NANDHAENGINEERINGCOLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, TamilNadu, India, Phone: 04294 – 225585

Curriculum and Syllabi
for
M.E – Computer Science and Engineering [R15]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year 2015-2016 onwards)

JUNE 2016

Approved by Third and Fourth Academic Council

NANDHA ENGINEERING COLLEGE
(Autonomous Institution Affiliated to Anna University, Chennai)
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.E. COMPUTER SCIENCE AND ENGINEERING
(For the students admitted during 2015-2016 and onwards)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The following Programme Educational Objectives are designed for M.E. Computer Science and Engineering programme in Computer Science and Engineeringbased on the Department Vision & Mission to provide higher engineering education and motivate research in the field of Computer Engineering.

PEO 1 The graduates of Computer Science and Engineering would demonstrate an exceptional involvement and active participation in Research and Development related to Computer Science and Engineering through precise education

PEO 2 The graduates of Computer Science and Engineering would practice their careers in industry/academia/research/ government with a strong foundation and in-depth knowledge

PEO 3 The graduates of Computer Science and Engineering would analyze, design and create products, solutions to problems with good scientific and engineering breadth.

PEO 4 The graduates of Computer Science and Engineering would demonstrate professional expertise by communicating their engineering ideas and solutions ethically to the society.

PROGRAMME OUTCOMES OF COMPUTER SCIENCE AND ENGINEERING (PO's)

Post Graduating student of Computer Science and Engineering programme will be able to

PO1 Apply basic principles and practices of Computer Science and Engineering to productively engage in the research.

PO2 Design and conduct experiments as well as to analyze, interpret data on experiments relevant to Computer Science and Engineering practice.

PO3 Design a system component or process to meet desired needs with realistic constraints such as economic, environmental, social, ethical, manufacturability and sustainability.

PO4 Define, assess, and tailor the software quality practices and software processes with methodologies for appropriate application on software development projects in various domain areas.

PO5 Identify, analyze, formulate and solve engineering problems.

PO6 Understand the impact of engineering solutions in a global, economic, environmental and societal context.

PO7 Recognize the necessity and ability to engage in life-long learning.

PO8 Acquire the knowledge of contemporary issues.

PO9 Use the techniques, skills and modern Engineering tools necessary for engineering practice.

PO10 Pursue life-long learning through post graduate education, participation in professional activities or the Acquisition of new technical proficiencies with managerial and leadership skills.

PO11 Able to undertake collaborative research projects with industries and other organizations

NANDHA ENGINEERING COLLEGE

REGULATIONS 2015

M.E. Computer Science and Engineering

I TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

SEMESTER I

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP101	Theoretical Foundations of Computer Science	3	1	0	4
15CP102	Design and Management of Computer Networks	3	0	0	3
15CP103	Object Oriented Software Engineering	3	0	0	3
15CP104	Advanced Data Structuresand Algorithms	3	1	0	4
15CP105	Multicore Architecture and Programming	3	0	0	3
E1	Elective (PE)	3	0	0	3

PRACTICAL					
CourseCode	**Course Title**	**L**	**T**	**P**	**C**
15CP111	Computer Networks Laboratory	0	0	4	2
15CP112	Data Structures Laboratory	0	0	4	2
	TOTAL	**18**	**2**	**8**	**24**

SEMESTER II

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP201	Web Services	3	1	0	4
15CP202	Advanced Database Technology	3	0	0	3
15CP203	Cloud Security	3	0	0	3
15CP204	Advanced Operating Systems	3	1	0	4
E2	Elective (PE)	3	0	0	3
E3	Elective (PE)	3	0	0	3

PRACTICAL					
CourseCode	**Course Title**	**L**	**T**	**P**	**C**
15CP211	Database Technology Laboratory	0	0	4	2
15CP212	Operating Systems Laboratory	0	0	4	2
15CP213	Technical Term Paper	0	0	2	1
	TOTAL	**18**	**2**	**10**	**25**

SEMESTER III

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
E4	Elective (PE)	3	0	0	3
E5	Elective (PE)	3	0	0	3
E6	Elective (OE)	3	0	0	3
PRACTICAL					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP311	Project Phase I	0	0	12	6
	TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

PRACTICAL					
CourseCode	**Course Title**	**L**	**T**	**P**	**C**
15CP411	Project Phase II	0	0	24	12
	TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS (24+25+15+12) =76 CREDITS
***PE- Professional Elective*OE-Open Elective**

NANDHA ENGINEERING COLLEGE, ERODE-52

REGULATIONS 2015

M.E. Computer Science and Engineering

I TO VI SEMESTERS (PART TIME) CURRICULUM AND SYLLABUS

SEMESTER I

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP101	Theoretical Foundations of Computer Science	3	1	0	4
15CP102	Design And Management of Computer Networks	3	0	0	3
15CP103	Object Oriented Software Engineering	3	0	0	3

PRACTICAL					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP111	Computer Networks Laboratory	0	0	4	2
	TOTAL	**9**	**1**	**4**	**12**

SEMESTER II

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP104	Advanced Data Structures and Algorithms	3	1	0	4
15CP105	Multicore Architecture and Programming	3	0	0	3
E1	Elective (PE)	3	0	0	3

PRACTICAL					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP112	Data Structures Laboratory	0	0	4	2
	TOTAL	**9**	**1**	**4**	**12**

SEMESTER III

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP201	Web Services	3	1	0	4
15CP202	Advanced Database Technology	3	0	0	3
15CP203	Cloud Security	3	0	0	3

PRACTICAL					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP211	Database Technology Laboratory	0	0	4	2
	TOTAL	**9**	**1**	**4**	**12**

SEMESTER IV

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP204	Advanced Operating Systems	3	1	0	4
E2	Elective (PE)	3	0	0	3
E3	Elective (PE)	3	0	0	3

PRACTICAL					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP212	Operating Systems Laboratory	0	0	4	2
15CP213	Technical Term Paper	0	0	2	1
	TOTAL	**9**	**1**	**6**	**13**

SEMESTER V

THEORY					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
E4	Elective (PE)	3	0	0	3
E5	Elective (PE)	3	0	0	3
E6	Elective (OE)	3	0	0	3

PRACTICAL					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CP311	Project Phase I	0	0	12	6
	TOTAL	**9**	**0**	**12**	**15**

SEMESTER VI

PRACTICAL					
CourseCode	**Course Title**	**L**	**T**	**P**	**C**
15CP411	Project Phase II	0	0	24	12
	TOTAL	**0**	**0**	**24**	**12**

LIST OF ELECTIVES

M.E.Computer Science and Engineering

Professional Electives:

LIST OF ELECTIVES FOR E1					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
15CPX01	TCP/IP Technology	3	0	0	3
15CPX02	Data Warehousing and Data Mining	3	0	0	3
15CPX03	Distributed Systems	3	0	0	3
15CPX04	Mobile Computing	3	0	0	3
15CPX05	Software Project Management	3	0	0	3
LIST OF ELECTIVES FOR E2					
15CPX06	High Speed Networks	3	0	0	3
15CPX07	Data Science and Big Data Analytics	3	0	0	3
15CPX08	Parallel Algorithms	3	0	0	3
15CPX09	Compiler Construction and Optimization	3	0	0	3
LIST OF ELECTIVES FOR E3					
15CPX10	Adhoc Networks	3	0	0	3
15CPX11	Machine Learning Techniques	3	0	0	3
15CPX12	Digital Image Processing and Applications	3	0	0	3
15CPX13	Software Requirement Engineering	3	0	0	3
LIST OF ELECTIVES FOR E4					
15CPX14	Wireless Sensor Networks	3	0	0	3
15CPX15	Virtualization Techniques	3	0	0	3
15CPX16	Soft Computing	3	0	0	3
15CPX17	Mobile Application Development	3	0	0	3
LIST OF ELECTIVES FOR E5					
15CPX18	Network Optimization Techniques	3	0	0	3
15CPX19	Pattern Recognition	3	0	0	3
15CPX20	Evolutionary Computing	3	0	0	3
15CPX21	Semantic Web	3	0	0	3

Open Electives

LIST OF OPEN ELECTIVES					
Course code	**Course Title**	**L**	**T**	**P**	**C**
15CPZ01	Information Retrieval Methodologies	3	0	0	3
15CPZ02	Internet of Things	3	0	0	3
15CPZ03	Java Programming	3	0	0	3
15CPZ04	Open Source Software	3	0	0	3

TOTAL CREDITS (24+25+15+12) =76 CREDITS

***PE- Professional Elective*OE-Open Elective**

15CP101 THEORETICAL FOUNDATIONS OF COMPUTER SCIENCE

L	T	P	C
3	1	0	4

OBJECTIVES:

- To understand and use the terms cardinality, finite and countable infinite sets and determine which of these characteristics is associated with a given set.
- To provide students with the understanding of various types of graphs including Regular graphs and Random graphs.
- To impart the knowledge of modelling and languages.

LEARNING OUTCOMES:

On completion of this course the students will be able to

CO1 Check the validity of the arguments.
CO2 Check whether a particular combination of words is a valid sentence or not.
CO3 Solve propositional logic, including modelling English description with propositions and connectives and doing with truth analysis and will be conversant in predicate logic.

UNIT I FOUNDATIONS (9+3)

Sets-Relations-Equivalence relations-Partial orders-Functions-Recursive functions-Sequences-Induction principle-Structural induction-Recursive algorithms-Counting - Pigeonhole principle-Permutations and Combinations (Self study)-Recurrence relations.

UNIT II LOGIC (9+3)

Propositional logic-Logical connectives-Truth tables-Normal forms (conjunctive and disjunctive)-Predicate logic-Universal and existential quantifiers-Proof techniques-Direct and Indirect-Proof by contradiction-Mathematical Induction (Self study).

UNIT III GRAPH STRUCTURES (9+3)

Tree Structures- Graph Structures- Graph Representations-Regular graph structures-Random graphs-Connectivity-Cycles-Graph coloring-Cliques, Vertex Covers, Independent sets-Spanning Trees-Network flows(Self study)-Matching.

UNIT IV QUEUE MODELS (9+3)

Characteristics of Queuing Models- Kendal's Notation-Single and Multi-Server Markovian queuing models – M/M/1, M/M/C(Self study) (finite and infinite capacity) and (M/G/1) :(∞/GD).

UNIT V MODELING COMPUTATION AND LANGUAGES (9+3)

Finite state machines – Deterministic and Non- deterministic finite state machines – Turing Machines – Formal Languages – Classes of Grammars – Type 0 – Context Sensitive – Context Free – Regular Grammars(Self study) – Ambiguity.

TOTAL = 60 PERIODS

REFERENCES:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Fifth Edition, TMH, 2003 .
2. M.K. Venkataraman, N. Sridharan and N.Chandrasekaran," Discrete Maths.", The National Publishing Company, 2003.
3. Kishore S Trivedi, "Probability and statistics with reliability, Queuing and computer science applications", PHI, 2006.
4. H. A.Taha, ," Operations Research" - An Introduction,8th Edition, Prentice Hall of India Ltd, New Delhi, 2008
5. Ralph P Girmaldi and B.V. Ramana ," Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education Asia, Delhi, 2007.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X			X	X	X	X	X		
2	X	X			X	X	X	X	X	X	X
3	X	X					X	X		X	X

15CP102 DESIGN AND MANAGEMENT OF COMPUTER NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the network design, services, requirements and management tool of the design issues and architecture of the network to understand the network management technology for the real world entity.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Understand the network analysis and its management application.
CO2 Able to know the design requirements, capacity for development and system requirements.
CO3 Understand the network flow and flow related algorithms.
CO4 Use the network architecture components and different architecture models.
CO5 Apply the protocols and techniques for designing the network.

UNIT I INTRODUCTION TO NETWORK MANAGEMENT (9)

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

UNIT II REQUIREMENTS ANALYSIS (9)

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

UNIT III FLOW ANALYSIS (9)

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

UNIT IV NETWORK ARCHITECTURE (9)

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

UNIT V NETWORK DESIGN (9)

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

TOTAL: 45 PERIODS

TEXT BOOK:

1. Network Analysis, Architecture, and Design by James D. McCabe, Morgan Kaufmann, Third Edition, 2007.ISBN-13: 978-0123704801.

REFERENCES:

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

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1		X									
2								X		X	
3			X								
4	X	X									
5		X									X

15CP103 OBJECT ORIENTED SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the basics of Software Engineering Life Cycle process.
- To Analyze Object-Oriented (OO) approach to software development through OO principles and design patterns and UML (Unified Modelling Language).

