BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE

Faculty of Engineering And Technology
M.Tech. - Computer Engineering
New Syllabus

Annexure B
Proposed Structure of M.Tech Computer Engineering
CBCS Pattern (2019 Course)
STRUCTURE & EXAMINATION PATTERN

Semester I									**Total Duration: 20 hrs/week** **Total Marks :500** **Total Credits: 18**		
Subjects	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme (Marks)**						**Examination Scheme (Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR/OR**	
Advanced Database Management System	04	02	60	20	10	10	25	25	04	01	05
Advanced Software Engineering	04	02	60	20	10	10	25	25	04	01	05
Mobile Operating System	04	--	60	20	10	10	-	-	04	-	04
Distributed Computing	04	--	60	20	10	10	--	--	04	-	04
Total	**16**	**04**	**240**	**80**	**40**	**40**	**50**	**50**	**16**	**02**	**18**

Semester II									**Total Duration: 20 hrs/week** **Total Marks :500** **Total Credits: 18**		
Subjects	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme (Marks)**						**Examination Scheme (Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR/OR**	
High Performance Computing	04	02	60	20	10	10	25	25	04	01	05
Advanced Computer Algorithms	04	02	60	20	10	10	25	25	04	01	05
Web Technologies	04	--	60	20	10	10	--	--	04	--	04
Wireless Communication and Security	04	--	60	20	10	10	--	--	04	--	04
Total	**16**	**04**	**240**	**80**	**40**	**40**	**50**	**50**	**16**	**02**	**18**

Semester III									**Total Duration: 28 hrs/week** **Total Marks : 500** **Total Credits: 40**		
Subject	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme**						**Examination Scheme (Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR /OR**	
Elective I	04	02	60	20	10	10	25	25	04	01	05
Elective II	04	02	60	20	10	10	25	25	04	01	05
Self Study Paper I	04	--	60	20	10	10	-	-	04	-	04
Seminar	-	05	-	-	--	--	25	25		05	05
Dissertation Stage I	-	07	-	-	**--**	**--**	25	-	-	21	21
Total	**12**	**16**	**180**	**60**	**30**	**30**	**100**	**75**	**12**	**28**	**40**

Elective – I	**Elective - II**
a) E-Commerce and ERP	a) Cryptography and Network Security
b) Information Storage Management	b)Parallel computing
c) Cyber Security	c)Wireless Sensor Network
d) Big Data & Analytics	d)Storage Area Network

Semester IV									**Total Duration: 14 hrs/week** **Total Marks : 325** **Total Credits: 34**		
Subject	**Teaching Scheme (Hrs) Hrs./Week**		**Examination Scheme**						**Examination Scheme (Credits)**		**Total Credits**
	L	**P**	**Theory**	**Unit Test**	**Attendance**	**Tutorial/assignments**	**TW**	**Pract/ Oral**	**TH**	**TW/PR/OR**	
Self-Study Paper-II	04	--	60	20	10	10	-	-	**04**	**-**	**04**
Dissertation Stage –II	-	10	-	-	--	-	150	75		30	30
Total	**04**	**10**	**60**	**20**	**10**	**10**	**150**	**75**	**04**	**30**	**34**

List of Self Study paper I & II

Self Study Paper I	**Self Study Paper II**
Enterprise Resource Planning	Grid Computing
Bioinformatics	Research Methods in Computer Science
Information Retrieval and Web Search	Middle ware Technologies
Speech Processing	Agile Systems
Sensor Network and Embedded Systems	Soft Computing
Computer Graphics and Visualization	E-Commerce and Payment Systems
Cloud Computing	Knowledge Representation and Reasoning
Pervasive computing	Computational Intelligence
Data Warehousing and Data Mining	High Performance Information systems
Software Security	Advanced Web Technologies

Advanced Database Management System

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	TW&OR : 50 Marks	01 Credits

