ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.E. COMPUTER SCIENCE AND ENGINEERING
(With Specialization in Networks)
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

1. To enable graduates to pursue research, or have a successful career in academia or industries associated with Computer Science and Networking, or as entrepreneurs.
2. To analyze and understand the foundations of networking and also advanced techniques and tools so as to build or improve current techniques to a higher standard to expand the horizons of easier computing.
3. To enhance the creativity and understanding of students through exposure of various Computer and analytical environments to enable them ethically to build innovative and research oriented systems or solutions of varying complexity.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

1. To analyze, design and develop computing solutions by applying foundational concepts of computer science and engineering.
2. To understand the concepts and theories of networking and apply them to various situations for classifying networks, analyzing performance and implementing new technologies.
3. To adapt to emerging next generation of networking technologies to design, build and dream up the technology networks

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

A. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

B. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

C. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for thepublic health and safety, and the cultural, societal, and environmental considerations.

D. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of theinformation to provide valid conclusions.

E. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

F. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

G. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

H. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

I. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

J. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

K. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

L. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	**PROGRAMME OUTCOMES**											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
1	2	2	1	3	2	1	1	1	1	1	1	1
2	3	3	3	3	3	1	1	1	1	1	1	1
3	2	2	2	2	3	3	3	3	3	3	3	3

Contribution 1: Reasonable 2:Significant 3:Strong

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OBJECTIVES	**PROGRAMME OUTCOMES**											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
1	3	3	3	3	2	1	1					1
2	3	3	3	3	3	1	1	1				
3	3	3	3	3	3	1	1					

Contribution 1: Reasonable 2:Significant 3:Strong

M.E. COMPUTER SCIENCE AND ENGINEERING WITH SPECIALIZATION IN NETWORKS

SEMESTER COURSE WISE PO MAPPING

		SUBJECTS	Programme Outcomes											
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I YEAR	SEMESTER I	Applied Probability and Statistics	3	3	2	3	1	1	1	1	1	2	3	1
		Advanced Data Structures and Algorithms	3	3	3	3	1	1	1	1	1	**2**	1	**3**
		Advanced Computer Architecture	3	3	3	3	1	1	1	1	1	**2**	1	**2**
		Operating System Internals	3	3	3	3	3	1	1	1	1	**2**	1	**2**
		Advanced Software Engineering	3	3	3	3	3	1	1	1	1	2	1	2
		Machine Learning Techniques	3	3	3	3	3	1	3	1	1	2	1	2
		Data Structures Laboratory	3	3	3	3	3	1	1	1	3	3	2	1
		Network Design and Programming	3	3	3	3	3	3	2	1	3	1	1	2
	SEMESTER II	Network Security	3	3	3	3	3	3	3	3	1	1	1	2
		Internet of Things	3	3	3	3	1	1	1	3	1	1	1	2
		Wireless Technologies	3	3	3	2	3	3	1	1	1	1	1	2
		Professional Elective –I												
		Software Architectures and Design	3	3	3	3	3	1	1	1	2	1	1	2
		Image Processing and Analysis	3	3	3	3	3	1	1	1	2	1	1	2
		Mobile Application Development	3	3	3	3	3	1	1	1	2	1	1	2
		Cloud Computing Technologies	3	3	3	3	3	1	1	1	2	1	1	2
		Professional Elective II												
		Multimedia Communication Networks	3	3	3	3	3	1	1	1	2	1	1	2
		Mobile and Pervasive Computing	3	3	3	3	3	1	1	1	2	1	1	2
		Simulation of Computer Systems and Networks	3	3	3	3	3	1	1	1	2	1	1	2

		High Speed Switching Architectures	3	3	3	3	3	1	1	1	2	1	1	2
		Network Design and Programming Laboratory	3	3	3	3	3	1	3	1	2	1	2	2
		Term Paper Writing and Seminar	3	3	3	3	3	3	1	1	2	1	2	2
II YEAR	**SEMESTER III**	**Professional Elective –III**												
		Network Management	3	3	3	3	3	1	1	1	1	1	1	2
		Network Performance Analysis	3	3	3	3	3	1	1	1	1	1	1	2
		Next Generation Networks	3	3	3	3	3	1	1	1	1	1	1	2
		SDN and NFV	3	3	3	3	3	3	3	1	1	1	1	2
		Professional Elective –IV												
		Embedded Software Development	3	3	3	3	3	1	1	1	2	1	1	2
		Protocols and Architectures for Wireless Sensor Networks	3	3	3	3	3	1	3	1	1	1	1	2
		Information Storage Management	3	3	3	3	3	1	1	1	2	1	1	2
		Big Data Analytics	3	3	3	3	3	1	1	1	2	1	1	2
		Professional Elective V												
		Social Network Analysis	3	3	3	3	3	1	1	1	1	1	1	2
		Web Engineering	3	3	3	3	3	1	1	1	1	1	1	2
		Ethical Hacking	3	3	3	3	3	1	1	1	1	1	1	2
		Digital Forensics	3	3	3	3	3	1	3	1	1	1	1	2
		Project Work Phase – I	3	3	3	3	3	1	1	3	3	3	3	1
	SEM IV	Project Work Phase – II	3	3	3	3	3	1	1	3	3	3	3	1

