise in color images. Image Compression – redundancy in images – coding redundancy – irrelevant information in images – image compression models – basic compression methods – digital image watermarking.

TOTAL: 45 PERIODS

OUTCOMES:

- Explain image modalities, sensing, acquisition, sampling, and quantization.
- Explain image noise models.
- Implement spatial filter operations.
- Explain frequency domain transformations.
- Implement frequency domain filters.
- Apply segmentation algorithms.
- Apply edge detection techniques.
- Apply corner and interest point detection algorithms.
- Apply morphological operations.
- Perform texture analysis Analyze color images.
- Implement image compression algorithms.

REFERENCES:

1. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
2. W. Burger and M. Burge, "Digital Image Processing: An Algorithmic Introduction using Java", Springer, 2008.
3. John C. Russ, "The Image Processing Handbook", Sixth Edition, CRC Press, 2011.
4. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Third Edition, Pearson, 2008.
5. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
6. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
7. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.

CP16007 PARALLEL PROGRAMMING PARADIGMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand models of and issues in concurrency in computing.
- To develop message-passing parallel programs using MPI.
- To develop shared-memory parallel programs using Pthreads.
- To develop shared-memory parallel programs using OpenMP.
- To use GPU for parallel programming using OpenCL and CUDA.

UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING **9**

Motivation for parallel programming – Concurrency in computing – basics of processes, Multiprocessing, and threads – cache – cache mappings – caches and programs – virtual memory – instruction level parallelism – hardware multi-threading – SIMD – MIMD – interconnection networks – cache coherence – shared-memory model – issues in shared-memory model – distributed-memory model – issues in distributed-memory model – hybrid model – I/O – performance of parallel programs – parallel program design.

UNIT II MESSAGE PASSING PARADIGM **9**

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD programs – message passing – MPI_Send and MPI_Recv – message matching – MPI I/O – parallel I/O – collective communication – MPI_Reduce – MPI_Allreduce – broadcast – scatter – gather – allgather – derived types – remote memory access – dynamic process management – MPI for grids – performance evaluation of MPI programs.

UNIT III SHARED MEMORY PARADIGM: PTHREADS **9**

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

UNIT IV SHARED MEMORY PRADIGM: OPENMP **9**

Basic OpenMP constructs – scope of variabls – reduction clause – parallel for directive – loops in OpenMP – scheduling loops – synchronization in OpenMP – Case Study: Producer-Consumer problem – cache issues – threads safety in OpenMP – OpenMP best practices.

UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND CUDA **9**

Introduction to CUDA – CUDA programming examples – CUDA execution model – CUDA memory hierarchy – CUDA case study - introduction to OpenCL – OpenCL programming examples – Programs and Kernels – Buffers and Images – Event model – OpenCL case study.

TOTAL: 45 PERIODS

OUTCOMES:

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

- To explain models of parallel programming.
- To explain hardware level support for concurrency.
- To explain issues in parallel programming.
- To develop message-passing parallel programs using MPI framework.
- To develop shared-memory parallel programs using Pthreads.
- To develop shared-memory parallel programs using OpenMP.
- To develop CUDA programs.
- To develop OpenCL programs.

REFERENCES:

1. Peter S. Pacheco, ―An introduction to parallel programming‖, Morgan Kaufmann, 2011.
2. M. J. Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
3. W. Gropp, E. Lusk, and R. Thakur, "Using MPI-2: Advanced features of the message passing interface", MIT Press, 1999.
4. W. Gropp, E. Lusk, and A. Skjellum, "Using MPI: Portable parallel programming with the message passing interface", Second Edition, MIT Press, 1999.
5. B. Chapman, G. Jost, and Ruud van der Pas, "Using OpenMP", MIT Press, 2008.
6. D. R. Butenhof, "Programming with POSIX Threads", Addison Wesley, 1997.
7. B. Lewis and D. J. Berg, "Multithreaded programming with Pthreads", Sun Microsystems Press, 1998.
8. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, "OpenCL programming guide", Addison Wesley, 2011.
9. Rob Farber, "CUDA application design and development", Morgan Haufmann, 2011.

CP16009 SPEECH PROCESSING AND SYNTHESIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the mathematical foundations needed for speech processing.
- To understand the basic concepts and algorithms of speech processing and synthesis.
- To familiarize the students with the various speech signal representation, coding and recognition techniques.
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING **9**

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING **9**

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXT ANALYSIS **9**

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT V SPEECH SYNTHESIS **9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word.
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals.
- Justify the use of formant and concatenative approaches to speech synthesis.
- Identify the apt approach of speech synthesis depending on the language to be processed.
- Determine the various encoding techniques for representing speech.

REFERENCES:

1. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, "Spoken Language Processing – A guide to Theory, Algorithm and System Development", Prentice Hall PTR, 2001.
2. Thomas F.Quatieri, "Discrete-Time Speech Signal Processing", Pearson Education, 2002.
3. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Prentice Hall Signal Processing Series, 1993.
4. Sadaoki Furui, "Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)", Marcel Dekker, 2000.
5. Joseph Mariani, "Language and Speech Processing", Wiley, 2009.

NW16001 MULTIMEDIA COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the Multimedia Communication Models.
- To analyze the Guaranteed Service Model.
- To study the Multimedia Transport in Wireless Networks.
- To solve the Security issues in multimedia networks.
- To explore real-time multimedia network applications.

UNIT I MULTIMEDIA COMMUNICATION MODELS 9

Architecture of Internet Multimedia Communication- Protocol Stack-Requirements and Design challenges of multimedia communications- Multimedia distribution models-Unicasting, Broadcasting and Multicasting.

UNIT II GUARANTEED SERVICE MODEL 9

Multicast routing-PIM- Best effort service model and its limitations- QoS and its metrics-Queuing techniques-WFQ and its variants-RED-QoS aware routing -Call Admission Control-RSVP-Policing and Traffic Shaping algorithms- QoS architectures.

UNIT III MULTIMEDIA TRANSPORT 9

End to end solutions-Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video Streaming-Interactive and non Interactive Multimedia- RTSP- RTP/RTCP – SIP-H.263.

UNIT IV MULTIMEDIA OVER WIRELESS NETWORKS 9

End to end QoS Provisioning-QoS enhancements-Call Admission Control-QoS Management-Multimedia support in 3G & 4G networks- Location Based Multimedia Service System.

