DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Scheme of Instruction

and

Syllabi of

M.Tech(Parallel And Distributed Systems)

2017-2018

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

OSMANIA UNIVERSITY

HYDERABAD – 500 007, TELANGANA

SCHEME OF INSTRUCTION
M.TECH (PARALLEL AND DISTRIBUTED SYSTEMS)
Proposed from the Academic year 2017-18

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 5221	Software Lab - I	--	3	3	--	**--**	2
8.	CS 5222	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 5223	Software Lab - II	--	3	3	--	**--**	2
8.	CS5224	Seminar - II	--	3	3	--	--	2
		Total	**18**	**6**	**24**	**280**	**420**	**22**

SCHEME OF INSTRUCTION
M.TECH (PARALLEL AND DISTRIBUTED SYSTEMS)
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.	CS5225	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.	CS5226	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 5201	Distributed Algorithms
2	CS 5202	Parallel Computer Architecture
3	CS 5203	Web Services
4	CS 5204	Distributed Computing
5	CS 5205	Parallel Programming
6	CS 5206	Grid Computing

***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 Systems
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	Artificial 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 5104	Object Oriented Software Engineering
21	CS 5154	Parallel Algorithms
22	CS 5251	Advanced Computer Networks
23	CS5253	Parallel and Distributed Databases
24	CS 5254	Wireless Sensor Networks
25	CS 5255	Storage Management
26	CS 5256	Performance Evaluation of Computing
27	CS 5304	Real Time Operating Systems
28	CS 5305	Simulation and Modeling

CS 5201 *With effect from the Academic year 2017-2018*

Distributed Algorithms

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT-I

Modelling-I: Synchronous Network Systems, Failures, Inputs and Outputs, Executions, Proof Methods, Complexity Measures, Randomization.

Leader Election in a Synchronous Ring: The Problem, Impossibility Resuot for Identical Processes, A Basic algorithm, An algorithm with O(n log n) communication Complexity, Non-Comparison-Based Algorithms, Lower Bound for Comparison-Based algorithms, Lower-Bound for Non-Comparison-Based algorithms.

Algorithms in General Synchronous Networks: Leader Election in a General Network, Breadth-First Search, Shortest Paths, Minimum Spanning Tree, Maximal Independent Set.

Distributed Consensus with Link Failures: The Coordinated Attack Problem - Deterministic Version, The coordinated Attack Problem - Randomized Version.

UNIT-II

Distributed Consensus with Process Failures: The Problem, algorithms for Stopping Failures, Algorithms for Byzantine Failures, Number of processes for Byzantine Agreement,, Byzantine Agreement in General Graphs, Weak Byzantine Agreement, Number of Rounds with Stopping Failures.

More Consensus Problems: k-Agreement, Approximate Agreement, The Commit Problem.

UNIT-III

Modelling-II: Asynchronous System Model, I/O Automata, Operations on Automata, Fairness, Inputs and Outputs for Problems, Properties and Proof Methods, Complexity Measures, Indistinguishable Executions, Randomization.

Modelling-III : Asynchronous System, Model Shared Memory Systems, Environment Model, Indistinguishable States, Shared Variable Type, Complexity Measures, Failures, Randomization.

UNIT-IV

Mutual Exclusion: Asynchronous Shared Memory Model, The Problem, Dijkstra's Mutual Exclusion algorithm, Stronger Conditions for Mutual Exclusion Algorithms. Lockout-Free Mutual Exclusion Algorithms, An Algorithm Using Single-Writer Shared Registers, The Bakery Algorithm, Lower Bound on the Number of Registers, Mutual Exclusion Using Read-Modify-Write Shared Variables.

Resource Allocation: The Problem, Nonexistence of symmetric Dining Philosophers Algorithm, Right-Left Dinning Philosophers Algorithm, Randomized Dining Philosophers Algorithm.