UNIT - I	**Parallel and Distributed Databases :**	**(08 Hours)**
	Architectures for parallel database, Parallel query Evaluation, Parallelizing individual operation, Parallel Query Optimization, Distributed DBMS Architecture, Storing data in distributed DBMS, Distributed Catalog Management, Distributed query processing, Updating distributed data, Distributed concurrence control, Distributed recovery.	
UNIT - II	**Web databases :**	**(08 Hours)**
	Web search engines, web search architecture, Inverted indexes the IR way, Inverted indexes for web search engines, web crawling, web search statistics.	
UNIT - III	**Data Warehousing and Data Mining:**	**(08Hours)**
	Data Warehousing: Introduction Data Warehousing OLAP, Implementation Techniques for OLAP, Views and decision support. **Data Mining:** Introduction, Counting Co-occurrences, Mining for rules, Tree structured rules, Clustering, Similarity search over sequences, Additional data mining tasks.	
UNIT - IV	**Object Database Systems and XML:**	**(08 Hours)**
	Object Database Systems: User defined abstract data types, Structured types, Objects, Objects Identity and Reference types, Inheritance, database design for an ORDBMS, Comparing RDBMS with OODBMS and ORDBMS. **XML:** Introduction, Structure of XML Data, XML Document Schema, Querying and Transformation, API to XML, Storage of XML Data, XML Applications.	
UNIT - V	**Spatial Data Management:**	**(08 Hours)**
	Types of Spatial Data and Queries Application involving Spatial data, Introduction to spatial Indexes, Indexing based on space filling Curves, Grid files, R trees, High command Indexing.	
UNIT - VI	**Deductive Databases AND Advanced Transaction Processing:**	**(08 Hours)**
	Deductive Databases: Recursive Queries, Theoretical foundation, Recursive Queries with Negation, Efficient evaluation of Recursive Queries, Additional Transaction Processing, Advance transaction processing Integrated access to Multiply data sources, Mobile database, multiplying database, Geographic Information systems, Temporal and Sequence database, Information Visualization. **Advanced Transaction Processing:** Transact ion-Processing Monitors, Transactional Workflows, Main- Memory Databases, Real-Time Transaction Systems, Long-Duration Transactions and Transaction Management in Multi-databases.	

Reference Books:

1. Rob & Colonel, “Database System Design Implementation & Management”, Thomson Learning
2. Date, “An Introduction to database system”, Addison Wesley Pub
3. Desai “Principles of Repagination database”, Galgotia Publications
4. Mallach, “Decision Support and Data Warehouse Systems”, TMH
5. Raghu Ram Krishnan, “Database Management Systems”, IInd edition
6. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, 5th Edition , McGraw Hill International Edition.
7. Jiawei Han, Micheline Kamber, “Data Mining: Concepts and Systems”,Morgan Kaufmann publishers

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Advanced Software Engineering

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	TW&OR : 50 Marks	01 Credits

UNIT - I	**Software Development Process:**	**(08 Hours)**
	Software Processes, SDLC Models, Waterfall Model, The V Model, Prototyping Model, Iterative Model, Spiral Model. Agile Development, Agile Principles, XP, Scrum, AUP, Kanban, ASD, DSDM, FDD, Agile practices, Empirical Model in Software engineering	
UNIT - II	**Requirement Engineering and Black Box Testing:**	**(08 Hours)**
	Requirement Engineering: Requirements phase and its importance, Requirement Elicitation and Analysis, Process models (DFD), Data models (ERD), Software, Requirement Specification Standard and Preparation, Characteristics of good SRS Documents, traceability matrix and its importance, CASE tool, and its basic features. Black box testing: Test case design and implementation, Automated testing and limitations, debugging methods, Black box testing methods.	
UNIT - III	**Process Improvement and Verification:**	[08 Hrs]
	Process and product quality, Process classification, Process Measurement, Process Analysis and Modelling, Process change, The CMMI process improvement framework, Configuration Management Planning, Change management, Version and release management, System building, CASE tools for configuration management.	
UNIT - IV	**User interface Design, Maintenance and reengineering:**	**(08 Hours)**
	User interface design issues: The UI design process, User analysis, User interface prototyping, Interface Evaluation. Software Maintenance: Reengineering, Business process reengineering, software reengineering, reverse engineering, restructuring, Forward engineering, The economics of reengineering.	
UNIT - V	**Software Reuse, CBSE:**	**(08 Hours)**
	The reuse landscape, Design patterns, Frameworks, Generator based reuse, Application frameworks, Application system reuse, components and component models, The CBSE process, component composition, service oriented software engineering - services as reusable components, service engineering, software development with services.	
UNIT - VI	**Quality Management and SAQ:**	**(08 Hours)**
	Quality Management - Quality Concepts, Software Quality, The review technique, cost impact of software defects, defect amplification and removal, Review metrics and their use, Reviews: A formal spectrum, Informal spectrum, Formal technical reviews, SQA: Background issues, Elements of SQA: SQA tasks, goals and metrics, Formal approaches to SQA: statistical SQA, Software reliability. The ISO 9126 quality factors, Mc Call's quality factors, The SQA plan	