UNIT V MULTIMEDIA NETWORK SECURITY AND APPLICATIONS 9

Security threats in Multimedia Communication- Digital Rights Management Architecture-DRM for Mobile Multimedia- Architectures, Requirements and Design Challenges of real time Multimedia Network Applications- Case Study-VoIP- Video Conferencing- Military Surveillance-Interactive TV- Video on Demand - Smart Phone.

TOTAL: 45 PERIODS

OUTCOMES:

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

- deploy the right multimedia communication models.
- apply QoS to multimedia network applications with efficient routing techniques.
- solve the security threats in the multimedia networks.
- develop the real-time multimedia network applications.

REFERENCES:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “Introduction to Multimedia Communications Applications, Middleware, Networking”, John Wiley and Sons, 2006.
2. Jean Warland, Pravin Vareya, “High Performance Networks”, Morgan Kauffman Publishers, 2002.
3. William Stallings, “High Speed Networks and Internets Performance and Quality of Service”, 2nd Edition, Pearson Education, 2002.
4. Aura Ganz, Zvi Ganz, Kitti Wongthawaravat, ‘Multimedia Wireless Networks Technologies, Standards and QoS‘, Prentice Hall, 2003.
5. Mahbub Hassan and Raj Jain, “High Performance TCP/IP Networking”, Pearson Education, 2004.
6. Shiguo Lian, “Multimedia Communication Security Recent Advances”, Nova Science Publishers, 2008.

NW16002 SENSING TECHNIQUES AND SENSORS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the sensor characteristics and the fundamental principles of sensing to understand the sensor interface electronics.
- To study selected motion-related sensors.
- To study light and radiation detectors.
- To study selected temperature sensors.
- To study selected chemical sensors.

UNIT I PRINCIPLES OF SENSING **9**

Data Acquisition – sensor characteristics – electric charges, fields, potentials – capacitance – magnetism – inductance – resistance – piezoelectric – pyroelectric – Hall effect – thermoelectric effects – sound waves – heat transfer – light – dynamic models of sensors.

UNIT II OPTICAL COMPONENTS AND INTERFACE ELECTRONICS **9**

Radiometry – Photometry – mirrors – lenses – fibre optics – concentrators – Interface circuits – amplifiers – light-to-voltage – excitation circuits – ADC – Digitization – Capacitance-to-voltage – bridge circuits – data transmission – noise in sensors and circuits – calibration – low power sensors.

UNIT III MOTION RELATED SENSORS **9**

Occupancy and motion detectors: ultrasonic – microwave – capacitive detectors – triboelectric – optoelectronic motion sensors – optical presence sensor – Pressure Gradient sensors Velocity and acceleration sensors: Accelerometer characteristics – capacitative accelerometers – piezoelectric accelerometers – piezoresistive accelerometers – thermal accelerometers – Gyroscopes – piezoelectric cables – gravitational sensors.

UNIT IV LIGHT AND RADIATION DETECTORS **9**

Light Detectors: Photo diodes – photo transistor – photo resistor – cooled detectors – CCD and CMOS image sensors – thermal detectors – optical design – gas flame detectors Radiation Detectors: scintillating detectors – ionization detectors – cloud and bubble chambers.

UNIT V TEMPERATURE AND CHEMICAL SENSORS **9**

Temperature Sensors: coupling with objects – temperature reference points – thermo resistive sensors – thermo electric contact sensors – semiconductor sensors – acoustic sensors – piezoelectric sensors Chemical sensors: characteristics – classes of chemical sensors – biochemical sensors – multi-sensor arrays – electronic noses and tongues.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain sensor characteristics.
- Explain the physics of sensors.
- Explain optical components of sensors.
- Apply sensor interface electronics.
- Choose and use appropriate motion-related sensors.
- Choose and use appropriate light and radiation detectors.
- Choose and use appropriate temperature sensors.
- Choose and use appropriate chemical sensors.

REFERENCES:

1. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", Fourth Edition, Springer, 2010.

NW16003 MOBILE AND PERVASIVE COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of Mobile Computing and Personal Computing.
- To learn the role of cellular networks in Mobile and Pervasive Computing.
- To expose to the concept of sensor and mesh networks.
- To expose to the context aware and wearable computing.
- To learn to develop applications in mobile and pervasive computing environment.

UNIT I INTRODUCTION **9**

Differences between Mobile Communication and Mobile Computing – Contexts and Names – Functions – Applications and Services – New Applications – Making Legacy Applications Mobile Enabled – Design Considerations – Integration of Wireless and Wired Networks – Standards Bodies – Pervasive Computing – Basics and Vision – Principles of Pervasive Computing – Categories of Pervasive Devices.

UNIT II 3G AND 4G CELLULAR NETWORKS **9**

Migration to 3G Networks – IMT 2000 and UMTS – UMTS Architecture – User Equipment – Radio Network Subsystem – UTRAN – Node B – RNC functions – USIM – Protocol Stack – CS and PS Domains – IMS Architecture – Handover – 3.5G and 3.9G a brief discussion – 4G LAN and Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC and MAC – WiMax IEEE 802.16d/e – WiMax Internetworking with 3GPP.

UNIT III SENSOR AND MESH NETWORKS **9**

Sensor Networks – Role in Pervasive Computing – In Network Processing and Data Dissemination – Sensor Databases – Data Management in Wireless Mobile Environments – Wireless Mesh Networks – Architecture – Mesh Routers – Mesh Clients – Routing – Cross Layer Approach – Security Aspects of Various Layers in WMN – Applications of Sensor and Mesh networks.

UNIT IV CONTEXT AWARE COMPUTING & WEARABLE COMPUTING **9**

Adaptability – Mechanisms for Adaptation - Functionality and Data – Transcoding – Location Aware Computing – Location Representation – Localization Techniques – Triangulation and Scene Analysis – Delaunay Triangulation and Voronoi graphs – Types of Context – Role of Mobile Middleware – Adaptation and Agents – Service Discovery Middleware Health BAN- Medical and Technological Requirements-Wearable Sensors-Intra-BAN communications.

UNIT V APPLICATION DEVELOPMENT **9**

Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design a basic architecture for a pervasive computing environment Design and allocate the resources on the 3G-4G wireless networks.
- Analyze the role of sensors in Wireless networks.
- Work out the routing in mesh network.
- Deploy the location and context information for application development.
- Develop mobile computing applications based on the paradigm of context aware computing and wearable computing.

