SCHEME OF INSTRUCTION
M.TECH (COMPUTER SCIENCE AND ENGINEERING)
Proposed from the Academic year 2016-17

SEMESTER - I

S.No	Course Code	Course Title	Scheme of Instruction		Contact Hrs/Wk	Scheme of Examination		Credits
			L/T	P		CIE	SEE	
1.	# Core	Core	3	--	3	30	70	3
2.	# Core	Core	3	--	3	30	70	3
3.	# Core/ *Elective	Core / Elective	3	--	3	30	70	3
4.	# Core/ *Elective	Core / Elective	3	--	3	30	70	3
5.	*Elective	Elective	3	--	3	30	70	3
6.	*Elective	Elective	3	--	3	30	70	3
Departmental Requirements								
7.	CS 5121	Software Lab - I	--	3	3	--	**--**	2
8.	CS 5122	Seminar - I	--	3	3	--	--	2
		Total	**18**	**6**	**24**	**280**	**420**	**22**

SEMESTER - II

S.No	Course Code	Course Title	Scheme of Instruction		Contact Hrs/Wk	Scheme of Examination		Credits
			L/T	P		CIE	SEE	
1.	# Core	Core	3	--	3	30	70	3
2.	# Core	Core	3	--	3	30	70	3
3.	# Core/ *Elective	Core / Elective	3	--	3	30	70	3
4.	# Core/ *Elective	Core / Elective	3	--	3	30	70	3
5.	*Elective	Elective	3	--	3	30	70	3
6.	*Elective	Elective	3	--	3	30	70	3
Departmental Requirements								
7.	CS 5123	Software Lab - I	--	3	3	--	**--**	2
8.	CS 5124	Seminar - I	--	3	3	--	--	2
		Total	**18**	**6**	**24**	**280**	**420**	**22**

L: Lecture T: Tutorial P:Practical
CIE: Continuous Internal Evaluation SEE: Semester End Examination

SCHEME OF INSTRUCTION
M.TECH (COMPUTER SCIENCE AND ENGINEERING)
Proposed from the Academic year 2016-17

SEMESTER III

S.No	Course Code	Course Title	Scheme of Instruction		Contact Hrs/Wk	Scheme of Examination		Credits
			L/T	P		CIE	SEE	
1.	CS5125	Project Seminar	--	4	4	100**	--	8
		Total	**--**	**4**	**4**	**100**		**8**

***Project Seminar Evaluation:** 50 marks to be awarded by Supervisor and 50 marks to be awarded by Viva-Voce committee comprising Head, Supervisor and an Examiner.*

SEMESTER – IV

S.No	Course Code	Course Title	Scheme of Instruction		Contact Hrs/Wk	Scheme of Examination		Credits
			L/T	P		CIE	SEE	
1.	CS5126	Dissertation	--	6	6	---	200	16
		Total	**--**	**6**	**6**	**---**	**200**	**16**

Note: Six Core subjects, Six Elective subjects, Two Laboratory Courses and Two Seminars must be offered in Semester I and II.

 # List of Core Subjects:

S.No	Course Code	Course Title
1	CS 5101	Advanced Algorithms
2	CS 5102	Advanced Operating Systems
3	CS 5103	Artificial Intelligence
4	CS 5104	Object Oriented Software Engineering
5	CS 5105	Distributed Computing
6	CS 5106	Advanced Databases

***List of Elective Subjects:**

S.No	Course Code	Course Title
1	CS 5051	Mobile Computing
2	CS 5052	Real Time Systems
3	CS 5053	Web Engineering
4	CS 5054	Multimedia Technologies
5	CS 5055	Data Mining
6	CS 5056	Network Security
7	CS 5057	Machine Learning
8	CS 5058	Information Retrieval System
9	CS 5059	Natural Language processing
10	CS 5060	Software Quality and Testing
11	CS 5061	Cloud Computing
12	CS 5062	Soft Computing
13	CS 5063	Neural Networks
14	CS 5064	Software Project Management
15	CS 5065	Image Processing

16	CS 5066	Software Reuse Techniques
17	CS 5067	Reliability and Fault Tolerance
18	CS 5068	Web Mining
19	CS 5069	Human Computer Interaction
20	CS 5151	Advanced Computer Graphics
21	CS 5153	Software Engineering for RTS
22	CS 5154	Parallel Algorithms
23	CS 5202	Parallel Computer Architecture
24	CS 5206	Grid Computing
25	CS 5301	Embedded System Design
26	CS 5304	Real Time Operating Systems
27	CS 5305	Simulation and Modelling

CS 5101 **ADVANCED ALGORITHMS**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Algorithm Analysis: Asymptotic Notation, Amortization.
Basic Data Structures: Stacks and Queues, Vectors, Lists and Sequences, Trees, Priority Queues, Heaps, Dictionaries and Hash Tables.
Search Trees: Ordered Dictionaries and Binary Search Trees, AVL Trees, Bounded-Depth Search Trees, and Splay Trees.

UNIT-II

Fundamental Techniques: The Greedy Method, Divide-and-Conquer, and Dynamic Programming.
Graphs: The Graph Abstract Data Type, Data Structures for Graphs, Graph Traversal, Directed Graphs.

UNIT-III

Weighted Graphs: Single-Source Shortest Paths, All-Pairs Shortest Paths, Minimum Spanning Trees.
Network Flow and Matching: Flows and Cuts, Maximum Bipartite Matching, Minimum-Cost Flow.

UNIT-IV

Text Processing: Strings and Pattern Matching Algorithms, Tries, Text Compression, Text Similarity Testing.
Number Theory and Cryptography: Fundamental Algorithms involving numbers, Cryptographic Computations, Information Security Algorithms and Protocols.

UNIT-V
Computational Geometry: Range Trees, Priority Search Trees, Quad Trees and k-D Trees, Convex Hulls.

Suggested Reading:

1. M T Goodrich, R Tomassia. *Algorithm Design – Foundations, Analysis, and Internet Algorithms*, Wiley, 2006.
2. E Horowitz S Sahani, S Rajasekaran, C*omputer Algorithms*, Silicon Press, 2nd Edition, 2007.
3. Aho, A V Hopcraft, Ullman J D, *The Design and Analysis of Computer Algorithms*, Pearson Education, 2007.
4. Hari Mohan Pandey, *Design Analysis and Algorithms*, Firewall Media, 2008.
5. Cormen, Lieserson, Rivest, *Introduction to Algorithms*, MIT Press, 2nd Edition, 2009.

CS 5102 ADVANCED OPERATING SYSTEMS

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*

CIE: 30 marks *SEE: 70 marks*

UNIT-I

Architecture of Distributed Systems: Types, Distributed Operating System, Issues in Distributed Operating Systems, Theoretical Foundations: Global Clock, Lamport's Logical Clock, Vector Clocks, Global State, and Termination Detection.

UNIT-II

Distributed Mutual Exclusion: Classification, requirement, performance, non-token based algorithms, Lamport's algorithm, the Richart-Agarwala algorithm, token-based algorithm-Suzuki liasamil's broadcast algorithm, Singhals heuristic algorithm.

Deadlock Detection: Resource Vs Communication deadlock, A graph- theoretic model, prevention, avoidance, detection, control organization, centralized deadlock-detection algorithm, the completely centralized algorithm, the HO-Ramamoorthy algorithm. Distributed deadlock detection algorithm - path - pushing, edge-chasing, hierarchical deadlock detection algorithm, menace-muntz and Ho-Ramamoorthy algorithm. Agreement Protocols: The system model, the Byzantine agreement, and the consensus problem.

UNIT-III

Distributed File System: Mechanisms, Design Issues.

Case Studies: Sun NFS, Sprite File System, DOMAIN, Coda File System.

Distributed Shared Memory: Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, Design Issues.

Case Studies: IVY, Mirage, Clouds.

Distributed Scheduling : Issues in Load Distribution, Components of Algorithm, Stability Load Distributing Algorithm, Performance.

UNIT IV

Failure Recovery: Backward, Forward Error Recovery in Concurrent Systems, Consistent Set of Check Points, Synchronous and Asynchronous Check Pointing and Recovery.

Fault Tolerance: Commit Protocols, Non-Blocking Commit Protocols, Voting Protocols.

Protection and Security: Access Matrix, Private Key, Public key, and Kerberos System.

UNIT -V

Multiprocessor Operating Systems: Motivation, Basic Multiprocessor System Architecture, Interconnection Networks for Multiprocessor Systems, Caching, Hypercube Architecture. Threads, Process Synchronization, Processor Scheduling, and Memory Management.

Database Operating System: Concurrence Control, Distributed Databases, and Concurrency Control Algorithms.