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CURRICULA AND SYLLABI

SEMESTER - I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA5160	Applied Probability and Statistics	FC	4	4	0	0	4
2.	CP5151	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
3.	CP5152	Advanced Computer Architecture	PC	3	3	0	0	3
4.	CP5153	Operating System Internals	PC	3	3	0	0	3
5.	CP5154	Advanced Software Engineering	PC	3	3	0	0	3
6.	CP5191	Machine Learning Techniques	PC	3	3	0	0	3
PRACTICALS								
7.	CP5161	Data Structures Laboratory	PC	4	0	0	4	2
			TOTAL	**24**	**20**	**0**	**4**	**22**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	NE5291	Network Design and Programming	PC	3	3	0	0	3
2.	NE5201	Network Security	PC	3	3	0	0	3
3.	CP5292	Internet of Things	PC	3	3	0	0	3
4.	NE5202	Wireless Technologies	PC	3	3	0	0	3
5.		Professional Elective -I	PE	3	3	0	0	3
6.		Professional Elective -II	PE	3	3	0	0	3
PRACTICALS								
7.	NE5281	Network Design and Programming Laboratory	PC	4	0	0	4	2
8.	CP5281	Term Paper Writing and Seminar	EEC	2	0	0	2	1
			TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective -III	PE	3	3	0	0	3
2.		Professional Elective -IV	PE	3	3	0	0	3
3.		Professional Elective -V	PE	3	3	0	0	3
PRACTICALS								
4.	NE5311	Project Work Phase - I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	NE5411	Project Work Phase - II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5160	Applied Probability and Statistics	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5151	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
2.	CP5152	Advanced Computer Architecture	PC	3	3	0	0	3
3.	CP5153	Operating System Internals	PC	3	3	0	0	3
4.	CP5154	Advanced Software Engineering	PC	3	3	0	0	3
5.	CP5191	Machine Learning Techniques	PC	3	3	0	0	3
6.	CP5161	Data Structures Laboratory	PC	4	0	0	4	2
7.	NE5291	Network Design and Programming	PC	3	3	0	0	3
8.	NE5201	Network Security	PC	3	3	0	0	3
9.	CP5292	Internet of Things	PC	3	3	0	0	3
10.	NE5202	Wireless Technologies	PC	3	3	0	0	3
11.	NE5281	Network Design and Programming Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5281	Term Paper Writing and Seminar	EEC	2	0	0	2	1
2.	CP5311	Project Work Phase – I	EEC	12	0	0	12	6
3.	CP5411	Project Work Phase – II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)*
SEMESTER II
ELECTIVE I

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5072	Software Architectures and Design	PE	3	3	0	0	3
2.	CP5071	Image Processing and Analysis	PE	3	3	0	0	3
3.	CP5097	Mobile Application Development	PE	3	3	0	0	3
4.	CP5092	Cloud Computing Technologies	PE	3	3	0	0	3

SEMESTER II
ELECTIVE II

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MU5251	Multimedia Communication Networks	PE	3	3	0	0	3
2.	CP5093	Mobile and Pervasive Computing	PE	3	3	0	0	3
3.	NE5001	Simulation of Computer Systems and Networks	PE	3	3	0	0	3
4.	NE5002	High Speed Switching Architectures	PE	3	3	0	0	3

SEMESTER III
ELECTIVE III

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	NE5071	Network Management	PE	3	3	0	0	3
2.	NE5003	Network Performance Analysis	PE	3	3	0	0	3
3.	NE5004	Next Generation Networks	PE	3	3	0	0	3
4.	NE5005	Software Defined Networks and Network Function Virtualization (SDN and NFV)	PE	3	3	0	0	3

SEMESTERIII

ELECTIVE IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5073	Embedded Software Development	PE	3	3	0	0	3
2.	NE5006	Protocols and Architectures for Wireless Sensor Networks	PE	3	3	0	0	3
3.	CP5076	Information Storage Management	PE	3	3	0	0	3
4.	CP5293	Big Data Analytics	PE	3	3	0	0	3

SEMESTER III

ELECTIVE V

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5074	Social Network Analysis	PE	3	3	0	0	3
2.	CP5091	Web Engineering	PE	3	3	0	0	3
3.	NE5007	Ethical Hacking	PE	3	3	0	0	3
4.	NE5008	Digital Forensics	PE	3	3	0	0	3

MA5160	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		4	0	0	4

OBJECTIVES :

This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

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

UNIT III ESTIMATION THEORY 12

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

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square 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 :

After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES:

1. Devore, J. L., “Probability and Statistics for Engineering and the Sciences”, 8th Edition, Cengage Learning, 2014.
2. Dallas E. Johnson, “Applied Multivariate Methods for Data Analysis”, Thomson and Duxbury press, 1998.
3. Gupta S.C. and Kapoor V.K.,” Fundamentals of Mathematical Statistics”, Sultan and Sons, New Delhi, 2001.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund’s Probability and Statistics for Engineers ", Pearson Education, Asia, 8th Edition, 2015.
5. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, 5th Edition, Pearson Education, Asia, 2002.

