P.S. R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Sevalpatti (P.O), Sivakasi – 626140

REGULATIONS 2016

CURRICULUM AND SYLLABI

FOR

M.E., COMPUTER SCIENCE AND ENGINEERING

(FULL TIME)

INSTITUTE VISION & MISSION

Vision	To contribute to the society through excellence in technical education with societal values and thus a valuable resource for industry and the humanity.
Mission	• To create an ambience for quality learning experience by providing sustained care and facilities. • To offer higher level training encompassing both theory and practices with human and social values. • To provide knowledge based services and professional skills to adapt tomorrow's technology and embedded global changes.

DEPARTMENT VISION & MISSION

Vision	To impart holistic education in Computer Science and Engineering to cater the needs in academia, industry and society.
Mission	• Offering under graduate and post graduate programmes by providing effective and balanced curriculum and equip themselves to gear up to the ethical challenges awaiting them. • To confer continuous activities in technical and research that will enable the students to face the real time challenges in the field of Computer Science and Engineering. • To provide training for the students in a socially responsible manner with inculcating integrity and human values.

PROGRAM SPECIFIC OUTCOMES (PSO)

1. Design, implement, test, and evaluate a computer system, component, or algorithm to meet desired needs and to solve a computational problem.
2. The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.
3. The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product.
4. Ability to use knowledge in various domains to identify research gaps and hence to provide solutions, new ideas, innovations.

PROGRAM OUTCOMES (POs)

1. Apply knowledge of mathematics, physical sciences and Computer Science and Engineering fundamentals.
2. Able to identify, formulate, analyze and solve Computer Science and Engineering problems.
3. Able to design and realize Computer Science and Engineering systems to meet desired needs within practical constraints such as economical, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
4. Able to investigate and conduct experiments, as well as to analyze and interpret data.
5. Use of techniques, skills, and modern engineering tools necessary for engineering practice.
6. Contextual knowledge to assess societal, health, safety, legal and cultural issues related to Engineering.
7. Realize the impact of Computer Science and Engineering solutions in a global, economic and environmental context.
8. Apply ethical principles and commitment to professional ethics and responsibility.
9. Function as an individual and as a member or leader in multidisciplinary teams.
10. Communicate effectively with the engineering community and society at large.
11. Knowledge and understanding of management and business practices and their limitations.
12. Recognize the need for, and have the ability to engage in life-long learning.

P.S.R. ENGINEERING COLLEGE, SIVAKASI-626140					
PG REGUALTION-2016 CHOICE BASED CREDIT SYSTEM					
M.E. COMPUTER SCIENCE AND ENGINEERING					
CURRICULUM [I – IV SEMESTERS - FULL TIME]					
					Total Credits: 71
SEMESTER - I					
Sl	**Code**	**Course Title**	**Category**	**L-T-P**	**C**
1	162CS11	Advanced Mathematics for Computing	FC	3-1-0	4
2	162CS12	Multi core Architecture	PC	3-0-0	3
3	162CS13	Advanced Data Structures and Algorithms	PC	3-0-0	3
4	162CS14	Network Design and Management	PC	3-0-0	3
5	162CSE*	Elective I	PE	3-0-0	3
6	162CSE*	Elective II	PE	3-0-0	3
7	162CS15	Advanced Data Structures Lab	EEC	0-0-4	2
8	162CS16	Network Design and Management Lab	EEC	0-0-4	2
9	162CS17	Technical Seminar	EEC	0-0-2	1
					No. of Credits: 24

SEMESTER – II					
Sl	**Code**	**Course Title**	**Category**	**L-T-P**	**C**
1	162CS21	Advanced Operating Systems	PC	3-0-0	3
2	162CS22	Internet of Things	PC	3-0-0	3
3	162CS23	Cloud Computing	PC	3-0-0	3
4	162CS24	Big Data Analytics	PC	3-0-0	3
5	162CSE*	Elective III	PE	3-0-0	3
6	162CSE*	Elective IV	PE	3-0-0	3
7	162CS25	Big Data Lab	EEC	0-0-4	2
					No. of Credits: 20

SEMESTER – III					
Sl	**Code**	**Course Title**	**Category**	**L-T-P**	**C**
1	162CSE*	Elective V	PE	3-0-0	3
2	162CSE*	Elective VI	PE	3-0-0	3
3	162CSE*	Elective VII	PE	3-0-0	3
4	162CS31	Project Work – Phase I	EEC	0-0-12	6
					No. of Credits: 15

SEMESTER – IV					
Sl	**Code**	**Course Title**	**Category**	**L-T-P**	**C**
1	162CS41	Project Work – Phase II	EEC	0-0-24	12
					No. of Credits: 12

ELECTIVES					
Sl	**Code**	**Course Title**	**Category**	**L-T-P**	**C**
1.	162CSE01	Protocols and Architecture for Wireless Sensor Networks	PE	3-0-0	3
2.	162CSE02	Real Time System Design	PE	3-0-0	3
3.	162CSE04	Machine Learning Techniques	PE	3-0-0	3
4.	162CSE05	Agent Based Intelligent Systems	PE	3-0-0	3
5.	162CSE06	Mobile Application Development	PE	3-0-0	3
6.	162CSE07	Social Network Analysis	PE	3-0-0	3
7.	162CSE08	AD HOC & Wireless Sensor Networks	PE	3-0-0	3
8.	162CSE10	Digital Imaging	PE	3-0-0	3
9.	162CSE11	Medical Image Processing	PE	3-0-0	3
10.	162CSE12	Bio Inspired Artificial Intelligence	PE	3-0-0	3
11.	162CSE13	Information Retrieval Techniques	PE	3-0-0	3
12.	162CSE14	Multimedia Systems	PE	3-0-0	3
13.	162CSE15	Robotics	PE	3-0-0	3
14.	162CSE18	Software Process and Project Management	PE	3-0-0	3
15.	162CSE20	Software Architectures	PE	3-0-0	3
16.	162CSE21	Software Quality Assurance	PE	3-0-0	3
17.	162CSE22	Software Requirements Engineering	PE	3-0-0	3
18.	162CSE24	Web Data Mining	PE	3-0-0	3
19.	162CSE28	Data Science	PE	3-0-0	3
20.	162CSE31	Security Principles and Practices	PE	3-0-0	3
21.	162CSE32	Ethical Hacking	PE	3-0-0	3
22.	162CSE33	Network and Information Security	PE	3-0-0	3
23.	162CSE34	Firewalls & Intrusion Detection Systems	PE	3-0-0	3
24.	162CSE39	Energy Aware Computing	PE	3-0-0	3
25.	162CSE40	Green Computing	PE	3-0-0	3
26.	162CSE41	High Performance Computing	PE	3-0-0	3

FC - Foundation Course, PC - Program Core, PE - Program Elective,

EEC - Employment Enhancebility Course

162CS11	ADVANCED MATHEMATICS FOR COMPUTING	L	T	P	C
		3	1	0	4

Programme:	M.E. Computer Science and Engineering	Sem:	1	Category:	PC
Aim:	To develop the mathematical skill in the area of Applications in Computer.				

Course Outcomes: The Students will be able to

CO1:	Understand distributions and random variables.
CO2:	Study and Design queuing model for a given system situation.
CO3:	Understand & simulate appropriate application.
CO4:	Familiarize with the Testing of Hypothesis.
CO5:	Formulate and Find Optimal solution in the real life optimizing.

UNIT I RANDOM VARIABLES 9

Random variables – Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, Erlang and Normal distributions – Function of a Random variable - Moments, Moment generating function.

UNIT II QUEUING MODELS 9

Poisson Process – Markovian Queues – Single and Multi-server Models – Little's formula – Machine Interference Model – Steady State analysis – Self Service Queue.

UNIT III SIMULATION 9

Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queuing systems.

UNIT IV TESTING OF HYPOTHESIS 9

Sampling distributions – Estimation of parameters - Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion.

UNIT V LINEAR PROGRAMMING 9

Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Problems.

Total Periods: 45

References

1. Johnson, R.A. Miller and Freund's," Probability and Statistical for Engineers, Prentice Hall of India Pvt., Ltd., New Delhi, Seventh Edition, 2005.
2. Hamdy A. Taha, "Operations Research: An Introduction", Prentice Hall of India Pvt., Ltd. New Delhi, Eighth Edition, 2007.
3. Jay L. Devore, " Probability and Statistics for Engineering and the Sciences", Cengage Learning, Seventh Edition, 2009.
4. Ross. S.M., "Probability Models for Computer Science", Academic Press, 2002.
5. Winston, W.L., "Operations Research", Thomson – Brooks/Cole, Fourth Edition, 2003.
6. Gross D. and Harris C.M., "Fundamentals of Queuing Theory", John Wiley and Sons, New York,1998.
7. J.Medhi," Stochastic models of Queuing Theory", Academic Press, Elsevier, Amsterdam, 2003.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2		1								1	1	2		
CO2	3	2		1								3		2	1	
CO3	2	1		2								2	1			2
CO4	3	2		1								2		2		1
CO5	1	2		2								2	2		1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS12 **MULTI CORE ARCHITECTURE**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem: 1 Category: PC**

Course Outcomes: The Students will be able to

CO1: Understanding of parallel hardware constructs, to include instruction-level parallelism, supercomputer architecture, multi-core processor design

CO2: Understanding of language design issues related to parallel programming

CO3: Understand multi-threaded debugging techniques

CO4: Understand OpenMP programming and MPI programming

CO5: Learn various Multi-core processors

CO6: Ability to identify and classify dependencies

CO7: Understanding of Operating System support for parallel computing

UNIT I MULTI-CORE PROCESSORS 9

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.

UNIT II PARALLEL PROGRAM CHALLENGES 9

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OpenMP 9

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops - Performance Considerations.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI program execution – MPI constructs – libraries – MPI send and receives – Point- to-point and Collective communication – MPI derived data types – Performance evaluation.

UNIT V PARALLEL PROGRAM DEVELOPMENT 9

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

Total Periods: 45

References

1. Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011. (unit 2)
3. Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
4. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.
5. John L. Hennessey and David A. Patterson, “Computer Architecture–A Quantitative Approach”, Morgan Kaufmann / Elsevier, 5th edition, 2012.
6. S.S.Jadhav, “Advanced Computer Architecture and Computing”, Technical Publications, 2009.
7. Richard Y. Kain, “Advanced Computer Architecture a Systems Design Approach”, Prentice Hall, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		3	2								2	3		
CO2	3		3		2											3
CO3	3	2											3			
CO4	3	3		2	3									2	2	
CO5	2		3				3									2
CO6	3	3		3	2								2			
CO7	3		3	2			2							3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS13 ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem: 1 Category: PC**

Course Outcomes: The Students will be able to

CO1: Design and apply iterative and recursive algorithms.

CO2: Design and implement optimization algorithms in specific applications.

CO3: Design appropriate shared objects and concurrent objects for applications.