Suggested Reading:

1. Singhal M, Shivaratri N.G, *Advanced Concepts in Operating Systems*, McGraw-Hill Intl., 1994.
2. Pradeep K Sinha, *Distributed Operating Systems Concepts and Design*, PHI, First Edition, 2002.
3 Andrew S. Tanenbaum, *Distributed Operating Systems*, Pearson Education India, First Edition, 2011

CS 5103 **ARTIFICIAL INTELLIGENCE**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT - 1

Introduction: History Intelligent Systems, Foundations of Artificial Intelligence, Sub areas of Al, Applications.

Problem Solving - State - Space Search and Control Strategies: Introduction, General Problem Solving Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative - Deepening A*, Constraint Satisfaction.

Game Playing, Bounded Look - ahead Strategy and use of Evaluation Functions, Alpha Beta Pruning.

UNIT – II

Logic Concepts and Logic Programming: Introduction, Propositional Calculus Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Table, A System in Propositional Logic, Resolution, Refutation in Propositional Logic, Predicate Logic, Logic Programming.

Knowledge Representation: Introduction, Approaches to knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT - III

Expert System and Applications: Introduction, Phases in Building Expert Systems Expert System Architecture, Expert Systems Vs Traditional Systems, Truth Maintenance Systems, Application of Expert Systems, List of Shells and tools.

Uncertainity Measure - Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainity Factor Theory, Dempster - Shafer Theory.

UNIT - IV

Machine - Learning Paradigms: Introduction, Machine learning System, Supervised and Unsupervised Learning, Inductive Learning, Learning Decision Trees, Deductive Learning, Clustering, Support Vector Machines.

Artificial Neural Networks: Introduction Artificial Neural Networks, Single - Layer Feed Forward Networks, Multi - Layer Feed Forward Networks, Radial - Basis Function Networks, Design Issues of Artificial Neural Networks, Recurrent Networks

UNIT - V

Advanced Knowledge Representation Techniques: Case Grammars, Semantic Web.

Natural Language Processing: Introduction, Sentence Analysis Phases, Grammars and Parsers, Types of Parsers, Semantic Analysis, Universal Networking Knowledge.

Suggested Reading:

1. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning India, First Edition, 2011.
2. Russell, Norvig, *Artificial Intelligence: A Modern Approach*, Pearson Education, 2nd Edition, 2004.
3. Rich, Knight, Nair , *Artificial Intelligence*, Tata McGraw Hill, 3rd Edition 2009.

CS5104 OBJECT ORIENTED SOFTWARE ENGINEERING

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Information Systems: Problems in Information systems Development, Project life cycles, Managing Information System Development, User Involvement and Methodological Approaches, Basic Concepts and Origins of Object Orientation Modeling Concepts.

UNIT-II

Requirement Capture, Requirement Analysis, Refining the Requirement Models, Object Interaction.

UNIT-III

Operations, Control, Design, System Design.

UNIT-IV

Object design, Design Patterns, Human Computer Interaction, Designing Boundary Classes
.

UNIT-V

Data Management Design, Implementation, Reusable Components, Managing Object Oriented Projects, System Development Methodologies.

Suggested Reading:

1. Simon Benett, Steve McRobb and Ray Farmer, *Object Oriented System Analysis and Design using UML*, McGraw-Hill Education, 2010.
2. Grady Booch, James Rumbaugh, Ivar Jacobson, *The Unified Modeling language-User guide*, Pearson Education India, 2nd Edition, 2005.
3. Subhash Mehta, Suresh K. Basandra, *Object Oriented Software Engineering*, Galgotia, 2004.

CS 5105 **DISTRIBUTED COMPUTING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT -I

Introduction: Definition of Distributed Systems, Goals: Connecting Users and Resources, Transparency, Openness, Scalability, Hardware Concepts: Multiprocessors, Homogeneous Multicomputer systems, Heterogeneous Multicomputer systems, Software Concepts: Distributed Operating Systems, Network Operating Systems, Middleware, The client-server model: Clients and Servers, Application Layering, Client-Server Architectures.

UNIT II

Communication: Layered Protocols, Lower-Level Protocols, Transport Protocols, Higher-Level Protocols, Remote Procedure Call: Basic RPC Operation, Parameter Passing, Extended RPC Models, Remote Object Invocation: Distributed Objects, Binding a Client to an Object; Static verses Dynamic Remote Method Invocations, Parameter Passing, Message Oriented Communication: Persistence and synchronicity in Communication, Message-Oriented Transient Communication, Message-Oriented' Persistent Communication, Stream Oriented Communication: Support for Continuous Media, Streams and Quality of Service, Stream Synchronization.

UNIT -III

Process: Threads: Introduction to Threads, Threads in Distributed Systems, Clients: user Interface-:, Client-Side Software for Distribution Transparency, Servers: General Design Issues, Object Servers, Software Agents: Software Agents in Distributed Systems, Agent Technology, Naming: Naming Entities: Names, Identifiers, and Address, Name Resolution, The Implementation of a Name System, Locating Mobile Entities: Naming verses Locating Entities, Simple Solutions, Home-Based Approaches, Hierarchical Approaches.

UNIT -IV

Distributed Object Based Systems: CORBA: Overview of CORBA, Communication, Processes, Naming, Synchronization, Caching and Replication, Fault Tolerance, Security, Distributed COM: Overview of DCOM, Communication, Processes, Naming, Synchronization, Replication, Fault Tolerance, Security, GLOBE: Overview of GLOBE, Communication, Process, Naming, Synchronization, Replication, Fault Tolerance, Security, Comparison of CORBA, IDCOM, and

Globe: Philosophy, Communication, Processes, Naming, Synchronization, Caching and Replication Fault Tolerance, Security, MTN

UNIT-V

Distributed Multimedia Systems: Introduction, Characteristics of Multimedia Data, Quality of Service Management: Quality of Service negotiation, Admission Control, Resource Management Resource Scheduling.

Suggested Reading:

1. Andrew S. Tanenbaum and Marteen Van Steen, *Distributed System*s: *Principles and Paradigms,* Pearson Prentice Hall, 2nd Edition, 2010.
2. Colouris G., Dollimore Jean, Kindberg Tim, *Distributed Systems Concepts and Design,* 3rd Edition Pearson Education, 5th Edition, 2011.

CS 5106 **ADVANCED DATABASES**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Object Based Databases: Overview, Complex Data Types, Structured Types and Inheritance in SQL, Table Inheritance, Array and Multi-set. Types in SQL, Object-Identity and Reference Types in SQL, Implementing O-R features, Persistent Programming Languages, Object-Relational Mapping, Object-Oriented versus Object-Relational.

UNIT-II

X M L: Motivation, Structure of XML data, XML Document Schema, Querying and Transformation, Application Program Interface to XML, Storage of XML data, XML applications.

UNIT-III

Query Processing : Overview, Measures of Query Cost, Selection Operation, Sorting, join Operation, Other Operations, Evaluation of Expressions.

Query Optimization: Overview, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans, Materialized Views.

UNIT-IV

Parallel Databases: Introduction,1/0 Parallelism, Interquery Parallelism, Intraquery Parallelism, Intra-operation Parallelism, Interoperation Parallelism, Query Optimization, Design of Parallel Systems.

Distributed Databases: Homogeneous and Heterogeneous Database, Distributed Data Storage, Distributed. Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud-Based Databases, Directory Systems.

UNIT- V

Advanced Application Development: Performance Tuning, Performance Benchmarks Other Issues in Application Development, Standardization.

Spatial and Temporal Data and Mobility: Motivation, Time in Databases, Spatial and Geographic Data, Multimedia Databases, Mobility and Personal Databases.

Suggested Reading:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, *Database System Concepts*, McGrawHill International Edition, 6th Edition, 2010.

2. Elmasri Navathe, Somayajulu, Gupta , *Fundamentals of Database Systems*, Pearson Education, 4th Edition, 2006.

3. CJ Date, A Kannan, S Swamynathan, *An Introduction to Database Systems*, Pearson Education, 8th Edition, 2006.

4. Raghu Ramakrishnan, and Johannes Gehrke, *Database Managemen*t *Systems*, McGraw-Hill International Edition, 3rd Edition, 2002.

CS 5121 **SOFTWARE LAB-I**

Credits: 2

Instruction: (3L) hrs per week
CIE: 50 marks

Documentation Using LATEX: Introduction to Linux Commands, Introduction to LateX, Creating & Editing Document, Formatting Document, Auto-text, Autocorrect, Spelling and Grammar tool, Page Formatting, Single/Multi column, Pictures/Objects, Drawing, Hyperlinks, Header/Footer, and Tables.