CP5151 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C

4 0 0 4

OBJECTIVES:

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

UNIT I ROLE OF ALGORITHMS IN COMPUTING 12

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

UNIT II HIERARCHICAL DATA STRUCTURES 12

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

UNIT III GRAPHS 12

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

UNIT IV ALGORITHM DESIGN TECHNIQUES 12

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

UNIT V NP COMPLETE AND NP HARD 12

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

TOTAL: 60 PERIODS

OUTCOMES:

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

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

REFERENCES:

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

CP5152	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

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

UNIT II MEMORY HIERARCHY DESIGN 9

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

UNIT III MULTIPROCESSOR ISSUES 9

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

UNIT IV MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers- Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

1. Darryl Gove, “Multicore Application Programming: For Windows, Linux, and Oracle Solaris”, Pearson, 2011
2. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors”, Morgan Kauffman, 2010
3. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture : A hardware/software approach” , Morgan Kaufmann /Elsevier Publishers, 1999
4. John L. Hennessey and David A. Patterson, “Computer Architecture – A Quantitative Approach”, Morgan Kaufmann / Elsevier, 5th edition, 2012.
5. Kai Hwang and Zhi.Wei Xu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, 2003

CP5153 OPERATING SYSTEM INTERNALS L T P C

3 0 0 3

OBJECTIVES :

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

UNIT I INTRODUCTION 9

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

UNIT II PROCESSES 9

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

UNIT III FILE SYSTEM 9

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

UNIT IV MEMORY MANAGEMENT 9

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

UNIT V PROCESS COMMUNICATION AND PROGRAM EXECUTION 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

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

CP5154 ADVANCED SOFTWARE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand Software Engineering Lifecycle Models
- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches
- To be familiar with DevOps practices

UNIT I INTRODUCTION 9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT III ARCHITECTURE AND DESIGN 9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter.- User interface design

UNIT IV TESTING 9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS 9

DevOps:Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture-Building and Testing-Deployment- Case study: Migrating to Microservices

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the advantages of various Software Development Lifecycle Models
- Gain knowledge on project management approaches as well as cost and schedule estimation strategies
- Perform formal analysis on specifications
- Use UML diagrams for analysis and design
- Architect and design using architectural styles and design patterns
- Understand software testing approaches
- Understand the advantages of DevOps practices

REFERENCES:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd edition, Pearson Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective", Pearson Education, 2016.
5. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

CP5191	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I INTRODUCTION 9

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

UNIT II LINEAR MODELS 9

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

UNIT III TREE AND PROBABILISTIC MODELS 9

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

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

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

UNIT V GRAPHICAL MODELS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

1. Ethem Alpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)”, Third Edition, MIT Press, 2014
2. Jason Bell, “Machine learning – Hands on for Developers and Technical Professionals”, First Edition, Wiley, 2014
3. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
4. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2013.

CP5161 DATA STRUCTURES LABORATORY **L T P C**
0 0 4 2

OBJECTIVES:

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

LIST OF EXPERIMENTS

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

EXPERIMENTS:

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

TOTAL: 60 PERIODS

OUTCOMES:

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

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

NE5291 NETWORK DESIGN AND PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I NETWORKING PRINCIPLES 9

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

UNIT II PHYSICAL NETWORK DESIGN 9

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

UNIT III LOGICAL DESIGN AND MANAGEMENT 9

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

UNIT IV INNOVATIVE NETWORKS 9

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

UNIT V NETWORK PROGRAMMING IN UNIX C 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

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

NE5201		L	T	P	C
	NETWORK SECURITY	**3**	**0**	**0**	**3**

OBJECTIVES:

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

UNIT I INTRODUCTION 10

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

UNIT II BLOCK CIPHERS & PUBLIC KEY ENCRYPTION 10

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

UNIT III HASH FUNCTIONS AND DIGITAL SIGNATURES 9

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

UNIT IV E-MAIL, IP & WEB SECURITY 8

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

UNIT V SYSTEM SECURITY 8

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

TOTAL : 45 PERIODS

OUTCOMES:

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

REFERENCES:

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

CP5292	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
3. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
4. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012

NE5202 WIRELESS TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES:

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

UNIT I WIRELESS LAN and PAN 9

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

UNIT II WIRELESS INTERNET 9

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

UNIT III AD-HOC SENSOR NETWORK 9

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

UNIT IV 3G NETWORKS 9

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

UNIT V 4G - LTE 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

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

NE5281 NETWORK DESIGN AND PROGRAMMING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

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

NETWORK PROGRAMMING

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

TOTAL :60 PERIODS

OUTCOMES:

- After completing this course the student should be able to
- Design and implement LANs and internetworks
- Develop network based applications in UNIX C and Python

CP5281 **TERM PAPER WRITING AND SEMINAR** **L T P C**
0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried Out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,	4th week	**6%** (the list of standard papers and reason for selection)

	• Favour papers from well-known journals and conferences, • Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce)

TOTAL : 30 PERIODS

CP5072 SOFTWARE ARCHITECTURES AND DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the design principles and to apply for large scale systems
- To design architectures for distributed heterogeneous systems ,environment through brokerage interaction
- To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services**.**

UNIT I **9**

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II **9**

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC)

UNIT III **9**

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM,CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture-Methodology of Architecture Decision, Quality Attributes.