CO4: Implement and apply concurrent linked lists, stacks, and queues.

CO5: Analyze the asymptotic performance of algorithms.

CO6: Synthesize efficient algorithms in common engineering design situations.

UNIT I ADVANCED DATA STRUCTURES 9

Introduction to Data structures- Implementation in C or C++: Operations (Create, Access, Insert and Delete) -Singly–linked List - Doubly–linked List - Circular–linked List - Operations on a Hash Table – Create, Insert, Find and Retrieve. Splay Trees, Top-down splay trees, Red-black Trees, Deterministic skip lists, AA-Trees, Tries, Treaps, K-D Trees.

UNIT II ITERATIVE AND RECURSIVE ALGORITHMS 9

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

UNIT III OPTIMISATION ALGORITHMS 9

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

UNIT IV DYNAMIC PROGRAMMING ALGORITHMS 9

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

UNIT V CASE STUDIES 9

Knapsack Problem and Memory functions, Approximate String Matching, Chinese remainder theorem, Integer factorization, naïve-string matching, Rabin-karp string matching.

Total Periods: 45

References

1. Jeff Edmonds, "How to Think about Algorithms", Cambridge University Press, 2008.
2. M. Herlihy& N. Shavit, "The Art of Multiprocessor Programming", Morgan Kaufmann, 2008.
3. Peter Brass, "Advanced Data Structures", Cambridge University Press, 2008.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithms", PHI Learning Private Limited, 2012.
5. Thomas H. Cormen,Charles E. Leiserson,Ronald L. Rivest,Clifford Stein, "Introduction to Algorithms", Cambridge University Press, 2009.

6. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Addison-Wesley Professional, 2011.
7. Mohamad Rahama,”Data Structures and Algorithms”, Pearson, 2012.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											3			
CO2	3	2											3	3		
CO3	3	3	2	1						1				3		
CO4	3	2	1										2			
CO5	2	2	3	2										2		
CO6	2	2			1									2	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS14 **NETWORK DESIGN AND MANAGEMENT**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem: 1 Category: PC**

Course Outcomes: The Students will be able to

CO1: Understand the networking fundamentals and requirements to design a network.

CO2: Analyze the flow models.

CO3: Design a network architecture and performance mechanisms.

CO4: Design network topology &implement the technologies fir campus & Enterprise networks.

CO5: Defining and analyzing the circuits available for voice and data networks, their transmission speeds (bandwidth), and how they are packaged for commercial use.

CO6: Analyze why networks need security and control, what errors might occur, and how to control network errors.

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 Periods: 45

References

1. Network Analysis, Architecture, and Design by James D. McCabe, Morgan Kaufmann, Third Edition, 2007.
2. Computer Networks: A Systems Approach by Larry L. Peterson, Bruce S. Davie – 5th Edition 2011, Elsevier Inc.
3. Top-down Network Design: [a Systems Analysis Approach to Enterprise Network Design] By Priscilla Oppenheimer, Cisco Press, 3rd Edition, 2010.
4. "Network Design and Management" – by Steven T.Karris, Orchard publications, Second edition, Copyright 2009.

5. “Network Analysis, Architecture, and Design”, James D. McCabe, Morgan Kaufmann, Third Edition, 2007.
6. “Ethernet Networks-Design, Implementation, Operation and Management”, Gilbert Held, JohnWiley and sons, Fourth Edition.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		3		2								3	2	2	
CO2	2	3			2				1				2	3		1
CO3	2		3				1						3	1	2	
CO4	2		3	2							1		3	1		2
CO5		3	3		2								3	3		2
CO6		3	2	2										3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS15 **ADVANCED DATA STRUCTURES LAB**

L	T	P	C
0	0	4	2

Programme: M.E. Computer Science and Engineering **Sem: 1 Category: EEC**

Course Outcomes: The Students will be able to

CO1: Design and apply iterative and recursive algorithms.

CO2: Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques.

CO3: Design and implement Dynamic programming concepts.

CO4: Design and implement Dynamic programming concepts.

CO5: Able to implement various kinds of searching and sorting techniques, and know when to choose which technique.

LIST OF EXPERIMENTS

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week.

There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

- Implementation of graph search algorithms.
- Implementation and application of network flow and linear programming problems.
- Implementation of algorithms using the hill climbing and dynamic programming design techniques.
- Implementation of recursive backtracking algorithms.
- Implementation of Shortest path algorithms.
- Implementation of dynamic programming
- Developing applications 0/1 Knapsack problem.

Total Periods: 30

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2			2						3			2	1		3
CO2			2							3					3	
CO3		2								3			1			
CO4		2								3					2	3
CO5										3		1	3			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS16 **NETWORK DESIGN AND MANAGEMENT LAB**

L	T	P	C
0	0	4	2

Programme: M.E. Computer Science and Engineering **Sem: 1 Category: EEC**

Course Outcomes: The Students will be able to

CO1: Understand various application layer protocols for its implementation in client/server environment.

CO2: Design and apply iterative and recursive algorithms.

CO3: Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques.

CO4: Identify and understand various techniques and modes of transmission.

CO5: Design and implement optimisation algorithms for specific applications.

CO6: Design and implement Dynamic programming concepts.

LIST OF EXPERIMENTS

Case Study 1: Analyzing the performance of various configurations and protocols in LAN.

1.1. Establishing a Local Area Network (LAN):

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

1.3 Analyzing the performance of various configurations and protocols

Case Study 2:RIP and OSPF Redistribution

Case Study 3: Dial-on-Demand Routing

Case Study 4: Network Security.

- Know your enemy (refers to attackers or intruders)
- Count the cost.
- Control your secrets.
- Identify your assumptions.
- Limit the scope of access.

Case Study 5: Controlling Traffic Flow

Case Study 6: Defining Access Lists

Case Study 7: Configuring a fire wall

Case Study 8: Integrating Enhanced Interior Gateway Routing Protocol into Existing Networks.

Total Periods: 30

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2			3			2						2	3		3
CO2				2												
CO3							2									2
CO4	2	2											3			
CO5				2										2		2
CO6	3	1		2			3						2	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS21 **ADVANCED OPERATING SYSTEMS**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** 2 **Category:** PC

Course Outcomes: The Students will be able to

CO1: Discuss the various synchronization, scheduling and memory management issues.

CO2: Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of distributed operating system.

CO3: Discuss the various resource management techniques for distributed systems.

CO4: Identify the different features of real time and mobile operating systems.

CO5: Install and use available open source kernel.

CO6: Modify existing open source kernels in terms of functionality or features used.

UNIT I DISTRIBUTED OPERATING SYSTEMS 9

Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

UNIT II DISTRIBUTED RESOURCE MANAGEMENT 9

Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distributing – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol – Security and Protection.

UNIT III REAL TIME OPERATING SYSTEM 9

Basic Model of Real Time Systems - Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing.

UNIT IV MOBILE OPERATING SYSTEM 9

Mobile Operating Systems –Micro Kernel Design - Client Server Resource Access – Processes and Threads - Memory Management – File system.

UNIT V CASE STUDIES 9

Linux System: Design Principles - Kernel Modules - Process Management Scheduling – Memory Management - Input-Output Management - File System - Interprocess Communication. iOS and Android: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer – File System – Symbian OS.

Total Periods: 45

References

1. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", ninth Edition, John Wiley & Sons, 2013.
2. MukeshSinghal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
3. Daniel P Bovet & Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.
4. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2006.
5. Neil Smyth, "iPhone iOS 4 Development Essentials-Xcode", 4th Edition, Payload media, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										3	3	1	
CO2	3	2	2										3	3		
CO3	3		2	2									3	3	1	
CO4	2	2	1										2	1		
CO5	1	2	1										2	1		
CO6	3	3	2										3	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS22 **INTERNET OF THINGS** **L T P C**
2 0 0 3

Programme: M.E. Computer Science and Engineering **Sem: 2 Category: PC**

Course Outcomes: The Students will be able to

CO1: Able to identify vulnerabilities, including recent attacks, involving the Internet of Things.

CO2: Identify and design the new models for market strategic interaction.

CO3: Design business intelligence and information security for WoB.

CO4: Analyze various protocols for IoT.

CO5: Design a middleware for IoT.

CO6: Analyze and design different models for network dynamics.

CO7: Analyze the societal impact of IoT security events

UNIT I INTRODUCTION 10

Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT–Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security.

UNIT II IOT PROTOCOLS 8

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security.

UNIT III WEB OF THINGS 10

Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards– Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

UNIT IV INTEGRATED 9

Integrated Billing Solutions in the Internet of Things Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects – Network Dynamics: Structural Models - Cascading Behavior in Networks - The Small-World Phenomenon.

UNIT V APPLICATIONS 8

The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronization and Software Agents. Applications - Smart Grid – Electrical Vehicle Charging.

Total Periods: 45

References

1. The Internet of Things in the Cloud:A Middleware Perspective-Honbo Zhou–CRC Press –2012.
2. Architecting the Internet of Things - Dieter Uckelmann; Mark Harrison; Florian Michahelles-(Eds.) Springer – 2011.
3. Networks, Crowds, and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, Cambridge University Press – 2010.
4. The Internet of Things: Applications to the Smart Grid and Building Automation by - OlivierHersent, Omar Elloumi and David Boswarthick - Wiley -2012.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2										3	2		
CO2	3	2	2										2	3		
CO3	2		2			2							3	2		
CO4	3		3							3			3	2	2	
CO5	2					3							3		2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS23 **CLOUD COMPUTING**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem: 2 Category: PC**

Course Outcomes: The Students will be able to

CO1: Understanding the systems, protocols and mechanisms to support cloud computing.

CO2: Develop applications for cloud computing.

CO3: Design and implement a novel cloud computing application.

CO4: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO5: Identify the architecture, infrastructure and delivery models of cloud computing.

CO6: Explain the core issues of cloud computing such as security, privacy and interoperability.

CO7: Choose the appropriate technologies, algorithms and approaches for the related issues.

UNIT I INTRODUCTION 9

Evolution of Cloud Computing -System Models for Distributed and Cloud Computing - NIST Cloud Computing Reference Architecture -IaaS - On-demand Provisioning - Elasticity in Cloud - Examples of IaaS Providers - PaaS - Examples of PaaS Providers - SaaS - Examples of SaaS Providers - Public , Private and Hybrid Clouds – Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus.

UNIT II VIRTUALIZATION 9

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

UNIT III VIRTUALIZATION INFRASTRUCTURE 9

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines –Desktop Virtualization – Application Virtualization – Work with App-V – Mobile OS for smart phones – Mobile Platform Virtualization – Collaborative Applications for Mobile platforms.