References

1. Ian Sommerville, "Software Engineering: Update", 8th Edition

2. Roger S. Pressman and Roger, “Software Engineering: A Practitioner's Approach”	
3. Shari Lawrence Pfleeger and Joanne M Atlee, “Software Engineering”, 3rd Edition	
Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

Mobile Operating System

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
	Continuous Assessment: 40 Marks	

UNIT - I	**Introduction to Mobile Operating Systems:**	**(08 Hours)**
	Brief History of Mobile Operating Systems, OS-Interfaces, Multilevel Views of OS, Categories, Small and Specialized OS, 64-Bit OS, Processes and Threads, System Performance and Models: Performance of Computer Systems, Performance Metrics, Workload and System Parameters, Simulation Models: Types, Discrete-Event Model, Stochastic Model.	
UNIT - II	**Multiprogramming:**	**(08 Hours)**
	System with Multiprogramming, Processor Scheduling, Synchronization, Deadlocks, File Management, Memory Management: Process Address Space, Contiguous Memory Allocation, Non Contiguous Memory Allocation, Virtual Memory, Paging with Virtual Memory.	
UNIT - III	**Security and Protection:**	**(08 Hours)**
	Components for Security and Protection, Physical Security, User Authentication, Protection, Secure Communications, Digital Certificates, System Vulnerabilities, Invasive and Malicious Software, Defending the System and User, Intrusion Detection Management.	
UNIT - IV	**Mobile Ecosystems:**	**(08 Hours)**
	Application Framework, Developing a Mobile Strategy, Mobile Information Architecture, Mobile Design: Elements of Mobile Design, Ubiquity in the Mobile Web, Mobile Web Development	
UNIT - V	**Introduction to Linux:**	**(08 Hours)**
	Command Line Interface, Files and Directories, Shell Variables, Script Files, Connecting a Remote Linux Server. Java Modeling Framework, Java and Posix Threads.	
UNIT - VI	**Case Study:**	**(08 Hours)**
	Android SDK, iOS, Windows, Mobile Web Apps vs. Mobile Applications	

Reference Books:

[1] Jose M Garrido, Richard Schlesinger, Kenneth Hoganson, Principles of Modern Operating Systems.

[2] By Brian Fling, Mobile Design and Development: Practical concepts and techniques for Creating Mobile Sites and Web Apps, O'Reilly Publications

[3] Brian Fling, Mobile Design and Development, O'Reilly Publications.

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

Distributed Computing

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04Hours / Week	End Semester Examination: 60 Marks	04 Credits
	Continuous Assessment: 40 Marks	