I. Implement the following using C/C++:

1. Single Source Shortest Path algorithms
2. All pairs shortest path algorithms
3. Minimal Spanning Tree algorithms
4. String and Pattern matching algorithms
5. Maximum Flow/ Minimum cut algorithms
6. Binary Search Tree- insertion and deletion
7. AVL trees

II. Object Oriented Software Engineering

1. Do the following for any two projects as a case study.
   a) Write the problem statement, Software Requirement Specification, entity relationship diagram,
   b) dataflow diagrams for level 0 and level 1,
   c) Draw use-case diagram
   d) Draw the activity diagram of all use cases.
   e) Draw sequence diagram of all use cases
   f) Draw collaboration diagram of all use cases, and Assign objects in Sequence diagram to classes and make class diagrams

Suggested Reading:

1. Leslie Lamport**,** *Latex: A Document Preparation System,* 2nd Edition, Pearson Education India, 1994.

2. Stefan Kottwitz, *LaTeX Beginner's Guide***,** Shroff/Packt Publishers, First Edition, 2012.

Note : The students have to submit a report at the end of the semester.

CS 5122 **SEMINAR - I**

Credits: 2

Instruction: (3L) hrs per week
CIE: 50 marks

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for systematic independent study of state of the art topics in broad area of his/her specialization.

Seminar topics can be choosen by the students with the advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.
Literature survey
Organization of material
Preparation of Power point Presentation slides
Technical writing

Each student is required to

1. Submit one page of synopsis of the seminar talk two days before for display on notice board.
2. Give 20 minutes presentation through MS-PowerPoint Presentation Slides followed by 10 minutes discussion.
3. Submit a report on the seminar topic with a list of references and slides used within a week.

Seminars are to be scheduled from the 3rd week of the last week of the semester and any change in schedule should be discouraged.
The CIE marks will be awarded to the students by atleast 2 faculty members on the basis of oral presentation and report as well as their involvement in the discussion.

CS 5123 **SOFTWARE LAB – II**

Credits: 2

*Instruction**:** (3L) hrs per week*
*CIE**:** 50 marks*

DISTRIBUTED COMPUTING:

1. Design a Distributed Application using RMI for remote computation

2. Design a Distributed Application using Message passing Interface for remote computation

3. Design a Distributed application which consist of a server and client using threads

4. Design a Distributed application which consist of a stateless server using socket primitives.

5.Installation & Configuration of Hadoop.

6.Using Hadoop for couting word frequency with Map Reduce.

7. Write a Map Reduce Application which processes a log file of a system. List out the users Who have logged for max period on the system. Use sample Log file from the internet and process it using a pseudo distribution mode on Hadoop platform.

Advanced Databases: An application involving above technologies and database has to be developed

Note: The students have to submit a report using LateX at the end of the semester.

CS 5124 **SEMINAR –II**

Credits: 2

Instruction: (3L) hrs per week
CIE: 50 marks

Oral presentation is an important aspects of engineering education . The objective of the seminar is to prepare the student for systematic independent study of state of the art topics in broad are his/her specialization.

Seminar topics can be chosen by the students with the advice from the faculty members.

Students are to be exposed to following aspects of seminar presentation.

Literature Survey

Organization of material

Preparation of Power point Presentation slides and Technical Writing.

Each Student is required to:

1. Submit one page of synopsis of the seminar talk two days before for display on notice board.
2. Give 20 minutes presentation through MS-Power Point presentation slides followed by 10 minutes discussion.
3. Submit a report on the seminar topic with a list of references and slides used within a week

Seminar are to be scheduled from the 3rd week to the last week of the semester and any change in schedule should be discouraged.

The CIE marks will be awarded to the students by atleast 2 faculty members on the basis of oral and a written presentation as well as their involvement in the discussion.

CS 5051 **MOBILE COMPUTING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction: Wireless Transmission, Frequencies for Radio Transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulations, Spread Spectrum, MAC, SOMA, FDMA, TDMA, CDMA, Cellular Wireless Networks.

UNIT-II

Telecommunication Systems: GSM, GPRS, Satellite Networks, Basics, Parameters and Configurations, Capacity Allocation, FAMA and DAMA, Broadcast Systems, DAB, DVB, CDMA and 3G.

UNIT-III

Wireless LAN: IEEE 802.11 Architecture, Services, MAC – Physical Layer, IEEE 802.11a – 802.11b standards, Bluetooth.

UNIT-IV

Routing Ad-hoc Network Routing Protocols: Ad-hoc Network Routing Protocols, Destination Sequenced Distance Vector Algorithm, Cluster Based Gateway Switch Routing, Global State Routing, Fish-eye state Routing, Dynamic Source Routing, Ad-hoc on-demand Routing, Location Aided Routing, Zonal Routing Algorithm.

Mobile IP - Dynamic Host Configuration Protocol.

Traditional TCP - Classical TCP Improvements – WAP, WAP 2.0.

UNIT-V

Publishing & Accessing Data in Air: Pull and Push Based Data Delivery models, Data Dissemination by Broadcast, Broadcast Disks, Directory Service in Air, Energy Efficient Indexing scheme for Push Based Data Delivery.

File System Support for Mobility: Distributed File Sharing for Mobility support, Coda and other Storage Manager for Mobility Support.

Mobile Transaction and Commerce: Models for Mobile Transaction, Kangaroo and Joey transactions, Team Transaction, Recovery Model for Mobile Transactions, Electronic Payment and Protocols for Mobile Commerce.

Suggested Reading:

1. Jochen Schiller, *Mobile Communications*, Pearson Education, 2nd Edition, 2009.
2. Kurnkum Garg, *Mobile Computing*, Pearson Education , 2010
3. Asoke K Talukder, Roopa R Yavagal, *Mobile Computing*, TMH 2008.
4. Raj Kamal, *Mobile Computing*, Oxford, 2009.
5. "*A Survey of Mobile Transactions appeared in Distributed and Parallel databases*" 16,193-230, 2004, Kluwer Academics Publishers.
6. S. Acharya, M. Franklin and S. Zdonil, "*Balancing Push and Pull for Data Broadcast, Proceedings of the ACM SIGMOD*", Tuscon, AZ, May 1997.
7. S.Acharya, R. Alonso, M.Franklin and S.Zdonik, "*Broadcast Disks: Data Management for Assymetric Communication Environments, Proceedings of the ACM SIGMOD Conference*", San Jose, CA, May 1995.

CS 5052 **REAL TIME SYSTEMS**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction: Definition, Applications and Types of Real Time Systems, Typical Case Studies of Real Time Systems, Time Constraints.

A Reference Model for Real Time Systems: Processors and Resources, Periodic Task Model, Precedence and Data Dependency, Temporal, Foundational and Resource Parameters, Scheduling Hierarchy.

UNIT-II

Real Time Scheduling: Different Approaches- Clock Driven, Priority Driven, Scheduling of Periodic and Sporadic Jobs in Priority- Driven Systems.

UNIT-III

Resource Management Resources and Resource Access Control, Critical Section, Priority-Ceiling Protocols, concurrent Access to Data Objects.

UNIT-IV

Implementation Aspects: Timing Services and Scheduling Mechanisms, Other Basic Operating System Functions, Processor Reserves and Resource Kernel, Open System Architecture, Capabilities of Commercial Real Time Operating Systems, Predictability of General Purpose Operating Systems.

UNIT-V

Case Studies: Vx – Works, and RT Linux.

Suggested Reading:

1. Jane W.S. Liu, *Real Time Systems*, Pearson Education, 2001.
2. C.M. Krishna and Kang G. Shin, *Real Time Systems*, Mc-Graw Hill Companies Inc., 1997.
3. Raymond J.A. Buhr, Donald L. Bailey, *An Introduction to Real Time Systems*, Prentice Hall International, 1999.
4. K.V.K.K. Prasad, *Embedded Real Time Systems, Concepts, Design and Programming*, Dreamtech Press, 2003.

CS 5053 **WEB ENGINEERING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Web Engineering: Concepts and Reference Model , Introduction and Perspectives, Web Engineering Resources Portal (WEP): A Reference Model and Guide.

UNIT-II

Web Application Development: Methodologies and Techniques, Web Application Development Methodologies, Relationship Analysis: A Technique to Enhance Systems Analysis for Web Development, Engineering Location-Based Services in the Web.

UNIT-III

Web Metrics and Quality: Models and Methods, **Architectural Metrics for E-Commerce:** A Balance between Rigor and Relevance, The Equal Approach to the Assessment of E-Commerce Quality: A Longitudinal Study of Internet Bookstores, Web Cost Estimation: An Introduction

UNIT-IV

Web Resource Management: Models and Techniques, Ontology Supported Web Content Management, Design Principles and Applications of XRML.