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Understand OO concepts and software engineering process.
CO2 Understand various techniques for gathering and analyzing user's requirements.
CO3 Construct static and dynamic models of software using UML.
CO4 Develop an efficient and effective test plan from software requirements.

UNIT I INTRODUCTION (9)

Introduction– Software Engineering Concepts– Development Activities– Managing Software Development– Unified Modelling Language– Project Organization and Communication.

UNIT II ANALYSIS (9)

Requirements Elicitation–Concepts– Activities–Management– Analysis concepts– Analysis Activities.

UNIT III SYSTEM DESIGN (9)

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

UNIT IV OBJECT DESIGN AND IMPLEMENTATION ISSUES (9)

Reusing Pattern Solutions–Specifying Interfaces– Mapping Models to Code–Testing .

UNIT V MANAGING CHANGE (9)

Rationale Management– Configuration Management–Project Management– Software Life Cycle.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 3rd Ed., Pearson Education,2010.

REFERENCES:

1. Timothy C. Lethbridge, Robert Laganiere, Object Oriented Software Engineering, Tata McGraw-Hill, 2004
2. Craig Larman, Applying UML and Patterns, 3rd Ed., Pearson Education, 2005.
3. Stephen Schach, Software Engineering 7th Ed., McGraw-Hill, 2007.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X		X		X		X	X	
2	X	X	X	X			X	X		X	X
3	X	X					X	X		X	X
4	X		X		X		X		X		

15CP104 ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To learn the basic techniques of algorithm analysis.
- To understand the concepts of notations and analysis.
- To familiar with writing recursive methods.
- To understand the concepts of Heaps and Search structures.
- To familiar with advanced algorithms.

LEARNING OUTCOMES:

On completion of this course the students will be able to

CO1 Use recursive design.
CO2 Implement the main data structures and use them to solve computational problems.
CO3 Master different algorithm design techniques.
CO4 Apply and implement learned algorithm design techniques to solve problems.

UNIT I FUNDAMENTALS (9+3)

Introduction to Linear and Non Linear data structures - Mathematical Induction - Asymptotic Notations – Properties of Big-oh Notation – Conditional Asymptotic Notation –Algorithm Analysis – Amortized Analysis – NP Completeness – NP-Hard – Recurrence Equations – Solving Recurrence Equations – Memory Representation of Multi-dimensional Arrays – Time-Space Tradeoff.

UNIT II HEAP STRUCTURES (9+3)

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

UNIT III SEARCH STRUCTURES (9+3)

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

UNIT IV ANALYSIS AND DESIGN OF ALGORITHMS (9+3)

Sorting - Searching - Design Techniques - Greedy Methods – Dynamic Programming - Divide and Conquer - Back Tracking –Applications.

UNIT V ADVANCED ALGORITHMS (9+3)

Huffman Coding – Convex Hull – Topological Sort – Tree Vertex Splitting – Activity Networks – Flow Shop Scheduling – Counting Binary Trees – Introduction to Randomized Algorithms.

TOTAL = 60 PERIODS

TEXT BOOK:

1. E. Horowitz, S.Sahni and Dinesh Mehta, “Fundamentals of Data structures in C++”, University Press, 2007.

REFERENCES:

1. E. Horowitz, S. Sahni and S. Rajasekaran, “Computer Algorithms/C++”, 2nd ed., University Press, 2007.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education,2002.
3. Alfred .V. Aho, John .E. Hopcroft, and Jeffrey .D. Ullman, "Data Structures and Algorithms", Addison-Wesley Publications.,2010.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X		X		X		X	X	X	X	X
2	X	X	X				X		X	X	X
3	X	X	X				X		X	X	X
4	X		X	X	X		X		X	X	X

15CP105 MULTICORE ARCHITECTURE AND PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic structure and operation of multicore process.
- To study the design of arithmetic and logic unit and implementation of arithmetic operations.
- To study the two types of control unit techniques and parallel programming.
- To study the hierarchical memory system including cache memories and.
- To provide knowledge of memory technologies, interfacing techniques and subsystem devices.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Understand multi-core architectures.
CO2 Write parallel programs.
CO3 Know the issues of operating system, compiler for multi-core system.
CO4 Understand the issues related to processors, memories, I/O devices.

UNIT I INTRODUCTION (9)

Instruction Level Parallelism, Thread level parallelism–parallel computer models–Symmetric and distributed shared memory architectures – Performance Issues – Multi-core Architectures - Software and hardware multithreading – SMT and CMP architectures –Design issues – Case studies – Intel Multi-core architecture – SUN CMP architecture.

UNIT II PARALLEL PROGRAMMING (9)

Fundamental concepts – Designing for threads – Scheduling - Threading and parallel Programming constructs – Synchronization – Critical sections – Deadlock - Threading APIs.

UNIT III MEMORY PROGRAMMING (9)

OpenMP – Threading a loop – Thread overheads – Performance issues – Library functions–Solutions to parallel programming problems – Cache memories (address mapping, line size, replacement and write-back policies) – Memory and cache related issues.

UNIT IV MPI PROGRAMMING (9)

MPI Model – Collective communication – Data decomposition – Communicators and topologies – Interconnection networks – Buses, crossbar-Multi-stage switches – Point-to-point communication – MPI Library.

UNIT V MULTITHREAD AND STORAGE APPLICATION (9)

Algorithms, program development and performance tuning-Advanced topics in disk storage-Video control–I/O Performance–SMART technology and fault detection–Processor to network interfaces.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.
2. Michael J Quinn, Parallel programming in C with MPI and OpenMP, Tata Macgraw Hill, 2003.

REFERENCES:

1. John L. Hennessey and David A. Patterson, “Computer architecture – A quantitative approach”, Morgan Kaufmann/Elsevier Publishers, 4th. Edition, 2007.
2. David E. Culler, Jaswinder Pal Singh, “Parallel Computing Architecture: A hardware/ Software Approach”, Morgan Kaufmann/Elsevier Publishers, 1999.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X										X
2	X		X								
3	X			X		X			X	X	X
4	X			X			X			X	X

15CP111 COMPUTER NETWORKS LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To understand how the data transferred from source to destination.
- To know that how the routing algorithms worked out in network layer.

LEARNING OUTCOMES:

Upon completion of the course, students will be able to

CO1 Know the contemporary issues in networking technologies,

CO2 Work with network tools and network programming

LIST OF EXPERIMENTS:

1. Simple topology creation.
2. Socket Programming.
   a. TCP Sockets.
   b. UDP Sockets.
   c. Application using sockets.
3. Routing Algorithms (Shortest Path, Link State).
4. Simulation of Congestion Control Algorithms using NS.
5. Development of applications such as DNS/ HTTP/ E – mail/ Multi - user Chat.
6. Simulation of Network Management Protocols.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X						X			X
2			X								

15CP112 DATA STRUCTURES LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To design and code algorithms for problem solutions
- Understand the concept of linear structures.
- Understand applicability for the various data structures.

LEARNING OUTCOMES:

Upon completion of the course, students will be able to

CO1 Design and analyze the time and space efficiency of the data structure.

CO2 Identity the appropriate data structure for given problem.

CO3 Have practical knowledge on the application of data structures.

LIST OF EXPERIMENTS:

1. Implementation of the following Heap Structures Min Heap Deaps(Insertion, Delete Min, Delete Max) Skew Heap(Priority Queue operations) Fibonacci Heap(Priority Queue operations).
2. Implementation of the following Search Structures AVL Trees (Insertion, Deletion and Search) Splay Trees (Insertion, Deletion and Search) B-Trees (Insertion, Deletion and Search) Red- Black Trees.
3. Implementation of Convex Hull.
4. Implementation of Topological sort.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X			X	X	X	X	X	X
2	X	X	X		X	X	X	X	X	X	X
3	X	X	X			X	X	X	X	X	X

15CP201 WEB SERVICES

L	T	P	C
3	1	0	4

OBJECTIVES:

- To employ basic XML specifications, technologies and applications.
- To Design and develop a simple interactive web application.
- To describe web service, supporting specifications and technologies including SOAP and UDDI, UDDI, JAX-RPC.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Analyze a web page and identify its elements and attributes.

CO2 Build and consume web services using SOAP and UDDI, UDDI, JAX-RPC.

UNIT I - XML **(9)**

XML Basis – XML Namespace – Working with DTD: Validating your XML document – Defining DTD Entities – Working with Attributes – Adding Style – XSL Transformations.

UNIT II - XML SCHEMA AND QUERY **(9)**

Using Schema: Schema Elements, Types and Groups – Defining Schema Attributes – XML Query – XLink – XPointer.

UNIT III - WEB SERVICES: SOAP & WSDL **(9)**

Web Services SOAP: – Structure of SOAP – SOAP Namespaces – SOAP Headers – SOAP Body – SOAP Messaging Modes – SOAP Faults – SOAP over HTTP. WSDL: Structure of WSDL – WSDL Declarations – WSDL Abstract Interface – Messaging Exchange patterns – WSDL Implementation.

UNIT IV - WEB SERVICES: UDDI **(9)**

UDDI: Introduction – Data structures – Business Entity Structure - Business Service and Binding Template Structures – tModel Structure – UDDI Inquiry API – Operations – UDDI Publishing API.

UNIT V - WEB SERVICES: JAX – RPC **(9)**

JAX- RPC: Overview – JAX-RPC Service Endpoints – JAX-RPC EJB Endpoints - JAX-RPC Clients APIs. SAAJ: Creating a SOAP Message – Working with SOAP Documents – Working with SOAP Faults – Sending SOAP messages with SAAJ.

TOTAL: 45 PERIODS

REFERENCES:

1. Heather Williamson, “The Complete Reference XML”, TMH, 2001.
2. Richard Monson-Haefel, “J2EE Web Services”, Eighth Edition, Person Education, 2012.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X			X			X		X
2	X	X	X	X		X	X	X	X	X	X

15CP202 ADVANCED DATABASE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented database
- To understand the usage of advanced data models.
- To acquire inquisitive attitude towards research topics in databases like cloud database and NoSQL.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Select the appropriate high performance database like parallel and distributed database.
CO2 Model and represent the real world data using object oriented database.
CO3 Design a semantic based database to meaningful data access
CO4 Embed the rule set in the database to implement intelligent databases.
CO5 Demonstrate competency in designing and selecting a particular NoSQL database for specific use cases.

UNIT I PARALLEL DATABASES

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems.

UNIT II DISTRIBUTED DATABASES **(9)**

Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies.

UNIT III OBJECT BASED DATABASES **(9)**

Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL .

UNIT IV INTELLIGENT DATABASES **(9)**

Active Databases: Syntax and Semantics -Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- Deductive Databases: Logic of Query Languages – Data log- Recursive Rules-Syntax and Semantics of Data log Languages- Implementation of Rules and Recursion- Recursive Queries in SQL- Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures-Spatial Access Methods- Mobile Databases.

UNIT V CLOUD DATABASE AND NOSQL

(9)

Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models- Query Languages- Introduction to Big Data-Storage- NoSQL Introduction – Differences from relational databases – Column family store- Document stores – key-value databases – Graph databases – Choosing a NoSQL database.

TOTAL: 45 PERIODS

REFERENCES

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Sixth Edition, Pearson Education/Addison Wesley.
1. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, sixth Edition, Pearson Education.
2. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw Hill.
3. C.J.Date, A.Kannan and S.Swamynathan, ”An Introduction to Database Systems”, Eighth Edition, Pearson Education.
4. Pramod J. Sadalage; Martin Fowler. NoSQL Distilled: A Brief Guide to the Emerging of Polyglot Persistence. Addison-Wesley. 2012.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X		X						X	
2	X		X	X	X		X		X		X
3		X					X	X		X	
4	X		X	X			X		X		
5				X			X	X	X	X	

5CP203 CLOUD SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic concepts of security systems in cloud.
- To understand The Various Attacks and Vulnerabilities in the Cloud.
- To understand the standards and protocols defines for security management.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Understand; analyze the various designs and protocols used in Cloud security systems.

CO2 Identify and formulate various policies and compliances related to cloud and able to overcome the security issues.

UNIT I INTRODUCTION (9)

Cloud computing security fundamentals: Security Objectives, Security services, Cloud security design principles, secure cloud software requirements, secure cloud Testing. Security Concepts: Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defense in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS.