REFERENCES:

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing: Technology, Applications and Service Creation", 2nd ed, Tata McGraw Hill, 2010.
2. Reto Meier, "Professional Android 2 Application Development", Wrox Wiley,2010.
3. Pei Zheng and Lionel M Li, 'Smart Phone & Next Generation Mobile Computing', Morgan Kaufmann Publishers, 2006.
4. Frank Adelstein, 'Fundamentals of Mobile and Pervasive Computing', TMH, 2005
5. Jochen Burthardt et al, 'Pervasive Computing: Technology and Architecture of Mobile Internet Applications', Pearson Education, 2003.
6. Feng Zhao and Leonidas Guibas, 'Wireless Sensor Networks', Morgan Kaufmann Publishers, 2004.
7. Uwe Hansmaan et al, 'Principles of Mobile Computing', Springer, 2003
8. Reto Meier, "Professional Android 2 Application Development", Wrox Wiley,2010.
9. Mohammad s. Obaidat et al, "Pervasive Computing and Networking",John wiley.
10. Stefan Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions", Wiley,2009.
11. Frank Adelstein Sandeep K. S. Gupta Golden G. Richard III Loren schwiebert Fundamentals of Mobile and Pervasive Computing, McGraw-Hill, 2005.

NW16004 **WEB ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the issues and process of Web design.
- To learn the concepts of Web design patterns and page design.
- To understand and learn the scripting languages with design of web applications.
- To learn the maintenance and evaluation of web design management.

UNIT I INTRODUCTION TO WEB ENGINEERING: 9

History of web Development, Evolution and Need for Web Engineering, World Wide Web, Introduction to TCP/IP and WAP , DNS, Email, TelNet, HTTP and FTP, Introduction to Browser and search engines, Web Servers, Features of web servers, caching, case study-IIS, Apache, Configuring web servers.

UNIT II INFORMATION ARCHITECTURE: 9

The role of Information Architect, Collaboration& Communication, Organizing Information, Organizational Challenges, Organizing Web sites parameters and Intranets, Creating Cohesive Websites, Architectural Page Mockups, Design Sketches, Navigation Systems, Searching Systems Good & bad web design, Process of Web Publishing, Phases of Web Site development, Requirements Engineering for Web Applications.

UNIT III HTML & DHTML: 9

HTML Basic Concept, Static & dynamic HTML, Structure of HTML documents, HTML Elements, Linking in HTML, Anchor Attributes, Image Maps, Meta Information, Image Preliminaries, Layouts, backgrounds, Colors and Text, Fonts, Tables, Frames and layers, Audio and Video Support with HTML Database integration, CSS, Positioning with Style sheets, Forms Control, Form Elements, Introduction to CGI PERL, JAVA SCRIPT, PHP, ASP , Cookies Creating and Reading Cookies.

UNIT IV XML 9

Introduction of XML, Validation of XML documents, DTD, Ways to use XML,XML for data files HTML Vs XML, Embedding XML into HTML documents, Converting XML to HTML for Display, Displaying XML using CSS and XSL, Rewriting HTML as XML, Relationship between HTML, SGML and XML, web personalization , Semantic web, Semantic Web Services, Ontology.

UNIT V APPLICATIONS AND SECURITY: 9

E-commerce Business Models, The Internet and World Wide Web, Modes of Electronic Commerce, Approaches to safe Electronic Commerce, Electronic Cash and Electronic Payment Schemes, Online Security and Payment Systems, E-commerce Marketing Concepts, Advertising on the Internet, Electronic Publishing issues, approaches, Legalities & technologies, Privacy & Security, Web Security, Encryption schemes, Secure Web document, Digital Signatures and Firewalls, Cyber crime and laws, IT Act.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the various issues of web design process and evaluation.
- Determine templates for web pages and layout.
- Develop simple web applications using scripting languages.
- Determine the various issues of web project development.
- Address the core issues of web page maintenance and evaluation.

REFERENCES:

1. Roger S. Pressman, David Lowe, "Web Engineering", Tata McGraw Hill Publication, 2007
2. Web Engineering: A Practitioner's Approach by Roger Pressman and David Lowe, McGrawHill, 2009.
3. Achyut S Godbole and Atul Kahate, "Web Technologies", Tata McGraw Hill
4. NEIL GRAY, "Web server Programming" Wiley
5. CHRIS BATES Web Programming :Building Internet applications, Wiley
6. Moller, "An Introduction to XML and Web Technologies", Pearson Education New Delhi,2009.

NW16005 **NETWORK PROTOCOLS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the existing network architecture models and analyze performance.
- To understand the high speed network protocols and design issues.
- To learn network security technologies and protocols.
- To study various protocols in wireless LAN, MAN.

UNIT I FUNDAMENTALS OF NETWORKING STANDARDS AND PROTOCOLS 9

Network Communication Architecture and Protocols - OSI Network Architecture seven Layers Model - Definition and Overview of TCP/IP Protocols -TCP/IP Four Layers Architecture Model - Other Network Architecture Models: IBM SNA.

UNIT II ROUTED AND ROUTING PROTOCOLS 9

Application Layer Protocols-Presentation Layer Protocols- Session Layer Protocols - Transport Layer Protocols - Network Layer Protocols - Data Link Layer Protocols - Routing Protocols - Multicasting Protocols - MPLS.

UNIT III ISDN AND NETWORK MANAGEMENT PROTOCOLS 9

Overview of ISDN − Channels − User access – Protocols Network management requirements− Network monitoring − Network control − SNMP V_1, V_2 and V_3 − concepts, MIBs −Implementation issuesRMON.

UNIT IV SECURITY AND TELEPHONY PROTOCOLS 9

Network Security Technologies and Protocols - AAA Protocols - Tunneling Protocols - Security Protocols- Private key encryption − Data encryption system, public key encryption − RSA −Elliptic curve cryptography − Authentication mechanisms− Web security -Secured Routing Protocols - IP telephony Voice over IP and VOIP Protocols –Signaling Protocols-Media/CODEC.

UNIT V NETWORK ENVIRONMENTS AND PROTOCOLS 9

Wide Area Network and WAN Protocols - Frame relay - ATM - Broadband Access Protocols – PPP Protocols - Local Area Network and LAN Protocols - Ethernet Protocols - Virtual LAN Protocols - Wireless LAN Protocols - Metropolitan Area Network and MAN Protocol - Storage Area Network and SAN Protocols.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Study, analyze and design seven layers of protocols of wired and wireless networks**.**

REFERENCES:

1. Javvin, “Network Protocols” , Javvin Technologies Inc , second edition, 2005
2. William Stallings, “Cryptography and Network Security”, PHI, 2000.
3. Mani Subramanian, “Network Management−Principles and Practices”, Addison Wesley, 2000.
4. William Stallings, “SNMP, SNMPV2, SNMPV3 and RMON1 and 2”, 3rd Edition, Addison Wesley, 1999.
5. William Stallings, “Data and Computer Communications” 5th Edition, PHI, 1997.