UNIT IV PROGRAMMING MODEL 9

Map Reduce Hadoop Distributed File Systems – Hadoop I/O – Developing Map Reduce Applications – Working of Map Reduce – Types and Formats – Setting up Hadoop Cluster

UNIT V CLOUD INFRASTRUCTURE AND SECURITY 9

Architectural Design of Compute and Storage Clouds - Inter Cloud Resource Management - Resource Provisioning and Platform Deployment - Global Exchange of Cloud Resources - Security Overview – Cloud Security Challenges – Software as a Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.

Total Periods: 45

References

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
4. DanielleRuest, NelsonRuest, “Virtualization: A Beginner’s Guide”, MG-Hill Osborne Media, 2009.
5. Tom White, " Hadoop: The Definitive Guide", Yahoo Press, 2012.

6. Rajkumar Buyya, Christian Vecchiola, ThamaraiSelvi, “Mastering Cloud Computing”, TMH, 2013.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		2							2		3			
CO2	2	2		3										3		
CO3		1		2		2					2			3		
CO4	2			2	3					2					2	
CO5	2	1		2						2	2					1
CO6	2	1		2		2					2					
CO7	2	2		1		2				2						

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS24 **BIG DATA ANALYTICS**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** 2 **Category:** PC

Aim: To understand big data analytics as the next wave for businesses looking for competitive advantage and to explore tools and practices for working with big data.

Course Outcomes: The Students will be able to

CO1: Master the concepts MapReduce framework.

CO2: Suggest areas to apply big data to increase business outcome.

CO3: Contextually integrate and correlate large amounts of information automatically to gain faster insights.

CO4: Understand about the research that requires the integration of large amounts of data.

CO5: Perform data analytics using Hive.

CO6: Work on a real life Project on Big Data Analytics.

CO7: Setup Hadoop Cluster and write Complex MapReduce programs

UNIT I INTRODUCTION TO BIG DATA 9

Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of Big Data - Security, Compliance, auditing and protection - Evolution of Big data – Best Practices for Big data Analytics - Big data characteristics - Volume, Veracity, Velocity, Variety – Data Appliance and Integration tools – Greenplum – Informatica.

UNIT II LAMBDA CALCULUS AND DATA ANALYSIS 9

Lambda notation for functions – syntax – curried functions – parametric polymorphism – lambda reduction – alpha reduction – beta reduction – beta abstraction – extensionality theorem – delta reduction – reduction strategies – normal forms – Church-Rosser Theorems – pure lambda calculus – constants – arithmetic – Evolution of analytic scalability - Convergence – parallel processing systems — map reduce – enterprise analytic sand box – analytic data sets – Analytic methods - analytic tools – Cognos – Microstrategy - Pentaho. Analysis approaches – Statistical significance – business approaches.

UNIT III STREAM COMPUTING 9

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real time Analytics Platform(RTAP) applications IBM Infosphere – Big data at rest – Infosphere streams – Data stage – Statistical analysis – Intelligent scheduler – Infosphere Streams.

UNIT IV PREDICTIVE ANALYTICS AND VISUALIZATION 9

Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models – Normal – Deviations from normal patterns – Normal behaviors – Expert options – Variable entry - Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.

UNIT V FRAMEWORKS AND APPLICATIONS 9

IBM for Big Data – Map Reduce Framework - Hadoop – Hive – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Hbase – Impala – Analyzing big data with twitter – Big data for Ecommerce – Big data for blogs.

Total Periods: 45

References

1. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series, 2013.
2. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier, Second Edition, 2015.
3. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.
4. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
5. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012.
6. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill, 2012.
7. Glenn J. Myatt, “Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining”, John Wiley & Sons, Second Edition, 2014.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1				3								3	3		1
CO2		2					2							3		
CO3			2										2	2		
CO4		2			2		2							3		
CO5	2						2						2	3		
CO6		3	1				3									2
CO7					2									2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CS25 **BIG DATA ANALYTICS LAB**

L	T	P	C
0	0	4	2

Programme: M.E. Computer Science and Engineering **Sem: 2 Category: EEC**

Aim: To understand about setting up of Hadoop Cluster and solve Big data problems using Map Reduce Technique.

Course Outcomes: The Students will be able to

CO1: Set up multi-node Hadoop Clusters.

CO2: Apply Map Reduce algorithms for various algorithms.

CO3: Design new algorithms that uses Map Reduce to apply on Unstructured and structured data

CO4: Implement HBase and MapReduce integration.

CO5: Work on a real life Project on Big Data Analytics.

LIST OF EXPERIMENTS

1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
2. MapReduce application for word counting on Hadoop cluster.
3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.
4. K-means clustering using map reduce.
5. Page Rank Computation.
6. Mahout machine learning library to facilitate the knowledge build up in big data analysis.
7. Application of Recommendation Systems using Hadoop/mahout libraries.

Total Periods: 30

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		2										1		3	
CO2	1												2			
CO3	3	2			1										3	
CO4			2												2	
CO5	2											2	3		2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE01	PROTOCOLS AND ARCHITECTURE OF WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To learn about the protocols and architecture that support for configuration and functioning of Wireless Sensor Networks

Course Outcomes: The Students will be able to

CO1: Understand the fundamentals of Wireless Sensor Networks

CO2: Know about the Architectures, and do the deployment and configuration of WSN

CO3: Implement the Routing Protocols in WSN

CO4: Use the Data Aggregation Techniques for the data manipulation in WSN

CO5: Know the sensor network platforms and tools and they can be able to use them for their research projects.

CO6: Design and develop foundational systems software, sensor-actuator-controller algorithms and network protocols.

CO7: Able to critique protocol designs in terms of their energy-efficiency

UNIT I INTRODUCTION AND OVERVIEW OF WIRELESS SENSOR NETWORKS 9

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

UNIT II ARCHITECTURES 9

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

UNIT III DEPLOYMENT AND CONFIGURATION 9

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

UNIT IV ROUTING PROTOCOLS AND DATA MANIPULATION 9

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

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

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

Total Periods: 45

References

1. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, “Wireless Sensor Network”, Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).

4. KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
5. N. P. Mahalik, “Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications” Springer Verlag.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2			2	2		3						2			
CO2	1	2											1	2		
CO3			1											2		
CO4				2										2		
CO5		2					2						2		3	
CO6	2													2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE02 **REAL TIME SYSTEM DESIGN**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To learn real time operating system concepts, associated issues & techniques.

Course Outcomes: The Students will be able to

CO1: Make use of real time concepts.

CO2: Solve the real time evaluation techniques.

CO3: Construct real time applications.

CO4: Design the real time databases.

CO5: Develop fault tolerant system in hardware and software.

CO6: Validate plan based on all documentation.

CO7: Participate in a team design project, utilizing varying skill sets of members.

UNIT I REAL TIME SPECIFICATION AND DESIGN TECHNIQUES 9

Introduction - Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment & Scheduling - Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

UNIT II REAL TIME SPECIFICATION AND DESIGN TECHNIQUES 9

Natural languages – mathematical specification – flow charts – structured charts – pseudocode and programming design languages – finite state automata – data flow diagrams – petri nets – Warnier Orr notation – state charts – polled loop systems – phase / sate driven code – coroutines – interrupt –driven systems – foreground/background system – full featured real time operating systems.

UNIT III INTERTASK COMMUNICATION AND SYNCHRONIZATION 9

Buffering data – mailboxes – critical regions – semaphores – deadlock – process stack management– dynamic allocation – static schemes – response time calculation – interrupt latency – time loading and its measurement – scheduling is NP complete – reducing response times and time loading –analysis of memory requirements – reducing memory loading – I/O performance.

UNIT IV REAL TIME DATABASES 9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency –Databases for Hard Real Time Systems.

UNIT V EVALUATION TECHNIQUES 9

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

Total Periods: 45

References

1. “Real Time System Designs and Analysis”, Phillip A. Laplante, Seppo J. Ovaska,2016 ISBN: 978-0-470-76864-8.
2. RajibMall, ”Real-time systems: theory and practice”, Pearson Education, 2007.
3. “Real Time Computer Control – An Introduction”, Pearson Education India,2012, ISBN: 9788131713884.
4. Phillip A. Laplante, “An Introduction to Real – Time Systems”, a john wiley & sons, inc, 2005.

5. Philip.A. Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, Third Edition, April 2004.
6. Allen Burns, Andy Wellings, “Real Time Systems & Programming Languages”, Pearson Education, 2003.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1					3						2			2
CO2		2					2								1	
CO3			2				2							2		
CO4	3	3											3			
CO5							2								2	
CO6		2											2	1		1
CO7	2				3										3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE04 **MACHINE LEARNING TECHNIQUES**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To familiarize the audience with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets.

Course Outcomes: The Students will be able to

CO1: Explain theory underlying machine learning.

CO2: Construct algorithms to learn linear and non-linear models.

CO3: Implement data clustering algorithms.

CO4: Construct algorithms to learn tree and rule-based models.

CO5: Apply reinforcement learning techniques.

CO6: Characterize machine learning algorithms as supervised, semi-supervised & unsupervised.

CO7: Be able to use regularized regression algorithms.

UNIT I FOUNDATIONS OF LEARNING **9**

Components of learning –learning models –geometric models –probabilistic models – logic models – grouping and grading –learning versus design –types of learning –supervised –unsupervised –reinforcement –theory of learning –feasibility of learning –error and noise –training versus testing –theory of generalization –generalization bound –approximation-generalization trade off –bias and variance –learning curve.

UNIT II LINEAR MODELS **9**

Linear classification –univariate linear regression –multivariate linear regression –regularized regression – Logistic regression –perceptrons –multilayer neural networks –learning neural networks structures –support vector machines –soft margin SVM –going beyond linearity –generalization and over fitting – regularization – validation.

UNIT III DISTANCE-BASED MODELS **9**

Nearest neighbor models –K-means – Clustering around medoids – silhouttes –hierarchical clustering –k-d trees –locality sensitive hashing –non-parametric regression –ensemble learning –bagging and random forests –boosting –meta learning.

UNIT IV TREE AND RULE MODELS **9**

Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining –first-order rule learning.

UNIT V REINFORCEMENT LEARNING **9**

Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an action-utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control.

Total Periods: 45

References

1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AML Book Publishers, 2012.
2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012.
3. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
4. D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2012.
5. M.Mohri, A.Rostamizadeh, A.Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1											1	1	1	
CO2		2			1								1			1
CO3	1			2										1		1
CO4			1	1		1									1	
CO5	1						1									1
CO6	1		1											1		
CO7	1				1								1			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE05 **AGENT BASED INTELLIGENT SYSTEMS**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To able to design and implement an agent systems.

Course Outcomes: The Students will be able to

CO1: Students understand agent structures and behavior.

CO2: Describe the agent concepts and currently used tools, languages and architectures.

CO3: Describe the current application field of multi agents systems.

CO4: Create logical agents to do inference using first order logic.

CO5: Apply Bayesian networks for probabilistic reasoning.

CO6: Perform statistical learning using EM algorithm.

CO7: Apply modeling methods of simple and complex decision making agents.