UNIT II INFRASTRUCTURE AND DATA SECURITY (9)

Infrastructure Security: The Network level, The Host Level, The Application level; Data Security: Aspects of data security, Data Security mitigation, Cloud Service Providers and its security. Case Study: Amazon web services(Iaas), Google(Saas,PaaS),Microsoft Azure (paaS).

UNIT III ATTACKS AND VULNERABILITIES (9)

Virtualization System-Specific Attacks: Distributed Denial of Service, Guest hopping, Packet sniffing, Sql Injection and hyper jacking. Virtualization System Vulnerabilities: Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities.

UNIT IV SECURITY MANAGEMENT IN THE CLOUD (9)

Identity and Access Management (IAM) : Challenges, Architecture, IAM Standards and protocols, Cloud Authorization management. Security Management Standards in the cloud, Availability Management (SaaS, PaaS, IaaS),

UNIT V AUDIT AND COMPLIANCE (9)

Internal Policy compliance, GRC, Illustrative Control Objectives, Incremental CSP-Specific Control Objectives, Additional Key Management Control Objectives, Regulatory/External Compliance, Auditing the Cloud for Compliance.

Case Study: Illustrating Potential Changes in the IT Profession Caused by Cloud Computing.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance [ISBN: 0596802765].

REFERENCES:

1. Ronald L. Krutz, Russell Dean Vines, Cloud Security [ISBN: 0470589876].
2. John Rittinghouse, James Ransome, Cloud Computing [ISBN: 1439806802].
3. J.R. ("Vic") Winkler, Securing the Cloud [ISBN: 1597495921].

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X		X				X	X		X	X
2	X		X				X			X	X

15CP204 ADVANCED OPERATING SYSTEMS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To learn how an operating system performs its duties is to garner insight into how a computer functions at its innermost levels.
- To learn a multiprogramming system, distributed operating systems.
- To learn the principles of managing the main memory, one of the most precious resources in mechanisms of synchronization, resource management, failure recovery and fault tolerance.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO3 Understand the potential benefits of distributed operating systems.

CO4 Understand multiprogramming system, resource management.

CO5 Understand the concepts of failure recovery, fault tolerance and Concurrency Control.

UNIT I - PROCESS SYNCHRONIZATION (9+3)

Overview - Functions of an Operating System – Design Approaches – Types of Advanced Operating System - Synchronization Mechanisms – Concept of a Process, Concurrent Processes – The Critical Section Problem, Other Synchronization Problems – Language Mechanisms for Synchronization – Axiomatic Verification of Parallel Programs – Process Deadlocks - Preliminaries – Models of Deadlocks- Resources – A Graph-Theoretic model of System State – Necessary and Sufficient conditions for a Deadlock – Systems with Single-Unit Requests, Consumable Resources, Reusable Resources.

UNIT II - DISTRIBUTED OPERATING SYSTEMS (9+3)

Issues – Communication Networks and Primitives – Theoretical Foundations - Inherent Limitations - Lamport‟s Logical Clock- Vector Clock- Causal Ordering of Messages- Global State- Distributed Mutual Exclusion – Classification- Preliminaries - Non-Token Based Algorithms – Lamport‟s Algorithm - Token-Based Algorithms – Suzuki-Kasami‟s Broadcast Algorithm– Distributed Deadlock Detection– Preliminaries – Handling of Deadlocks - Issues –Centralized Deadlock-Detection Algorithms - Distributed Deadlock Detection Algorithms – Hierarchical Deadlock Detection Algorithms.

UNIT III - DISTRIBUTED RESOURCE MANAGEMENT (9+3)

Distributed file system - Architecture–Design issues-Distributed Shared Memory- Algorithms for implementing DSM – Memory Coherence and Coherence Protocols – Design Issues- Distributed Scheduling – Issues in Load Distributing – Components of a Load Distributing Algorithm – Stability – Load Distributing Algorithm – Performance Comparison – Selecting a Suitable Load Sharing Algorithm – Requirements for Load Distributing - Task Migration and Issues.

UNIT IV - FAILURE RECOVERY AND FAULT TOLERANCE (9+3)

Recovery : Introduction – Basic Concepts – Classification of Failures – Backward and Forward Error Recovery Approaches - Recovery in Concurrent Systems – Synchronous and Asynchronous Check Pointing and Recovery – Check Pointing for Distributed Database Systems - Recovery in Replicated Distributed Databases Systems – Fault Tolerance – Issues- Commit Protocol- Non Blocking Commit Protocol-Voting Protocol - Dynamic Voting Protocol – Dynamic Vote Reassignment Protocol – Failure Resilient Processes – Reliable Communication.

UNIT V - DATABASE OPERATING SYSTEMS (9+3)

Introduction- Requirements of a Database Operating System- Concurrency Control: Theoretical Aspects – Database Systems – The Problem of Concurrency Control – Serializability. Theory- Distributed Database Systems- Concurrency Control Algorithms- Basic Synchronization Primitives – Lock Based Algorithms - Timestamp Based Algorithms - Optimistic Algorithms – Data Replication.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Mukesh Singhal and N. G. Shivaratri, “Advanced Concepts in Operating Systems”, McGraw-Hill, 2011.

REFERENCES:

1. Abraham Silberschatz, Peter B. Galvin and G. Gagne, “Operating System Concepts”, 9th ed., Addison Wesley Publishing Co., 2013.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, 2nd ed., Addison Wesley, 2001.
3. Pradeep K.Sinha, “Distributed operating system -Concepts and design”, PHI, 2007.
4. Andrew S.Tanenbaum, “Distributed operating system”, Pearson education, 2013.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X				X	X	X	X	X
2	X	X	X	X	X		X	X	X	X	X
3	X	X	X		X		X	X		X	X

15CP211 DATABASE TECHNOLOGY LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To develop an understanding of corporate data resources and their value for modern businesses
- To collect, analyze and consolidate relevant information from many sources and use it in supporting claims about the advantages and disadvantages of corporate data management tools and techniques.

LEARNING OUTCOMES:

Upon completion of the course, students will be able to

CO1 Evaluate and Apply Advanced Database Development Techniques. Evaluate Database Systems.

CO2 Administer Database Systems.

CO3 Design & Implement Advanced Database Systems.

LIST OF EXPERIMENTS:

1. Create a distributed database and do some basic SQL on that database.
2. Implement deadlock detection algorithm for distributed database using wait-for graph.Produce local wait for graph for each of the sites and construct global wait for graph and check for dead lock.
3. Design an Enhanced Entity Relationship (EER) Model and Write relevant OQL.
4. Implement a application using parallel database [State any assumptions you have made].
5. Implement parallel join and parallel sort algorithms in a parallel database.
6. Design a relational database schema and implement some relevant triggers and assertions to make that database as active database.
7. Construct a knowledge database for kinship domain (family relations) with facts. Extract the following relations using rules. Parent, Sibling, Brother, Sister, Child, Daughter, Son, Spouse, Wife, husband, Grandparent, Grandchild, Cousin, Aunt and Uncle.
8. Implement Query Optimizer with Relational Algebraic expression construction and execution plan generation for choosing an efficient execution strategy for processing the given query.

Use Eucalyptus or Open Nebula or equivalent to set up the cloud and demonstrate:

9. Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.
10. Find procedure to set up the one node Hadoop cluster.
11. Write a word count program to demonstrate the use of Map and Reduce tasks.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X		X			X	X	X		X
2	X		X	X	X		X		X	X	X
3		X	X		X		X	X		X	

15CP212 OPERATING SYSTEM LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To learn about various operating systems including Windows, Mac and Unix OS.
- To learn about systems configuration and administration.

LEARNING OUTCOMES:

Upon completion of the course, students will be able to

CO1 Point the problems related to process management and synchronization as well as are able to apply learned methods to solve basic problems.

CO2 Explain the cause and effect related to deadlocks and is able to analyse them related to common circumstances in operating systems.

CO3 Explain the basics of memory management, the use of virtual memory in modern operating systems as well as the structure of the most common file-systems.

LIST OF EXPERIMENTS:

1. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time
2. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time
3. Implement the Producer – Consumer problem using semaphores
4. Implement Best fit, First Fit Algorithm for Memory Management.
5. Implement BankerAlgorithm
6. Implement FIFO and LRU page replacement algorithms
7. Multiple sleeping barbers - Multiprocessor operating systems
   Write a multi-class multithreaded Java program that simulates multiple sleeping barbers, all in one barbershop that has a finite number of chairs in the waiting room. Each customer is instantiated from a single Customer class, each barber is instantiated from a single Barber class.
8. Real time operating systems
   A real-time program implementing an alarm clock shall be developed.
   [Alarm clock, using C and Simple_OS].
   The program shall fulfill the following requirements:
   Clock with alarm functionality shall be implemented, It shall be possible to set the time, It shall be possible to set the alarm time, the alarm shall be *enabled* when the alarm time is set, the alarm shall be *activated* when the alarm is enabled, and when the current time is equal to the alarm time, an activated alarm must be acknowledged. Acknowledgement of an alarm shall lead to the alarm being *disabled, the* alarm is enabled again when a new alarm time is set, an alarm which is not acknowledged shall be repeated every 10 seconds. The program shall communicate with a graphical user interface, where the current time shall be displayed, and where the alarm time shall be displayed when the alarm is enabled. It shall be possible to terminate the program, using a command which is sent from the graphical user interface.
9. Transactions and Concurrency -Database operating systems Exercises
   Assume any application (e.g. banking) on your own and do the following exercises.
   1. Investigate and implement the ObjectStore's concurrency options.
   2. Implement the concurrency conflict that occurs between multiple client applications.
   3. Observe and implement the implication of nested transactions.

10. Distributed operating systems
    Design a RMI Lottery application. Each time you run the client program -- “java LotteryClient n”, the server program “LotteryServer” will generate n set of Lottery numbers. Here n is a positive integer, representing the money you will spend on Lottery in sterling pounds. Write this program in a proper engineering manner, i.e. there should be specifications, design (flow chart, FD, or pseudo code), coding, test/debug, and documentation.
11. Consider a distributed system that consists of two processes which communicate with each other. Let P be a state predicate on the local state of one process and Q be a state predicate on the local state of the other process. Assume that neither P nor Q are stable (i.e. closed). Design a superimposed computation which detects that there exists an interleaving of underlying events in this system where at some state P ^Q holds. (A superposed computation is one that does not a_ect the underlying system; it may \read" but not \write" the state of the underlying system. Events in a superposed computation may occur in at the same instant as the underlying events and/or at di_erent instants.) State any assumptions you make. [Hint: Use vector clocks.]

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X						X	X	X	X
2	X	X			X	X	X		X	X	
3		X	X		X	X			X	X	X

15CP213 TECHNICAL TERM PAPER

L	T	P	C
0	0	2	1

OBJECTIVES:

- To provide exposure to the students to refer, read and review the research articles in referred journals and conference proceedings.
- To improve the technical report writing and presentation skills of the students.

LEARNING OUTCOMES:

CO1 At the end of the course the student will be able to read and review the research articles and publish a technical paper

<table>
<tr><td>METHODOLOGY</td><td colspan="2">Each student is allotted to a faculty of the department by the Dean/ HOD.
By mutual discussions, the faculty guide will assign a topic in the general /subject area to the student.
The students have to refer the Journals and Conference proceedings and collect the published literature.
The student is expected to collect atleast 20 such Research Papers published in the last 5 years.
Using OHP/Power Point, the student has to make presentation for 15 -20 minutes followed by 10 minutes discussion.
The student has to make two presentations, one at the middle and the other near the end of the semester.
The student has to write a Technical Report for about 30 -50 pages (Title page, one page Abstract, Review of Research paper under various subheadings, Concluding Remarks and List of References). The technical report has to be submitted to the Dean/ HOD one week before the final presentation, after the approval of the faculty guide.</td></tr>
<tr><td rowspan="8">EXECUTION</td><td>Week</td><td>Activity</td></tr>
<tr><td>I</td><td>Allotment of Faculty Guide by the Dean/ HoD</td></tr>
<tr><td>II</td><td>Finalizing the topic with the approval of Faculty Guide</td></tr>
<tr><td>III-IV</td><td>Collection of Technical papers</td></tr>
<tr><td>V-VI</td><td>Mid semester presentation</td></tr>
<tr><td>VII-VIII</td><td>Report writing</td></tr>
<tr><td>IX</td><td>Report submission</td></tr>
<tr><td>X-XI</td><td>Final presentation</td></tr>
<tr><td rowspan="6">EVALUATION</td><td colspan="2">100% by Continuous Assessment - 3 Hrs/week and 1 credit</td></tr>
<tr><td>Component</td><td>Weightage</td></tr>
<tr><td>Mid semester presentation</td><td>25%</td></tr>
<tr><td>Final presentation (Internal)</td><td>25%</td></tr>
<tr><td>End Semester Examination Report</td><td>30%</td></tr>
<tr><td>Presentation</td><td>20%</td></tr>
<tr><td>Total</td><td>100%</td></tr>
</table>

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**Pos**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X	X		X	X	X	X	X	X	X

15CPX01 TCP/IP TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the design of internetworking, IP and TCP
- To Interpret TCP/IP application services
- Understand the fundamentals of network design and implementation.
- Learn to design and implement network applications.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability

CO1 To gain practical experience in designing communication protocols

CO2 To outline the various ways of connecting a network

CO3 To gain practical experience of IP addresses, and the fundamentals of IP routing

CO4 To build the trade–offs between UDP and TCP and its uses.