CP16008 SOFTWARE REQUIREMENTS ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand system requirements.
- Identify different types of requirement.
- Generate requirements be elicitation.
- Develop requirements documentation.
- Evaluate the requirements.

UNIT I DOMAIN UNDERSTANDING **9**

Introduction – Types of requirements – Requirements engineering process – Validating requirements – Requirements and design – Requirements and test cases – introduction to business domain – Problem analysis – Fish bone diagram – Business requirements – Business process modeling – Business use cases – Business modeling notations – UML Activity diagrams.

UNIT II REQUIREMENTS ELICITATION **9**

Introduction – Understanding stakeholders' needs – Elicitation techniques – interviews, questionnaire, workshop, brainstorming, prototyping – Documenting stakeholders' needs.

UNIT III FUNCTIONAL REQUIREMENTS **9**

Introduction – Features and Use cases – Use case scenarios – Documenting use cases – Levels of detai ls – SRS documents.

UNIT IV QUALITY ATTRIBUTES AND USER EXPERIENCE **9**

Quality of solution – Quality attributes – Eliciting quality attributes – Quality attribute workshop (QAW) – Documenting quality attributes – Six part scenarios – Usability requirements – Eliciting and documenting usability requirements – Modeling user experience – Specifying UI design.

UNIT V MANAGING REQUIREMENTS **9**

Defining scope of the project – Context diagram – Managing requirements – Requirements properties – Traceability – Managing changes – Requirements metrics – Requirements management tools.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Define a process for requirements engineering.
- Execute a process for gathering requirements through elicitation techniques.
- Validate requirements according to criteria such as feasibility, clarity, preciseness etc.
- Develop and document functional requirements for different types of systems.
- Develop and document quality attributes of the system to be implemented.
- Communicate the requirements to stakeholders.
- Negotiate with stakeholders in order to agree on a set of requirements.
- Detect and resolve feature interactions.

REFERENCES:

1. Axel van Lamsweerde, "Requirements Engineering", Wiley, 2009.
2. Gerald Kotonya, Ian Sommerville, "Requirements Engineering: Processes and Techniques", John Wiley and Sons, 1998.
3. Dean Leffingwell and Don Widrig, “Managing Software Requirements: A Use Case Approach (2nd Edition) ”, Addison-wesley, 2003.
4. SEI Report, “Quality Attributes Workshop”, http://www.sei.cmu.edu/library/abstracts/reports/03tr016.cfm **,** 2003.
5. J Nielsen, “Usability Engineering”, Academic Press, 1993.

CP16011 **CONCURRENCY MODELS** **L T P C**
3 0 0 3

OBJECTIVES:

- To model concurrency in FSP.
- To specify and check safety and liveness properties.
- To understand concurrency architectures and design.
- To apply linear temporal logic to safety and liveness analysis.
- To apply Petri nets for concurrency modeling and analysis.

UNIT I FSP AND GRAPH MODELS **9**

Concurrency and issues in concurrency – models of concurrency – graphical models – FSP & LTSA – modeling processes with FSP – concurrency models with FSP – shared action – structure diagrams – issues with shared objects – modeling mutual exclusion – conditional synchronization – modeling semaphores – nested monitors – monitor invariants.

UNIT II SAFETY AND LIVENESS PROPERTIES **9**

Deadlocks – deadlock analysis in models – dining philosophers problem – safety properties – single-lane bridge problem – liveness properties – liveness of the single-lane bridge – readerswriters problem – message passing – asynchronous message passing models – synchronous message passing models – rendezvous.

UNIT III CONCURRENCY ARCHITECTURES AND DESIGN **9**

Modeling dynamic systems – modeling timed systems – concurrent architectures – Filter pipeline – Supervisor-worker model – announcer-listener model – model-based design – from requirements to models – from models to implementations – implementing concurrency in Java – program verification.

UNIT IV LINEAR TEMPORAL LOGIC (LTL) **9**

Syntax of LTL – semantics of LTL – practical LTL patterns – equivalences between LTL statements – specification using LTL – LTL and FSP – Fluent proposition – Temporal propositions – Fluent Linear Temporal Logic (FLTL) – FLTL assertions in FSP – Database ring problem.

UNIT V PETRI NETS **9**

Introduction to Petri nets – examples – place-transition nets – graphical and linear algebraic representations – concurrency & conflict – coverability graphs – decision procedures – liveness – colored Petri nets (CPN) – modeling & verification using CPN – non-hierarchical CPN – modeling protocols – hierarchical CPN – timed CPN – applications of Petri Nets.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop concurrency models and FSP.
- State safety and liveness properties in FSP.
- Verify properties using LTSA tool.
- Explain concurrency architectures.
- Design concurrent Java programs from models.

- Apply Linear Temporal Logic to state safety and liveness properties.
- Assert LTL properties in FSP and check using LTSA tool.
- Model and analyze concurrency using Petri nets.

REFERENCES:

1. Jeff Magee & Jeff Kramer, "Concurrency: State Models and Java Programs", Second Edition, John Wiley, 2006.
2. M. Huth & M. Ryan, "Logic in Computer Science – Modeling and Reasoning about Systems", Second Edition, Cambridge University Press, 2004.
3. B. Goetz, T. Peierls, J. Bloch, J. Bowbeer, D. Holmes, and D. Lea, "Java Concurrency in Practice", Addison-Wesley Professional, 2006.
4. Wolfgang Reisig, "Petri Nets: An Introduction", Springer, 2011.
5. K. Jensen and L. M. Kristensen, "Colored Petri Nets: Modeling and Validation of Concurrent Systems", Springer, 2009.
6. Wolfgang Reisig, "Understanding Petri Nets: Modeling Techniques, Analysis Methods, Case Studies", Springer, 2013.

CP16012 **REAL TIME SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide good understanding of fundamental concepts in real time systems.
- To provide understanding of advanced topics in real time systems.
- To provide understanding on basic multi-task scheduling algorithms for periodic, a periodic, and sporadic tasks as well as understand the impact of the latter two on scheduling.
- To expose to understand capabilities of commercial off-the-shelf R-T kernel.
- To expose to real time communications and databases.