UNIT I INTRODUCTION **9**

Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching Heuristics -Constraint Satisfaction Problems - Game playing.

UNIT II KNOWLEDGE REPRESENTATION AND REASONING **9**

Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution mStrategies-Knowledge Representation- Objects-Actions-Events

UNIT III PLANNING AGENTS **9**

Planning Problem-State Space Search-Partial Order Planning-Graphs-Nondeterministic Domains-Conditional Planning-Continuous Planning-Multi Agent Planning.

UNIT IV AGENTS AND UNCERTAINITY **9**

Acting under uncertainty – Probability Notation-Bayes Rule and use – Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory – Decision Network – Complex Decisions.

UNIT V HIGHER LEVEL AGENTS **9**

Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars-Future of AI.

Total Periods: 45

Text Books

1. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 2nd Edition, Prentice Hall, 2002.

References

1. Michael Wooldridge, "An Introduction to Multi Agent System", John Wiley, 2002.
2. John McCarthy ,"Artificial Intelligence", second edition,2003
3. Joseph C. Giarratano, Gary D. Riley, "Principles and Programming", Fourth Edition, Thomson Course Technology, 2005.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	2	1	2	1	2	1	1	3	3	2	2
CO2	2	2	2	2	3	3	1	2	2	1	1	2	2	3	2	2
CO3	3	2	2	3	2	2	2	2	2	1	2	1	2	3	3	3
CO4	2	2	2	2	2	2	2	2	2	1	1	2	3	3	2	2
CO5	2	2	2	2	2	2	2	3	2	2	1	1	3	3	3	2
CO6	3	3	2	2	3	3	2	2	2	2	3	2	3	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE06 **MOBILE APPLICATION DEVELOPMENT**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To provide students with the tools and knowledge necessary to create mobile applications that can run on mobile devices.

Course Outcomes: The Students will be able to

CO1: Describe the requirements for mobile applications.

CO2: Explain the challenges in mobile application design and development.

CO3: Develop design for mobile applications for specific requirements.

CO4: Implement the design using Android SDK.

CO5: Implement the design using Objective C and iOS.

CO6: Deploy mobile applications in Android and iPhone marketplace for distribution.

UNIT I INTRODUCTION **5**

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

UNIT II BASIC DESIGN **8**

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

UNIT III ADVANCED DESIGN **8**

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

UNIT IV TECHNOLOGY I - ANDROID **12**

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

UNIT V TECHNOLOGY II - iOS **12**

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

Total Periods: 45

References

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

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3					2							2			2
CO2	2			2									1		3	
CO3		3			2									2		
CO4		3			1										2	
CO5		3											2			1
CO6								3				2			1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE07 **SOCIAL NETWORK ANALYSIS**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To gain knowledge about the current Web development & emergence of Social Web.

Course Outcomes: The Students will be able to

CO1: To model, aggregate and represent knowledge for Semantic Web.

CO2: To design extraction and mining tools for Social networks.

CO3: To develop personalized web sites and visualization for Social networks.

CO4: Analyzing the impact of network structure on patterns through network statistics.

CO5: Applying social network analysis to understand socially meaningful outcomes in political action and online interaction.

CO6: Utilizing network analysis software to characterize social network structure in list, matrix and graph form.

UNIT I INTRODUCTION TO SOCIAL NETWORK ANALYSIS 8

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis - Electronic discussion networks, Blogs and online communities, Web-based networks - Applications of Social Network Analysis.

UNIT II MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION 8

Ontology and their role in the Semantic Web - Ontology-based Knowledge Representation – Ontology languages for the Semantic Web – RDF and OWL - Modelling and aggregating social network data - State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data, Advanced Representations.

UNIT III EXTRACTION & MINING COMMUNITITES IN WEB SOCIAL NETWROKS 10

Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Definition of Community - Evaluating Communities - Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Tools for Detecting Communities Social Network Infrastructures and Communities - Decentralized Online Social Networks- Multi- Relational Characterization of Dynamic Social Network Communities.

UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 10

Understanding and Predicting Human Behaviour for Social Communities - User Data Management, Inference and Distribution - Enabling New Human Experiences - Reality Mining - Context-Awareness - Privacy in Online Social Networks - Trust in Online Environment - Trust Models Based on Subjective Logic - Trust Network Analysis - Trust Transitivity Analysis - Combining Trust and Reputation – Trust Derivation Based on Trust Comparisons - Attack Spectrum and Countermeasures.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 8

Graph Theory- Centrality- Clustering - Node-Edge Diagrams, Matrix representation, Visualizing Online Social Networks, Visualizing Social Networks with Matrix-Based Representations- Matrix + Node-Link Diagrams, Hybrid Representations - Applications - Covert Networks - Community Welfare - Collaboration Networks - Co-Citation Networks.

Total Periods: 45

References

1. Peter Mika, "Social networks and the Semantic Web", Springer, 1st edition 2007.
2. BorkoFurht, "Handbook of Social Network Technologies & Applications", 1st Edition, 2010.
3. Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking Techniques and applications", Springer, 1stEdition, 2011.
4. Dion Goh and Schubert Foo, "Social information retrieval systems: emerging technologies and applications for searching the Web effectively", IGI Global snippet, 2008.
5. Max Chevalier, Christine Julien and ChantalSoulé-Dupuy, "Collaborative & social information retrieval and access: techniques for improved user modelling", IGI Global snippet, 2009.
6. John G. Breslin, Alexander Passant & Stefan Decker, "The Social Semantic Web", Springer, 2009.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	2	3	2	1	2	2	3	3	3	3	2
CO2	3	3	2	2	3	3	1	2	2	2	3	2	2	3	2	3
CO3	3	2	2	3	3	3	2	2	2	2	2	2	2	3	3	3
CO4	2	2	2	3	3	2	2	2	2	2	1	2	3	3	2	2
CO5	2	2	3	3	2	2	2	3	2	2	2	2	3	2	3	2
CO6	2	3	2	2	3	3	2	2	2	2	3	2	3	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE08 **AD HOC AND WIRELESS SENSOR NETWORKS**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Course Outcomes: The Students will be able to

CO1: Describe the unique issues in ad-hoc/sensor networks.

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

CO3: Discuss the challenges in designing MAC, routing & transport protocols for wireless ad-hoc / sensor networks.

CO4: Identify different issues in wireless ad hoc and sensor networks.

CO5: Analyze protocols developed for ad hoc and sensor networks.

CO6: Identify and understand security issues in ad hoc and sensor networks.

CO7: Comprehend the various sensor network Platforms, tools and applications.

UNIT I MAC & ROUTING IN AD HOC NETWORKS 9

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols.

UNIT II TRANSPORT & QOS IN AD HOC NETWORKS 9

TCP's challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model.

UNIT III MAC & ROUTING IN WIRELESS SENSOR NETWORKS 9

Introduction-Applications-Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zig bee – Topology Control – Routing Protocols.

UNIT IV TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS 9

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control – In-network processing – Operating systems for wireless sensor networks – Examples.

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Antitamper techniques – Water marking techniques – Defense against routing attacks - Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS.

Total Periods 45

References

1. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad Hoc Mobile Wireless Networks", Auerbach Publications, 2008.
2. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Inc., 2005.
3. ErdalÇayırcı, ChunmingRong, "Security in Wireless Ad Hoc and Sensor Networks", John Wiley and Sons, 2009.

4. C.Siva Ram Murthy &B.S.Manoj, “Ad Hoc Wireless Networks – Architectures & Protocols”, Pearson Edu, 2004.
5. Carlos De MoraisCordeiro, Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition)”, World Scientific Publishing, 2011.
6. WaltenegusDargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		1		2						3	2		
CO2	2	3			3		1						3		2	
CO3	2	2					2						3	2		1
CO4		3	3		2								3	2		
CO5	3	3		2	1								3		3	
CO6	3	3	2		1								3	2		
CO7	2	2		3			1						3	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE10 **DIGITAL IMAGING**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Course Outcomes: The Students will be able to.

CO1: Explain image modalities, sensing, acquisition, sampling, and quantization.

CO2: Explain image noise models.

CO3: Implement spatial filter operations.

CO4: Implement frequency domain filters.

CO5: Apply segmentation algorithms.

CO6: Apply edge detection techniques.

CO7: Apply corner and interest point detection algorithms.

CO8: Implement image compression algorithms.

UNIT I DIGITAL IMAGE FUNDAMENTALS 8

Introduction – Origin –Steps in Digital Image Processing – Components; Elements of Visual Perception – Light and Electromagnetic Spectrum – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering–Frequency Domain: Introduction to Fourier Transform–Smoothing & Sharpening frequency domain filters–Ideal, Butterworth & Gaussian filters.

UNIT III IMAGE RESTORATION 9

Noise models – Mean filters – Order Statistics – Adaptive filters – Band reject –Band pass – Notch – Optimum notch filtering – Inverse Filtering – Constrained Least Square Filtering – Wiener filtering.

UNIT IV IMAGE COMPRESSION 9

Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit – Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding –Wavelet Coding – Compression Standards – JPEG2000.

UNIT V IMAGE SEGMENTATION AND REPRESENTATION 10

Segmentation–Detection of Discontinuities – Edge Linking and Boundary detection – Region based segmentation, Representation–Boundary descriptors–Simple Descriptors–Shape numbers–Regional descriptors–Simple and Topological Descriptors – Introduction to Image Processing Toolbox– Practice of Image Processing Toolbox –Case studies–Various Image Processing Techniques.

Total Periods 45

References

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Pearson Edu, 3rd Ed, 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. BhabatoshChanda, 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.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		1										3	2		
CO2	3												3		2	1
CO3			3										2	3	1	
CO4			3										2	3		1
CO5	2				3								1		3	2
CO6	2				3								1		3	2
CO7	2				3								1		3	2
CO8	2				3								1		3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE11 **MEDICAL IMAGE PROCESSING**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To show how to extract, model, and analyze information from medical data and applications in order to help diagnosis, treatment and monitoring of diseases through computer science.

Course Outcomes: The Students will be able to.

CO1: Identify major processes involved in formation of medical images.

CO2: Recognize the imaging modality from their visualizations.

CO3: Classify the various medical image processing algorithms.

CO4: Learn about the computational and mathematical methods in medical image processing.

CO5: Impart knowledge about main sources of medical imaging data.

CO6: Appraise efficacy and drawbacks of several techniques for image segmentation.

CO7: Analyzevarious method used to enhance & extract Useful information from medical images.

UNIT I INTRODUCTION **9**

Introduction to medical imaging technology, systems, and modalities. Brief history; importance; applications; trends; challenges. Medical Image Formation Principles: X-Ray physics; X-Ray generation, attenuation, scattering; dose Basic principles of CT; reconstruction methods; artifacts; CT hardware.