UNIT IV **9**

Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA-Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT V **9**

Aspect Oriented Architectures- AOP in UML,AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the need of software architecture for sustainable dynamic systems.
- Sound knowledge on design principles and to apply for large scale systems
- Ability to design architectures for distributed heterogeneous systems
- Good knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- Working knowledge to develop appropriate architectures through various case studies

REFERENCES :

1. Ion Gorton, "Essentials of software Architecture , Second Edition", Springer- Verlag, 2011.
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010

CP5071 IMAGE PROCESSING AND ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications

UNIT I IMAGE PROCESSING FUNDAMENTALS 9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.'

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing OperationsDistance Transforms-Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions-Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL :45 PERIODS

OUTCOMES:

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

- Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing
- Familiar with the use of MATLAB and its equivalent open source tools
- Critically analyze different approaches to image processing applications
- Explore the possibility of applying Image processing concepts in various applications

REFERENCES:

1. Alasdair McAndrew, —Introduction to Digital Image Processing with Matlab‖, Cengage Learning 2011,India
2. Anil J Jain, —Fundamentals of Digital Image Processing‖, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor,‖ Biomedical signals and Image Processing‖, CRC – Taylor and Francis, New York, 2006
4. Rafael C.Gonzalez and Richard E.Woods, —Digital Image Processing‖, Third Edition, Pearson Education, 2008, New Delhi
5. S.Sridhar, "Digital Image Processing", Oxford University Press, 2011

CP5097	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.
- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

UNIT I INTRODUCTION **5**

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II BASIC DESIGN **8**

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN **8**

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV ANDROID **12**

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V IOS **12**

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL :45 PERIODS

OUTCOMES:

- Describe the requirements for mobile applications
- Explain the challenges in mobile application design and development
- Develop design for mobile applications for specific requirements
- Implement the design using Android SDK
- Implement the design using Objective C and iOS
- Deploy mobile applications in Android and iPhone marketplace for distribution

REFERENCES:

1. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6 Development: Exploring the iOS SDK”, Apress, 2013.
3. http://developer.android.com/develop/index.html.
4. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012.
5. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox,2012.
6. Reto Meier, “PProfessional android Development”, Wiley-India Edition, 2012.

CP5092 CLOUD COMPUTING TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

UNIT I VIRTUALIZATION 9

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

UNIT II VIRTUALIZATION INFRASTRUCTURE 9

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

UNIT III CLOUD PLATFORM ARCHITECTURE 9

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

UNIT IV PROGRAMMING MODEL 9

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

UNIT V CLOUD SECURITY 9

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

TOTAL :45 PERIODS

OUTCOMES:

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

- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing
- Apply the security models in the cloud environment

REFERENCES:

1. Danielle Ruest, Nelson Ruest, “Virtualization: A Beginner‟s Guide”, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O’Reilly Media, Inc.,2009.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
7. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

MU5251	MULTIMEDIA COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the multimedia communication models
- To study the multimedia transport in wireless networks
- To explore real-time multimedia network applications

UNIT I MULTIMEDIA COMMUNICATION MODELS 9

Common Multimedia applications - VoIP- Video Conferencing- Military Surveillance- Interactive TV- Video on Demand- Smart Phone - Requirements and Design challenges of multimedia communications-Architecture of Internet Multimedia Communication- Protocol Stack-H.323.

UNIT II BEST EFFORT AND GUARANTEED SERVICE MODEL 9

Best effort service model and its limitations-Resource allocation-Metrics-Max and Min fair sharingQueuing-FIFO-Priority queue-Fair queue- Waited fair queue-Traffic policing-Token bucket-leaky bucket-Admission control-Packet classification and scheduling.

UNIT III MULTIMEDIA ON IP NETWORKS 9

QoS aware routing-RSVP-Integrated and Differentiated services-MPLS-Multicasting-IGMP-PIMDVMRP

UNIT IV TRANSPORT LAYER SUPPORT FOR MULTIMEDIA 9

Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video StreamingInteractive and non Interactive Multimedia-RTP/RTCP-SIP-RTSP.

UNIT V MULTIMEDIA QOS ON WIRELESS NETWORKS 9

IEEE 802.11e, IEEE 802.16, 3G networks-UMTS, 3GPP, 4G networks-LTE-IMS

TOTAL : 45 PERIODS

OUTCOMES:

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

- To select suitable multimedia communication model for the required application
- Deploy the right Multimedia Communication models
- Apply QoS to multimedia network applications with efficient routing techniques
- Develop the real-time multimedia network applications

REFERENCES:

1. James F. Kurose and Keith W. Ross, “Computer Networking-A Top-Down Approach Featuring the Internet”, Pearson, 2012.
2. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A Systems Approach”, Morgan Kaufmann Publishers, 2007.
3. Mario Marques da Silva, “Multimedia Communications and Networking”, CRC Press, 2012.
4. Mark Wuthnow, Jerry Shih, Matthew Stafford, “IMS: A New Model for Blending Applications”, Auerbach Publications, 2009.

CP5093	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basic architecture and concepts till Third Generation Communication systems.
- To understand the latest 4G Telecommunication System Principles.
- To introduce the broad perspective of pervasive concepts and management
- To Explore the HCI in Pervasive environment
- Apply the pervasive concepts in mobile environment

UNIT I INTRODUCTION 9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT II OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM 9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA. Summary of OFDMA.