UNIT I INTRODUCTION (9)

Internetworking concepts and architecture model – classful Internet address – CIDR – Subnetting and Supernetting – AARP – RARP- IP- IP Routing – ICMP – IPV6..

UNIT II TCP (9)

Services – header – connection establishment and termination – interactive data flow – bulk data flow – timeout and retransmission – persist timer – keep alive timer.

UNIT III IP IMPLEMENTATION (9)

IP global software organization –routing table–routing algorithms – fragmentation and reassembly –error processing (ICMP) – Multicast Processing (IGMP).

UNIT IV TCP IMPLEMENTATION I

Data structure and input processing – transmission control blocks – segment format – comparison–finite state machine implementation – Output processing – mutual exclusion –the computing the TCP Data length.

UNIT V TCP IMPLEMENTATION II (9)

Timers – events and messages – timer process – deleting and inserting timer event – flow control and adaptive retransmission– congestion avoidance and control – urgent data processing and push function.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Douglas E Comer,"Internetworking with TCP/IP Principles,Protocols and Architecture",Vol 1 V edition 2006.
2. Internetworking with TCP/IP Vol. II: ANSI C Version: Design, Implementation,and Internals:2, III Edition, 1999.

REFERENCES:

1. W.Richard Stevens "TCP/IP Illustrated" Vol 1. Pearson Education, 2012.
2. W.Richard Stevens "TCP/IP Illustrated" Volume 2, Pearson Education 2003.
3. Forouzan, " TCP/IP Protocol Suite" Second Edition, Tata MC Graw Hill, 2003

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X			X			X	X		X	
2		X	X			X				X	X
3	X	X		X	X				X		
4	X		X	X				X	X	X	

15CPX02 DATA WAREHOUSING AND DATA MINING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To compare and contrast different conceptions of data mining as evidenced in both research and application.
- To explain the role of finding associations in commercial market basket data.
- To characterize the kinds of patterns that can be discovered by association rule mining.
- To describe how to extend a relational system to find patterns using association rules.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Learn the concepts of database technology evolutionary path which has led to the need for data mining and its applications.

CO2 Evaluate and implement a wide range of emerging and newly-adopted methodologies and technologies to facilitate the knowledge discovery Discover and measure interesting patterns from different kinds of databases.

CO3 Discuss the role of data warehousing and enterprise intelligence in industry and government.

CO4 Summarize the dominant data warehousing architectures and their support for quality attributes.

UNIT I DATA WAREHOUSING (9)

Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT II DATA MINING AND PREPROCESSING (9)

Data Mining: - Data Mining Functionalities – Data Pre-processing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint- Based Association Mining.

UNIT III FREQUENT PATTREN MINING (9)

Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT IV CLASSIFICATION AND PREDICTION (9)

Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint- Based Cluster Analysis – Outlier Analysis.

UNIT V CLUSTERING AND TRENDS IN DATA MINING (9)

Mining Object, Spatial, Multimedia, Text and Web Data-Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

TOTAL: 45 PERIODS

REFERENCES:

1. Jiawei Han and Micheline Kamber “Data Mining Concepts and Techniques”, 3rd ed.,Elsevier, 2012.
2. Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGrawHill Edition, Tenth Reprint 2007.
3. K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”,Easter Economy Edition, Prentice Hall of India, 2006.
4. G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, PH of India, 2006.
5. Pang-Ning Tan, Michael Steinbach & Vipin Kumar “Introduction to Data Mining”, Pearson Edu. 2007.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1				X	X		X	X	X	X	X
2	X			X				X		X	X
3		X	X	X	X	X		X	X		
4		X	X		X	X	X				

15CPX03 DISTRIBUTED SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn distributed system and operating system.
- To understand threads in distributed system.
- To learn knowledge about synchronization and fault tolerance.
- To learn about file system in distributed system.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Present the main characteristics of distributed systems, as well as the related problems and the most common solutions.

CO2 Implement small-scale distributed systems.

CO3 Explore about various file systems.

UNIT I INTRODUCTION (9)

Definition of Distributed system – Goals- Hardware concepts: Multiprocessors, Homogeneous and Heterogeneous multicomputer systems– Software concepts: Distributed Operating Systems, Network operating systems and Middleware – Client server model.

UNIT II COMMUNICATION AND PROCESSES (9)

Layered Protocol – Remote procedure call – Remote object invocation – Message oriented communication – Processes: Threads in distributed systems- Code Migration-Software Agents.

UNIT III SYNCHRONIZATION (9)

Clock synchronization –Physical clocks- Logical clocks- Election algorithms- Mutual exclusion – Distributed transactions.

UNIT IV FAULT TOLERANCE (9)

Basic concepts –Design Issues- Reliable client server communication- Reliable group communication. Distributed object based systems: CORBA – Distributed COM – GLOBE – Comparison of CORBA, DCOM and GLOBE.

UNIT V DISTRIBUTED FILE SYSTEM (9)

Sun Network File system- CODA File system – XFS and SFS File system. Distributed document based systems: WWW – LOTUS NOTES.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Andrew S. Tanenbaum and Maarten Van Steen ,Distributed Systems – Principles and paradigms, Prentice Hall of India Pvt. Ltd, New Delhi, 2009.

REFERENCES:

1. George Coulouris, Tim Kindberg and Jean Dollimore, “Distributed Systems Concept and Design”, Pearson Education, New Delhi, 2005.
2. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufmann Publishers, New Delhi, 2000.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X				X		X		X		
2			X		X			X			
3											X

15CPX04 MOBILE COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To have deep knowledge about wireless communication and mobile technologies
- To understand the development environments and computing strategies
- To know the future trends in mobile technologies

LEARNING OUTCOMES:

Upon the completion of this course given in the curriculum, students should be able to

CO1 Understand the concept of wireless communication and mobile technologies
CO2 Develop applications that are used in mobile device using SDK
CO3 Demonstrate current practice in Mobile computing contexts

UNIT I WIRELESS COMMUNICATION TECHNOLOGIES (9)

Cellular networks, wireless 802.11, TCP/IP for mobile, Geo location and Geo positioning systems.

UNIT II OVERVIEW OF MOBILE COMPUTING (9)

Overview of Mobile Technologies, Anatomy of mobile device, survey of mobile device, Applications of mobile device, Native vs Mobile applications, Architecture.

UNIT III DEVELOPMENT ENVIRONMENT (9)

Introduction to Objective-C, Model view Controller Model, Mobile computing Software framework, Android SDK , iPhone SDK, Common user interface guidelines.

UNIT IV MOBILE COMPUTING STRATEGIES (9)

Application Environment, Limited Resource Computing, Mobile Memory management, Low power Computing, Fault tolerance and Persistence, Security Issues

UNIT V FUTURISTIC COMPUTING (9)

Upcoming Technologies, Convergence of Media and Communication devices, Case Studies

TOTAL: 45 PERIODS

TEXT BOOK:

1. Asoke K Taukder,Roopa R Yavagal, Mobile Computing, Tata McGraw Hill Publication Co., New Delhi, 2010.
2. Ivan Stojmenovic , Handbook of Wireless Networks and Mobile Computing, John Wiley & sons Inc, Canada, 2006.
3. Mobile Ad Hoc Networks: Current Status and Future Trends edited by Jonathan Loo, Jaime Lloret Mauri, Jesús Hamilton Ortiz, 2012.

REFERENCES:

1. J.Schiller, “Mobile Communication”, Addison Wesley, 2009.
2. William Stallings, “Wireless Communication and Networks”, Pearson Education, 2003.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X				X	X	X	X	X
2	X			X	X		X	X	X	X	X
3	X	X	X	X	X		X	X	X	X	X

15CPX05 SOFTWARE PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- Deliver successful software projects that support organization's strategic goals
- Match organizational needs to the most effective software development model
- Plan and manage projects at each stage of the software development life cycle (SDLC) Create project plans that address real-world management challenges
- Develop the skills for tracking and controlling software deliverables.

LEARNING OUTCOMES:

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

CO1 Provide how different project contexts will impact upon all aspects of a software development project

CO2 Identify and describe the key phases of project management and the key skills associated

CO3 Determine an appropriate project management approach through an evaluation of the business context and project scope and knowledge of agile and traditional project management approaches

CO4 Demonstrate through application, knowledge of the key project management skills,such as product and work break-down structure, schedule; governance including progress reporting, risk and quality management.

UNIT I BASIC CONCEPTS **(9)**

Product, Process and Project – Definition – Product Life Cycle – Project Life Cycle Models

UNIT II FORMAT PROCESS MODELS AND THEIR USE **(9)**

Definition and Format model for a process – The ISO 9001 and CMM Models and their relevance to Project Management – Other Emerging Models like People CMM.

UNIT III UMBRELLA ACTIVITIES IN PROJECTS **(9)**

Metrics – Configuration Management – Software Quality Assurance – Risk Analysis.

UNIT IV IN STREAM ACTIVITIES IN PROJECTS **(9)**

Project Initiation **–** Project Planning **–** Execution and Tracking **–** Project Wind up **–** Concept of Process/Project Database.

UNIT V ENGINEERING AND PEOPLE ISSUES IN PROJECT MANAGEMENT **(9)**

Phases (Requirements, Design, Development, Testing, Maintenance, Deployment) – Engineering Activities and Management Issues in Each Phase – Special Considerations in Project Management for India and Geographical Distribution Issues.

REFERENCES:

1. Ramesh, Gopalaswamy, "Managing Global Software Projects", Tata McGraw Hill, 2008.
2. Humphrey,Watts,"Managing the Software Process ",Addison Wesley,1986.
3. Pressman,Roger,"Software Engineering",A Practitioner‟s approach.McGraw Hill,1997.
4. Bob Hughes and Mike Cotterell,"Software Project Management

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X	X				X	X	X	X	X
2	X			X	X		X	X	X	X	X
3	X	X	X	X	X		X	X	X	X	X
4		X		X		X	X	X		X	X

15CPX06 HIGH SPEED NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To have a thorough understanding of the various Packet Switched Networks.
- To learn the overview of circuit switched networks
- To understand in detail about the concepts of ATM and Frame relay.
- To discuss in detail about the Optical networks, Wi-MAX and UWB.

LEARNING OUTCOMES:

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

CO1 Students will have a strong foundation of OSI model and various protocols used in each layer
CO2 Be familiar with ATM networks and its layers.
CO3 Able to analyze various memory hierarchies both internal and external.
CO4 Students will have a thorough knowledge in Wi-MAX and UWB.
CO5 Analyze various protocols used in Bluetooth technology

UNIT I PACKET SWITCHED NETWORKS (9)

OSI and IP models – Ethernet (IEEE 802.3) – Token ring (IEEE 802.5) –FDDI – DQDB – SMDS: Internetworking with SMDS. Wireless LAN (IEEE 802.11).

UNIT II CIRCUIT SWITCHED NETWORKS (9)

SONET - Dense Wave Division Multiplexing (DWDM) – Digital Subscriber Line (DSL) – Intelligent Network Architecture- CATV.

UNIT III ATM NETWORKS (9)

ATM: Main Features of ATM– Addressing, Signaling and Routing– ATM Header Structure– Adaptation Layer– Management and control– Internetworking with ATM.