UNIT II STORAGE AND PROCESSING **9**

Medical Image Storage, Archiving and Communication Systems and Formats Picture archiving and communication system (PACS); Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement, Filtering Basic image processing algorithms Thresholding; contrast enhancement; SNR characteristics; filtering; histogram modeling.

UNIT III VISUALIZATION **9**

Medical Image Visualization Fundamentals of visualization; surface and volume rendering/visualization; animation; interaction. Magnetic Resonance Imaging (MRI) Mathematics of MR; spin physics; NMR spectroscopy; imaging principles and hardware; image artifacts.

UNIT IV SEGMENTATION AND CLASSIFICATION **9**

Medical Image Segmentation - Histogram-based methods; Region growing and watersheds; Markov Random Field models; active contours; model-based segmentation. Multi-scale segmentation; semi-automated methods; clustering-based methods; classification-based methods; atlas-guided approaches; multi-model segmentation. Medical Image Registration Intensity-based methods; cost functions; optimization techniques.

UNIT V NUCLEAR IMAGING **9**

PET and SPECT Ultrasound Imaging methods; mathematical principles; resolution; noise effect; 3D imaging; positron emission tomography; single photon emission tomography; ultrasound imaging; applications. Medical Image Search and Retrieval Current technology in medical image search, content-based image retrieval, new trends: Ontologies. Applications. Other Applications of Medical Imaging Validation, Image Guided Surgery, Image Guided Therapy; Computer Aided Diagnosis/Diagnostic Support Systems.

Total Periods 45

References

1. Paul Suetens, "Fundamentals of Medical Imaging", 2nd Edition, Cambridge University Press, 2009.
2. J. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Publications, 2009.
3. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005.
4. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
5. Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", First Edition, Prentice Hall, 2005.
6. John L. Semmlow, "Biosignal & Medical Image Processing", Second Edition, CRC Press, 2008.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2			2					2			2	3		
CO2					2	2						2			2	
CO3		1		2	2		2							2		
CO4					2		2						2		1	2
CO5	2	1	2		2		2					3				
CO6			2	1		2		2							1	
CO7				2			2							1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE12 **BIO-INSPIRED ARTIFICIAL INTELLIGENCE**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Course Outcomes: The Students will be able to.

CO1: Use methods and tools suitable for solving simple artificial intelligence tasks.

CO2: Use existing open source tools to build an application using genetic approaches.

CO3: Identify different applications suitable for different types of neural networks by justifications.

CO4: Critically analyze the use of cellular systems.

CO5: Differentiate the different models of immune systems.

CO6: Do a literature survey on applications of artificial immune systems.

CO7: Implement the Particle swarm and Ant colony algorithms within a framework & build Applications.

UNIT I EVOLUTIONARY SYSTEMS **9**

Evolutionary Systems – Artificial Evolution - Genetic Representations - Evolutionary Measures - Types of Evolutionary Algorithms - Schema Theory. Evolutionary Computation- Representation- Selection- Reproduction. Genetic Algorithms - Canonical Genetic Algorithm – Crossover- Mutation -Control Parameters – Applications. Genetic Programming - Tree-Based Representation – Building Block Genetic Programming –Applications. Evolutionary Programming – Basics – Operators –Strategy Parameters -Evolutionary Programming Implementations.

UNIT II NEURAL AND FUZZY SYSTEMS **9**

Neural Networks - Biological Nervous Systems - Artificial Neural Learning - Architecture. Unsupervised Learning - Self-Organizing Feature Maps. Supervised Learning – Types- Learning Rules. Radial Basis Function Networks. Reinforcement Learning – Model Free - Neural Networks and Reinforcement Learning. Fuzzy Systems- Fuzzy Sets – Logic and Reasoning – Controllers- Rough Sets.

UNIT III CELLULAR AND DEVELOPMENT SYSTEMS **9**

Cellular Systems - The Basic Ingredients - Cellular Automata -Modeling - Classic Cellular Automata –Other Cellular Systems – Computation - Artificial Life - Complex Systems - Analysis and Synthesis of Cellular Systems. Developmental Systems - Potential Advantages of a Developmental Representation-Rewriting Systems - Synthesis of Developmental Systems - Evolution and Development – Defining Artificial Evolutionary Developmental Systems - Evolutionary Rewriting Systems –Developmental Programs and Processes.

UNIT IV IMMUNE SYSTEMS AND COLLECTIVE SYSTEMS **10**

Natural Immune systems - Classical View -Working -Constituents of Biological Immune Systems - Immunity Types - Learning the Antigen Structure - The Network Theory - The Danger Theory – Artificial Immune Systems - Algorithms - Classical View Models - Clonal Selection Theory Models – Network Theory Models - Danger Theory Models - Applications and Other AIS models Applications- Biological Self-Organization - Particle Swarm Optimization - Basics - Social Network Structures – Variations -Basic PSO Parameters - Optimization - Applications. Ant Colony Optimization – Cemetery Organization and Brood Care – Di.

UNIT V BEHAVIORAL SYSTEMS **8**

Behavioral Systems - Behavior in Cognitive Science - Behavior in Artificial Intelligence –

Behavioral Systems – Behavior Based Robots –Evolution - Co-evolution - Learning and Self Reproduction of Behavioral Systems. Cultural Algorithms - Culture and Artificial Culture - Cultural Algorithm – Belief Space – Fuzzy Cultural Algorithms – Applications. Co-evolution – Types - Competitive and Cooperative Co-evolution.

Total Periods 45

References

1. Claudio Mattiussi, Dario Floreano "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies" (Intelligent Robotics and Autonomous Agents series), MIT Press, 2008.
2. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition, Wiley; 2007.
3. Russell C. Eberhart, Yuhui Shi Computational Intelligence: Concepts to Implementations, MorganKaufmann; 1 edition 2007vision of Labor –Applications.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		2	1								3	2		1
CO2	3	3	2	2	3					1			3	3		
CO3	3	2	3	2	1					1			2	3	3	2
CO4	2	3	2	1	1									3	2	
CO5	2	2		3	3								3	2		2
CO6	3	1		2	2					2			3	2		3
CO7	3	2		2	3								3	2	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE13 **INFORMATION RETRIEVAL TECHNIQUES**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Course Outcomes: The Students will be able to.

CO1: Use different information retrieval techniques in various application areas.

CO2: Build an Information Retrieval system using the available tools.

CO3: Identify and design the various components of an Information Retrieval system.

CO4: Apply machine learning techniques to text classification and clustering which is used forefficient Information Retrieval.

CO5: Analyze the Web content structure.

CO6: Design an efficient search engine.

UNIT I INTRODUCTION **8**

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 **10**

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 **8**

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 **10**

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 andLanguages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

Total Periods 45

References

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition 2011
2. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, 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.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1		3	3		2						3	2	1	
CO2	3	2	3		3		1						3	3	1	
CO3	3	2	3	1	2								3	2	3	
CO4	3	2		3									3	3	2	1
CO5	3	3	2	2			1							3		
CO6	3	2		2			2						3	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE14 **MULTIMEDIA SYSTEMS**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Course Outcomes: The Students will be able to.

CO1: Describe different realizations of multimedia tools and the way in which they are used.

CO2: Analyze the effects of scale and use on both presentation and lower - level requirements (ietop down approach).

CO3: Describe mechanisms for providing QoS guarantees in the network and to propose experiments to analyze their performance.

CO4: Design and implement Inter-process communication.

CO5: Design and implement multimedia file systems.

CO6: Design and Implement Synchronization in multimedia.

CO7: Plan experiments to test user perception of multimedia tools.

UNIT I INTRODUCTION AND QOS **9**

Introduction-QOS Requirements and Constraints-Concepts-Resources- Establishment Phase-Run-Time Phase-Management Architectures.

UNIT II OPERATING SYSTEMS **9**

Real-Time Processing-Scheduling-Interprocess Communication-Memory and Management-Server Architecture-Disk Management.

UNIT III FILE SYSTEMS AND NETWORKS **9**

Traditional and Multimedia File Systems-Caching Policy-Batching-Piggy backing-Ethernet-Gigabit Ethernet-Token Ring-100VG Any LAN-Fiber Distributed Data Interface (FDDI)- ATM Networks-MAN-WAN.

UNIT IV COMMUNICATION **9**

Transport Subsystem-Protocol Support for QOS-Transport of Multimedia-Computer Supported Cooperative Work-Architecture-Session Management-MBone Applications.

UNIT V SYNCHRONIZATION **9**

Synchronization in Multimedia Systems – Presentation-Synchronization Types – Multimedia Synchronization Methods - Case Studies – MHEG – MODE - ACME.

Total Periods 45

Text Books

1. Ralf Steinmetz and Klara Nahrstedt, “Multimedia Systems”, Springer, I Edition 2004.

References

1. Ralf Steinmetz and Klara Nahrstedt,” Media Coding and Content Processing”, PHI, 2002.
2. Shane Conder, Lauren Darcey, Joseph Annuzzi Jr, “Advanced Android Application Development”, Fourth Edition, Addison-Wesley Professional, 2014.
3. K.R. Rao, Zoran S. Bojkovic, Dragorad A. Milovacovic, D.A. Milovacovic ,“Multimedia Communication Systems: Techniques, Standards, and Networks, PHI”, 1st Edition, 2002.
4. Ze-Nian Li and Mark S. Drew,” Fundamentals of Multimedia”, Pearson, 2004.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1							2						2			
CO2		2												2		
CO3				2											2	
CO4			2										2			
CO5			2										2			
CO6			2													2
CO7					2										2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE15 **ROBOTICS**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Course Outcomes: The Students will be able to.

CO1: Explain robot locomotion.

CO2: Apply kinematics models and constraints.

CO3: Implement vision algorithms for robotics.

CO4: Implement robot localization techniques.

CO5: Implement robot-mapping techniques.

CO6: Implement SLAM algorithms.

CO7: Explain planning and navigation in robotics.

UNIT I LOCOMOTION AND KINEMATICS **9**

Introduction to Robotics – key issues in robot locomotion – legged robots – wheeled mobile robots – aerial mobile robots – introduction to kinematics – kinematics models & constraints – robot Maneuverability.

UNIT II ROBOT PERCEPTION **9**

Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data.

UNIT III MOBILE ROBOT LOCALIZATION **9**

Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments

UNIT IV MOBILE ROBOT MAPPING **9**

Autonomous map building – occupancy grip mapping – MAP occupancy mapping – SLAM – extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fast SLAM algorithm

UNIT V PLANNING AND NAVIGATION **9**

Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms

Total Periods 45

References

1. Roland Seigwart, Illah Reza Nourbakhsh, and DavideScaramuzza, “Introduction to autonomous mobile robots”, Second Edition, MIT Press, 2011.
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005.
3. Howie Choset et al., “Principles of Robot Motion: Theory, Algorithms, and Implementations”, A Bradford Book, 2005.
4. Gregory Dudek and Michael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010.
5. Maja J. Mataric, “The Robotics Primer”, MIT Press, 2007.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1			2										2			
CO2								2							2	
CO3				2										3		
CO4					2											2
CO5						2							2			
CO6					2									2		
CO7					2										3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE18	SOFTWARE PROCESS AND PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Prerequisites:

Aim: To understand overall SDLC and adopt suitable processes to develop a quality software.