UNIT I INTRODUCTION **9**

Real-time systems – Applications – Basic Model – Characteristics – Safety and Reliability – Real-Time tasks – Timing Constraints – Modelling Timing Constraints.

UNIT II SCHEDULING REAL-TIME TASKS **9**

Concepts – Types of RT Tasks and their Characteristics – Task Scheduling – Clock-Driven Scheduling – Hybrid Schedulers - Event-Driven Scheduling – EDF Scheduling – RMA – Issues with RMA – Issues in Using RMA in Practical Situations.

UNIT III RESOURCE SHARING AMONG RT TASKS & SCHEDULING RT TASKS **9**

Resource Sharing Among RT Tasks – Priority Inversion – PIP – HLP – PCP – Types of Priority Inversions Under PCP – Features of PCP – Issues in using Resource Sharing Protocol – Handling Task Dependencies – Multiprocessor Task Allocation – Dynamic Allocation of Tasks – Fault-Tolerant Scheduling of Tasks – Clocks in Distributed RT Systems – Centralized and Distributed Clock Synchronization.

UNIT IV COMMERCIAL RT OPERATING SYSTEMS **9**

Time Services – Features of RT OS – Unix as a RT OS – Unix Based RT OS – Windows as a RT OS – POSIX – Survey of RTOS: PSOS – VRTX – VxWorks – QNX - µC/OS-II – RT Linux – Lynx – Windows CE – Benching RT Systems.

UNIT V RT COMMUNICATION & DATABASES **9**

Examples of Applications Requiring RT Communication – Basic Concepts – RT Communication in a LAN – Soft & Hard RT Communication in a LAN – Bounded Access Protocols for LANs – Performance Comparison – RT Communication Over Packet Switched Networks – QoS Framework – Routing – Resource Reservation – Rate Control – QoS Models - Examples Applications of RT Databases – RT Databases – Characteristics of Temporal Data – Concurrency Control in RT Databases – Commercial RT Databases.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the basics and importance of real-time systems.
- Generate a high-level analysis document based on requirements specifications.
- Generate a high-level design document based on analysis documentation.

- Generate a test plan based on requirements specification.
- Generate a validation plan based on all documentation.
- Understand basic multi-task scheduling algorithms for periodic, aperiodic, and sporadic tasks as well as understand the impact of the latter two on scheduling.
- Understand capabilities of at least one commercial off-the-shelf R-T kernel.

REFERENCES:

1. Rajib Mall, "Real-Time Systems: Theory and Practice," Pearson, 2008.
2. Jane W. Liu, "Real-Time Systems" Pearson Education, 2001.
3. Krishna and Shin, "Real-Time Systems," Tata McGraw Hill. 1999.
4. Alan C. Shaw, “Real-Time Systems and Software”, Wiley, 2001.
5. Philip Laplante, “Real-Time Systems Design and Analysis”, 2nd Edition, Prentice Hall of India.
6. Resource Management in Real-time Systems and Networks, C. Siva Ram Murthy and G. Manimaran, MIT Press, March 2001.

CP16013 **COMPUTER VISION** **L T P C**
3 0 0 3

OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- To study some applications of computer vision algorithms.

UNIT I IMAGE PROCESSING FOUNDATIONS **9**

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT II SHAPES AND REGIONS **9**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT III HOUGH TRANSFORM **9**

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT IV VISION AND MOTION **9**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT V APPLICATIONS **9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

TOTAL: 45 PERIODS

OUTCOMES:

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

- To implement fundamental image processing techniques required for computer vision To perform shape analysis.
- To implement boundary tracking techniques.
- To apply chain codes and other region descriptors.
- To apply Hough Transform for line, circle, and ellipse detections.
- To apply 3D vision techniques.
- To implement motion related techniques.
- To develop applications using computer vision techniques.

REFERENCES:

1. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
4. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
5. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
6. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.

CP16015 SOFTWARE ARCHITECTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand architectural requirements.
- Identify architectural structures.
- Develop architectural documentation.
- Generate architectural alternatives.
- Evaluate the architecture against the drivers.

UNIT I ARCHITECTURAL DRIVERS 9

Introduction – Standard Definitions of Software Architecture– Architectural structures – Influence of software architecture on organization – Architecture Business Cycle – Functional requirements – Technical constraints – Quality Attributes – Quality Attribute Workshop (QAW) – Documenting Quality Attributes – Six part scenarios.

UNIT II ARCHITECTURAL VIEWS AND DOCUMENTATION 9

Introduction – Standard Definitions for views – Structures and views- Perspectives: Static, dynamic and physical and the accompanying views – Representing views-available notations – Good practices in documentation– Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages - Architectural Description Languages – ACME.

UNIT III ARCHITECTURAL STYLES 9

Introduction – Data flow styles – Call-return styles – Shared Information styles - Event styles – Case studies for each style.

UNIT IV ARCHITECTURAL DESIGN 9

Approaches for architectural design – System decomposition – Attributes driven design – Architecting for specific quality attributes – Performance, Availability – Security – Architectural conformance.

UNIT V ARCHITECTURE EVALUATION AND SOME SPECIAL TOPICS 9

Need for evaluation – Scenario based evaluation against the drivers – ATAM and its variations – Case studies in architectural evaluations – SOA and Web services – Cloud Computing – Adaptive structures.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain key architectural drivers.
- Explain the influence of architecture on business and technical activities.
- Identify key architectural structures.
- Adopt good practices for documenting the architecture.
- Develop alternative architectures for a given problem.
- Explain how to use formal languages to specify architecture.
- Evaluate the architecture against the drivers.

- Describe the recent trends in software architecture.

REFERENCES:

1. Len Bass, Paul Clements, and Rick Kazman, "Software Architectures Principles and Practices", 2n Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, "Architecting Software Intensive System. A Practitioner's Guide", Auerbach Publications, 2010.
3. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views and Beyond", 2 Edition, Addison-Wesley, 2010.
4. Paul Clements, Rick Kazman, and Mark Klein, "Evaluating software architectures: Methods and case studies.", Addison-Wesley, 2001.
5. David Garlan and Mary Shaw, "Software architecture: Perspectives on an emerging discipline", Prentice Hall, 1996.
6. Rajkumar Buyya, James Broberg, and Andrzej Goscinski, "Cloud Computing. Principles and Paradigms", John Wiley & Sons, 2011
7. Mark Hansen, "SOA Using Java Web Services", Prentice Hall, 2007.
8. David Garlan, Bradley Schmerl, and Shang-Wen Cheng, "Software Architecture-Based Self-Adaptation," 31-56. Mieso K Denko, Laurence Tianruo Yang, and Yan Zang (eds.), "Autonomic Computing and Networking". Springer Verlag, 2009.