UNIT-V

Web Maintenance and Evolution: Techniques and Methodologies, Program Transformations for Web Application Restructuring, The Requirements of Methodologies for Developing Web Applications. A Customer Analysis-Based Methodology for Improving Web Business Systems.

Web Intelligence : Techniques and Applications, Analysis and Customization of Web-Based Electronic Catalogs, Data Mining using Qualitative Information on the Web.

Suggested Reading:

1. Woojong Suh, *Web Engineering Principles and Techniques*, Idea Group Publications 2005.

CS 5054 **MULTIMEDIA TECHNOLOGIES**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Media and Data Streams: Properties of multimedia systems, Data streams characteristics: Digital representation of audio, numeric instruments digital interface Bark concepts, Devices, Messages, Timing Standards Speech generation, analysis and transmission.

UNIT-II

Digital Image: Analysis, recognition, transmission, **Video**: Representation, Digitalization transmission **Animations**: Basic concepts, animation languages, animations control transmission

UNIT-III

Data Compression Standards: JPEG, H-261, MPEG DVI

Optical storage devices and Standards: WORHS, CDDA, CDROM, CDWO, CDMO.

Real Time Multimedia, Multimedia file System.

UNIT-IV

Multimedia Communication System: Collaborative computing session management, transport subsystem, QOS, resource management.

Multimedia Databases: Characteristics, data structures, operation, integration in a database model. **A Synchronization**: Issues, presentation requirements, reference to multimedia synchronization, MHEG

UNIT-V

Multimedia Application: Media preparation, Composition, integration communication, consumption, entertainment.

Suggested Reading:

1. Ralf Steninmetz, Klara Hahrstedt, *Multimedia: Computing, Communication and Applications,* PHI PTR Innovative Technology Series.
2. John F.Koegel Bufford, *Multimedia System,* Addison Wesley, 1994.
3. Mark Elsom – Cook, *Principles of Interactive Multimedia* , Tata Mc-Graw Hill, 2001.
4. Judith Jefcoate, *Multimedia in Practice: Technology and Application* , PHI 1998.

CS 5055 **DATA MINING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction: Challenges – Origins of Data Mining and Data mining Tasks

Data: Types of Data Quality – Data Preprocessing – Measures of similarity and Dissimilarity OLAP and Multidimensional Data Analysis.

UNIT-II

Classification : Preliminaries – General Approach to Solving a Classification Problem – Decision Tree Induction- Model Overfitting – Evaluating the Performance of a Classifier - Methods of Comparing Classifiers- Rule – Based Classifier.

UNIT-III

Classification : Nearest-Neighbor classifiers – Bayesian Classifiers – Artificial Neutral Networks – Support Vector Machine – Ensemble Methods – Class Imbalance Problem – Multiclass Problem.

UNIT-IV

Association Analysis : Problem Definition – Frequent Item Set Generation – Rule Generation – Compact Representation of frequent Item Sets – Alternative Methods for Generating Frequent Item Sets – FP-Growth Algorithms – Evaluation of Association patterns – Effect of Skewed Support Distribution – Handling Categorical Attributes a Handling Continuous Attributes - Handling a concept Hierarchy.

UNIT-V

Cluster Analysis: Overview – k-means –Agglomerative Hierarchical Clustering – DBSCAN Cluster evaluation on Characteristics of Data, Clusters, and Clustering Algorithms.

Suggested Reading:

1. Pang-Ning Tan, Michael Steinbach, Vipin kumar, *Introduction to Data Mining,* Pearson Education, 2008.
2. K.P. Soman, Shyam Diwakar, V.Ajay, *Insight into Data Mining Theory and Practice,* PHI.2010.
3. Arun K Pujari, *Data Mining Techniques ,* University Press, 2nd Edition, 2009.
4. Vikram Pudi P.Radha Krishna, *Data Mining,* Oxford University Press, 1st Edition, 2009.
5. S.Sumathi, S N Sivanandam, *Introduction to Data Mining and its Applications,* Springer.2006

CS 5056 **NETWORK SECURITY**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction: Attributes of Security, Integrity, Authenticity, Non-repudiation, Confidentiality Authorization, Anonymity, Types of Attacks, DoS, IP Spoofing, Replay, Man-in-the-Middle attacks General Threats to Computer Network, Worms, Viruses, -Trojans

UNIT-II

Secret Key Cryptography : DES, Triple DES, AES, Key distribution, Attacks

Public Key Cryptography: RSA, ECC, Key Exchange (Diffie-Hellman), Java Cryptography Extensions, Attacks

UNIT-III

Integrity, Authentication and Non-Repudiation : Hash Function (MD5, SHA5), Message Authentication Code (MAC), Digital Signature (RSA, DSA Signatures), Biometric Authentication.

UNIT-IV

PKI Interface: Digital Certificates, Certifying Authorities, POP Key Interface, System Security using Firewalls and VPN's.

Smart Cards: Application Security using Smart Cards, Zero Knowledge Protocols and their use in Smart Cards, Attacks on Smart Cards

UNIT-V

Applications: Kerberos, Web Security Protocols (SSL), IPSec, Electronic Payments, E-cash, Secure Electronic Transaction (SET), Micro Payments, Case Studies of Enterprise Security (.NET and J2EE)

Suggested Reading:

1. William Stallings, *Cryptography and Network Security*, 4th Edition. Pearson,. 2009.

2. Behrouz A Forouzan, *Cryptography and Network Security*, TMH, 2009

3. Joseph Migga Kizza, *A Guide to Computer Network Security*, Springer, 2010

4. Dario Cataiano, *Contemporary Cryptology*, Springer, 2010.

CS 5057 **MACHINE LEARNING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction: Learning, Types of Machine Learning.
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm. **Learning with Trees:** Constructing Decision Trees, CART, Classification Example

UNIT-II

Linear Discriminants: The Perceptron, Linear Separability, Linear Regression

Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back **Propagation SUPPORT Vector Machines**: Optimal Separation, Kernels

UNIT-III

Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-Variance Tradeoff Bayesian learning: Introduction, Bayes theorem. Bayes Optimal Classifier, Naive Bayes Classifier.

Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.

UNIT-IV

Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming **Ensemble learning:** Boosting, Bagging

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

UNIT-V

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison

Suggested Reading:

1. Tom M. Mitchell, *Machine Learning*, Mc Graw Hill, 1997
2. Stephen Marsland, *Machine Learning - An Algorithmic Perspective*, CRC Press, 2009
3. Margaret H Dunham, *Data Mining*, Pearson Edition., 2003.
4. Galit Shmueli, Nitin R Patel, Peter C Bruce, *Data Mining for Business Intelligence*, Wiley India Edition, 2007
5. Rajjan Shinghal, *Pattern Recognition*, Oxford University Press, 2006.

CS 5058 INFORMATION RETRIEVAL SYSTEMS

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

Course Objectives:

- To understand indexing and querying in information retrieval systems
- To learn the different models for information retrieval
- To expose the students to text classification and clustering
- To learn about web searching

Course Outcomes:

On completion of the course the students will be able to

- Understand the algorithms and techniques for information retrieval (document indexing and retrieval, query processing)
- Quantitatively evaluate information retrieval systems
- Classify and cluster documents
- Understand the practical aspects of information retrieval such as those in web search engines.

UNIT-I

Boolean Retrieval: An example information, Building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval.

The term vocabulary and postings lists: Document delineation and character sequence decoding, determining the vocabulary of terms, Faster postings list intersection via skip pointers, Positional postings, and Phrase queries.

Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spelling correction.

Index Construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes.

UNIT-II

Index Compression: Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression.

Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, and Variant tf-idf functions.

Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Vector space scoring and query operator interaction.

Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance.

UNIT-III

Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.

XML retrieval: Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Probabilistic information retrieval: Basic probability theory, The Probability Ranking Principle, The Binary Independence Model.

Language models for information retrieval: Language models, The query likelihood model.

UNIT-IV

Text classification and Naive Bayes: The text classification problem, Naive Bayes text classification, The Bernoulli model, Properties of Naive Bayes, and Feature selection.

Vector space classification: Document representations and measures of relatedness in vector spaces, Rocchio classification, k- nearest neighbor, Linear versus nonlinear classifiers.

Flat clustering: Clustering in information retrieval, Problem statement, Evaluation of clustering, k-means.

Hierarchical clustering: Hierarchical agglomerative clustering, Single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Divisive clustering.

UNIT-V

Matrix decompositions and Latent semantic indexing: Linear algebra review, Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

Web search basics: Background and history, Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation, Near-duplicates and shingling.

Web crawling and Indexes: Overview, Crawling, Distributing indexes, Connectivity servers.

Link analysis: The Web as a graph, Page Rank, Hubs and Authorities.