Course Outcomes: The Students will be able to.

CO1: Evaluate and select the most desirable projects.

CO2: Adopt a suitable process for software development.

CO3: Analyze, prioritize, and manage requirements and perform trade-off among conflicting requirements.

CO4: Estimate the efforts required for software development.

CO5: Perform planning and tracking activities.

CO6: Perform various tests to ensure quality.

CO7: Define new processes based on the needs and adopt best practices for process improvement.

UNIT I DEVELOPMENT LIFE CYCLE PROCESSES 9

Overview of software development life cycle – introduction to processes – Personal Software Process (PSP) – Team software process (TSP) – Unified processes – agile processes – choosing the right process.

UNIT II REQUIREMENTS MANAGEMENT 9

Functional requirements and quality attributes – elicitation techniques – Quality Attribute Workshops (QAW) – analysis, prioritization, and trade-off – Architecture Centric Development Method (ACDM) – requirements documentation and specification – change management – traceability of requirements.

UNIT III ESTIMATION, PLANNING, AND TRACKING 9

Identifying and prioritizing risks – risk mitigation plans – estimation techniques – use case points – function points – COCOMO II – top-down estimation – bottom-up estimation – work breakdown structure – macro and micro plans – planning poker – wideband delphi – documenting the plan – tracking the plan – earned value method (EVM).

UNIT IV CONFIGURATION AND QUALITY MANAGEMENT 9

Identifying artifacts to be configured – naming conventions and version control – configuration control – quality assurance techniques – peer reviews – Fegan inspection – unit, integration, system, and acceptance testing – test data and test cases – bug tracking – causal analysis.

UNIT V SOFTWARE PROCESS DEFINITION AND MANAGEMENT 9

Process elements – process architecture – relationship between elements – process modeling – process definition techniques – ETVX (entry-task-validation-exit) – process base lining – process assessment and improvement – CMMI – Six Sigma.

Total Periods 45

References

1. Pankaj Jalote, “Software Project Management in Practice”, Pearson, 2002.
2. Jack T. Marchewka, “Software Project Management – Readings and Cases”, John Wiley & Sons, 2012 ISBN: 9781118057636.
3. Watts S. Humphrey, “PSP: A self-improvement process for software engineers”, Addison - Wesley, 2005.

4. Watts S. Humphrey, “Introduction to the Team Software Process”, Addison-Wesley, 2000.
5. Orit Hazzan and Yael Dubinsky, “Agile software engineering”, Springer, 2008.
6. James R. Persse, “Process Improvement Essentials”, O’Reilly, 2006.
7. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, 7th Ed., MGHill, 2010.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3											3		3	
CO2							2								3	
CO3		3														
CO4				3											3	
CO5					3											
CO6					3								2			
CO7					3											3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE20 **SOFTWARE ARCHITECTURES**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To study about software architectural drivers, architectural styles and design evaluate the architectural design according to the recent trends in software architecture.

Course Outcomes: The Students will be able to.

CO1: Explain key architectural drivers.

CO2: Explain the influence of architecture on business and technical activities.

CO3: Identify key architectural structures.

CO4: Adopt good practices for documenting the architecture.

CO5: Develop alternative architectures for a given problem.

CO6: Explain how to use formal languages to specify architecture.

CO7: Evaluate the architecture against the drivers.

CO8: Describe the recent trends in software architecture

UNIT I ARCHITECTURAL DRIVERS **9**

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

UNIT II ARCHITECTURAL VIEWS AND DOCUMENTATION **9**

Introduction – Standard Definitions for views – Structures and views- Perspectives: Static, dynamic and physical and the accompanying views – Representing views-available notations – Good practices in documentation– Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages - Architectural Description Languages – ACME44

UNIT III ARCHITECTURAL STYLES **9**

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

UNIT IV ARCHITECTURAL DESIGN **9**

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

UNIT V ARCHITECTURE EVALUATION AND SOME SPECIAL TOPICS **9**

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

Total Periods 45

References

1. Len Bass, Paul Clements, and Rick Kazman, “Software Architectures Principles and Practices”, 2n Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, “Architecting Software Intensive System. A Practitioner's Guide”, Auerbach Publications, 2010.
3. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, “Documenting Software Architectures. Views and Beyond”, 2nd Edition, Addison-Wesley, 2010.

4. RajkumarBuyya, James Broberg, and Andrzej Goscinski, “Cloud Computing. Principles and Paradigms”, John Wiley & Sons, 2011.
5. Mark Hansen, “SOA Using Java Web Services”, Prentice Hall, 2007.
6. Mieso K Denko, Laurence Tianruo Yang, and Yan Zang (eds.), “Autonomic Computing and Networking”. Springer Verlag, 2009.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		1										3	2		
CO2	3	2		1									3		2	1
CO3			3										2	3	1	
CO4		2	3	1									2	3		1
CO5	2	1			3									1	3	2
CO6	2		1		3								1		3	2
CO7	2	1			3									3	1	2
CO8	2			1	3								1		3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE21	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To study and understand approaches to quality assurance and evaluate the system based on the chosen quality mode.

Course Outcomes: The Students will be able to.

CO1: Describe different approaches to testing software applications.

CO2: Identify applicable measurements for the verification and validation effort.

CO3: Analyze specifications and identify appropriate test generation strategies.

CO4: Develop an appropriate test design for a given test object.

CO5: Execute the test design.

CO6: Evaluate the testing effort based on adequate measures.

UNIT I INTRODUCTION **9**

Introduction – Views on quality – Cost of quality - Quality models – Quality frameworks – Verification and Validation – Defect taxonomy – Defect management – Statistics and measurements – IEEE standards – Quality assurance and control processes

UNIT II VERIFICATION **6**

Introduction – Verification techniques – Inspections, reviews, walk-throughs – Case studies

UNIT III TEST GENERATION **12**

Software testing- Validation – Test plan – Test cases - Test Generation – Equivalence partitioning – Boundary value analysis – Category partition method – Combinatorial generation – Decision tables – Examples and Case studies

UNIT IV STRUCTURAL TESTING **12**

Introduction – Test adequacy criteria – Control flow graph – Coverages: block, conditions, multiple conditions, MC/DC, path – Data flow graph – Definition and use coverages – C-use, P-use, Def-clear, Def-use – Finite state machines – Transition coverage – Fault based testing – Mutation analysis – Case studies

UNIT V FUNCTIONAL TESTING **6**

Introduction – Test adequacy criteria - Test cases from use cases – Exploratory testing - Integration, system, acceptance, regression testing – Testing for specific attributes: Performance, load and stress testing – Usability testing – Security testing - Test automation – Test oracles

Total Periods 45

References

1. BorizBeizer, "Software Testing Techniques", 2nd Edition, Dream Tech, 2009.
2. Aditya P. Mathur, "Foundations of Software Testing", Pearson, 2008.
3. Mauro Pezze and Michal Young, "Software Testing and Analysis. Process, Principles, and Techniques", John Wiley 2008.
4. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", 2nd Ed, Pearson, 2003.
5. Kshirasagar Naik and Priyadarshi Tripathy (Eds), "Software Testing and Quality Assurance: Theory and Practice", John Wiley, 2008.
6. "Combinatorial Methods in Software Testing", ttp://csrc.nist.gov/groups/SNS/acts/index.html.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		1	2					1		1	2	1	1	
CO2	1	3		2										2	3	
CO3	2	1		2										1	3	
CO4	2		1	2	1									2	3	
CO5	2	2		3	2								2			
CO6	2	1		2	3									1	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE22	SOFTWARE REQUIREMENTS ENGINEERING	L	T	P	C
		3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** PE

Prerequisites:

Aim:
- Understand system requirements
- Generate requirements be elicitation
- Develop requirements documentation and evaluate the requirements

Course Outcomes: The Students will be able to.

CO1: Define a process for requirements engineering.

CO2: Execute a process for gathering requirements through elicitation techniques.

CO3: Validate requirements according to criteria such as feasibility, clarity, preciseness etc.

CO4: Develop and document functional requirements for different types of systems.

CO5: Develop and document quality attributes of the system to be implemented.

CO6: Communicate the requirements to stakeholders.

CO7: Negotiate with stakeholders in order to agree on a set of requirements.

UNIT I DOMAIN UNDERSTANDING 9

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

UNIT II REQUIREMENTS ELICITATION 9

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

UNIT III FUNCTIONAL REQUIREMENTS 9

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

UNIT IV QUALITY ATTRIBUTES AND USER EXPERIENCE 9

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

UNIT V MANAGING REQUIREMENTS 9

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

Total Periods 45

References

1. Axel van Lamsweerde, "Requirements Engineering", Wiley, 2009.
2. Derek Hatley, Peter Hruschka, ImtiazPirbhai, " Process for System Architecture and Requirements Engineering", Addison-Wesley Professional, 2013 ISBN: 9780133488562", John Wiley and Sons, 1998.
3. Dean Leffingwell and Don Widrig, "Managing Software Requirements: A Use Case Approach (2nd Edition)", Addison-wesley, 2003.
4. J Nielsen, "Usability Engineering", Academic Press, 1993.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		3			3						3	2	2	
CO2	3	2		3	3						2		2	1		
CO3	3			3	2		2							3	2	
CO4	2	3		2							2		3	2		
CO5	2	2		2									1		2	
CO6	3	3		3										3		2
CO7	3														2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE24	WEB DATA MINING	L	T	P	C
		3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To understand web data retrieval and web search, web information integration and web usage mining.

Course Outcomes: The Students will be able to.

CO1: Identify and differentiate between application areas for web content mining, web structure mining and web usage mining.

CO2: Understand techniques used to collect, analyze, and understand the data from Internet and the web (including social networks)

CO3: Develop skills of using recent data mining software for solving practical problems of Web Mining.

CO4: Perform analysis of linguistically processed data using a suitable statistical classifier.

CO5: Set requirements to, compare and assess the quality of existing web mining tools.

CO6: Analyze it through theoretical studies seeking information beyond the course literature.

UNIT I INTRODUCTION **9**

Introduction: World Wide Web, History of the Web and the Internet, What is Data Mining? What is Web Mining? Introduction to Association Rule Mining, Supervised Learning & Unsupervised Learning. **Information Retrieval and Web Search:** Basic Concepts of Information Retrieval, Information Retrieval Models, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Inverted Index and Its Compression, Latent Semantic Indexing, Web Search, Meta-Search: Combining Multiple Rankings, Web Spamming.