UNIT IV OPTICAL NETWORKS (9)

Optical Links - WDM Systems – Optical Cross Connects - Optical LANs. Optical Paths and Networks- Ring Networks – Hierarchical Mesh Networks – Optical Networks.

UNIT V ULTRA WIDEBAND (UWB) AND WIMAX (9)

UWB: Introduction– Time-Hopping Ultra wide band– Direct Sequence Ultra wideband– Multiband– Other Types of UWB. WiMAX: Introduction– WiMAX Overview– Competing Technologies– Overview of the Physical Layer– PMP Mode– Mesh Mode– Multi hop Relay Mode.

REFERENCES:

1. Walrand .J. Varatya, “High performance communication network”, Morgan Kauffman – Harcourt Asia Pvt. Ltd. 2nd Edition, 2000.
2. David tung chong wong, Peng-yong kong, Ying-chang liang, Kee chaing chua and Jon W. Mark, “Wireless Broadband Networks,” John Wiley & Sons, 2009.
3. William Stallings,”ISDN and Broadband ISDN with Frame Relay and ATM”, 4th edition, Pearson education Asia, 2002
4. Jennifer Bray and Charles F.Sturman,”Blue Tooth” Pearson education Asia, 2001
5. Shahin Farahani, “ZigBee Wireless Networks and Transceivers”, Elsevier Ltd,2008.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X	X				X	X	X	X	X
2	X			X	X		X	X	X	X	X
3	X	X	X	X	X		X	X	X	X	X
4		X		X		X	X	X		X	X
5	X		X		X		X	X	X	X	X

15CPX07 DATA SCIENCE AND BIG DATA ANALYTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Explore the fundamental concepts of big data and analytics
- To learn analytical techniques and tools to analyze big data, create statistical models, and identify insights that can lead to actionable results.
- To understand about visualization techniques and tools to analyze big data and create statistical models.
- To analyze the big data using intelligent techniques.
- To Use tools such as: R and RStudio, MapReduce/Hadoop, in-database analytics, Window and MADlib functions.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Identify the need for big data analytics for a domain.
CO2 Deploy the Data Analytics Lifecycle to address big data analytics projects.
CO3 Select appropriate data visualizations to clearly communicate analytic insights to business sponsors and analytic audiences.
CO4 Design efficient algorithms for mining the data from large volumes.
CO5 Design applications using Map Reduce Concepts.

UNIT I INTRODUCTION TO BIG DATA ANALYTICS (9)

Big Data overview, State of the practice in analytics role of data scientists, Big Data Analytics in industry verticals.

UNIT II END-TO-END DATA ANALYTICS LIFE CYCLE (9)

Key roles for successful analytic project, main phases of life cycle, Developing core deliverables for stakeholders.

UNIT III BASIC ANALYTIC METHODS (9)

Introduction to "R", analyzing and exploring data with "R", statistics for model building and evaluation.

UNIT IV ADVANCED ANALYTICS AND STATISTICAL MODELING FOR BIG DATA (9)

Naïve Bayseian Classifier, K-means Clustering, Association Rules, Predictive modelling using Decision Trees, Linear and Logistic Regression, Time Series Analysis, Text Analytics.

UNIT V MAPREDUCE/HADOOP (9)

Technology and Tools – MapReduce/Hadoop Ecosystem - Stream Computing Challenges - In-database analytics with SQL extensions – Advanced SQL techniques - MADlib functions.

TOTAL: 45 PERIODS

REFERENCES:

1. Noreen Burlingame , "The little book on Big Data", New Street publishers, 2012.
2. Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.
3. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press; 1 edition , 2011.
4. Jared Dean 2014, Big Data, Data Mining and Machine Learning", Wiley publications.
5. Tom White, "Hadoop, The definitive guide", O'Reilly Media, 2010
6. http://www.johndcook.com/R_language_for_programmers.html.
7. http://bigdatauniversity.com/.
8. http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X			X		X	X	X	X	
2	X	X	X	X	X		X	X	X	X	X
3	X	X	X	X	X		X	X	X	X	X
4	X	X	X	X	X		X	X	X	X	X
5	X	X	X	X			X	X	X	X	X

15CPX08 PARALLEL ALGORITHMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the need for parallel algorithms
- To expose the students to different models of parallel computation
- To expose the students to parallel sorting and searching algorithms
- To understand the application of the concepts studied to different types of problems
- To analyze parallel algorithms

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Discuss the classification of parallel architectures and identify suitable programming models

CO2 Perform sorting on CRCW, CREW, EREW Models

CO3 Search a sorted as well as random sequence

CO4 Develop and analyze algorithms for different applications like matrix multiplication, shortest path, job sequencing and the knapsack problem.

UNIT I INTRODUCTION (9)

Introduction to Parallel Algorithms –Models of Parallel Computation –Sorting on an EREW-SIMD PRAM Computer – Relation between PRAM Models –SIMD Algorithms –MIMD Algorithms –Selection –Desirable Properties for Parallel Algorithms -Parallel Algorithm for Selection –Analysis of Parallel Algorithms.

UNIT II SORTING AND SEARCHING (9)

Merging on the EREW and CREW Models -Fast Merging on EREW -Sorting Networks –Sorting on a Linear Array – Sorting on CRCW, CREW, EREW Models –Searching a Sorted Sequence –Searching a Random Sequence.

UNIT III ALGEBRAIC PROBLEMS (9)

Generating Permutations and Combinations in Parallel –Matrix Transpositions –Matrix by Matrix Multiplications – Matrix by Vector multiplication.

UNIT IV GRAPH THEORY AND COMPUTATIONAL GEOMETRY PROBLEMS (9)

Connectivity Matrix –Connected Components –All Pairs Shortest Paths –Minimum Spanning Trees –Point Inclusion – Intersection, Proximity and Construction Problems -Sequential Tree Traversal -Basic Design Principles –Algorithm – Analysis.

UNIT V DECISION AND OPTIMIZATION PROBLEMS (9)

Computing Prefix Sums –Applications -Job Sequencing with Deadlines –Knapsack Problem-The Bit Complexity of Parallel Computations.

TOTAL: 45 PERIODS

REFERENCES:

1. Selim G. Akl, “The Design and Analysis of Parallel Algorithms”, Prentice Hall, New Jersey, 1989.
2. Michael J. Quinn, “Parallel Computing : Theory & Practice”, Tata McGraw Hill Edition, 2003.
3. Justin R. Smith, “The Design and Analysis of Parallel Algorithms”, Oxford University Press, USA , 1993.
4. Joseph JaJa, “Introduction to Parallel Algorithms”, Addison-Wesley, 1992.

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COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X		X				X		X	X	
2	X			X	X	X				X	
3		X	X	X	X	X	X	X	X		X
4	X		X	X		X			X	X	

15CPX09 COMPILER CONSTRUCTION AND OPTIMIZATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the optimization techniques used in compiler design.
- To be aware of the various computer architectures that support parallelism.
- To become familiar with the theoretical background needed for code optimization.
- To understand the techniques used for identifying parallelism in a sequential program.
- To learn the various optimization algorithms.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Design Compilers for a programming language.
CO2 Map the process of Compilation for a programming paradigm and design compiler for the same.
CO3 Data log Implementation leads to a more efficient implementation of the dataflow analysis.

UNIT I INTRODUCTION (9)

Language Processors - The Structure of a Compiler – The Evolution of Programming Languages The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator -Parser Generator - Overview of Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Principle Sources of Optimization.

UNIT II INSTRUCTION-LEVEL PARALLELISM (9)

Processor Architectures – Code-Scheduling Constraints – Basic-Block Scheduling – Global Code Scheduling – Software Pipelining.

UNIT III OPTIMIZING FOR PARALLELISM AND LOCALITY-THEORY (9)

Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse Array data dependence Analysis.

UNIT IV OPTIMIZING FOR PARALLELISM AND LOCALITY – APPLICATION (9)

Finding Synchronization - Free Parallelism – Synchronization between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms.

UNIT V INTERPROCEDURAL ANALYSIS (9)

Basic Concepts – Need for Interprocedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Interprocedural Analysis - Context Sensitive Pointer-Analysis - Datalog Implementation by Binary Decision Diagrams.

TOTAL: 45 PERIODS

REFERENCES:

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, “Compilers:Principles, Techniques and Tools”, Second Edition, Pearson Education,2008.
2. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence-based Approach”, Morgan Kaufmann Publishers, 2002.
3. Steven S. Muchnick, “Advanced Compiler Design and Implementation”,Morgan Kaufmann Publishers Elsevier Science, India, Indian Reprint 2003.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X				X		X	X	X
2	X	X	X						X	X	X
3	X	X	X	X			X		X	X	X

15CPX10 AD HOC NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know about the fundamental principles of Adhoc Networks
- To develop a comprehensive understanding of Adhoc network protocols.
- To understand current and emerging trends in Wireless Networks.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Describe the unique issues in ad-hoc networks.

CO2 Describe current technology trends for the implementation and deployment of ad-hoc networks.

CO3 Insight in medium access mechanisms in WLAN and IEEE 802.11-based multi-hop ad-hoc networks

CO4 Broad knowledge on future wireless networks and awareness of a few new trends within the area of ad-hoc networks.

UNIT I AD HOC MAC (9)

Introduction – Issues in Ad-Hoc Wireless Networks, MAC Protocols – Issues, Classifications of MAC protocols, Multi channel MAC & Power control MAC protocol.

UNIT II AD-HOC NETWORK ROUTING & TCP (9)

Issues – Classifications of routing protocols – Hierarchical and Power aware. Multicast routing –Classifications, Tree based, Mesh based- Ad Hoc Transport Layer Issues. TCP Over Ad Hoc –Feedback based, TCP with explicit link, TCP-Bus, Ad Hoc TCP, and Split TCP.

UNIT III WSN -MAC (9)

Introduction – Sensor Network Architecture, Data dissemination, Gathering. MAC Protocols – self-organizing, Hybrid TDMA/FDMA and CSMA based MAC.

UNIT IV WSN ROUTING, LOCALIZATION & QoS (9)

Issues in WSN routing – OLSR, AODV- Localization – Indoor and Sensor Network Localization. QoS in WSN.

UNIT V MESH NETWORKS (9)

Necessity for Mesh Networks – MAC enhancements – IEEE 802.11s Architecture –Opportunistic routing – Self configuration and Auto configuration – Capacity Models – Fairness – Heterogeneous Mesh Networks – Vehicular Mesh Networks.

TOTAL: 45 PERIODS

REFERENCES:

1. C.Siva Ram Murthy and B.Smanoj, " Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.
2. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufman Publishers, 2004.
3. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, 2002.
4. Thomas Krag and Sebastin Buettrich, "Wireless Mesh Networking", O"Reilly Publishers,2007.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1									X		
2		X	X	X							
3	X	X	X				X				
4			X	X	X				X		

15CPX11 MACHINE LEARNING TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

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

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Implement a neural network for an application of your choice using an available tool.

CO2 Implement probabilistic discriminative and generative algorithms for an application of your choice and analyze the results.

CO3 Use a tool to implement typical clustering algorithms for different types of applications.

CO4 Identify applications suitable for different types of machine learning with suitable Justification.

UNIT I INTRODUCTION (9)

Machine Learning - Machine Learning Foundations –Overview – applications - Types of machine learning - basic concepts in machine learning Examples of Machine Learning -Applications – Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison.

UNIT II SUPERVISED LEARNING (9)

Linear Models for Classification - Discriminant Functions -Probabilistic Generative Models -Probabilistic Discriminative Models - Bayesian Logistic Regression - Neural Networks -Feed-forward Network Functions - Error Back propagation- Regularization - Mixture Density and Bayesian Neural Networks - Kernel Methods - Dual Representations - Radial Basis Function Networks.

UNIT III UNSUPERVISED LEARNING (9)

Clustering- K-means - EM - Mixtures of Gaussians - The EM Algorithm in General -Model selection for latent variable models - high-dimensional spaces -- The Curse of Dimensionality –Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independent components analysis.

UNIT IV TREE MODELS (9)

Decision trees – Classification Trees - Regression Trees - Clustering Trees- Pruning - Ensemble methods - Bagging - Boosting.

UNIT V PROBABILISTIC GRAPHICAL MODELS (9)

Directed Graphical Models - Bayesian Networks - Exploiting Independence Properties - FromDistributions to Graphs -Examples -Markov Random Fields - Inference in Graphical Models – Learning –Naive Bayes classifiers-Markov Models – Hidden Markov Models – Inference – Learning- Generalization.