Suggested Reading:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, *An Introduction to Information Retrieval*, Cambridge University Press, Cambridge, England, 2008
2. David A. Grossman, Ophir Frieder, *Information Retrieval – Algorithms and Heuristics*, Springer, 2nd Edition (Distributed by Universities Press), 2004.
3. Gerald J Kowalski, Mark T Maybury. *Information Storage and Retrieval Systems*, Springer, 2000
4. Soumen Chakrabarti, *Mining the Web: Discovering Knowledge from Hypertext Data*, Morgan-Kaufmann Publishers, 2002.

CS 5059 **NATURAL LANGUAGE PROCESSING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction of Elementary Probability Theory, Essential Information Theory

UNIT-II

Linguistic Essentials Corpus-Based Work Collocations.

UNIT-III

Statistical Inference: Bins: Forming Equivalence Classes, Reliability vs. Discrimination, n-gram models, Building ngram models, An Information Theoretic Approach.
Word Sense Disambiguation: Methodological Preliminaries, Supervised and unsupervised learning, Pseudo words, Upper and lower bounds on performance, Supervised Disambiguation, Bayesian classification.

UNIT-IV

Evaluation Measures, Markov Models: Hidden Markov Models, Use, General form of an HMM Part-of-Speech Tagging

UNIT-V

Probabilistic Context Free Grammars: Introduction of Clustering **Information Retrieval:** Background, The Vector Space Model.

Suggested Reading:

1. Christopher D. Manning, Hinrich Schutze, *Foundations of Statistical Natural Language Processing*, MIT Press, 1999.
2. James Allan, *Natural Language Understanding*, Pearson Education, 1994.
3. Tanveer Siddiqui, US Tiwary, *Natural Language Processing and Information Retrieval*, Oxford University Press, 2008.

CS 5060 SOFTWARE QUALITY AND TESTING

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Software Quality, Quality Management, Software Quality Metrics, Product Quality Metrics, In Process Quality Maintenance, Examples.

UNIT - II

Quality tools in Software Development, Seven Basic Tools, Check List, Pareto Diagram, Histogram, Run Charts, Scatter Diagram, Control Chart, Cause and Effect Diagram, Defect Removal, Effect Removal Effectiveness, Quality Planning, Cost Effectiveness of Phase Effect Removal.

UNIT – III

Software Testing Background, Software Development Process, Realities of Software Testing, Examining the Specification, Testing the Software with Blinders on Examining the Code, Testing the Software with X-ray.

UNIT - IV

Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Website Testing, Automated Testing and Test Tools Bug Bashes and Beta Testing.

UNIT - V

Planning Your Test Effort, Writing and Tracking Test Cases, Reporting Measuring SQA.

Suggested Reading:

1. Stepen H. Khan, *Metrics and Models in Software Quality Engineering*, Pearson Education, India,1995.
2. Ron Patton, *Software Testing*, Sams Pubishing, 2001.
3. Boris Beizzer, *Software Testing Techniques*, Sams Pubishing, 2001.
4. Allan Gilles, *Software Quality Theory And Management*, Thomson International Press, 1997.

CS 5061 **CLOUD COMPUTING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

The Evolution of Cloud Computing: Hardware Evolution, Internet Software Evolution, Establishing a Common Protocol for Internet, Evolution of IPv6, Finding a common method to Communicate Using the Internet Protocol, Building a Common Interface to the Internet.

Cloud Formations: From One Computer to the Grid of Many, Server Virtualization, Parallel Processing, Symmetric Multiprocessing Systems, Massively Parallel Processing Systems.

UNIT II

Web services and the cloud: Communication-as-a-Service(CaaS), Infrastructure-as-a-Service(IaaS), Monitoring-as-a-Service(MaaS), Platform-as-a-Service(PaaS0,Software-NIS-a-Service(SaaS)

Building Cloud Networks: The Evolution from the MSP Model to cloud, Computing and Software-as-a-Service, The cloud Data Center, Collaboration i. Service-Oriented Architectures as a Step Toward Cloud Computing, Basic Approach to a Data Center-Based SOA

The Role of Open Source Software in Data Centers, Where Open Source Software Is Used Case Studies: Amazon web services, Google App Engine.

UNIT III

Virtualization: Introduction, types and technologies, Accomplishing Virtualization, importance of virtualization in Cloud Computing,

Case studies: Xen Virtual machine monitor-Xen API, VMware- VMware products- VMware Features, Microsoft Virtual Server-Features of Microsoft Virtual server

UNIT IV

Federation in the Cloud, Presence in the Cloud I Privacy and Its Relation to Cloud-Based Information System. Cloud Security Challenges I Software-as-a-Service Security I Security-as-a-Service, the New MSSP.

UNIT V

Common Standards in Cloud Computing: The Open Cloud Consortium, The Distributed Management Task Force, Standards of Application Developers I Standards for messaging, Internet Messaging Access. Protocol(IMAP) I Standards for Security.

Examples of End-User Access to Cloud Computing.

Mobile Internet Devices and the Cloud: Mobile Operating Systems for Smartphones. Mobile Platform Virtualization I Collaboration Applications for Mobile Platforms.

Suggested Reading:

1. John W. Rittinghouse, James F. Ransome, *Cloud Computing: Implementation, Management, and Security*, CRC Press 2009.
2. Ivanka Menken , *Cloud Computing Specialist Certification kit Virtualization*,
3. William von Hagen, *Professional Xen Virtualization*, Wrox Publications, First Edition, 2008.
4. Chris Wolf, Erik M. Halter, *Virtualization: From the Desktop to the Enterprise*, Apress, 2005.
5. David Marshall, Wade A. Reynolds, *Advanced Server Virtualization: VMWare and Microsoft Platform in Virtual Data Center*, Auerbach Publications, 2006.

Web Resources:

1. http://aws.amazon.com
2. http://code.google.com/appsengine

CS 5062 **SOFT COMPUTING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction to Soft Computing and Neural Networks: Evolution of Computing Soft Computing Constituents From Conventional AI to Computational Intelligence-Machine Learning Basics.

UNIT II

Genetic Algorithms: Introduction to Genetic Algorithms (GA) –Applications of GA in Machine Learning-Machine Learning Approach to Knowledge Acquisition.

UNIT III

Neural networks: Machine Learning Using Neural Network, Adaptive Networks –Feed forward Networks –Supervised Learning Neural Networks–Radial Basis Function Networks-Reinforcement Learning– Unsupervised Learning Neural Networks–Adaptive Resonance architectures – Advances in Neural networks.

UNIT IV

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems ,Fuzzy Expert Systems, Fuzzy Decision Making.

UNIT V

Neuro-Fuzzy Modeling: Adaptive Neuro, Fuzzy Inference Systems, Coactive Neuro, Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rule base Structure Identification, Neuro-Fuzzy Control, Case studies.

Suggested Reading:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, *Neuro-Fuzzy and Soft Computing*, Prentice-Hall of India, 2003.
2. George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic-Theory and Applications*, Prentice Hall, 1995.
3.James A. Freeman and David M. Skapura, *Neural Networks Algorithms, Applications, and Programming Techniques*, Pearson Edn., 2003.
4.Mitchell Melanie, *An Introduction to Genetic Algorithm*, Prentice Hall, 1998.
5.David E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Addison Wesley, 1997.

CS 5063 **NEURAL NETWORKS**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT -I

Introduction: Concept of a Neural Network. Human Brain. Models of a Neuron. Neural Networks Viewed as Directed Graphs. Feedback. Neural Network Architectures. Knowledge Representation. Artificial Intelligence and Neural Networks. History of Neural Networks.

UNIT-II

Learning processes: Introduction. Error-Correction Learning. Memory-Based Learning. Hebbian Learning, Competitive Learning. Boltzmann Learning. Credit Assignment Problem. Learning with a Teacher. Learning without a Teacher.

UNIT-III

Single Layer Perceptrons: Introduction. Least-Mean-Square Algorithm. Learning Curves. Learning Rate Annealing Schedules Perceptron. Perceptron Convergence Theorem.

UNIT-IV

Multilayer Perceptrons: Introduction. Some Preliminaries. Back-Propagation Algorithm. Summary of the. Back-Propagation Algorithm. XOR Problem. Virtues and limitations of Back-Propagation learning.

UNIT -V

Neurhdynamics' Introduction. Dynamical Systems. Stability of eqilibrium States. Attractors Neurodynamical Models. Manipulation of Attractors as a Recurrent Network Paradigm. Hopfield Models. Cohen-Grossberg Theorem.