UNIT III PERVASIVE CONCEPTS AND ELEMENTS 9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management -Service Management - Data Management - Security Management - Pervasive Computing Environments - Smart Car Space - Intelligent Campus

UNIT IV HCI IN PERVASIVE COMPUTING 9

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context-Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm

UNIT V PERVASIVE MOBILE TRANSACTIONS 9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Obtain a through understanding of Basic architecture and concepts of till Third Generation Communication systems.
- Explain the latest 4G Telecommunication System Principles.
- Incorporate the pervasive concepts.
- Implement the HCI in Pervasive environment.
- Work on the pervasive concepts in mobile environment.

REFERENCES:

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications, Springer, 2016.
2. J.Schiller, "Mobile Communication", Addison Wesley, 2000
3. Juha Korhonen, "Introduction to 4G Mobile Communications" , Artech House Publishers, 2014
4. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive Computing, IGI Global, 2013.
5. M. Bala Krishna, Jaime Lloret Mauri, "Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks", CRC 2016
6. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, " Pervasive Computing: Concepts, Technologies and Applications " CRC Press, 2016.

NE5001 SIMULATION OF COMPUTER SYSTEMS AND NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- To understand how simulators are built.
- To understand the statistical models used in simulations.
- To learn different ways of generating random numbers.
- To learn modeling of the data given as input to simulators.
- To understand how computer networks are simulated using case studies.

UNIT I STATISTICAL AND QUEUING MODELS 9

Statistical models – Discrete, continuous and empirical distributions – Characteristics of Queuing systems – Measures of performance of queuing systems – Markovian models.

UNIT II RANDOM NUMBER AND RANDOM VARIATE GENERATION 9

Properties of random numbers – Generating uniform random numbers – Generating non-uniform random numbers - Tests for random numbers – Random-variate generation

UNIT III ANALYSIS OF SIMULATION DATA 9

Input modeling – Identifying the distribution – Parameter estimation – Goodness-of-fit tests – Multivariate and time-series input models – Verification and validation of simulation models

UNIT IV SIMULATION OF COMPUTER NETWORKS 9

Introduction – Performance modeling – Modeling Techniques – Protocol modeling – Workload modeling – Network Topology modeling – Performance metrics in computer network simulation – Validation and verification – Discrete event simulation – GPU-based simulations – Multi-agent-based simulations –Network simulators

UNIT V CASE STUDIES OF NETWORK SIMULATORS 9

NS-3 based Simulative Platform - Evolved packet system – Differentiated services domain – ns-3 simulator – Simulation techniques for next generation wireless heterogeneous networks - Features of common network simulators - OpNet, mininet.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the modeling and development of simulations and simulators
- Differentiate the different ways in which simulators are designed
- Analyse how computer networks are simulated
- Use simulators like ns-3
- Compare the features of different simulators

REFERENCES:

1. J. B. Sinclair, “Simulation of Computer Systems and Computer Networks: A Process-Oriented Approach”, 2004.
2. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, “Discrete-event System Simulation, Fifth Edition, Pearson, 2010.
3. Law, Averill, “Simulation Modeling and Analysis with Expert Software”, Mc Graw Hill, 2006.
4. Mohammad S. Obaidat, Petros Nicopolitidis, Faouzi Zarai, “Modeling and Simulation of Computer Networks and Systems – Methodologies and Applications”, Morgan Kaufmann, 2015.
5. Sheldon M. Ross, “Simulation”, Fifth Edition, Elsevier, 2013.

NE5002 HIGH SPEED SWITCHING ARCHITECTURES L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I SWITCHING BASICS 9

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

UNIT II SWITCHING ARCHITECTURES 9

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

UNIT III PACKET QUEUES AND DELAY ANALYSIS 9

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

UNIT IV P ROUTER ARCHITECTURE 9

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

UNIT V MPLS ROUTERS 9

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

TOTAL: 45 PERIODS

OUTCOMES

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

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

REFERENCES:

1. Damitri P Bertsekas and Gallager, “Data Networks”, 2nd edition, PHI, 1992
2. Elhanany, Itamar, Hamdi and Mounir, “High Performance Packet Switching Architectures”, Springer 2007
3. H.Jonathan Chao and Bin Liu, “High Performance Switches and Routers”, John Wiley and Sons, 2007
4. Howard C Berkowitz, “Designing Routing and Switching Architectures for Enterprise Networks”, Sams, 1999
5. Luc De Ghein, “MPLS Fundamentals”, Cisco Press 2014.

NE5071	NETWORK MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To appreciate the need for interoperable network management as a typical distributed application
- To familiarize concepts and terminology associated with SNMP
- To be aware of current trends in network management technologies

UNIT I OSI NETWORK MANAGEMENT 8

OSI Network management model - Organizational model - Information model, Communication model. Abstract Syntax Notation - Encoding Structure, Macros Functional Model CMIP/CMIS.

UNIT II BROADBAND NETWORK MANAGEMENT 9

Broadband networks and services, ATM Technology - VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN, ATM Network Management - ATM Network reference model, Integrated local Management Interface. ATM Management Information base, Role of SNMP and ILMI in ATM Management, M1, M2, M3, M4 interface. ATM Digital Exchange Interface Management.

UNIT III SIMPLE NETWORK MANAGEMENT PROTOCOL 10

SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model, Functional model. SNMP Management SNMPv2: Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base,SNMPv2 Protocol, Compatibility With SNMPv1.Configuration management, Fault management, Performance management, Event Correlation Techniques 168 security management, Accounting management, Report Management, Policy Based Management, Services Level Management.