TOTAL: 45 PERIODS

REFERENCES:

1. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
3. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
5. Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning” (2nd ed)., Springer, 2008.
6. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X		X	X				X		X	X
2	X	X	X		X		X				
3	X	X		X		X	X				
4	X						X	X	X		

15CPX12 DIGITAL IMAGE PROCESSING AND APPLICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.
- To Analyze and implement image processing algorithms.
- To Gain hands-on experience in using software tools for processing digital images.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.

CO2 Acquire the fundamental concepts of a digital image processing system.

CO3 Analyze and implement image processing algorithms.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING (9)

Introduction – Image Processing System - Steps In Image Processing Systems –Sampling And Quantization – Color Fundamentals And Models, File Formats. Image Transforms: DFT, FFT, DCT, Walsh, Hadamard, Haar, Slant, KL and Radon Transforms.

UNIT II IMAGE ENHANCEMENT AND RESTORATION (9)

Histogram processing – Fundamentals of Spatial Filtering – Histogram Processing– Smoothing and Sharpening Spatial Filters. Filtering in Frequency Domain: Image Smoothing and Sharpening using Frequency Domain Filters. Noise Models – Inverse Filtering – Geometric Spatial transformation – image rest ration technique.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS (9)

Detection of Isolated Points – Line Detection – Edge Models – Edge Linking and Boundary Detection – Thresholding – Region based Segmentation – The use of motion in Segmentation – Feature analysis and Extraction.

UNIT IV MULTI RESOLUTION ANALYSIS AND COMPRESSIONS (9)

Multi Resolution processing: Image pyramids - Sub band Coding – Multiresolution Expansions – Wavelet Transform in one dimension and two dimensions – Wavelet Packets. Image Compression: Fundamentals – Models – Elements of Information Theory – Lossy compression – Compression Standards – JPEG/MPEG.

UNIT V APPLICATIONS OF IMAGE PROCESSING (9)

Represetation and Description, Image Recognition – Image Understanding – Image Classification – Video Motion Analysis – Image Fusion – Image Steganography – Color Image Processing.

TOTAL: 45 PERIODS

REFERENCES:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Pearson Education, Third Edition, 2010.
2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt.Ltd., 2011.
3. Jayaraman S., Esaki Rajan S., T.Veera Kumar, “Digital Image Processing”,Tata McGraw Hill Pvt. Ltd., Second Reprint, 2010.
4. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Tata McGraw Hill Pvt. Ltd., Third Edition, 2011.
5. Bhabatosh Chanda, Dwejesh Dutta Majumder, “Digital Image Processing and analysis”, PHI Learning Pvt. Ltd., Second Edition, 2011.
6. Malay K.Pakhira, “Digital Image Processing and Pattern Recognition”, PHI Learning Pvt. Ltd., First Edition, 2011.
7. Annadurai S., Shanmugalakshmi R., “Fundamentals of Digital Image Processing”, Pearson Education, First Edition, 2007.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X	X	X		X		X		X	X
2	X	X	X		X		X		X	X	
3	X	X		X		X	X	X			X

15CPX13 SOFTWARE REQUIREMENTS ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic concepts of software requirements engineering.
- To understand the stakeholders involved in requirements engineering.
- Be able to recognize requirements of each type, a prerequisite for effective documentation writing.
- Be capable of extensive further on-the-job learning, within a sound conceptual framework, in the field of requirements analysis.

LEARNING OUTCOMES:

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

CO1 Define a process for requirement engineering.

CO2 Design a software engineering system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturing, and sustainability.

CO3 Understand the professional and ethical responsibilities of a software engineer.

UNIT I INTRODUCTION

Introduction – Requirements engineering – categories of requirements –requirements in software life cycle-agile development process and requirement engineering- identifying stake holders-arte-fact driven elicitation techniques-stake holder driven elicitation technique-risk analysis-requirement prioritization.

UNIT II REQUIREMENT SPECIFICATION AND DOCUMENTATION (9)

Diagrammatic notations: system scope-conceptual structures-activities and data-instruction flow-interaction scenarios-system behavior-stimuli and behavior-formal specification

UNIT III QUALITY ASSURANCE AND EVOLUTION (9)

Requirements inspection and review-validation by specification animation-verification through formal checks-evolution: time space dimension-change anticipation-traceability management- control management-runtime monitoring.

UNIT IV BUILDING SYSTEM MODELS (9)

Modeling system objectives with goal diagrams-building goal models-risk analysis on goal models-modeling conceptual objects with class diagrams.

UNIT V REASONING ABOUT SYSTEM MODELS (9)

Semiformal reasoning-formal specification of system models-formal reasoning for specification construction and analysis.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Axel van Lamsweerde, "Requirements Engineering", Wiley, 2009.

REFERENCES:

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

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X		X	X		X		X	X	X
2		X	X	X	X		X	X	X	X	X
3		X			X			X			X

15CPX14 WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the basics of wireless sensor network.
- To enhance the working knowledge on Localization and Tracking.
- To gain knowledge about routing protocols.
- To learn Sensor Network Databases.
- To know recent Tools and Techniques for real time application.

LEARNING OUTCOMES:

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

CO1 Explain about the various applications, Constraints and Challengesof wireless sensor networks.
CO2 Work on Localization and Tracking.
CO3 Summarize IEEE standards and routing protocols.
CO4 Develop applications onwireless motes, smart phones and other embedded platforms.
CO5 Identify suitable tools and techniques for sensor network applications.

UNIT I INTRODUCTION TO SENSOR NETWORKS (9)

Background of Sensor Network Technology and Their Applications – Constraints and Challenges – Collaborative Processing – Basic Sensor Network Architectural Elements – Basic Wireless Sensor Technology – Hardware Components – Operating System and Execution Environment – Comparison of Wireless Sensor Networks with Mobile Adhoc Networks.

UNIT II LOCALIZATION AND TRACKING (9)

Tracking Scenario – Problem Formulation – Distributed Representation and Inteface of States – Tracking Multiple Objects – Sensor Models – Performance Comparison and Metrics.

UNIT III NETWORK STANDARDS AND ROUTING PROTOCOLS (9)

The SMAC Protocol – IEEE 802.15.4 Standard and ZigBee – Routing challenges and design issues in Wireless Sensor Network – Energy Efficient Unicast Routing – Geographical Routing.

UNIT IV SENSOR NETWORK DATA BASES (9)

Sensor Data base challenges–Querying the Physical Environment – Query Interfaces – High level Data Base Organization – Network aggregation – TinyDB Query Processing – Data Centric Storage – Data indices and Range Queries – Distributed Hierarchical Aggregation.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS (9)

Sensor Node Hardware – Berkeley Motes – Programming Challenges– Node-level Software Platforms – Node-level Simulators – State-centric Programming – Emerging Applications of Wireless Sensor Networks – Case study using SENSE.

TOTAL = 45 PERIODS

REFERENCES:

1. F. Zhao and L. Guibas,“Wireless Sensor Network: Information Processing Approach”, Elsevier, 2012.
2. Holger Karl & Andreas Willig,”Protocols And Architectures for Wireless Sensor Networks”,Elsevier, 2007.
3. KazemSohraby, Daniel Minoli, &TaiebZnati,”Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
4. E. H. Callaway, Jr. E. H. Callaway, “Wireless Sensor Networks Architecture and Protocols”, CRC Press, 2004.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X		X	X		X		X	X	X
2	X	X	X		X	X	X		X	X	X
3	X	X			X	X	X		X	X	X
4	X	X	X	X			X	X	X	X	X
5	X	X	X	X	X				X	X	X

15CPX15 VIRTUALIZATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn basics of virtualization.
- To study how to allocate memory in different environment.
- To know the virtual infrastructure management.
- To learn how effectively migrate a running production in virtual machine.
- To get knowledge about virtual server.

LEARNING OUTCOMES:

On completion of this course the students will be able to

CO1 Understand the main concepts, key technologies, strengths, and limitations of virtualization.
CO2 Develop the infrastructure of interfacing, including public cloud, private cloud, and hybrid cloud.
CO3 Manage capabilities for planning, deploying, managing, and optimizing virtual infrastructure.
CO4 Solve the appropriate machine learning solutions and then recommended.
CO5 Apply the Microsoft Virtual Server Environment in virtual machine.

UNIT I OVERVIEW OF VIRTUALIZATION (9)

Basics of Virtualization – Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization – System-leveler Operating Virtualization – Application Virtualization–Virtualization Advantages –VirtualMachine:CPUvirtualization –Privileged instructions handling –Hypervisor –Para virtualization– Hardware Assisted virtualization – Booting up – Time keeping – CPU scheduling –Commercial examples.

UNIT II MEMORY SERVER CONSOLIDATION (9)

Hardware Virtualization – Virtual Hardware Overview – Sever Virtualization – Physical and Logical Partitioning – Types of Server Virtualization – Business cases for Sever Virtualization – Uses of Virtual server Consolidation –Partitioning – Reclamation – Ballooning – Memory sharing – OS level virtualization –VM Ware –Red Hat Enterprise Virtualization.

UNIT III NETWORK VIRTUALIZATION (9)

Design of Scalable Enterprise Networks – Virtualizing the Campus WAN Design – WAN Architecture – WAN Virtualization – Virtual Enterprise Transport Virtualization–VLANsand Scalability – Theory Network Device Virtualization Layer 2 – VLANs Layer3 VRFInstances Layer 2 – VFIs Virtual Firewall Contexts Network Device Virtualization – Data-PathVirtualization Layer 2: 802.1q – Trunking Generic Routing Encapsulation –IPsecL2TPv3 Label Switched Paths – Control-Plane Virtualization–Routing Protocols– VRF –Aware Routing Multi–Topology Routing.

UNIT IV I/O VIRTUALIZING STORAGE (9)

SCSI– Speaking SCSI– Using SCSI buses – Fiber Channel – Fiber Channel Cables –Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI – SAN backup and recovery techniques – RAID – SNIA Shared Storage Model – Classical StorageModel – SNIA Shared Storage Model – Host based Architecture – Storage basedarchitecture – Network basedArchitecture– Fault tolerance to SAN – PerformingBackups – Virtual tape libraries.

UNIT V VIRTUALIZEDMACHINE COMPUTING (9)

Xen Virtual machine monitors– Xen API – VMware – VMware products – VMwareFeatures – Microsoft Virtual Server – Features of Microsoft Virtual Server–Virtual machine based distributed computing, elastic cloud computing, clustering, cold and hot migration – Commercial examples – Challenges and future trends.

TOTAL = 45 PERIODS

REFERENCES:

1. William von Hagen, “Professional Xen Virtualization”, Wrox Publications, January, 2008.
2. Jim Smith, “Virtual Machines: Versatile Platforms for Systems and Processes” Auerbach Publications,2006.
3. Chris Wolf, Erick M. Halter, “Virtual Infrastructure and Virtualization: From the Desktop to the Enterprise”, APress Publications, 2005.
4. James E. Smith, Ravi Nair,” Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann Publications, 2005.
5. David Marshall, Wade A. Reynolds, ”Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X	X					X	X		X
2	X	X	X	X	X			X		X	X
3	X		X	X				X		X	X
4	X	X	X		X		X	X		X	
5	X	X	X		X	X	X	X		X	

15CPX16SOFT COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the key aspects of soft computing.
- To understand the concepts of Genetic algorithm and its applications using image processing.
- To be familiar with neural networks and generalize its appropriate rules for inference systems.
- To learn the ideas of fuzzy sets, fuzzy logic and its operations.
- To gain insight into Neuro-Fuzzy modeling and control.

LEARNING OUTCOMES:

On completion of this course the students will be able to

CO1 Understandthe soft computing techniques and their roles in building intelligent Machines.
CO2 Apply genetic algorithms to combinatorial optimization problems.
CO3 Differentiate supervised and unsupervised learning neural networks.
CO4 Solve fuzzy logic to handle uncertainty engineering problems.
CO5 Apply neuro fuzzy modeling to pattern classification and regression problems.

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS (9)

Evolution of Computing – Soft Computing Constituents – From Conventional AI to Computational Intelligence – Machine Learning basics.

UNIT II GENETIC ALGORITHMS (9)

Introduction to Genetic Algorithms (GA)– Applications of GA in Machine Learning – GA based Image processing.