NW16006	PROTOCOLS AND ARCHITECTURE FOR WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION AND OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Background of Sensor Network Technology, Application of Sensor Networks, Challenges for Wireless Sensor Networks, Mobile Adhoc NETworks (MANETs) and Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks.

UNIT II ARCHITECTURES 9

Single-node Architecture, Hardware Components & Design Constraints, Operating Systems and Execution Environments, Introduction to TinyOS and nesC, Network Architecture, Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles for WSNs, Service Interfaces of WSNs, Gateway Concepts.

UNIT III DEPLOYMENT AND CONFIGURATION 9

Localization and Positioning, Coverage and Connectivity, Single-hop and Multi-hop Localization, Self Configuring Localization Systems, Sensor Management Network Protocols: Issues in Designing MAC Protocol for WSNs, Classification of MAC Protocols, S-MAC Protocol, B-MAC Protocol, IEEE 802.15.4 Standard and Zig Bee, Dissemination Protocol for Large Sensor Network.

UNIT IV ROUTING PROTOCOLS AND DATA MANIPULATION 9

Issues in Designing Routing Protocols, Classification of Routing Protocols, Energy-Efficient Routing, Unicast, Broadcast and Multicast, Geographic Routing. Data Centric and Content based Routing, Storage and Retrieval in Network, Compression Technologies for WSN, Data Aggregation Technique.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level Software Platforms, Node -level Simulators, State-centric Programming.

TOTAL: 45 PERIODS

REFERENCES:

1. Holger Karl & Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, “Wireless Sensor Network”, Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
5. N. P. Mahalik, “Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications” Springer Verlag.
6. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

NW16007 SIMULATION OF COMPUTER SYSTEMS AND NETWORKS

L	T	P	C
3	0	0	3

UNIT I MODELLING OF COMMUNICATION SYSTEM 9

Model of speech and picture signals, Pseudo noise sequences, Non-linear sequences, Analog channel model, Noise and fading, Digital channel model-Gilbert model of bustry channels.

UNIT II SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS 9

Univariate and multivaraiate models, Transformation of random variables, Bounds and approximation, Random process models-Markov AND ARMA Sequences, Sampling rate for simulation, Computer generation and testing of random numbers.

UNIT III ESTIMATION OF PERFORMANCE MEASURES 9

Quality of an estimator, estimator for SNR, Probability density functions of analog communication system, BER of digital communication systems, Montre carlo method and Importance sampling method, estimation of power spectral density of a process.

UNIT IV INTORDUCTION TO NS-2 9

Introduction, NS-2 Simulator Preliminaries, Work with Trace Files, Description and Simulation of TCP/IP Queuing models, M/M/I and M/M/I/N queues, Little formula, Burke's theorem, M/G/I queue.

UNIT V SIMULATION OF NETWORK ROUTING PROTOCOL USING NS-2 9

Routing Network Dynamics, Routing Network Dynamics, Differentiated Services, Simulation of LAN, Simulation of LAN, Classical Queuing Model.

TOTAL: 45 PERIODS

REFERENCES:

1. Jeruchim M.C., Philip Balabanand Sam Shanmugam. S, “Simulation of Communication Systems”, Plenum Press, New York, 1992.
2. Eitan, Tania, “NS Simulator for Beginners”, Lecture Notes, University of Los Angels.
3. Issariyakul, Teerawat,Hossain, Ekram, “An Introduction to Network Simulator NS2”, 2008.
4. Law A.M and David Kelton W, Simulation Modeling and analysis, Mc Graw Hill Inc., New York , 1991.
5. Hayes J.F, Modeling and Analysis of Computer Communication networks, Plenum Press, New York, 1984.
6. Jerry Banks and John S. Carson, “Discrete-event System Simulation”, Prentice Hall Inc.., New Jersey,1984.

NW16008 **NETWORK MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

The objective of this course is to

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

UNIT I FUNDAMENTALS OF COMPUTER NETWORK TECHNOLOGY 9

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

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

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

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, M4 Interface. ATM Digital Exchange Interface Management-,TMN conceptual Model- TMN Architecture, TMN Management Service Architecture.

UNIT V NETWORK MANAGEMENT APPLICATIONS 9

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 PERIODS

OUTCOMES:

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

- Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
- Apply network management standards to manage practical networks. Formulate possible approaches for managing OSI network model.
- Use on SNMP for managing the network.
- Use RMON for monitoring the behavior of the network.
- Explore the possibilities of improving the speed of the network and managing them.
- Identify the various components of network and formulate the scheme for managing them.

REFERENCES:

1. Mani Subramanian, "Network Management Principles and practice ", Pearson Education, New Delhi, 2010.
2. STALLINGS, WILLIAM, "SNMP, SNMPv2, SNMPv3, and RMON 1 and 2," Pearson Education, 2012.
3. Salah Aiidarous, Thomas Plevayk, "Telecommunications Network Management Technologies and Implementations ", eastern Economy Edition IEEE press, New Delhi, 1998.
4. Lakshmi G. Raman, "Fundamentals of Telecommunication Network Management ", Eastern Economy Edition IEEE Press, New Delhi, 1999.

NW16009 **4G TECHNOLOGIES** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn various generations of wireless and cellular networks.
- To study about fundamentals of 3G Services, its protocols and applications.
- To study about evolution of 4G Networks, its architecture and applications.
- To study about WiMAX networks, protocol stack and standards.
- To Study about Spectrum characteristics & Performance evaluation.

UNIT I INTRODUCTION **9**

Introduction: History of mobile cellular systems, First Generation, Second Generation, Generation 2.5, Overview of 3G & 4G, 3GPP and 3GPP2 standards.

UNIT II 3G NETWORKS **9**

3G Networks: Evolution from GSM, 3G Services & 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.

UNIT III 4G LTE NETWORKS **9**

4G Vision, 4G features and challenges, Applications of 4G, 4G Technologies – Multi carrier modulation, Smart Antenna Techniques, OFDM-MIMO Systems, Adaptive Modulation and Coding with Time-Slot Scheduler, Bell Labs Layered Space Time (BLAST) System, Software-Defined Radio, Cognitive Radio**.**

UNIT IV WiMAX NETWORKS **9**

WiMax: Introduction – IEEE 802.16, OFDM, MIMO, IEEE 802.20.