UNIT IV NETWORK MANAGEMENT SYSTEMS 9

Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Commercial Network management Systems, System Management and Enterprise Management Solutions.

UNIT V WEB-BASED MANAGEMENT 9

NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Diagnose problems and make minor repairs to computer networks using appropriate diagnostics software
- Demonstrate how to correctly maintain LAN computer systems
- Maintain the network by performing routine maintenance tasks
- Apply network management tools

REFERENCES:

1. Lakshmi G Raman, "Fundamentals of Telecommunication Network Management", Eastern Economy Edition IEEE Press, New Delhi, 1999.
2. Mani Subramanian, "Network Management - Principles and Practice", Pearson Education, Second edition, 2010.
3. Mani Subramanian, "Network Management Principles and Practice", Addison Wesley, Second edition, 2010.
4. Mark Burges, "Principles of Network System Administration", Wiley, 2000.
5. Salah Aiidarons and Thomas Plevayk, "Telecommunications Network Technologies and Implementations", Eastern Economy Edition IEEE press, New Delhi, 1998.
6. Stephen Morris, "Network Management, MIBs and MPLS - Principles, Design and Implementation", Pearson Education, 2003.

WEB REFERENCES:

1. http://www.apps.ietf.org/rfc/rfc1095.html
2. ycchen.im.ncnu.edu.tw/nm/ch_5x.ppt
3. en.wikipedia.org/wiki/Systems_management
4. www.rivier.edu/faculty/vriabov/NWM_ch_14.ppt 169

NE5003	NETWORK PERFORMANCE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the mathematical basis for analyzing the performance of networks.
- To understand queuing theory and queuing models.
- To analytically model traffic control protocols, and error control protocols using these concepts.
- To model performance of wired and wireless MAC such as 802.3, 802.11 and 802.16.
- To model network traffic and study the performance of different packet scheduling algorithms.

UNIT I MARKOV CHAINS BASICS 9

Overview of Random Processes, Markov Chains – Markov matrices, State transition matrix, Markov chains at equilibrium – steady state distribution vector.

UNIT II REDUCIBLE AND PERIODIC MARKOV CHAINS 9

Reducible Markov chain – Transition matrix, Reducible Composite Markov chain, Transient analysis, Steady state, Periodic Markov chain – Transition matrix, canonical form, Strongly and weakly periodic Markov chains, Queuing Analysis –M/M/1 queues, M/M/1/B queues, D/M/1/B queues, performance, communicating Markov chains

UNIT III TRAFFIC CONTROL, ERROR CONTROL AND MAC MODELING 9

Modeling traffic control protocols – Modeling leaky bucket and token bucket algorithms, Modeling Error control protocols - Stop and wait and GBN ARQ performance, Modeling media access control protocols – 802.1p, ALOHA, 802.3.

UNIT IV WIFI AND WIMAX PERFORMANCE 9

Modeling 802.11 protocol – Basic DCF modeling, RTS/CTS modeling, Modeling 802.11e, Performance, 802.11e HCCA Performance. Modeling 802.16 protocol – system and user performance.

UNIT V NETWORK TRAFFIC AND SCHEDULING 9

Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis.

TOTAL 45 PERIODS

OUTCOMES :

On completing this course, the student will be able to:

- Apply markov chain models and analyse the behavior of network systems.
- Perform queuing theory based analysis of various L2 layer functions, such as flow control, error control, and MAC.
- Build network traffic models.
- Analyse QoS functions such as scheduling and traffic control.

REFERENCES:

1. Anurag Kumar, D. Manjunath, Joy Kuri, Communication Networking: An analytical Approach, Elsevier, 2004.
2. Bertsekas D and Gallager R, Data Networks, 2nd Edition, Prentice-Hall, 1992.
3. Fayez Gebali, Analysis of computer networks, 2nd Edition, Springer, 2015.
4. Harrison P G and Patel N M, Performance Modelling of Communication Networks and Computer Architectures, Addison-Wesley, 1993.
5. Robertazzi T G, Computer Networks and Systems: Queuing Theory and Performance Evaluation, 2nd, Edition, Springer-Verlag, 1994.

NE5004 NEXT GENERATION NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- To learn the technical, economic and service advantages of next generation networks.
- To learn the evolution of technologies of 4G and beyond.
- To learn Software defined Mobile Network issues and integrating challenges with LTE.
- To explore the NGN framework catering the services of end user with QoS provisioning.
- To learn about the NGM management and standards.

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 4G and BEYOND 9

Introduction to LTE-A –Requirements and Challenges, network architectures –EPC, E-UTRAN architecture-mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT III SDMN-LTE INTEGRATION 9

SDN paradigm and applications, SDN for wireless-challenges, Leveraging SDN for 5G networks-ubiquitous connectivity-mobile cloud-cooperative cellular network-restructuring mobile networks to SDN-SDN/LTE integration benefits.

UNIT IV NGN ARCHITECTURE 9

Evolution towards NGN-Technology requirements, NGN functional architecture- Transport stratum, service stratum, service/ content layer and customer terminal equipment function. NGN entities, Network and Service evolution -fixed, mobile, cable and internet evolution towards NGN.