UNIT-V

Consensus: The Problem, Agreement Using Read/Write Shared Memory, Agreement Using Read-Modify-Write Shared Memory, Other Types of Shared Memory, commutability in Asynchronous Shared Memory Systems.

Atomic Objects: Definitions and Basic Results, Implementing Read-Modify-Write Atomic Objects in Terms, atomic Snapshots of Shared Memory, Read/Write Atomic Objects.

Suggested Reading:

1. Nancy A Lynch, *Distributed Algorithms*, Morgan Kaufmann, 1996.

2. Nicola Santoro, *Design and Analysis of Distributed Algorithms*, John Wiley, 2007.

CS 5202 *With effect from the Academic year 2017-2018*

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 – Write-Invalidate protocols (MSI, MESI, MOESI), and Write-update protocols.

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 5203 *With effect from the Academic year 2017-2018*

Web Services

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT -I

SOA and Web Services Fundamentals: Introducing SOA, The Evolution of SOA, Web Services and Primitive SOA.

UNIT-II

SOA and WS-*Extensions: Web Services and Contemporary SOA (I: Activity Management and Composition), Web Services and Contemporary SOA (II: Advanced Messaging, Metadata and Security).

UNIT-III

SOA and Service-Orientation: Principles of Service-Orientation, and Service Layers.

UNIT-TV

Building SOA (Planning and Analysis): SOA Delivery Strategies, Service-Oriented Analysis (Part I:Introduction), Service-Oriented Analysis (Part II: Service Modeling).

UNIT-V

Building SOA (Technology and Design): Service-Oriented Design (Part I: Introduction), Service-Oriented Design (Part II:SOA Composition Guidelines), Service-Oriented Design (Part III: Service Design), Service-Oriented Design (Part IV: Business Process Design), Fundamental WS-*Extensions, and SOA Platforms.

Suggested Reading:

1. Thomas Erl, *Service-Oriented Architecture (SOA): Concepts, Technology and Design* , Prentice Hall Service Technology, 2nd Edition, 2016.

2. James McGovern, Sameer Tyagi, Stevens, and Mathew, *Java Web Services Architecture*, Morgan Kaufmann , 1st Edition, 2003.

CS 5204 *With effect from the Academic year 2017-2018*

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, and 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, and Security.

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 Readings:

1. Andrew S. Tanenbaum and Van Steen , *Distributed Systems*, Pearson Education Inc., 2002

2. Colouris G., Dollimore Jean, Kindberg Tim, *Distributed Systems Concepts and Desig*n, Pearson Education Inc., 3rd Edition, 2002.

CS 5205 *With effect from the Academic year 2017-2018*

Parallel Programming

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT -I

Principles of Parallel Algorithm Design - Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

UNIT-II

Communication Operations - One-to-All Broadcast and All-to-one Reduction, All-to-all Broadcast and Reduction, All-Reduce and Prefix-sum Operations, All-to-all Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

UNIT-III

Analytical Modeling of Parallel Programs - Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time,

Asymptotic Analysis of Parallel Programs: Sorting and Graph Algorithms, Search algorithms for discrete optimization problems.

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UNIT-IV

Introduction to Parallel Programming: Introduction to Parallel Programming, Introduction to OpenCL, OpenCL Device Architectures, Basic OpenCL Examples, Parallel programming using OpenCL/C++ AMP/CUDA.

UNIT-V

Introduction to OpenCL: Understanding OpenCL's Concurrency and Execution Model, Dissecting a CPU/GPU OpenCL Implementation.

Suggested Reading:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, *Introduction to Parallel Computing* , 2nd Edition, Pearson Publishers.
2. David Kaeli, Perhaad Mistry, Dana Schaa and Dong Ping Zhang **,** *Heterogeneous Computing with OpenCL 2.0***,** 1st Edition, Mourgan Kaufmann, 2015.
3. Benedict Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry, and Dana Schaa, *Heterogeneous Computing with OpenCL™ 1.2***,** Mourgan Kaufmann , 2011
4. Gregory V. Wilson, *Practical Parallel Programming*, PHI, 1998.