UNIT V SPECTRUM & PERFORMANCE **9**

Spectrum for LTE-Flexibility-Carrier Aggregation-Multi standard Radio base stations-RF requirements for LTE-Power level requirements-Emission requirements-Sensitivity and Dynamic range-Receiver susceptibility. Performance Assessment-Performance Evaluation.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Acquaint with the latest 3G/4G and WiMAX networks and its architecture.
- Interpret the various protocols and standards in various layers in Wireless networks.
- Design and implement wireless network environment for any application using latest wireless protocols and standards.
- Analyze the performance of networks.
- Explore the benefits of WiMax networks Exploit various diversity schemes in LTE.

REFERENCES:

1. Introduction to 3G Mobile Communication, Juha Korhonen, Artech House,(

www.artechhouse.com), Jan 2003, ISBN-10: 1580535070.

2. 4G LTE/LTE – Advanced for Mobile Broadband, Erik Dahlman, Stefan Parkvall, Johan Skold, Academic Press 2011.
3. 3G Evolution HSPA and LTE for Mobile Broadband, Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, Academic Press, Oct 2008, ISBN-10: 0123745381.
4. UMTS Mobile Communication for the Future, Flavio Muratore, John Wiley & Sons Ltd, Jan 2001, ISBN-10: 0471498297.
5. HSDPA/HSUPA for UMTS, Harri Holma and Antti Toskala, Johan Wiley & Sons Ltd, May 2006, ISBN-10: 0470018844.
6. Savo G.Glisic, "Advanced Wireless Networks - 4GTechnologies", Wiley, 2006.
7. Magnus Olsson, Catherine Mulligan, "EPC and 4G packet network", Elsevier 2012.
8. Vijay Garg, "Wireless Communications and Networking", Elsevier, Morgan kufmann publisher 2007.

NW16010 HIGH SPEED SWITCHING ARCHITECTURE

L	T	P	C
3	0	0	3

UNIT I HIGH SPEED NETWORK **9**

LAN and WAN network evolution through ISDN to BISDN - Transfer mode and control of BISDN - SDH multiplexing structure - ATM standard , ATM adaptation layers.

UNIT II LAN SWITCHING TECHNOLOGY **9**

Switching concepts; Switch forwarding techniques; switch path control - LAN switching; cut through forwarding; store and forward - virtual LANs.

UNIT III ATM SWITCHING ARCHITECTURE **9**

Switch models - Blocking networks – basic and enhanced banyan networks - sorting networks– merge sorting - rearrange able networks - full and partial connection networks - nonblocking networks – recursive network – construction and comparison of non-blocking network - switches with deflection routing – shuffle switch - tandem banyan.

UNIT IV QUEUES IN ATM SWITCHES **9**

Internal queuing – Input, output and shared queuing - multiple queuing networks – combined input, output and shared queuing – performance analysis of queued switches.

UNIT V IP SWITCHING **9**

Addressing mode -IP switching types-flow driven and topology driven solutions - IP Over ATM address and next hop resolution – multicasting - IPv6 over ATM.

TOTAL: 45 PERIODS

REFERENCES:

1. Ranier Handel, Manfred Huber N, Stefan Schrodder, ATM Networks-concepts, protocols, applications, Adisson Wesley, New York, 3rd Edition, 1999.
2. John Chiong A, Internetworking ATM for the internet and enterprise networks, McGraw Hill, New York, 1998.
3. Achille Patavina, Switching Theory: Architectures and performance in Broadband ATM Networks, John Wiley and Sons Ltd., New York.1998.

NW16011	ADVANCED NETWORK ALGORITHMS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **9**

Network Algorithmics, Network Implementation Models: Protocols, Hardware, Network Device Architectures, Operating Systems, Fifteen Implementation Principles.

UNIT II PRINCIPLES OF NETWORK ALGORITHMICS **9**

Buffer Validation of Application Device Channels, Scheduler for Asynchronous Transfer Mode Flow Control, Route Computation Using Dijkstra's Algorithm, Ethernet Monitor Using Bridge Hardware, Demultiplexing in the X-Kernel, Tries with Node Compression, Packet Filtering in Routers, Avoiding Fragmentation of Link State Packets, Policing Traffic Patterns etc. Reducing Copying via Local Restructuring, Avoiding Copying Using Remote DMA, Broadening to File Systems, Broadening beyond Copies, Broadening beyond Data Manipulations, transferring control.

UNIT III MAINTAINING TIMERS, DEMULTIPLEXING **9**

Maintaining timers, Demultiplexing, Protocol Processing, Buffer Management, Cyclic Redundancy Checks and Checksums, Generic Protocol Processing, Reassembly, Exact-Match Lookups, Prefix-Match Lookups: Finessing Lookups, Non-algorithmic Techniques for Prefix Matching, Unibit Tries, Multi-bit Tries, Level- Compressed (LC) Tries, Lulea-Compressed Tries, Tree Bitmap, Binary Search on Ranges, Binary Search on Prefix Lengths, Memory Allocation in Compressed Schemes, Lookup-Chip Model.

UNIT IV SWITCHING **9**

Packet-Classification Problem, Simple Solutions, Two-Dimensional Schemes, Approaches to General Rule Sets, Using Divide-and-Conquer, Bit Vector Linear Search, Cross Product, Equivalence Cross-Product, Decision Tree Approaches, Switching, Scheduling Packets.

UNIT V ROUTING **9**

Routers as Distributed Systems: Internal Flow Control, Internal Striping, Asynchronous Updates, Measuring Network Traffic : Reducing SRAM Width Using DRAM Backing Store, Reducing Counter Width Using Randomized Counting, Reducing Counters Using Threshold Aggregation, Reducing Counters Using Flow Counting , Reducing Processing Using Sampled NetFlow , Reducing Reporting Using Sampled Charging, Correlating Measurements Using Trajectory Sampling, A Concerted Approach to Accounting, Computing Traffic Matrices, Sting as an Example of Passive Measurement.

TOTAL: 45 PERIODS

REFERENCES:

1. George Varghese, "Network Algorithmics,: An Interdisciplinary Approach to Designing Fast Networked Devices ", The Morgan Kaufmann Series in Networking, ISBN-10: 0120884771, 13: 978- 0120884773.

NW16012	NEXT GENERATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the technical, economic and service advantages of next generation networks.
- To learn the basic architecture of a next generation network (NGN) with reference
- To understand NGN services
- To learn the role of IP Multimedia Sub-system (IMS), network attachment and admission control functions.
- To learn and compare the various methods of providing connection-oriented services over a NGN with reference to MPLS, MPLS-TE and T-MPLS.