UNIT III NEURAL NETWORKS (9)

Machine Learning Using Neural Network, Adaptive Networks – Feed forward Networks – Supervised Learning Neural Networks–Radial Basis Function Networks – Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance architectures – Case Study: River Flow Forecasting.

UNIT IV FUZZY LOGIC (9)

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Logic – Fuzzy Expert Systems – Fuzzy Decision Making.

UNIT V NEURO-FUZZY MODELING (9)

AdaptiveNeuro-FuzzyInferenceSystems – CoactiveNeuro-FuzzyModeling–Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control.

TOTAL = 45 PERIODS

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2008.
2. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 2003.
3. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, Fourth Impression 2009.
4. S.N.Sivanandam, S.Sumathi and S.N.Deepa, “Introduction to Fuzzy Logic using MATLAB”, Springer, 2007.
5. S.N.Sivanandam, S.N.Deepa, “Introduction to Genetic Algorithms”, Springer, 2007.
6. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.
7. SandhyaSamarasinghe,“Neural Networks for Applied Sciences and Engineering”, Auerbach Publications, 2006.

Mapping of Course Outcome and Programme Outcome

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COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X					X	X		X
2	X	X	X	X	X			X		X	X
3	X	X	X	X	X	X	X	X		X	X
4	X	X	X	X		X	X	X	X	X	X
5	X	X	X	X					X	X	X

15CPX17 MOBILE APPLICATION DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand system requirements for mobile applications.
- Tolearn suitable design using specific mobile development frameworks.
- Tocreate mobile application design.
- To understand the design using specific mobile development frameworks.
- Toknow the latest technologies available in mobile application.

LEARNING OUTCOMES:

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

CO1 Describe the requirements for mobile applications.
CO2 Explain the challenges in mobile application design and development.
CO3 Design mobile applications for specific requirements.
CO4 Develop the design using Android SDK and iOS SDK.
CO5 Deploy mobile applications in Android and iPhone.

UNIT I INTRODUCTION (9)

Introduction to mobile applications – Importance of mobile strategies – Cost of development – Mobile myths – Market and business drivers for mobile applications – Mobile web presencee – Mobile applications – Benefits of a mobile app.

UNIT II BASIC DESIGN (9)

Introduction– Mobile user interface design–Understanding mobile application users–Understanding mobile information design – Understanding mobile platforms – Using the tools of mobile interface design.

UNIT III ADVANCED DESIGN (9)

Choosing a mobile web option – Adaptive mobile websites – Dedicated mobile websites – Mobile web apps with HTML5 – Design patterns for mobile applications – Advanced web service techniques for mobile devices.

UNIT IV DEVELOPMENT ENVIRONMENT (9)

Android development practices – Android fundamentals – Android SDK – Common interactions– Offline storage – iOSSDK– Debugging iOS apps – Objective -C basics – iOS features.

UNIT V TECHNOLOGY (9)

Using google maps – GPS–Wi-Fi and WiMAX– Integration with social media applications– Foldable displays – Centralized storage – Mobile commerce.

TOTAL = 45 PERIODS

REFERENCES:

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

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X	X				X		X	X
2	X		X					X		X	X
3	X		X	X	X			X		X	X
4	X		X	X	X	X	X	X		X	X
5	X		X	X				X		X	X

15CPX18 NETWORK OPTIMIZATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn basics of network flow problems.
- To be familiar with various algorithms.
- To study basics of nonlinear network optimization.
- To understand the issues in the design of networks.
- To know the techniques used for network problems with integer constraints.

LEARNING OUTCOMES:

On completion of this course the students will be able to

CO1 Identify the network optimization problems and algorithms for solving them.
CO2 Develop algorithmic thinking skills.
CO3 Categorize nonlinear network optimization problems.
CO4 Solve the network flow problems.
CO5 Select suitable techniques used for network problems.

UNIT I INTRODUCTION AND SHORTEST FLOW PROBLEMS (9)

Introduction – Graphs and Flows– Network Flow Models– Examples – Network Flow Algorithms –Shortest Path Problems – Problem Formulation and Applications – A Generic Shortest Path Algorithm– Label Setting (Dijkstra) Methods – Label Correcting Methods– Single Origin/Single Destination Methods – Auction Algorithms– Multiple Origin/Multiple Destination Methods.

UNIT II MAX-FLOW PROBLEM AND MIN-COST FLOW PROBLEM (9)

The Max-Flow and Min-Cut Problems–The Ford-Fulkerson Algorithm– Price-Based Augmenting Path Algorithms– Min-Cost Flow Problem– Transformations and Equivalences– Duality.

UNIT III NONLINEAR NETWORK OPTIMIZATION (9)

Convex and Separable Problems– Problems with Side Constraints– Multicommodity Flow Problems– Integer Constraints– Networks with Gains– Optimality Conditions– Duality– Algorithms and Approximations.

UNIT IV CONVEX SEPARABLE NETWORK PROBLEMS (9)

ConvexFunctions of a Single Variable– Optimality Conditions– Duality– Dual Function Differentiability– Algorithms for Differentiable Dual Problems– Auction Algorithms– Monotropic Programming.

UNIT V NETWORK PROBLEMS WITH INTEGER CONSTRAINTS (9)

Formulation of Integer-Constrained Problems– Branch-and-Bound– Lagrangian Relaxation– Local Search Methods– Rollout Algorithms.

TOTAL = 45 PERIODS

REFERENCES:

1. Dimitri P. Bertsekas, “Network Optimization: Continuous and Discrete Models”,Athena Scientific, 1998.
2. Ravindra K. Ahuja, Thomas L. Magnanti and James B. Orlin, “Network Flows: Theory, Algorithms, and Applications”, Prentice Hall, 1993.
3. Teresa C. Mann-Rubinson and KornelTerplan, “Network Design, Management and Technical Perspective”, CRC Press, 1999.
4. J.C.Pant, “Introduction to Optimization”, Jain Brothers, 2008.
5. H.A.Taha, “Operations Research”, Pearson Education, 2007.

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1	X	X	X		X		X	X		X	
2	X	X	X		X		X	X		X	
3	X	X	X		X		X	X	X	X	
4	X	X	X		X		X	X		X	
5	X	X	X		X	X	X	X		X	

15CPX19PATTERN RECOGNITION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To obtain knowledge about the pattern classifier.
- To know about classification problems.
- To gain knowledge on various structural pattern recognition techniques.
- To perceive knowledge on basic feature extraction techniques.
- To learn neural networks and fuzzy logic.

LEARNING OUTCOMES:

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

CO1 Explain about the pattern recognition problems.
CO2 Build appropriate clustering techniques for various problems.
CO3 Gain insight into the principles and commonly used grammars for structural pattern recognition.
CO4 Analyze about feature extraction and subset selection methods for various real world applications.
CO5 Apply the neural network concepts in real world applications.

UNIT I PATTERN CLASSIFIER (9)

Overview of pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum likelihood estimation – Bayesian parameter estimation – Perception algorithm – LMSE algorithm – Problems with Bayes approach – Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT II UNSUPERVISED CLASSIFICATION (9)

Clustering for unsupervised learning and classification – Clustering concept – C-means algorithm – Hierarchical clustering procedures – Graph theoretic approach to pattern clustering – Validity of clustering solutions.

UNIT III STRUCTURAL PATTERN RECOGNITION (9)

Elements of formal grammars – String generation as pattern description – Recognition of syntactic description – Parsing – Stochastic grammars and applications – Graph based structural representation.

UNIT IV FEATURE EXTRACTION AND SELECTION (9)

Entropy minimization – Karhunen – Loeve transformation – Feature selection through functions approximation – Binary feature selection.

UNIT V RECENT ADVANCES (9)

Neural network structures for Pattern Recognition – Neural network based Pattern associators – Unsupervised learning in neural Pattern Recognition – Self-organizing networks – Fuzzy logic – Fuzzy pattern classifiers – Pattern classification using Genetic Algorithms.Case study: Web Applications- Medical Applications.

TOTAL = 45 PERIODS

REFERENCES:

1. Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 2007.
2. Morton Nadier and Eric Smith P, “Pattern Recognition Engineering”, John Wiley & Sons, New York, 1993.
3. Tou and Gonzales,”Pattern Recognition Principles”, Wesley Publication Company, London, 2006.
4. Duda R.O., and HarP.E.,”Pattern Classification and Scene Analysis”, Wiley, NewYork, 2001.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X			X		X	X		X	X
2	X	X	X	X							X
3	X	X	X	X			X				
4	X	X		X		X					X
5	X	X		X	X				X		X

15CPX20EVOLUTIONARY COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic knowledge about evolutionary computation.
- To learn various evolutionary computation methods and selection operators.
- To know a variety of evolutionary approaches for problem solving.
- To learn different optimization algorithms used for evolutionary-computation.
- To understand various feasible and optimal solutions for specific problem.

LEARNING OUTCOMES:

On completion of this course the students will be able to

CO1 Explain different historical branches of evolutionary computation.
CO2 Describe the basic properties of evolutionary computation.
CO3 Implement a variety of evolutionary approaches for problem solving.
CO4 Gain experience in applying various optimization algorithms.
CO5 Apply the methods of optimization in real life situation.

UNIT I INTRODUCTION (9)

Introduction to evolutionary computing Components of Evolutionary Algorithms – Introduction to different historical branches of Evolutionary Computation– Genetic Algorithms– Evolutionary Programming– Evolutionary strategies– Genetic Programming– A simple evolutionary algorithm.

UNIT II VARIANTS OF EVOLUTIONARY COMPUTATION (9)

Evolutionary Algorithmvs traditional methods – Representation – Mutation – Recombination –Population models – Parent selection – Survivor selection.

UNIT III EVOLUTIONARY TECHNIQUES (9)

Simulated annealing –Memetic algorithms – Local search – Constraint handling – Common techniques – Penalty methods - repair methods.

UNIT IV EVOLUTIONARY OPTIMIZATION (9)

Ant Colony Optimization (ACO) – Real to artificial ants – ACO algorithm – Convergence proofs – Particle Swarm Optimization (PSO) – Principles of bird flocking and fish schooling – PSO algorithm – Variants of PSO – Application: TSP.

UNIT V OPTIMIZATION METHODS (9)

Introduction – Combinatorial optimization – Constrained optimization – Multi –Objective evolutionary algorithms.

TOTAL = 45 PERIODS

REFERENCES:

1. Eiben A E and Smith J E, “Introduction to Evolutionary Computing”, Springer, New York, 2008.
2. Dan simon ,“Evolutionary Optimization Algorithms ”,John wiley& sons,Canada,2013
3. Frank Neumann and Carsten Witt, “Bio-inspired Computation in Combinatorial Optimization”, Springer, New York, 2010.
4. Marco Dorigo and Thomas Stutzle, “Ant Colony Optimization”, Prentice Hall, New Delhi, 2005.
5. Jun Sun, Choi-Hong Lai and Xiao-Jun Wu, “Particle Swarm Optimization: Classical and Quantum Perspectives”, Taylor and Francis, USA, 2012.
6. Carlos A Coello , Gary B Lamont and David A Van Veldhuizen, “Evolutionary Algorithms for Solving Multi-Objective Problems”, Springer, New York, 2007.

Mapping of Course Outcome and Programme Outcome

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COs	POs										
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1	X	X	X		X		X			X	X
2	X	X	X		X		X			X	X
3	X	X	X	X	X		X	X		X	X
4	X	X	X	X	X	X	X	X		X	X
5	X	X	X	X	X	X	X	X		X	X

15CPX21 SEMANTIC WEB

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn fundamentalconcepts of semantic web.
- To know about different framework used in semantic web.
- To learn the methodologies of ontology.
- To know about ontology management and tools used for Ontology annotation.
- To comprehend the role of semantics in web services.

LEARNING OUTCOMES:

On completion of this course the students will be able to

CO1 Understand the fundamental concepts of the semantic web.
CO2 Outline for semantic syntax and schema.
CO3 Design ontology using Web Ontology Language (OWL).
CO4 Differentiate monotonic and non-monotonic rules.
CO5 Apply Semantic web technology to real world applications.

UNIT I INTRODUCTION (9)

History – Semantic web layers – Semantic web technologies – Semantics in semantic web – XML – Structuring – Namespaces – Addressing – Querying – Processing XML.

UNIT II RDF AND QUERYING THE SEMANTIC WEB (9)

RDF data model – syntax – Adding semantics – RDF schema – RDF and RDF schema in RDF schema – An axiomatic semantics for RDF and RDF schema – Querying in SPARQL.