CS 5206 *With effect from the Academic year 2017-2018*

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-Schedulers 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 Web 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: Globus-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, Jie 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, and 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 Publishers, 2003.
6. Joshey Joseph, Craig Fellenstein, *Grid Computing*, IBM Press, 2004.

CS 5221 *With effect from the Academic year 2017-2018*

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. As a case study select any two projects and do the following:
   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 5222 *With effect from the Academic year 2017-2018*

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 5223 *With effect from the Academic year 2017-2018*

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 counting 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 5224 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

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 Asymmetric Communication Environments, Proceedings of the ACM SIGMOD Conference*", San Jose, CA, May 1995.

CS 5052 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

Data Mining

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT-I

Introduction: Why Data Mining? What is Data Mining? What kinds of data can be mined? What kinds of patterns can be mined? Which technologies are used ? Which kinds of applications are targeted? Major issues in Data Mining. Getting to know your data: Data objects and attributed types. Basic statistical descriptions of data. Data visualization, Measuring data similarity and dissimilarity.

UNIT-II

Mining frequent patterns, Associations and correlations, Basic concepts and methods, Basic concepts, Frequent Item set Mining Methods, Which patterns are interesting? Pattern evaluation methods.

UNIT-III

Classification : Basic concepts, Decision tree induction, Bayes classification methods,

Classification: Advance methods, Bayesian Belief Network, Classification by back propagation, Support vector machine,

UNIT-IV

Cluster Analysis: Concepts and Methods: Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of clustering.

UNIT-V

Data Mining Trends and Research Frontiers, Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining trends.

Suggested Reading:

1. Jiawei Han, Micheline Kamber, Jin Pei, Data Mining: Concepts & Techniques, Morgon Koffman ,3rd Edition,2011.
2. Vikram Pudi P.Radha Krishna, *Data Mining*, Oxford University Press, 1st Edition, 2009.
3. Pang-Ning Tan, Michael Steinbach, Vipin kumar, *Introduction to Data Mining*, Pearson Education, 2008.

CS 5056 *With effect from the Academic year 2017-2018*

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

CS 5057 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

Information Retrieval Systems

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

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 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

Software Quality and Testing

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT - I

The Software Quality Challenge, Introduction Software Quality Factors, The Components of the Software Quality Assurance System – Overview, Development and Quality Plans.

UNIT - II

Integrating Quality Activities in the Project Life Cycle, Assuring the Quality of Software Maintenance Components, CASE Tools and their effect on Software Quality, Procedure and Work Instructions, Supporting Quality Devices, Configuration Management, Documentation Control, Project Progress Control.

UNIT - III

Software Quality Metrics, Costs of Software Quality, Quality Management Standards - ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, Malcom Balridge, 3 Sigma, 6 Sigma, SQA Project Process Standards – IEEE Software Engineering Standards.

UNIT - IV

Building a Software Testing Strategy, Establishing a Software Testing Methodology, Determining Your Software Testing Techniques, Eleven – Step Software Testing Process Overview, Assess Project Management Development Estimate and Status, Develop Test Plan, Requirements Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results, Acceptance Test, Report Test Results, Test Software Changes, Evaluate Test Effectiveness.

UNIT - V

Testing Client / Server Systems, Testing the Adequacy of System Documentation, Testing Web-based Systems, Testing Off – the – Shelf Software, Testing in a Multiplatform Environment, Testing Security, Testing a Data Warehouse, Creating Test Documentation, Software Testing Tools, Taxonomy of Testing Tools, Methodology to Evaluate Automated Testing Tools, Load Runner, Win Runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.