UNIT V NGN MANAGEMENT AND STANDARDIZATION 9

NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management. Service and control management- End-to-End QoS and security. ITU and GSI-NGN releases, ETSI-NGN concept and releases, NGMN alliance and NGMN.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to understand the issues and challenges of wireless domain in future generation network design.
- To be able to explore the LTE concepts and technologies.
- To be able to understand the integration of SDN with LTE.
- To be able to understand the NGN management and standardizations.

REFERENCES:

1. Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, January 2008.
2. Madhusanga Liyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015.
3. Martin Sauter,"3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.
4. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
5. Thomas Plavyk, “Next generation Telecommunication Networks, Services and Management”, Wiley & IEEE Press Publications, 2010.

NE5005	SOFTWARE DEFINED NETWORKS AND NETWORK FUNCTION VIRTUALIZATION (SDN AND NFV)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of software defined networks
- To learn the interface between networking devices and the software controlling them
- To learn network virtualization and tools
- To explore modern approaches like vmware, openflow, openstack

UNIT I SOFTWARE DEFINED NETWORK (SDN) 9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework

UNIT II VIRTUALIZATION BASICS 9

Primer on Virtualization, Benefits of virtual machines, Hypervisors, Managing Virtual resources, Virtualized cloud/data center

UNIT III NETWORK FUNCTIONS VIRTUALIZED 9

Virtualize a Network, virtualizing appliances, virtualizing core networking functions, scalability and performance

UNIT IV MODERN NETWORKING APPROACHES 9

Openflow, VMware NSX, OpenDayLight project-ODL architecture & controller platform, control network, Business case for SDN

UNIT V SECURITY & VISIBILITY 9

Security-Preventing Data leakage, Logging and auditing, Encryption in Virtual Networks
Visibility-Overlay networks, Network management tools, Monitoring Traffic

TOTAL :45 PERIODS

OUTCOMES:

Upon successful completion ofthis course, a student will be able to:

- To identify/design software defined network for the required application/platform
- To deploy network virtualization tool & design
- To equip in various network security measures and tackle

REFERENCES:

1. Jim Doherty,"SDN and NFV Simplified", Addison Wesley, 2016
2. SiamakAzodoimolky, "Software Defined Networking with OpenFlow", Packt Publishing Limited, 2013
3. Thomas D.Nadeau and Ken Gray, “SDN – Software Defined Networks”, O"Reilly Publishers, 2013

CP5073 EMBEDDED SOFTWARE DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I EMBEDDED PROCESSORS 9

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

UNIT II EMBEDDED COMPUTING PLATFORM 9

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

UNIT III EMBEDDED NETWORK ENIVIRONMENT 9

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

UNIT IV REAL-TIME CHARACTERISTICS 9

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

UNIT V SYSTEM DESIGN TECHNIQUES 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

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

REFERENCES:

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

NE5006	PROTOCOLS AND ARCHITECTURES FOR WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of wireless sensor networks
- To understand the protocols for WSN
- To get exposure on WSN environment with TinyOS and like
- To understand the layered approach in sensor networks
- To design WSN and analyse performance

UNIT I WIRELESS SENSOR NETWORK ARCHITECTURE 9

Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II DATA LINK LAYER 9

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols - SMAC, BMAC,TRAMA, Link Layer protocols – fundamentals task and requirements, error control, framing, link management, Naming and addressing – address assignment, unique, Content-based and geographical addressing.

UNIT III NETWORK LAYER 9

Routing protocols – Requirements, Taxonomy - Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques, Localization and positioning – Properties, Approaches, Mathematical basics for single hop and multi-hop environment.

UNIT IV TRANSPORT LAYER 9

Transport Protocol, Coverage and deployments - Sensing models, Coverage measures, Random deployments: Poisson model, Boolean sensing model, general sensing model, Coverage determination, grid deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control, Time synchronization – Issues and protocol – Sender/Receiver, Security – protocols and Key Distribution Techniques.

UNIT V TOOLS FOR WSN 9

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming.

TOTAL : 45 PERIODS

OUTCOMES:

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

- To be able to design energy efficient WSNs.
- To design and implement protocols in TinyOS and Contiki.
- To design application dependent WSNs.

REFERENCES:

1. Anna Hac, “Wireless Sensor Network Design”, John Wiley & Sons, 2003.
2. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, “Wireless Sensor Networks”, Springer Publication, 2004
3. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
4. KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless Sensor Networks TechnologyProtocols and Applications”, John Wiley & Sons, 2007.
5. Paolo Santi, “Topology Control in Wireless Adhoc and Sensor Networks”, John Wiley & Sons, 2005.
6. Philip Levis, David Gay,"TinyOS Programming", Cambridge University Press, 2009
   Contiki - Open Source Operating System for IOT - http://www.contiki-os.org/

CP5076	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I STORAGE TECHNOLOGY 9

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

UNIT II STORAGE SYSTEMS ARCHITECTURE 9

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

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

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

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS 9

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

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- To select from various storage technologies to suit for required application
- To apply security measures to safeguard storage & farm
- Analyse QoS on Storage

REFERENCES:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Marc Farley, “Building Storage Networks”, Tata McGraw Hill ,Osborne, 2001.
3. Robert Spalding, “Storage Networks: The Complete Reference“, Tata McGraw Hill , Osborne, 2003.