Suggested Reading :

1. Simon Haykin, *Networks Networks - A Comprehensive Foundation*, Pearson Education
   2nd Edition, 2001.
2. Jacek M.Zurada, *Introduction to Artificial Neural Systems*, PWS Publishing Company, 1992

CS 5064 SOFTWARE PROJECT MANAGEMENT

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Conventional Software Management, Evolution of Software Economics, Improving Software Economics, Old Way & New.

UNIT-II

Life – Cycle phases, Artifacts of the process, Model Based Software Architectures, Workflows of the Process, Checkpoints of the process.

UNIT-III

Iterative Process Planning, Project Organizations & Responsibilities, Process Automation, Project Control of Process Instrumentation, Tailoring the Process.

UNIT-IV

Modern Project profiles, Next Generation Software Economics, Modern process Transitions, Managing Contacts, Managing People & Organizing Terms.

UNIT-V

Process improvement & mapping to the CMM, ISO 12207 – an overview, programme management.

Suggested Reading:

1. Walker Royce, *Software Project Management – A Unified frame work*, Pearson Education, Addision, 1998,
2. Bob Hughes and Mike Cotterell , *Software Project Management*, Tata Mc Graw Hill, 3rd Edition, 2010.
3. Watt.S. Humphery, *Managing Software Process* , Addison - Wesley, 2008.

CS 5065 **IMAGE PROCESSING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT I

Image Processing: Introduction, Examples, Fundamental steps, Components, Elements of visual perception, Light and Electromagnetic Spectrum, Image sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels.

Intensity Transformations and Spatial Filtering: Background, Some basic intensity transformation functions, Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining Spatial Enhancement Methods.

UNIT II

Filtering in the Frequency Domain: Background, Preliminary concepts, Sampling and Fourier Transform of Sampled Functions, Discrete Fourier Transform (DFT) of one variable, Extension to functions of two variables, Some Properties of the 2-D Discrete Fourier Transform, Basics of Filtering in the Frequency Domain, Image Smoothing, Image Sharpening, Homomorphic Filtering.

Image Restoration: Noise Models, Restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering.

Linear Degradation, Position-invariant Degradation, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error Filtering, Constrained Least Squares Filtering, Geometric Mean Filter.

UNIT III

Color Image Processing: Color fundamentals, Color models, Pseudocolor Image Processing, Basics of Full-color Image Processing, Color Transformations, Smoothing and Sharpening, Color-based Image Segmentation, Noise in Color Images, Color Image Compression.

Wavelets and Multi resolution Processing: Background, Multiresolution Expansions, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets.

UNIT IV

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory, Error- free Compression, Lossy Compression, Image Compression Standards, Some Basic Compression Methods.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms, Some Basic Gray-Scale Morphological Algorithms.

UNIT V

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-based Segmentation, Segmentation using Morphological Watersheds, The use of Motion in Segmentation.

Object Recognition: Patterns and Pattern Classes, Recognition based on Decision-theoretic Methods, Structural Methods.

Suggested Reading:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, PHI Learning Pvt. Limited, 3rd Edition, 2008.

2. William K. Pratt, *Digital Image Processing*, John Wiley & Sons, Inc., 3rd Edition, 2001.

CS 5066 **SOFTWARE REUSE TECHNIQUES**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Software Reuse Success Factors, Reuse Driven Software Engineering Business, Object Oriented Software Engineering, Applications and Component Subsystem, Use case Components, Object Components

UNIT-II

Design Patterns: Introduction, **Creational Patterns:** Factory, Factory Method, Abstract Factory, Singleton, Builder Prototype.

UNIT-III

Structural Patterns: Adapter, Bridge, Composite, Decorator, Fiacade, Flyweight, Proxy.

Behavioral Patterns: Chain of Responsibility, Command, Interpreter.

UNIT-IV

Behavioral Patterns: Iterator, Mediator, Momento, Observer, Stazte, Strategy, Template, Visitor, Other Design Pattern: Whole Part, Master-Slave, View Handler-reciever, Client-Dispatcher-Server, Publisher-Subscriber.

UNIT-V

Architectural Patterns: Layers, Pipes and Filters, Black Board, Broker, Model View Controller.

Presentation: Abstraction-Control, Micro Kernet, Reflection.

Suggested Reading:

1. Ivar Jacobson, Martin Griss, Patrick Kohnson, *Software Resue. Architecture, Process and Organisation for Business for Business Success*, ACM Press, 1997.
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, *Design Patterns*, Pearson Education, 1995.
3. Frank Buschmann, Kevlin Henney, Douglas C. Schmidt, *Pattern Oriented Software Architecture* , Wiley 1996.
4. James W Cooper, *Java Design Patterns, A Tutorial*, Addison Wesley Publishers 2000.

CS 5067 **RELIABILITY AND FAULT TOLERANCE**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction to Reliability Engineering: Reliability, Repairable and Non-repairable Systems, Maintainability and Availability, Designing, Reliability, Repairable and Non-repairable Systems, MTBF MTBF, MTTF MDT, k out of in systems.

UNIT-II

Software Reliability:Software Reliability, Software Reliability Vs Hardware Reliability, Failures and Faults, Classification of Failures, Counting, System configuration, Components and Operational Models, Concurrent Systems, Sequential Systems, Standby Redundant Systems.
Software Reliability Approaches: Fault Avoidance, Passive Fault Detection, Active Fault Detection, Fault Tolerance, Fault Recovery, Fault Treatment.

UNIT-III

Software Reliability Modeling: Introduction to Software Reliability Modeling, Parameter Determination and Estimation, Model Selection, Markovian Models, Finite and Infinite failure category Models, Comparison of Models, Calendar Time Modeling.

UNIT-IV

Fault Tolerant Computers: General Purpose Commercial Systems, Fault Tolerant Multiprocessor and VLSI based Communication Architecture.
Design – N – Version programming Recovery Block, Acceptance Tests, Fault Trees, Validation of Fault Tolerant Systems.

UNIT-V

Fault Types: Fault Detection and Containment, Redundancy, Data Diversity, Reversal, Reversal Checks, Obtaining Parameter Values, Reliability Models for Hardware Redundancy, Software Error Models, Checks, Fault /Tolerant Synchronization, Synchronization in Software.

Suggested Reading:

1. John D. Musa, *Software Reliability*, McGraw Hill, 1995.
2. Patrick O'Connor, *Practical Reliability Engineering*, 4th Edition, John Wesley & Sons, 2003.
3. C.M. Krishna, Kang G. Shin, *Real Time Systems*, McGraw Hill, 1997.

CS 5068 **WEB MINING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

Course Objectives:

- To have a foundation in data mining
- To understand information retrieval and web search
- To expose the students to the applications of web mining

UNIT-I

Introduction: The World Wide Web, History of the Web and the Internet, Web Data Mining

Association Rules and Sequential Patterns: Basic Concepts, Apriori Algorithm, Data Formats for Association Rule Mining, Mining with Multiple Minimum Supports, Mining Class Association Rules

Supervised Learning: Basic Concepts, Decision Tree Induction, Classifier Evaluation, Naïve Bayesian Classification, Naïve Bayesian Text Classification, K-Nearest Neighbor Learning, Ensemble of Classifiers

UNIT-II

Unsupervised Learning: Basic Concepts. K-means Clustering, Representation of Clusters, Hierarchical Clustering, Distance Functions, Data Standardization, Handling of Mixed Attributes, Which Clustering Algorithm to Use? Cluster Evaluation

Information Retrieval and Web Search: Basic Concepts, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Inverted Index and Its Compression

UNIT-III

Information Retrieval and Web Search: Web Search, Meta-Search: Combining Multiple Rankings, Web Spamming

Link Analysis: Social Network Analysis, Co-Citation and Bibliographic Coupling, PageRank , HITS, Community Discovery

UNIT-IV

Web Crawling: A Basic Crawler Algorithm, Implementation Issues, Evaluation, Crawler Ethics and Conflicts

Structured Data Extraction: Wrapper Generation**,** Preliminaries, Wrapper Induction, Instance-Based Wrapper Learning, Automatic Wrapper Generation, String Matching and Tree Matching, Building DOM Trees.

Information Integration: Introduction to Schema Matching, Pre-Processing for Schema Matching, Schema-Level Match, Domain and Instance-Level Matching, Combining Similarities, 1: Match.

UNIT-V

Opinion Mining and Sentiment Analysis: Sentiment Classification, Feature-Based Opinion Mining and Summarization, Comparative Sentence and Relation Mining, Opinion Search, Opinion Spam.

Web Usage Mining: Data Collection and Pre-Processing, Data Modeling for Web Usage Mining.