Suggested Reading:

1. Daniel Galin, *Software Quality Assurance – From Theory to Implementation*, Pearson Education.2004
2. Mordechai Ben – Menachem / Garry S.Marliss, *Software Quality – Producing Practical, Consistent Software*, BS Publications, 2014
3. William E. Perry, *Effective Methods for Software Testing*, 3 rd Edition, 2006, Wiley .
4. Srinivasan Desikan, Gopalaswamy Ramesh, *Software Testing, Principles and Practices*, 2006. Pearson Education.
5. Dr.K.V.K.K. Prasad, *Software Testing Tool*, Wiley Publishers

Web Resources :

1. http://www.sei.cmu.edu/cmmi/
2. www.ibm.com/**software**/awdtools/**test**er/functional/index.html
3. www.ibm.com/**software**/awdtools/**test**/manager/
4. java-source.net/open-source/testing-tools
5. www.junit.org
6. java-source.net/open-source/web-testing-tools

CS 5061 *With effect from the Academic year 2017-2018*

Cloud Computing

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

Unit- I

Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning

Unit -II

Scaling in the Cloud, Capacity Planning , Load Balancing, File System and Storage,

Unit-III

Multi-tenant Software, Data in Cloud , Database Technology, Content Delivery Network, Security Reference Model , Security Issues, Privacy and Compliance Issues

Unit-IV

Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

Unit- V

Enterprise architecture and SOA, Enterprise Software , Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested reading:

1. Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.

2. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016.

3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, "*Distributed and Cloud Computing From Parallel Processing to the Internet of Things*", Elsevier, 2012.

CS 5062 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

Artificial Neural Networks

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

Unit-I

Background to ANN: Introduction to artificial neural networks (ANN), intelligence, learning and knowledge. Historical development of Artificial Intelligence (AI) leading to ANN. PDP models -- Interactive and competetion (IAC) and Constraint Satifaction (CS) models.

Unit-II

Baiscs of ANN: Basics of ANN, terminology, models of neurons, topology, basic learning laws, activation and synaptic dynamics models

Unit-III

Analysis of Feedforward Neural Networks (FFNN): Overview, linear associative networks, perceptron network, multilayer perceptron, gradient descent methods, backpropagation learning

Unit-IV

Analysis of Feedback Neural Networks (FBNN): Overview, Hopfield model, capacity, energy analysis, state transition diagrams, stochastic networks, Boltzmann-Gibbs Law, simulated annealing, Boltzmann machine

Unit-V

Applications of ANN: Travelling salesman problem, image smoothing, speech recognition and texture classification.

Suggested Reading:

1.B Yegnanarayana, Artificial Neural Networks, Prentice-Hall of India, New Delhi, 1999

2. Simon Haykin, Neural networks and learning machines, Pearson Education, 2011

3. Jacek M Zurada, Introduction to artificial neural systems, PWS publishing Company, 1992

4. David E Rumelhart, James McClelland, and the PDP research group, Eds, Parallel and Distributed Processing: Explorations in Microstructure of Cognition, Vol 1, Cambridge MA: MIT Press, 1986a

5. James McClelland, David E Rumelhart, and the PDP research group, Eds, Parallel and Distributed Processing: Explorations in Microstructure of Cognition, Vol 2, Cambridge MA: MIT Press, 1986b

6. David Rumelhart, James McClelland, and the PDP research group, Eds, Parallel and Distributed Processing: A handbook of models, Cambridge MA: MIT Press, 1989

CS 5064 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

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*, 3rd Edition, PHI Learning Pvt. Limited, 2008.
2. William K. Pratt, *Digital Image Processing*, 3rd Edition, John Wiley & Sons, Inc., 2001.

CS 5066 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

Web Mining

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

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, Universal Crawlers, Focused Crawlers, Topical Crawlers, 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, Multiple Alignment, Building DOM Trees, Extraction based on a single list page, extraction based on a single list page : Nested doda records, Extraction based on multiple pages, Some other issues.

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

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, Discovery & analysis of web usage patterns.