UNIT II SOCIAL NETWORK ANALYSIS **9**

Social Network Analysis: Introduction, Co-Citation and Bibliographic Coupling, PageRank, HITS Algorithm, Community Discovery. **Web Crawling:** A Basic Crawler Algorithm, Implementation Issues, Universal Crawlers, Focused Crawlers, Topical Crawlers, Evaluation, Crawler Ethics and Conflicts.

UNIT III STRUCTURED DATA EXTRACTION **9**

Structured Data Extraction: Wrapper Generation, Preliminaries, Wrapper Induction, Instance-Based Wrapper Learning, Automatic Wrapper Generation: Problems, String Matching and Tree Matching, Building DOM Trees, Extraction Based on a Single List Page, Extraction Based on Multiple Pages,

UNIT IV INFORMATION INTEGRATION **9**

Information Integration: Introduction to Schema Matching, Pre-Processing for Schema Matching, Schema -Level Matching, Domain and Instance-Level Matching, Combining Similarities, 1:m Match, Integration of Web Query Interfaces, Constructing a Unified Global Query Interface.

Opinion Mining and Sentiment Analysis: The Problem of Opinion Mining, Document Sentiment Classification, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Opinion Mining, Opinion Search and Retrieval, Opinion Spam Detection.

UNIT V WEB USAGE MINING **9**

Web Usage Mining: Data Collection and Pre-Processing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns, Recommender Systems and Collaborative Filtering, Query Log Mining, Computational Advertising.

Total Periods 45

Text Books

1. Wilbert Liu, Bing, ”Web Data Mining”, 2nd Edition., Elseiver, 2011.

References

1. Soumen Chakrabarti, “Mining the Web”, Morgan-Kaufmann Publishers, Elseiver, 2002.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		3		2					3			1	2
CO2	3	3			2		3					2		2		
CO3	3		2		3		2							1	3	
CO4	3	2					3							3		
CO5		3			3		3							2	1	2
CO6	3	2					3					2		3		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE28	DATA SCIENCE	L	T	P	C
		3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** PE

Aim: To introduce the concepts of dataware housing and datamining withits techniques, issues, and implication.

Course Outcomes: The Students will be able to.

CO1: Understanding the principles of data mining.

CO2: Know a range of techniques for data mining and where they can be applied.

CO3: Evolve multidimensional intelligent model from typical system.

CO4: Discover the knowledge imbibed in the high dimensional system.

CO5: Evaluate various mining techniques on complex data objects.

CO6: Apply data mining techniques to solve problems for decision making in well-defined business problems.

CO7: Aware of ethical issues that are present in data mining applications.

UNIT I INTRODUCTION TO DATA WAREHOUSING 9

Evolution of Decision Support Systems- Data warehousing Components – Building a Data warehouse, Data Warehouse and DBMS, Data marts, Metadata, Multidimensional data model, OLAP vs OLTP, OLAP operations, Data cubes, Schemas for Multidimensional Database: Stars, Snowflakes and Fact constellations

UNIT II DATA WAREHOUSE PROCESS AND ARCHITECTURE 9

Types of OLAP servers, 3–Tier data warehouse architecture, distributed and virtual data warehouses. Data warehouse implementation, tuning and testing of data warehouse. Data Staging (ETL) Design and Development, data warehouse visualization, Data Warehouse Deployment, Maintenance, Growth, Business Intelligence Overview- Data Warehousing and Business Intelligence Trends - Business Applications- tools-SAS

UNIT III INTRODUCTION TO DATA MINING 9

Data mining-KDD versus data mining, Stages of the Data Mining Process-task primitives, Data Mining Techniques -Data mining knowledge representation – Data mining query languages, Integration of a Data Mining System with a Data Warehouse – Issues, Data preprocessing – Data cleaning, Data transformation, Feature selection, Dimensionality reduction, Discretization and generating concept hierarchies-Mining frequent patterns- association-correlation

UNIT IV CLASSIFICATION AND CLUSTERING 9

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Clustering techniques – , Partitioning methods- k-means- Hierarchical Methods – distance based agglomerative and divisible clustering, Density-Based Methods – expectation maximization -Grid Based Methods – Model-Based Clustering Methods – Constraint – Based Cluster Analysis – Outlier Analysis

UNIT V PREDICTIVE MODELING OF BIG DATA AND TRENDS IN DATAMINING 9

Statistics and Data Analysis – EDA – Small and Big Data –Logistic Regression Model - Ordinary Regression Model-Mining complex data objects – Spatial databases – Temporal databases – Multimedia databases – Time series & sequence data – Text mining – Web mining – Applications in Data mining

Total Periods 45

References

1. Jiawei Han, Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann, Third edition, 2011.
2. Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw Hill, Tenth Reprint, 2007.
3. G. K. Gupta, “Introduction to Data Min Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, Third Edition, 2014.
4. Ian.H.Witten, Eibe Frank and Mark.A.Hall, “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann, Third edition, 2011.
5. Bruce Ratner, “Statistical and Machine - Learning Data Mining: Techniques for Better Predictive Modeling and Analysis of Big Data”, CRC Press, Second Edition, 2012.
6. Mehmed kantardzic, “Data mining: Concepts, Models, Methods, and Algorithms”, Wiley-Blackwell, Second Edition, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												1	3		
CO2		2							2						3	
CO3			3		1				3							2
CO4				1							2					2
CO5		2											2			
CO6									3					2		
CO7								3							2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE31 **SECURITY PRINCIPLES AND PRACTICES** **L T P C**
3 0 0 3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To study about the current trends in security principles.

Course Outcomes: The Students will be able to.

CO1: Use the mathematical foundations in security principles.
CO2: Identify the features of encryption and authentication.
CO3: Use available security practices.
CO4: Evaluating cryptography techniques used to secure information systems.
CO5: Creating information security titles and their respective roles.
CO6: Distinguishing between unethical and illegal behavior.

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATION 9

An illustrative communication game – safeguard versus attack – Probability and Information Theory - Algebraic foundations – Number theory.

UNIT II ENCRYPTION – SYMMETRIC TECHNIQUES 9

Substitution Ciphers – Transposition Ciphers – Classical Ciphers – DES – AES –Confidentiality Modes of Operation – Key Channel Establishment for symmetric cryptosystems.

UNIT III ENCRYPTION – ASYMMETRIC TECHNIQUES AND DATA TECHNIQUES 9

Diffie-Hellman Key Exchange protocol – Discrete logarithm problem – RSA cryptosystems & cryptanalysis – ElGamal cryptosystem – Need for stronger Security Notions for Public key Cryptosystems – Combination of Asymmetric and Symmetric Cryptography – Key Channel Establishment for Public key Cryptosystems - Data Integrity techniques – Symmetric techniques - Asymmetric techniques.

UNIT IV AUTHENTICATION 9

Authentication Protocols Principles – Authentication protocols for Internet Security – SSH Remote logic protocol – Kerberos Protocol – SSL & TLS – Authentication frame for public key Cryptography – Directory Based Authentication framework – Non - Directory Based Public-Key Authentication framework.

UNIT V SECURITY PRACTICES 9

Protecting Programs and Data – Information and the Law – Rights of Employees and Employers– Software Failures – Computer Crime – Privacy – Ethical Issues in Computer Security.

Total Periods 45

References

1. William Stallings, “Crpyptography and Network security: Principles and Practices”, Pearson/PHI, 5th Edition, 2010.
2. Behrouz A. Forouzan, “Cryptography and Network Security”, 2nd Edition, Tata McGraw Hill Education, 2010.
3. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 2nd Edition, Pearson, 2007.
4. Douglas R. Stinson, “Cryptography Theory and Practice”, 3rd Ed, Chapman & Hall/CRC, 2006.
5. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, 2nd Edition, 2007.
6. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, 2006.
7. Charlie Kaufman, Radia Perlman and Mike Speciner, “Network Security Private Communication in a Public World”, PHI, Second Edition, 2012.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2			2								3		2	2
CO2			3			3								3		
CO3				2							3				3	
CO4			2		3	2							3	2		
CO5							2	3	2							2
CO6				2		2		3						2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE32 **ETHICAL HACKING** **L T P C**
3 0 0 3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Course Outcomes: The Students will be able to.

CO1: Identify and analyze the stages an ethical hacker requires to take in order to compromise a target system.
CO2: Identify tools and techniques to carry out a penetration testing.
CO3: Critically evaluate security techniques used to protect system and user data.
CO4: Defend hacking attacks and protect data assets.
CO5: Demonstrate systematic understanding of the concepts of security at the level of policy and strategy in a computer system.
CO6: Defend a computer against a variety of security attacks using various tools.
CO7: Practice and use safe techniques on the World Wide Web.

UNIT I INTRODUCTION TO HACKING **9**

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

UNIT II SCANNING AND ENUMERATION **9**

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

UNIT III SYSTEM HACKING **9**

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

UNIT IV PROGRAMMING FOR SECURITY PROFESSIONALS **9**

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

UNIT V PENETRATION TESTING **9**

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

Total Periods 45

References

1. Ec-Council, “Ethical Hacking and Countermeasures: Attack Phases”, Delmar Cengage Learning, 2009.
2. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking and Network Defense”, Cengage Learning, 2012.
3. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy”, Syngress Media, Second Revised Edition, 2013.
4. Jon Erickson, “Hacking: The Art of Exploitation”, No Starch Press, Second Edition, 2008.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3	2											3		
CO2		3			2									3		
CO3			3			2							3			
CO4			3										3			
CO5											3		3			
CO6			3			3										3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE33	NETWORK AND INFORMATION SECURITY	L	T	P	C
		3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **OE**

Aim: To acquire knowledge on the fundamentals of Cryptography and how to apply cryptographic techniques to secure data in transit across data networks.

Course Outcomes: The Students will be able to.

CO1: Implement basic security algorithms required by any computing system.

CO2: Analyze the vulnerabilities in any computing system and hence be able to design a security solution.

CO3: Analyze the possible security attacks in complex real time systems & their effective countermeasures.

CO4: Identify the security issues in the network and resolve it.

CO5: Evaluate security mechanisms using rigorous approaches, including theoretical derivation, modeling, and simulations.

CO6: Formulate research problems in the computer security field.