UNIT I INTRODUCTION **9**

Evolution of public mobile services - motivations for IP based services, Wireless IP network architecture – 3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.

UNIT II IMS AND CONVERGENT MANAGEMENT **9**

IMS Architecture - IMS services, QoS Control and Authentication, Network and Service management for NGN, IMS advantages, Next Generation OSS Architecture - standards important to oss architecture, Information framework, OSS interaction with IMS, NGN OSS function/ information view reference model, DMTF CIM.

UNIT III MPLS AND VPN **9**

Technology overview –MPLS & QoS, MPLS services and components – layer 2 VPN, layer 2 internetworking, VPN services, signaling, layer 3 VPN –Technology overview, Remote Access and IPsec integration with MPLS VPN.

UNIT IV MULTICAST **9**

MPLS Multicast VPN overview – Applications, examples, IPv6 and MPLS - Technology overview, Future of MPLS –Integrating IP and optical networks, Future layer 3 services, future layer 2 services.

UNIT V NGN MANAGEMENT **9**

Network Management and Provisioning – Configuration, Accounting, performance, security, case study for MPLS, Future enhancements – Adaptive self healing networks.

TOTAL:45 PERIODS

COURSE OUTCOMES:

- To be able to design routing mechanism meeting the desired QoS in NGN.
- To be able to design network management protocols in NGN.
- To be able to compare various methods of providing connection-oriented services over a NGN with reference to MPLS, MPLS-TE and T-MPLS.
- To be able to compare various NGN virtual network services with reference to VPNs, VLANs, pseudo wires, VPLS and typical applications.

REFERENCES:

1. Thomas Plavyk, “Next generation Telecommunication Networks, Services and Management”, Wiley & IEEE Press Publications, 2012.
2. Neill Wilkinson, “Next Generation Network Services”, John Wiley Publications, 2002.
3. Robert Wood ,“Next Generation Networks”, CISCO Press, 2007.
4. Monique J. Morrow, “MPLS and Next Generation Networks: Foundations for NGN and Enterprise Virtualization", CISCO Press, 2006.
5. Ina Minie, Julian Lucek, “MPLS enabled Applications – Emerging developments and new technologies”, 3rd edition, Wiley. 2011.

CU16201 WIRELESS COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concepts of wireless communication.
- To make the students to know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.
- To enhance the understanding of Wi-fi, 3G systems and 4G networks.

UNIT I WIRELESS CHANNEL PROPAGATION AND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-Small scale fading- channel classification- channel models – COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading – shadowing Distributions, Link power budget Analysis.

UNIT II DIVERSITY 9

Capacity of flat and frequency selective fading channels-Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter.

UNIT III MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain:Beamforming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spacial Multiplexing and BLAST Architectures.

UNIT IV MULTI USER SYSTEMS 9

Multiple Access : FDMA,TDMA, CDMA,SDMA, Hybrid techniques: Random Access: , ALOHA,SALOHA,CSMA, Scheduling, power control, uplink downlink channel capacity, multiuser diversity, MIMO-MU systems.

UNIT V WIRELESS NETWORKS 9

3G Overview, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, 4G features and challenges, Technology path, IMS Architecture - Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer.

TOTAL: 45 PERIODS

OUTCOMES:

- The students understand the state of art techniques in wireless communication.
- Students are enriched with the knowledge of present day technologies to enable them to face the world and contribute back as researchers.

REFERENCES:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. HARRY R. ANDERSON, "Fixed Broadband Wireless System Design" John Wiley – India, 2003.
3. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
4. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
5. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
6. Clint Smith. P.E., and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw Hill, 2007.
7. Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, http://books.elsevier.com/9780123735805:, 2007.
8. Kaveth Pahlavan,. K. Prashanth Krishnamuorthy,"Principles of Wireless Networks", Prentice Hall of India, 2006.
9. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.
10. Sumit Kasera and Nishit Narang, "3G Networks – Architecture, Protocols and Procedures", Tata McGraw Hill, 2007.

NW16013	CONVERGENCE TECHNOLOGY	L	T	P	C
		3	0	0	3

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

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.

NW16014 ADVANCED INFRASTRUCTURE MANAGEMENT

L	T	P	C
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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 11

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 10

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 6

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

TOTAL: 45 PERIODS

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.

NW16023	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: 45 PERIODS

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).

NW16024 ADVANCED COGNITIVE RADIO NETWORKS

L	T	P	C
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OBJECTIVES:

- Know the basics of the software defined radios.
- Learn the design of the wireless networks based on the cognitive radios.
- Understand the concepts of wireless networks and next generation networks.

UNIT I SOFTWARE DEFINED RADIO **9**

Basic SDR , Spectrum Management, DARPA,FCC,NSF,CSTB,SDR as platform for CRN- Hardware and Software architecture, SDR development and Design, Cognitive waveform Development.

UNIT II COGNITIVE RADIO TECHNOLOGIES **9**

Introduction – Radio flexibility and capability – Aware – Adaptive – Comparison of Radio capabilities and Properties – Available Technologies – IEEE 802 Cognitive Radio related activities – Application, Spectrum Awareness.

UNIT III COGNITIVE RADIO TECHNIQUES **9**

Physical and Link, Position Awareness, Network, Network support- REM.

UNIT IV COGNITIVE RADIO ARCHITECTURE **9**

CRA I,CRA II,CRA III,CRA IV,CRA V.

UNIT V NEXT GENERATION WIRELESS NETWORKS **9**

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL: 45 PERIODS

OUTCOMES:

- Describe the basics of the software defined radios.
- Design the wireless networks based on the cognitive radios.
- Explain the concepts behind the wireless networks and next generation networks.

REFERENCES:

1. Bruce A. Fette, “Cognitive Radio Technology”, 2nd Edition, Elsevier, 2009.
2. Simon Haykin,"Cognitive Dynamic Systems: Perception-action Cycle, Radar and Radio”, Cambridge University Press, 22-Mar-2012.
3. Joseph Mitola III, ”Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering”, John Wiley & Sons Ltd. 2000.
4. Thomas W.Rondeau, Charles W. Bostain, “Artificial Intelligence in Wireless communication”, ARTECH HOUSE .2009.
5. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey” Elsevier Computer Networks, May 2006.

NW16025	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: 45 PERIODS

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 Storage Area Networks Boston, MA: Addison Wesley (Pearson Education) ©2002 ISBN: 0-201-75277-8.