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 *With effect from the Academic year 2017-2018*

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 5104 *With effect from the Academic year 2017-2018*

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, User Requirements, Requirements Capture and Modelling, Requirement Analysis, Use Case Realization, The Class Diagram, Assembling the Analysis Class Diagram, Refining the Requirement Models, Component-based Development, Software Development Patterns, Object Interaction, Object Interaction and Collaboration, Interaction Sequence Diagrams, Collaboration Diagrams, Model Consistency

UNIT-III

Specifying Operations, The Role of Operation Specifications, Contracts, Describing Operation Logic, Object Constraint Language, Creating an Operation Specification, Specifying Control, States and Events, Basic Notation, Further Notation, Preparing a Statechart, Consistency Checking, Quality Guidelines, Moving Into Design, Logical and Physical Design, System Design and Detailed Design, Qualities and Objectives of Analysis and Design, Measurable Objectives in Design, Planning for Design, System Design, The Major Elements of System Design, Software Architecture, Concurrency, Processor Allocation, Data Management Issues, Development Standards, Prioritizing Design Trade-offs, Design for Implementation

UNIT-IV

Object design, Class Specification, Interfaces, Criteria for Good Design, Designing Associations, Integrity Constraints, Designing Operations, Normalization, Design Patterns, Software Development Patterns, Documenting Patterns-Pattern Templates, Design Patterns, How to use Design Patterns, Benefits and Dangers of Using Patterns, Human Computer Interaction, The User Interface, Approaches to User Interface Design, Standards and Legal Requirements, Designing Boundary Classes, The Architecture of the Presentation Layer,

Prototyping the User Interface, Designing Classes, Designing Interaction with Sequence Diagrams, The Class Diagram Revisited, User Interface Design Patterns, Modelling the Interface Using Statecharts.

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UNIT-V

Data Management Design, Persistence, File Systems, Database Management Systems, Designing for Relational Database Management Systems, Designing for Object Database Management Systems, Distributed Databases, Designing Data Management Classes, Implementation, Software Implementation, Component Diagrams, Deployment Diagrams, Software Testing, Data Conversion, User Documentation and Training, Implementation Strategies, Review and Maintenance, Reusable Components, Planning a Strategy for Reuse, Commercially Available Componentware, Managing Object Oriented Projects, Resource Allocation and Planning, Managing Iteration, Dynamic Systems Development Method, Extreme Programming, Software Metrics, Process Patterns, Legacy Systems, System Development Methodologies, 'Method' and 'Methodology', A Brief Historical Review, The Unified Software Development Process, Participative Design Approaches, Issues in Choosing a Methodology, Hard versus Soft 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 5154 *With effect from the Academic year 2017-2018*

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 and Analysis of Parallel Algorithms, Performance Measures of Parallel Algorithms

UNIT-II

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

Dense Matrix algorithms: Matrix vector Multiplication and Matrix- matrix multiplication

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 5251 *With effect from the Academic year 2017-2018*

Advanced Computer Networks

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT I

History of Computer Networks and the Internet: Protocol Layers and Their Service Models Review of OSI and TCP/IP Delay, Loss, and Throughput in Packet-Switched Networks

UNIT II

Wireless and Mobile Networks: Introduction, Wireless Links and Network Characteristics, WiFi:802.11 Wireless LANs, Cellular Internet Access, Mobility Management: Principles Managing Mobility in Cellular Networks, Wireless and Mobility: Impact on Higher-layer Protocols, Bluetooth, Securing Wireless LANs

UNIT III

The Network Layer: Virtual Circuit and Datagram Networks, **The Internet Protocol** (IP): Forwarding and Addressing in the Internet Routing in the Internet Broadcast and Multicast Routing, Congestion Control QOS Label Switching and MPLS, Mobile IP, Voice over IP, IPv6 , **Network-LayerSecurity**:IPsec

UNIT IV

Transport Layer: Introduction and Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control, Securing TCP Connections: SSL, Application Layer: Principles of Network Application, The Web and HTTP, HTTPS, File Transfer: FTP, Electronic Mail in the Internet, Securing E-mail
DNS—The Internet's Directory Service, Peer-to-Peer Applications

UNIT V

Network Management: The Infrastructure for Network Management, The Internet-Standard Management Framework, ASN.1, Multimedia Networking, Multimedia Networking Applications , Streaming Stored Audio and Video , Making the Best of the Best-Effort Service, Protocols for Real-Time Interactive Applications, Providing Multiple Classes of Service, Providing (QOS) Quality of Service Guarantees.