CP5293 BIG DATA ANALYTICS L T P C

3 0 0 3

OBJECTIVES:

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

UNIT I INTRODUCTION TO BIG DATA 7

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT II HADOOP FRAMEWORK 9

Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT III DATA ANALYSIS 13

Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT IV MINING DATA STREAMS 7

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT V BIG DATA FRAMEWORKS 9

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand how to leverage the insights from big data analytics
- Analyze data by utilizing various statistical and data mining approaches
- Perform analytics on real-time streaming data
- Understand the various NoSql alternative database models

REFERENCES:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Richard Cotton, Learning R – A Step-by-step Function Guide to Data Analysis, O’Reilly Media, 2013.

CP5074	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the components of the social network
- To model and visualize the social network
- To mine the users in the social network
- To understand the evolution of the social network
- To know the applications in real time systems

UNIT I INTRODUCTION 9

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

UNIT II MODELING AND VISUALIZATION 9

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

UNIT III MINING COMMUNITIES 9

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

UNIT IV EVOLUTION 9

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

UNIT V APPLICATIONS 9

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

TOTAL : 45 PERIODS

OUTCOMES:

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

- Work on the internals components of the social network
- Model and visualize the social network
- Mine the behaviour of the users in the social network
- Predict the possible next outcome of the social network
- Apply social network in real time applications

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2011
3. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2014
4. Giles, Mark Smith, John Yen, “Advances in Social Network Mining and Analysis”, Springer, 2010.
5. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2012
6. Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007.
7. Przemyslaw Kazienko, Nitesh Chawla,”Applications of Social Media and Social Network Analysis”, Springer,2015

CP5091	WEB ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods
- Be familiar with the testing techniques for web applications

UNIT I INTRODUCTION TO WEB ENGINEERING 9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures- Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages-Analysis Modeling for WebApps-The Content Model-The Interaction Model-Configuration Model.

UNIT III WEB APPLICATION DESIGN 9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines-Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design-WepApp Functionality- Design Process- Functional Architecture- Detailed Functional Design.

UNIT IV TESTING WEB APPLICATIONS 9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches-Conventional Approaches, Agile Approaches- Testing concepts- Testing Process -Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability Testing-Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing- Test Automation.

UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9

Introduction-challenges in launching the web Application-Promoting Web Application-Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Explain the characteristics of web applications.
- Model web applications.
- Design web applications.
- Test web applications.

REFERENCES:

1. Chris Bates, "Web Programming: Building Internet Applications", Third Edition, Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, "Web Engineering", John Wiley and Sons Ltd, 2006.
3. Guy W. Lecky-Thompson, "Web Programming", Cengage Learning, 2008.
4. John Paul Mueller, "Web Development with Microsoft Visual Studio 2005", Wiley Dream tech, 2006.
5. Roger S. Pressman, David Lowe, "Web Engineering", Tata McGraw Hill Publication, 2007.

NE5007	ETHICAL HACKING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand and analyse Information security threats & couter measures
- To perform security auditing & testing
- To understand issues relating to ethical hacking
- To study &employ network defense measures
- To understand penetration and security testing issues

UNIT I ETHICAL HACKING OVERVIEW 9

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Footprinting – Information Gathering Methodology – Footprinting Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines.

UNIT II SCANNING AND ENUMERATION 9

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools

UNIT III SYSTEM HACKING 9

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Counter measures – Escalating Privileges –Executing Applications – Keyloggers and Spyware.

UNIT IV PROGRAMMING FOR SECURITY PROFESSIONALS 9

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.

UNIT V PENETRATION TESTING 9

Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools

TOTAL : 45 PERIODS

OUTCOMES:

Upon successful completion ofthis course, a student will be able to:

- Understand vulnerabilities, mechanisms to identify vulnerabilities/threats/attacks
- Perform penetration & security testing
- Become a professional ethical hacker

REFERENCES:

1. EC-Council, “Ethical Hacking and Countermeasures: Attack Phases”, Delmar Cengage Learning, 2009.
2. Jon Erickson, “Hacking: The Art of Exploitation”, No Starch Press, Second Edition, 2008.
3. Michael T. Simpson,"Hands-on Ethical Hacking & Network Defense", Course Technology, 2010
4. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy”, Syngress Media, Second Revised Edition, 2013.
5. RajatKhare, "Network Seuciry and Ethical Hacking", Luniver Press, 2006
6. Ramachandran V,BackTrack 5 Wireless Penetration Testing Beginner’s Guide 3rd ed.. Packt Publishing, 2011
7. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003.

NE5008	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I INTRODUCTION 9

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

UNIT II EVIDENCE AND INVESTIGATIONS 9

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

UNIT III OPEN SOURCE EXAMINATION PLATFORM 9

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

UNIT IV DISK AND FILE SYSTEM ANALYSIS 9

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

UNIT V LAWS AND ACTS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

1. Cory Altheide and Harlan Carvey, “Digital Forensics with Open Source Tools” Elsevier publication, 3rd Edition, April 2011
2. Eoghan Casey , “Digital Evidence and Computer Crime", Forensic Science, Computers, and the Internet, Elsevier, 3rd Edition, 2011
3. Kevin Mandia, Chris Prosise, Matt Pepe, “Incident Response and Computer Forensics “, TataMcGraw -Hill, New Delhi, 2006
4. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi, 2009.
5. Robert M Slade,” Software Forensics”, Tata McGraw - Hill, New Delhi, 2005.