Suggested Reading:

1. Bing Liu , *Web Data Mining*, Springer India, 2010
2. Soumen Chakrabarti, *Mining the Web*, Morgan-Kaufmann Publishers, Elseiver, 2002
3. Manu Konchady, *Text Mining Application Programming*, Cengage Learning, 2006

CS 5069 **HUMAN COMPUTER INTERACTION**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT- I

Interaction Paradigms: Computing Environments, Analyzing Interaction Paradigms, Interaction Paradigms
Interaction Frameworks and Styles: Frameworks for Understanding Interaction, Coping with Complexity, Interaction Styles.

UNIT- II

Interaction Design Process: Iterative Design, User-Centered Design, Interaction Design Models, Overview of Interaction Design Models
Discovery: Discovery Phase Framework, Collection, Interpretation , Documentation
Design: Conceptual Design, Physical Design, Evaluation, Interface Design Standards, Designing the Facets of the Interface.

UNIT- III

Design Principles: Principles of Interaction Design, Comprehensibility, Learnability, Effectiveness/Usefulness, Efficiency/Usability, Grouping, Stimulus Intensity , Proportion , Screen Complexity, Resolution/Closure, Usability Goals
Interaction Design Models: Model Human Processor, Keyboard Level Model, GOMS, Modeling Structure, Modeling Dynamics, Physical Models
Usability Testing: Usability, Usability Test, Design the Test, Prepare for the Test, Perform the Test, Process the Data

UNIT- IV

Interface Components: The WIMP Interface, Other Components
Icons: Human Issues Concerning Icons, Using Icons in Interaction Design, Technical Issues Concerning Icons
Color: The Human Perceptual System, Using Color in Interaction Design, Color Concerns for Interaction Design, Technical Issues Concerning Color

UNIT- V

Text: Human Issues Concerning Text, Using Text in Interaction Design, Technical Issues Concerning Text
Speech and Hearing: The Human Perceptual System, Using Sound in Interaction Design, Technical Issues Concerning Sound
Touch and Movement: The Human Perceptual System, Using Haptics in Interaction Design, Technical Issues Concerning Haptics

Suggested Reading:

1. Steven Heim, *The Resonant Interface: HCI Foundations for Interaction Design*, Addison-Wesley, 2007
2. J. Preece, Y. Rogers, and H. Sharp, *Interaction Design: Beyond Human-Computer Interaction*, Wiley & Sons, 2nd Edition, 2007
3. Ben Shneiderman , Catherine Plaisant, *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, Addison-Wesley, 5th Edition, 2009.

CS 5151 **ADVANCED COMPUTER GRAPHICS**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Raster Graphics System and its Working: Line-Drawing Algorithms (DDA and Bresenham's algorithms), Polygon Filling, 2-D Transformations.

UNIT-II

Fundamentals of 3-D Graphics: Projections (Parallel projection and Perspective projection), 3-D Transformations, Bezier curves and B-spline curves, Visible-Surface Detection Methods (Painter's algorithm and Z-buffer method).

UNIT-III

Structures and Hierarchical Modeling: Structure Concepts, Editing Structures, Basic Modeling Concepts, Hierarchical Modeling with Structures.

UNIT -IV

Graphics Standards: GKS, PHIGS-their salient features.

OpenGL-the new graphics standard, important OpenGL functions, advantages of OpenGL, Sample graphics programs showing the use of OpenGL functions.

UNIT-V

Fractals: Fractal-Geometry Methods, Fractal-Generation Procedures, Classification of Fractals, Fractal Dimension, Geometric Construction of Deterministic Self-Similar Fractals, Geometric Construction of Statistically Self-Similar Fractals. Affine Fractal-Construction methods, Random Midpoint-Displacement Methods, Controlling Terrain Topography, Self-squaring Fractals, Self-inverse Fractals.

Suggested Reading:

1. Hearn Donald, Pauline Baker M., *Computer Graphic*s, Pearson Education, 2nd Edition, 1997.
2. Foley, Vandam, Feiner, Hughes, *Computer Graphics - Principles & Practice*, Addison- Wesley, 2nd Edition, 1996.
3. David F Rogers, *Procedural Elements for Computer Graphics*, McGraw-Hill, 2nd Edition, 2001.
4. Hill, Jr. & Kelley by F. S.,Hill Jr,Kelley Jr,Stephen M**,** *Computer Graphics Using OpenGL*, PHI, 3rd Edition, 2009.

CS 5153 **SOFTWARE ENGINEERING FOR REAL TIME SYSTEMS**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

I**ntroduction:** Review of Software Engineering Concepts, Characteristics of Real Time Systems, Importance of including Time Factor, The Real Time System Life Cycle: Requirement Specifications, State Charts.

UNIT-II

Structured Design Approaches: Event Based Model, Process-Based Structured Design, Graph-Based Theoretical Model, Petri Net Models: Stochastic Petri Net (SPN) Model Analysis, Annotated Petri Nets, Time-Augmented Petri Nets, Assessment of Petri Net Methods.

UNIT-III

Axiomatic Approaches: Weakest Precondition Analysis, Real Time Logic, Time Related History variables, State Machines and Real-Time Temporal Logic.

UNIT-IV

Language Support Restrictions: Real-Time Programming Descipline, Real-Time Programming Languages, Schedulability Analysis.

UNIT-V

Verification and Validation of Real-Time Software: Testing Real Time Properties, Simulation as Verification Tool, Testing Control and Data Flow, Proof Systems, Operational Approach.

Suggested Reading:

1. Shem – Tow Levi and Ashok K. Agarwal, *Real Time System Design*, McGraw Hill International Editions, 1999.
2. Cooling J.E. Jim Cooling, *Software Engineering for Real Time Systems*, Addison Wesly,2002

CS 5154 **PARALLEL ALGORITHMS**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction to Parallel Algorithms and Architectures: Approaches to Design of Parallel Algorithms, Architectural Constraints and Design of Parallel Algorithms, Performance Measures of Parallel Algorithms

UNIT-II

Parallel Design Strategies: Parallel Prefix. Computations, Pointer Jumping, Matrix Operations in Parallel.

UNIT-III

Parallel Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quicksort, Bucket and Sample Sort.

UNIT-IV

Parallel Graph Algorithms: Definitions and Representations, Minimum Spanning Tree: Prim's Algorithm, Single Source Shortest Path - Dijkstra's Algorithm, All pairs shortest path algorithms, Algorithms for Sparse Graphs.

UNIT-V

Search Algorithms for Discrete Optimization Problems: Definitions, Sequential search Algorithms, Search Overhead Factor, Parallel Depth first Search, Parallel Breadth first Search, Speedup factors in Parallel Search Algorithms.

Suggested Reading:

I. Kenneth A. Berman and Jerome Paul, *Parallel Algorithms* , Cengage Learning, 2002.

2. Ananth Grama and Anshul Gupta, *Introduction to Parallel Computing*, Pearson Education Second Edition, 2004.

CS 5202 PARALLEL COMPUTER ARCHITECTURE

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT I

Instruction Level Parallelism: Concepts and challenges, Instruction Pipeline Design, Hardware and software approaches, Dynamic scheduling, Speculation, Compiler techniques for exposing ILP, Branch Handling Techniques.

UNIT-II

Advanced Processor Technologies: CISC and RISC Architectures, Superscalar Processors, and VLIW Architectures.

Memory Hierarchy Design: Cache basics and Cache performance, Reducing miss rate and Miss penalty, Multilevel cache hierarchies, Main memory organizations, and Design of Memory Hierarchies.

UNIT-III

Parallel Computer Models: Classification of Parallel Computers, Multiprocessors and Multicomputer, and Multi-vector and SIMD computers.

Shared Memory Multiprocessors: Cache Coherence, Memory Consistency, Snoopy-based Cache coherence protocols (MSI, MESI, MOESI).

UNIT-IV

Snoopy-based Multi-Processor Design: Single-level Caches with an Atomic Bus, Multi-level Cache Hierarchies, and Split-Transaction Bus.

Directory-Based Cache Coherence: Scalable Cache Coherence, Overview of Directory-based approaches, Design Challenges for Directory Protocols, Memory-Based Directory Protocols, Cache-Based Directory Protocols.

UNIT -V

Interconnection Network Design: Basic Definitions, Basic Communication Performance, Organizational Structure, Interconnection Topologies, Routing, Switch Design, and Flow Control.

Latency Tolerance: Overview of Latency Tolerance, Latency Tolerance in Explicit Message Passing, Latency Tolerance in a Shared Address Space - Block Data Transfer, Proceeding Past Long-Latency Events, Pre communication in a Shared Address Space, and Multithreading.

Suggested Reading:

1. John L. Hennessy, David A. Patterson, *Computer Architecture: A Quantitative Approach*, Morgan Kaufmann Publishers Inc., 5th Edition, 2012.
2. Id. Culler, Jaswinder Pal Singh, and Anoop Gupta, *Parallel Computer Architecture: A Hardware/Software Approach*, Morgan Kaufmann, 1999.
3. Kai Hwang, *Advanced Computer Architecture*, Tata McGraw-Hill Education, 2nd Edition, 2011.