UNIT III ONTOLOGY (9)

Introduction – Ontology movement – OWL – OWL specification – OWL elements – OWL constructs – Simple and complex – Ontology engineering – Introduction – Constructing ontologies – Reusing ontologies – On-To-Knowledge semantic web architecture.

UNIT IV LOGIC AND INFERENCE (9)

Logic – Description logics – Rules – Monotonic rules – syntax – semantics and examples – Non-monotonic rules – Motivation – syntax – Examples – Rule markup in XML– Monotonic rules – Non-Monotonic rules.

UNIT V APPLICATIONS OF SEMANTIC WEB TECHNOLOGIES (9)

Case Study – Horizontal information products at Elsevier – Openacademia – Bibster – Data Integration at Audi – Skill finding at Swiss Life – Think tank portal at Enersearch – e-learning – web services – other scenarios.

TOTAL: 45 PERIODS

REFERENCE BOOKS:

1. Grigorous Antoniou and Van Hermelen, “A Semantic Web Primer”, PHI Learning Private Limited, Second Edition, 2010.
2. James Hendler, Henry Lieberman and Wolfgang Wahlster, “Spinning the Semantic Web: Bringing the world wide web to its full potential”, The MIT Press, 2005.
3. Shelley Powers, “Practical RDF”, O’reilly publishers, 2009.
4. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, “Foundations of Semantic Web Technologies”, Chapman & Hall/CRC, 2009.

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Mapping of COs and POs											
COs	POs										
	1	2	3	4	5	6	7	8	9	10	11
1	X	X	X		X		X	X		X	
2	X	X	X		X		X	X		X	
3	X	X	X		X		X	X	X	X	
4	X	X	X		X		X	X		X	
5	X	X	X		X	X	X	X		X	

15CPZ01 INFORMATION RETRIEVAL METHODOLOGIES
(Common to All M.E Programmes except CSE)

L	T	P	C
3	0	0	3

PREREQUISITES:

1. Basic knowledge in Advanced Databases.
2. Basic knowledge in Web Technologies.

OBJECTIVES:

- To understand the basics of Information Retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering
- To understand the various applications of Information Retrieval giving emphasis to Multimedia IR, Web Search
- To understand the concepts of digital libraries

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Build an Information Retrieval system using the available tools
CO2 Identify and design the various components of an Information Retrieval system
CO3 Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval
CO4 Analyze the Web content structure and Design an efficient search engine

UNIT I - INTRODUCTION (9)

Motivation – Basic Concepts – Practical Issues - Retrieval Process – Architecture – Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems– History of Web Search – Web Characteristics–The impact of the web on IR —IR Versus Web Search–Components of a Search Engine.

UNIT II - MODELING (9)

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting –Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models –Algebraic Models – Structured Text Retrieval Models – Models for Browsing.

UNIT III - INDEXING (9)

Static and Dynamic Inverted Indices – Index Construction and Index Compression Searching -Sequential Searching and Pattern Matching. Query Operations - Query Languages– Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis –Measuring Effectiveness and Efficiency.

UNIT IV - CLASSIFICATION AND CLUSTERING (9)

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning.

UNIT V - SEARCHING AND RANKING (9)

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking -Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

TOTAL: 45 PERIODS

REFERENCES:

1. Ricardo Baeza – Yates, BerthierRibeiro – Neto, Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition 2011.
2. Christopher D. Manning, PrabhakarRaghavan, HinrichSchutze, Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition 2012.
3. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts, London, England, 2010.

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COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X	X				X	X	X	X	X
2	X	X	X				X	X	X	X	X
3	X	X	X					X	X		X
4	X	X	X					X	X		X

15CPZ02 INTERNET OF THINGS

(Common to All M.E Programmes except CSE)

L	T	P	C
3	0	0	3

PREREQUISITES:

1. Basic programming skills
2. Basic electronics skills

OBJECTIVES:

- To learn the basic issues, policy and challenges in the Internet
- To understand the components and the protocols in Internet
- To build a small low cost embedded system with the internet
- To understand the various modes of communications with internet
- To learn to manage the resources in the Internet
- To deploy the resources into business
- To understand the cloud and internet environment

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Identify the components of IOT
CO2 Design a portable IOT using appropriate boards
CO3 Program the sensors and controller as part of IOT
CO4 Develop schemes for the applications of IOT in real time scenarios
CO5 Establish the communication to the cloud through Wi-Fi / Bluetooth
CO6 Manage the internet resources

UNIT I - INTRODUCTION **(9)**

Definition – phases – Foundations – Policy– Challenges and Issues - identification - security – privacy. Components in internet of things**:** Control Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – RF links – Mobile Internet – Wired Communication.

UNIT II - PROGRAMMING THE MICROCONTROLLER FOR IOT **(9)**

Basics of Sensors and actuators – Examples and working principles of sensors and actuators – Cloud computing and IOT – Arduino/Equivalent Microcontroller platform – Setting up the board - Programming for IOT – Reading from Sensors - Communication-Connecting microcontroller with mobile devices – communication through Bluetooth and USB – connection with the internet using WiFi / Ethernet.

UNIT III - RESOURCE MANAGEMENT IN THE INTERNET OF THINGS **(9)**

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object - Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behavior of Objects.

UNIT IV - BUSINESS MODELS FOR THE INTERNET OF THINGS **(9)**

The Meaning of DiY in the Network Society- Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things – Semantic Interoperability as a Requirement for DiY Creation - Ontology- Value Creation in the Internet of Things- Application of Ontology Engineering in the Internet of Things-Semantic Web-Ontology – The Internet of Things in Context of EURIDICE - Business Impact.

UNIT V - FROM THE INTERNET OF THINGS TO THE WEB OF THINGS **(9)**

Resource-oriented Architecture and Best Practices- Designing RESTful Smart Things - Web-enabling Constrained Devices - The Future Web of Things - Set up cloud environment – send data from microcontroller to cloud – Case study –CAM:cloud Assisted Privacy– Other recent projects.

TOTAL: 45 PERIODS

REFERENCES:

1. Charalampos Doukas , “Building Internet of Things with the Arduino”, Create space, April 2012.
2. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011
3. Luigi Atzor et.al, “The Internet of Things: A survey”, Journal on Networks, Elsevier Publications, October, 2010
4. Huang Lin, Gainesville, Jun Shao, Chi Zhang, Yuguang Fang, “CAM: Cloud-Assisted Privacy Preserving Mobile Health Monitoring”, IEEE Transactions on Information Forensics and Security, 2013
5. Pengwei Hu; Fangxia Hu, “An optimized strategy for cloud computing architecture”, 3rd IEEE Transactions on Computer Science and Information Technology (ICCSIT), 2010.

Mapping of Course Outcome and Programme Outcome

Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X		X				X	X	X	X	X
2	X	X	X		X		X		X	X	X
3	X	X	X	X	X		X		X	X	X
4	X		X	X	X		X		X	X	X
5	X	X	X	X	X		X	X	X	X	X
6	X	X	X	X	X		X	X	X	X	X

15CPZ03 JAVA PROGRAMMING

(Common to All M.E Programmes except CSE)

L	T	P	C
3	0	0	3

PREREQUISITES :

1. Basic knowledge of Computer
2. Basic knowledge of Programming
3. Basic Knowledge of Object Oriented Design

OBJECTIVES:

- To Understand the fundamental concepts of object-oriented programming in Java.

LEARNING OUTCOMES:

A student who successfully completes the course will have the ability to

CO1 Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods,etc.

CO2 Implement Java programs to solve specified problems.

CO3 Create standalone applications.

UNIT I - INTRODUCTION TO JAVA (9)

The Genesis of Java – Overview of Java – Data types, Variables, Arrays-Operators-Control statements.

UNIT II - INTRODUCING CLASSES (9)

Class Fundamentals-Declaring objects-Methods-Constructors-This keyword-Overloading methods-Inheritance-Packages-Interfaces-Exception Handling.

UNIT III - EXPLORING I/O AND LANG PACKAGES (9)

String Handling: String Constructors, special String operations, character extraction, string comparison,Modifying String, String buffer- String tokenizer -Exploring java.lang: Simple type wrappers, object, math-Exploring java.io: File, Input Stream, Output Stream, File Input Stream, File Output Stream, Object Input Stream, Object Output Stream.

UNIT IV - EXPLORING UTILITY PACKAGE (9)

Overview of Collections-Collection Interfaces-Collection classes-Legacy classes and Interfaces-Date-Calendar-Time Zone-Random-Timer-java.util. zip, jar-Multithreaded environment.

UNIT V - EXPLORING APPLET, AWT (9)

The Applet class: applet initialization and termination-Applet skeleton- Simple Applet display method-Event handling: Event handling mechanisms-Event classes- Sources of Events-Event Listener interfaces-Introducing AWT: working with Windows, Controls, Layout managers, menus-Introduction to JDBC.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Patrick Naughton and Herbert Schildt, "Java 2- The Complete Reference", 8th ed., Tata McGrawHill, New Delhi, 2008.

REFERENCES:

1. H.M. Deitel and P.J. Deitel, "JAVA (TM) How to program", 9th ed., Pearson Education, 2009.
2. George Reese, "Database Programming with JDBC & Java",2nd ed., O"Reilly Media,2000.

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Mapping of COs and POs											
COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	X	X	X	X			X	X	X	X	X
2	X	X	X	X	X		X	X	X	X	X
3	X	X	X	X			X	X	X	X	X

15CPZ04 OPEN SOURCE SOFTWARE
(Common to All M.E Programmes except CSE)

L	T	P	C
3	0	0	3

PREREQUISITES:

1. Basic programming skills
2. Basic knowledge in Database Management System
3. Basic knowledge in Unix

OBJECTIVES:

- To understand the basics of open source operating systems.
- To gain the knowledge of working with Linux platform and open source database.
- To be familiar with programming languages PHP, Perl, Python.

LEARNING OUTCOMES:

CO1 A student who successfully completes the course will have the ability to
CO2 Ability to install and run open-source operating systems.
CO3 Ability to gather information about Free and Open Source Software projects from software releases and from sites on the internet.
CO4 Develop programs using PHP, Perl, Python and MySQL.

UNIT I - INTRODUCTION (9)

Introduction to Open sources – Need of Open Sources – Advantages of Open Sources –Application of pen Sources. Open source operating systems: LINUX: Introduction – General Overview – Kernel Mode and user mode – Process – Advanced Concepts – Scheduling – Personalities – Cloning – Signals –Development with Linux.

UNIT II - OPEN SOURCE DATABASE (9)

MySQL: Introduction – Setting up account –Starting, terminating and writing your own SQL programs – Record selection Technology – Working with strings –Date and Time – Sorting Query Results – Generating Summary – Working with metadata – Using sequences –MySQL and Web.

UNIT III - OPEN SOURCE PROGRAMMING LANGUAGES (9)

PHP: Introduction – Programming in web environment – variables – constants – data types – operators – Statements – Functions – Arrays – OOP –String Manipulation and regular expression – File handling and data storage – PHP and SQL database – PHP and LDAP – PHP Connectivity – Sending and receiving E-mails – Debugging and error handling – Security –Templates.

UNIT IV - PYTHON (9)

Syntax and Style – Python Objects – Numbers – Sequences – Strings –Lists and Tuples – Dictionaries – Conditionals and Loops – Files – Input and Output –Errors and Exceptions – Functions – Modules – Classes and OOP –Execution Environment.

UNIT V - PERL (9)

Perl backgrounder – Perl overview – Perl parsing rules – Variables and Data – Statements and Control structures – Subroutines, Packages, and Modules- Working with Files –Data Manipulation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Remy Card, Eric Dumas and Frank Mevel, “The Linux Kernel Book”, Wiley Publications, 2003.
2. Steve Suchring, “MySQL Bible”, John Wiley, 2002

REFERENCES:

1. Rasmus Lerdorf and Levin Tatroe, "Programming PHP", O'Reilly, 2002
2. Wesley J. Chun, "Core Phython Programming", Prentice Hall, 2001
3. Martin C. Brown, "Perl: The Complete Reference", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
4. Steven Holzner, "PHP: The Complete Reference", 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.

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1	X	X	X					X			
2	X	X	X					X			
3	X	X	X				X	X		X	X
4	X	X	X		X		X	X	X	X	X