Suggested Reading:

1. E James, Keith W. Ross and F. Kurose, *Computer Networking: A Top-Down Approach*, Addison-Wesley, 4th Edition, 2008.
2. Andrew S Tanenbaum, *Computer Networks*, Prentice Hall PTR, 4th Edition, 2003

CS 5253 *With effect from the Academic year 2017-2018*

Parallel and Distributed Databases

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT- I

Introduction: Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Object-Based and Semistructured Databases, Data Storage and Querying, Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators, History of Database Systems.

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational-Algebra Operations, Extended Relational-Algebra Operations, Null Values, Modification of the Database.

UNIT-II

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-III

Parallel Systems: Speedup and Scaleup, Interconnection Networks, Parallel Database Architectures.

Parallel Databases: Introduction, I/O Parallelism, Interquery Parallelism, Intraquery Parallelism, Interoperation Parallelism, Intraoperation Parallelism, Design of Parallel Systems.

UNIT-IV

Distributed Databases: Reference architecture for DDB, Types of Data Fragmentation, Distribution Transparency for Read-only applications, Distribution Transparency for Update applications, Distributed Database Access Primitives, Integrity Constraints in DDB.

Distributed Database Design: A frame work for Distributed Database Design, The design of Database fragmentation, The allocation of fragmentation.

UNIT-V

Translation of Global Queries to Fragment Queries: Equivalence transformations for queries, Transforming global queries into fragment queries, Distributed grouping and aggregate function evaluation, Parametric queries.

Optimization of Access Strategies: Access Control Models, Database Security, A framework for query optimization, Join queries, General queries.

Suggested Reading:

1. Silberschatz A, Korth HF, Sudarshan S, *Database System Concepts*, McGraw-Hill International Edition, 5th Edition, 2006.
2. Ceri S, Pelagatti G, *Distributed Databases: Principles and Systems*, McGraw-Hill International Edition, 1984.

CS 5254 *With effect from the Academic year 2017-2018*

Wireless Sensor Networks

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UN1T-I

Mobile Ad-Hoc Networking with a View of 4G Wireless: Imperatives and Challenges, Off-the-Shelf Enables of Ad-Hoc Networks, IEEE 802.11 in Ad Hoc Networks : Protocols, Performance and Open Issues; Sctternet Formation in Bluetooth Networks, Antenna Beamforming and Power Control for Ad Hoc Networks.

UNIT-II

Topology Control in Wireless Ad Hoc Networks Broadcasting and Activity Scheduling in Ad Hoc Networks, Location Discovery, Mobile Ad Hoc Networks (MANETSs): Routing Technology for Dynamic, Wireless Networking, Routing Approaches in Mobile Ad Hoc Networks.

UNIT-III

Energy-Efficient Communication in Ad Hoc Wireless Networks, Ad Hoc Networks Security, Self-Organized and Cooperative Ad Hoc Networking, Simulation and Modeling of Wireless, Mobile, and Ad Hoc Networks, Modeling Cross-Layering Interaction Using Inverse Optimization, Algorithmic Challenges in Ad Hoc Networks.

UNIT-IV

Introduction and Overview of Wireless Sensor Networks: Application of Wireless Sensor Networks, Examples of Category 1 WSN Applications, Another Taxonomy of WSN Technology.
Basic Wireless Sensor Technology: Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends.

UNIT-V

Wireless Transmission Technology and Systems: Radio Technology Primer, Available Wireless Technologies. Medium Access Control Protocols for Wireless Sensor Networks: Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC Case Study, IEEE 802.15.4 LR-WPANS Standard Case Study.