CS 5206 **GRID COMPUTING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction to Grid Computing: Grid Computing Concept, History of Distributed Computing Computational Grid Applications, Grid Computing Infrastructure Development, Grid Computing Software Interface

Job Submission: Introduction, Globus Job Submission. Transferring Files

UNIT-II

Schedulers: Scheduler Features, Scheduler Examples, Grid Computing Meta-Schedule Distributed Resource Management Application (DRMAA)

Security Concepts: Introduction, Symmetric Key Cryptography, Asymmetric Key Cryptography (Public Key Cryptography), Public Key Infrastructure. Systems/Protocols Using Security Mechanisms

Grid Security: Introduction, Grid Security Infrastructure (GSI). Delegation, Higher-Level Authorization Tools

UNIT-III

System Infrastructure I: Web Services: Service-Oriented Architecture, Web Services and Service Implementation

System Infrastructure II: Grid Computing Services: Grid Computing and Standardization Bodies Interacting Grid Computing Components, Open Grid Services Architecture (OGSA), WSRF,

User-Friendly Interfaces: Introduction Grid Computing Workflow Editors, Grid Portals

UNIT-IV

Grid-Enabling Applications: Introduction, Parameter Sweep, Using an Existing Program on Multiple Grid Computers, Writing an Application Specifically for a Grid, Using Multiple Grid Computers to Solve a Single Problem

UNIT-V

Case Studies: Overview of Globus Toolkit 4, Installation of Globus, GT4 Configuration; Main Components and programming Model ,Using Globus

gLite : Introduction ,Internal Workings of gLite ,Logging and Bookkeeping (LB) , Security Mechanism Using gLite Resource management using Gridway and Gridbus Scheduling using Condor, SGE, PBS, LSF Grid scheduling with QoS.

Suggested Reading:

1. Barry Wilkinson, *Grid Computing Techniques and Applications*, CRC Press, 2010.
2. Frederic Magoules, lie Pan, Kiatan Tan, Abhinit Kumar, *Introduction to Grid Computing*, CRC Press 2009.
3. Vladimir Silva, *Grid Computing for Developers*, Dreamtech Press, 2006.
4. Ian Foster, Carl Kesselman, *The Grid 2: Blueprint for a new computing Infrastructure*, Elsevier Series, 2004
5. Fran Berman, Geoffrey Fox, Anthony J.G Hey, *Grid Computing: Making the Global Infrastructure a Reality*, Wiley, 2003.
6. Joshey Joseph, Craig Fellenstein, *Grid Computing*, IBM Press, 2004.

CS 5301 **EMBEDDED SYSTEM DESIGN**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction to Embedded Systems: Characteristics and quality attributes of Embedded Systems Challenges in Embedded System Design, Application and Domain specific Embedded Systems.

UNIT –II

Embedded System Architecture: Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller Architecture, C1SC Examples-Motorola (68HCI1), RISC Example- ARM, DSP Processors, Harvard Architecture Microcontroller Example - PIC.

UNIT -III

Embedded Hardware Design and Development: VLSI and Integrated Circuit Design, EDA tools, usage of EDA tools and PCB layout.

Embedded firmware and Design and Development: Embedded Firmware Design Approaches and Development languages and Programming in Embedded in C.

UNIT -IV

Introduction to Real Time Operating System: Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer functions, Events, Memory Management, Interrupt Routines in an RTOS Environment, OS Security Issues and Mobile OS.

UNIT-V

Embedded Systems Development Environment: IDE, Cross Compilation, Disassembler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan. Product Enclosure Design and Development Tools, Embedded Product Development Life Cycle- Different phases and Approaches' of EDLC. Trends in Embedded Industry.

Suggested Reading:

1. Shibu K V, *Introduction to Embedded Systems*, Tata McGraw HilI,2010.
2. Raj Kamal, *Embedded Systems Architecture, Programming & Design*, Tata McGraw Hill, 2010.
3. Dr K.V.K.K. Prasad, *Embedded/Real Time Systems: Concepts, Design and Programming*, Dreamtech Press, 2004.

CS 5304 **REAL TIME OPERATING SYSTEMS**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT I

Brief Review of Unix Operating Systems (Unix Kernel – File system, Concepts of – Process, Concurrent Execution & Interrupts. Process Management – forks & execution. Programming with system calls, Process Scheduling. Shell programming and filters).

Portable Operating System Interface (POSIX) – IEEE Standard 1003.13 & POSIX real time profile. POSIX versus traditional Unix signals, overheads and timing predictability.

UNIT II

Hard versus Soft Real-time systems – examples, Jobs & Processors, Hard and Soft timing constraints, Hard Real-time systems, Soft Real-time systems. Classical Uniprocessor Scheduling Algorithms – RMS, Preemptive EDF, Allowing for Preemptive and Exclusion Condition.

UNIT III

Concept of Embedded Operating Systems, Differences between Traditional OS and RTOS. Real-time System Concepts, RTOS Kernel & Issues in Multitasking – Task Assignment, Task Priorities, Scheduling, Intertask Communication & Synchronization – Definition of Context Switching, Foreground ISRs and Background Tasks. Critical Section – Reentrant Functions, Interprocess Communication (IPC) – IPC through Semaphores, Mutex, Mailboxes, Message Queues or Pipes and Event Flags.

UNIT IV

VxWorks – POSIX Real Time Extensions, timeout features, Task Creation, Semaphores (Binary, Counting), Mutex, Mailbox, Message Queues, Memory Management – Virtual to Physical Address Mapping.

UNIT V

Debugging Tools and Cross Development Environment – Software Logic Analyzers, ICEs.

Comparison of RTOS – VxWorks, µC/OS-II and RT Linux for Embedded Applications.

Suggested Reading:

1. Jane W.S.Liu , *Real Time Systems* , Pearson Education, Asia, 2001.
2. Betcnhof, D.R., *Programming with POSIX threads*, Addison - Wesley Longman, 1997.
3. *VxWorks Programmers Guide*, Windriver, 1999.
4. Jean.J.Labrosse, *MicroC/OS-II*, Taylor & Francis, 2002.
5. C.M.Krishna and G.Shin, *Real Time Systems*, McGraw-Hill International Edition, 1997.

CS 5305 **SIMULATION AND MODELING**

Credits: 3

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*

UNIT-I

Introduction to simulation: Advantages & Dis-advantages of simulation – Areas of applications, Systems and Systems Environment, Concept of a system, Discrete & Continuous system – Models, types of models, Steps in a simulation study – Examples, Discrete – Event System simulation.

UNIT-II

Overview of Statistical Models and Queuing Systems, Programming languages for Simulation: Continuous and Discrete Simulation Languages – FORTAN, GPSS, SIMAN, SIMSCRIPT, SLAM and MODSIM.

UNIT-III

Random Numbers: Generation, Properties of Random Numbers, Generation of Pseudo Random Numbers, Tests for Random Numbers.

Random Variate: Generation, Inverse Transformation Technique, Uniform Distribution, Exponential Distribution, Weibul's Distribution, Triangular Distribution, Empirical Continuous Distribution, Discrete Distributions, Direct Transformation for the Normal Distribution, Convolution Method of Erlang Distribution, Acceptance Rejection Techniques: Poisson Distribution, Gamma Distribution.

UNIT-IV

Input Data Analysis: Data Collection: Identify the Distribution, Parameter and Estimation.

Goodness of fit tests: Chi-Square Test – KS Test; Multivariate and time series input models, Verification and Validations of Simulation Models, Model Building, Verification and Validation: Verification of Simulation Models, Calibration and Validation of Models, face validity, Validation of Model Assumptions. Validation Input/output Transformations, Input/output Validation using Historical Input Data, Input/output Validation Sing Turning Test.

UNIT-V

Output Data Analysis, Stochastic, Nature of output data, Types of Simulation with respect to output Analysis, Measures of Performance and their Estimation, output Analysis for Terminating Simulations, Output Analysis for steady – State Simulations. **Comparison and Evaluation of Alternative System Designs:** Comparison of several system Designs, Statistical Models for Estimating the Effect of Design Alternatives

Suggested Reading:

1. Jabey Banks, John S. Cansen and Barry L. Nelson, *Discrete – Event System Simulation*, Prentice Hall of India, 2001.
2. Nursing Deo, *System Simulation with Digital computer*, Prentice Hall of India, 1979.
3. Anerill M. Law and W. David Kelton, *Simulation Modelling and Analysis*, McGraw Hill. 2001.