UNIT I INTRODUCTION **9**

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

UNIT II CRYPTOSYSTEMS & AUTHENTICATION **9**

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

UNIT III PUBLIC KEY CRYPTOSYSTEMS **9**

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

UNIT IV SYSTEM IMPLEMENTATION **9**

Design Principles, Representing Identity, Access Control Mechanisms, Information Flow and Confinement Problem Secure Software Development: Secured Coding - OWASP/SANS Top Vulnerabilities - Buffer Overflows - Incomplete mediation - XSS - Anti Cross Site Scripting Libraries - Canonical Data Format - Command Injection - Redirection - Inference – Application Controls

UNIT V NETWORK SECURITY **9**

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

Total Periods 45

References

1. William Stallings, “Cryptography and Network Security: Principles and Practices”, Third Edition, Pearson Education, 2006.
2. Matt Bishop, “Computer Security art and science”, Second Edition, Pearson Education, 2002.
3. Wade Trappe and Lawrence C. Washington, “Introduction to Cryptography with Coding Theory” Second Edition, Pearson Education, 2007.
4. Jonathan Katz, and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press, 2007
5. Douglas R. Stinson, “Cryptography Theory and Practice”, Third Edition, Chapman & Hall/CRC, 2006.
6. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, 1st Ed, 2006.
7. Network Security and Cryptography, Menezes Bernard, Cengage Learning, New Delhi, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1			3			2							3			
CO2		3	2											3		
CO3		3		2										3		
CO4		3														3
CO5		3											3	2		
CO6		3			2								3	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE34 **FIREWALLS AND INTRUSION DETECTION SYSTEM** **L T P C**
3 0 0 3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **PE**

Aim: To describe the importance of firewall and intrusion detection and prevention.

Course Outcomes: The Students will be able to.

CO1: Identify firewall in a network.
CO2: Classify attack types that affect security of the network.
CO3: Analyze IP network traffic for malicious packet identification.
CO4: Develop predictive measures to assess and prevent intrusion.
CO5: Identify ACE, PIE, PDP, and PEP.
CO6: Diagnose possible hacks and propose policies to outline what do when an intrusion occurs.

UNIT I INTRODUCTION **5**

Introduction – overview of TCP/IP – The Different Layers - Routers and Routing Protocols – The Domain Name System – Standard Services – R PC-based Protocols – File Transfer Protocols – The "*r*" Commands – Information Services – The X11 System - Patterns of Trust

UNIT II FIREWALL GATEWAY **10**

Firewall Gateways – How to Build an Application-Level Gateway – Authentication – Gateway Tools – Traps, Lures, and Honey pots – The Hacker's Workbench

UNIT III FIREWALL ARCHITECTURE **10**

Building Firewalls – Packets and protocols – Firewall Technologies – Firewall architecture – Firewall Design – Packet Filtering – Proxy systems

UNIT IV INTRUSION DETECTION **10**

Traditional Network Security Approaches – Layers of Network Security – I&A for network security entities – network access control – Internet protocol – Supporting protocols for IP – ARP – DNS – RIP – UDP – TCP – TCP/IP Application Security – Role of Firewall in Traditional Security – Role of Intrusion Detection – Intrusion Detection: Concepts and Definitions – Classes of Attacks– Layers of Information Sources – System Data Sources

UNIT V INTRUSION DETECTION FOR NT **10**

Vulnerability Scanners – UNIX System level IDSs – Sniffing for Intruders – Intrusion Detection for NT – Anamoly based Intrusion Detection Systems – Setting up an ABS – PAYL – POSEIDON – SOM – Threat Response System – System Architecture – ACE – PIE – PDP – PEP – Case Study: e–mail server.

Total Periods 45

References

1. William R. Cheswick, Steven M. Bellovin, Aviel D. Rubin "Firewalls and Internet Security: Repelling the Wily Hacker" Addison-Wesley, First Edition, 2003
2. Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, "Building Internet Firewalls", Second Edition, O'Reily Publishers, 2000.
3. Terry Escamilla "Intrusion Detection Network Security beyond the firewall", John Wiley & Sons Inc, 1998.
4. Roberto Di Pietro,Luigi V.Mancini, "Intrusion Detection Systems",Springer International, 2010.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2		2		2			2	2		2		1		2
CO2	2	2		1								2	2	1		
CO3		1		2		2				2						1
CO4	2				2				1				1		2	
CO5	2	1		2					2	2		1	1		3	
CO6		3	2	1		2					2		1	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE39 **ENERGY AWARE COMPUTING** **L T P C**
3 0 0 3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **OE**

Aim: To examine the design of power efficient architecture, power and performance tradeoffs, restructuring of software and applications and standards for energy aware Hardware and Software.

Course Outcomes: The Students will be able to.

CO1: Design Power efficient architecture Hardware and Software.
CO2: Analyze power and performance tradeoff between various energy aware storagedevices.
CO3: Implement various energy aware algorithms.
CO4: Restructure the software and Hardware for Energy aware applications.
CO5: Explore the Energy aware applications.
CO6: Present clear and concise descriptions of complex systems/methods.

UNIT I INTRODUCTION **9**

Energy efficient network on chip architecture for multi core system-Energy efficient MIPSCPU core with fine grained run time power gating – Low power design of Emerging memory technologies.

UNIT II ENERGY EFFICIENT STORAGE **9**

Disk Energy Management-Power efficient strategies for storage system-Dynamic thermal management for high performance storage systems-Energy saving technique for Disk storage systems.

UNIT III ENERGY EFFICIENT ALGORITHMS **9**

Scheduling of Parallel Tasks – Task level Dynamic voltage scaling – Speed Scaling –Processor optimization- Memetic Algorithms – Online job scheduling Algorithms.

UNIT IV REAL TIME SYSTEMS **9**

Multi processor system – Real Time tasks- Energy Minimization – Energy aware scheduling-Dynamic Reconfiguration- Adaptive power management-Energy Harvesting Embedded system.

UNIT V ENERGY AWARE APPLICATIONS **9**

On chip network – Video codec Design – Surveillance camera- Low power mobile storage.

Total Periods 45

References

1. Ishfaq Ah mad, Sanjay Ranka, Handbook of Energy Aware and Green Computing, Chapman and Hall/CRC, 2012.
2. Chong-Min Kyung, Sungiooyoo, Energy Aware system design Algorithms and Architecture, Springer, 2011.
3. Bob steigerwald, Chris:Luero, Energy Aware computing, Intel Press,2012.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1			3		2									3		
CO2		2		2										2		
CO3		2											3	2		
CO4			3	2										2	2	
CO5		2	2	3											3	
CO6					2											2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE40 **GREEN COMPUTING** **L T P C**
3 0 0 3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **OE**

Aim: To create awareness of energy efficient computing and to understand the power management in computing devices.

Course Outcomes: The Students will be able to.

CO1: Understand the concepts of technologies that conform to low-power computation.
CO2: Identify the benefits and challenges of energy efficient computing.
CO3: Have a basic understanding of a variety of technologies applied in building a green system (especially green datacenters), including networks, Virtual Machine (VM) management and storage systems.
CO4: Develop energy efficient computing applications.
CO5: Apply the strategies of going Green.
CO6: Able to use a range of tools to help monitor and design green systems.

UNIT I INTRODUCTION **9**

Energy- efficient – power efficient and thermal aware computing and communication - Newton‟s cooling model and basic thermodynamics and sustainability

UNIT II POWER MANAGEMENT **9**

Operating system Directed power management – Power management history and motivation – key power management concepts – power management scenarios – ACPI desktop motherboard design

UNIT III DEVELOPMENT OF EFFICIENT POWER MANAGEMENT SYSTEM **9**

Dual mode desktop power delivery – system BIOS – Designing mobile systems - Communication with peripheral devices – Drivers – Developing robust power managed applications

UNIT IV ENERGY EFFICIENT DATA CENTER **9**

Data center power consumption – Power metrics – Energy efficient data center tuning - energy efficient server management – Industry vision and recommendations

UNIT V CASE STUDIES AND APPLICATION **9**

Google green datacenter - IBM green technology - Microsoft – Case Studies – Applying Green IT Strategies and Applications to a Home – Hospital - Packaging Industry and Telecom Sector.

Total Periods 45

References

1. Jerzy Kolinski, Ram Chary, Andrew Henroid, and Barry Press, “Building the Power-Efficient PC A Developer's Guide to ACPI Power Management”, Intel Press August 2001.
2. Lauri Minas, Brad Ellison, “Energy Efficiency for Information Technology: How to Reduce Power Consumption in Servers and Data Centers”, Intel Press, 2009.
3. BhuvanUnhelkar, “Green IT Strategies and Applications-Using Environmental Intelligence”, CRC Press, June 2011.
4. Wu Chun Feng, “Green Computing: Large-Scale Energy Efficiency”, CRC Press INC, 2013.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					3	3	1								
CO2	3	3						3	3	1						3
CO3	3	3	1			2		3	3	1					3	
CO4	3	2	1			2		3	2	1						3
CO5	1		1			3	3	1								
CO6	1					3	3	1							3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162CSE41 **HIGH PERFORMANCE COMPUTING**

L	T	P	C
3	0	0	3

Programme: M.E. Computer Science and Engineering **Sem:** **Category:** **OE**

Aim:

Course Outcomes: The Students will be able to.

CO1: Able to analyze a given problem for possibilities of parallel computations.

CO2: Be familiar with Parallel processing technology.

CO3: Design new Processor Architectures and parallel programming with CUDA.

CO4: Point out the design issues in parallel Computing and their limitations.

CO5: Explain Power-Aware Computing and Communication.

CO6: Identify advanced Topics on Petascale Computing and Optical Systems.

CO7: Use appropriate programming languages efficiently for scientific computations.

UNIT I PARALLEL PROCESSING CONCEPTS **9**

Levels of parallelism (instruction, transaction, task, thread, memory, function-Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc)- Architectures: N-wide superscalar architectures, multi-core, multi-threaded.

UNIT II PARALLEL PROGRAMMING WITH CUDA **9**

Processor Architecture – Interconnect – Communication - Memory Organization-Programming Models in high performance computing architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Micro architecture and Intel Nehalem micro architecture)- Memory hierarchy and transaction specific memory design - Thread Organization.

UNIT III FUNDAMENTAL DESIGN ISSUES IN PARALLEL COMPUTING **9**

Synchronization - Scheduling - Job Allocation - Job Partitioning - Dependency Analysis - Mapping Parallel Algorithms onto Parallel Architectures - Performance Analysis of Parallel Algorithms

UNIT IV LIMITATIONS OF PARALLEL COMPUTING AND POWER-AWARE COMPUTING **9**

Bandwidth Limitations - Latency Limitations - Latency Hiding/Tolerating Techniques -their limitations - Power-aware Processing Techniques - Power-aware Memory Design - Power-aware Interconnect Design - Software Power Management.

UNIT V ADVANCED TOPICS **9**

Petascale Computing - Optics in Parallel Computing - Quantum Computers- Recent developments in Nanotechnology and its impact on HPC

Total Periods 45

References

1. "Highly Parallel Computing", by George S. Almasi and Alan Gottlieb.
2. "Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang, McGraw Hill 2008.
3. "Principles and Practices on Interconnection Networks", by William James Dally and Brian Towles, Morgan Kauffman 2004.
4. Introduction to Parallel Computing, AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd Edition, Addison-Welsey, © 2003.
5. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										2		3	
CO2	3	2	2										1			
CO3	3		2	2										2		
CO4	2	2	1										2		2	2
CO5	1	2	1											1		
CO6	3	3	2													
CO7	2		1	2									2	2	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)