Suggested Reading:

1. Stefano Basagni, Silvia Giordano, Ivan Stojmenvic, *Mobile Ad Hoc Networking,* A John Wiley & Sons, Inc, Publication 2004.

2. Kazem Sohraby, Daniel Minoli, Taieb Znati, *Wireless Sensor Networks*, A John Wiley & Sons, Inc, Publication 2007.

CS 5255 *With effect from the Academic year 2017-2018*

Storage Management

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT -I

Introduction to Information Storage and Management, Storage System Environment, Intelligent Storage System.

UNIT-II

Direct-Attached Storage and Introduction to SCSI, Storage Area Networks, Network-Attached Storage.

UNIT-III

IP SAN, Content-Addressed Storage, Storage Virtualization.

UNIT-IV

Introduction to Business Continuity, Backup and Recovery, Local Replication.

UNIT -V

Remote Replication,Securing the Storage Infrastructure, Managing the Storage Infrastructure.

Suggested Reading:

1. G. Somasundaram, Alok Shrivastava, *Information Storage and Management*, Wiley Publishing Inc., 2009.
2. Raplh H. Thornburgh, Burry J Schoenborn, *Storage Area Networks*, Prentice-Hall, 2000.

CS 5256 *With effect from the Academic year 2017-2018*

Performance Evaluation of Computing

Credits:3

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

CIE : 30 Marks *SEE : 70 Marks*

UNIT -I

Fundamental Concepts and Performance Measures

Tiem, Events, Measurements, .Intervals, Response, Independence, Randomness, Workload Problems Encountered in Model Development and Use. A Case Study.

General Measurement Principles, Scheduling Algorithms, Workloads.

UNIT –II

Probability: Random Variables, Jointly Distributed Random Variables, Probability Distributions, Densities Expectation, Some Example Probability Distributions.

Stochastic Processes: Basic Definitions, Poisson Process, Birth-Death Process, Markov Process.

UNIT -III

Queuing Theory:Networks of Queues, Estimating Parameters and Distributions

Computational Methods for Queuing Network Solutions, Simulation Analysis

Simulation Process, Time Control, Systems and Modeling, Simulation Languages, Applications of Simulation.

UNIT -IV

Petri Nets: Basic Notation, Classical Petri Nets, Times Petri Nets, Priority-Based Petri Nets, Colored Pt Nets, Generalized Petri Nets.

Hardware Testbeds, Instrumentation, Measurement, Data Extraction, and Analysis

Derivation of Performance Evaluation parameters, Network performance tests, General Methods of Data Extraction, Tested and Model Workloads, Experimental Design, Data presentation.

System Performance Evaluation Tool Selection and Use: Validation of Results, Conducting Experiments, Performance Metrics, Evaluation

UNIT -V

Analysis of Computer Architectures: Case I : Central Server Computer System

Case II : Multiple Server Computer System

Case III : Petri Net Example

Analysis of Operating System Components

System Architectures, Workloads, Experimental Design and Simulation, Experimental Analysis and Conclusion.

Database Systems Performance Analysis

The Testbed Systems, The Database Systems Tested Performance Analysis Testing, The Results.

Analysis of Computer Networks Components

Analytical Modeling Examples, Simulation Modeling of Local Area Networks.

Suggested Reading:

1. Paul. J. Fortier and Howard E. Michel, *Computer Systems Performance Evaluation and Prediction*, 1st Edition, Digital Press, 2002.

2. Raj Jain, *The art of Computer Systems performance analysis, techniques for experimental design, measurement and modeling*, John Wiley & Sons, 1991.

3. Neil J. Gunther, *Analyzing Computer System Performance with Peri::PDQ*, 2nd Edition, Springer, 2011.

CS 5304 *With effect from the Academic year 2017-2018*

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 *With effect from the Academic year 2017-2018*

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 – GPSS, SIMAN, SIMSCRIPT, MATLAB and SIMULINK

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.
4. Agam kumar tyagi, MATLAB and Simulink for Engineers, Oxford Publishers, 2011