UNIT – I	**Distributed System Concepts:**	**(08 Hours)**
	Distributed Computing Models, Software Concepts, Issues in Designing Distributed Systems Client-Server Model. Case Studies. Network Communication: LAN and WAN Technologies, Protocols for Network Systems, Asynchronous Transfer Mode, Protocols for Distributed Systems.	
UNIT – II	**Interprocess Communication:**	**(08 Hours)**
	Message Passing, Advantages and Features of Message Passing Systems, IPC Message Format, IPC Synchronization, Message Buffering Strategies, Multidatagram Messaging, Process Addressing Techniques, Failure Handling Mechanism. Case Study: IPC in Mach	
UNIT – III	**Remote Communication:**	**(08 Hours)**
	Introduction, Remote Procedural Call, RPC Implementation, RPC Implementation, Parameter Passing Semantics, Server Management, RPC Call Semantics, Communication Protocols, Client Server Binding, Exception Handling and Security, RPC in Heterogeneous Environment, Failure Handling, RPC Optimization, Case Study: Sun RPC, Java RMI.	
UNIT – IV	**Synchronization:**	**(08 Hours)**
	Clock Synchronization, Physical Clocks, Clock Synchronization Algorithms, Logical Clocks, Global State, Mutual Exclusion, Election Algorithms, Deadlocks: Prevention, Detection Recovery, Deadlocks in Message Communication.	
UNIT – V	**Distributed System Management:**	
	Resource Management, Task Assignment Approach, Load Balancing Approach, Load Sharing Approach, Process Management in Distributed Environment, Process Migration, Threads, Fault Tolerance, Component Faults, System Failures and Use of Redundancy	**(08 Hours)**
UNIT – VI	**Distributed Shared Memory:**	
	Architecture, Types of DSM, Hardware DSM, and Design Issues in DSM Systems. Distributed File Systems, Naming, Security in Distributed Systems, Real Time Distributed Operating System, Distributed Database Management System, Emerging Trends in Distributed Computing.	**(08 Hours)**

Reference Books:

1. H. Attiya, J. Welch Distributed Computing - Fundamentals, Simulation and Advanced Topics, Wiley Publications.
2. Vijay Garg, Elements of Distributed Computing, Wiley Publications.
3. S. Mahajan, S. Shan, Distributed Computing, Oxford Publications.

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II
Unit Test -2	UNIT – III, UNIT – IV
Unit Test-3	UNIT –V, UNIT-VI

High Performance Computing

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	PR & OR : 50 Marks	01 Credits

UNIT - I	**Computer organization:**	**(08 Hours)**
	Memory, Registers, Instruction set architecture, Instruction processing, Pipelined processors: Pipelining, Structural, data and control hazards, Impact on programming. Cache memory: Organization, impact on programming, virtual caches, Operating systems: Processes and system calls, Process management, Program profiling.	
UNIT - II	**Modern Computer Architectures :**	**(08 Hours)**
	Memory, Floating-Point Numbers, Programming and Tuning Software - What a Compiler Does, Timing and Profiling, Eliminating Clutter, Loop Optimizations, Program execution, Program, Compilation, Object files, Function call and return, Address space, Data and its representation. Parallel Processing Concepts - Levels of parallelism instruction, transaction, task, thread, memory, and function, Models SIMD, MIMD, SIMT, SPMD, Dataflow Models, and Demand-driven Computation etc. Case Study: Cluster Computing network.	
UNIT - III	**Parallel Algorithms:**	**(08 Hours)**
	Parallel models: ideal and real frameworks, Basic Techniques: Balanced Trees, Pointer Jumping, Divide and Conquer, Partitioning, Regular Algorithms: Matrix operations and Linear Algebra, Irregular Algorithms: Lists, Trees, Graphs, Randomization: Parallel Pseudo-Random Number Generators, Sorting, Monte Carlo techniques	
UNIT - IV	**Parallel Programming:**	**(08 Hours)**
	Revealing concurrency in applications, Task and Functional Parallelism, Task Scheduling, Synchronization Methods, Parallel Primitives (collective operations), SPMD Programming (threads, OpenMP, MPI), I/O and File Systems, Parallel Matlabs (Parallel Matlab, Star-P, Matlab MPI), Partitioning Global Address Space (PGAS) languages (UPC, Titanium, Global Arrays).	
UNIT - V	**High-End Computer Systems:**	**(08 Hours)**
	Memory Hierarchies, Multi-core Processors: Homogeneous and Heterogeneous, Shared-memory Symmetric Multiprocessors, Vector Computers, Distributed Memory Computers, Supercomputers and Petascale Systems, Application Accelerators / Reconfigurable Computing, Novel computers: Stream, multithreaded, and purpose-built, Architectures: N-wide superscalar architectures, multi-core, multi-threaded	
UNIT - VI	**Achieving Performance:**	**(08 Hours)**
	Performance metrics and measurements, Measuring performance, Identifying performance bottlenecks, Restructuring applications for deep memory hierarchies, Partitioning applications for heterogeneous resources, Using existing libraries, tools, and frameworks, CASE tools.	

Reference Books:

1. Highly Parallel Computing", by George S. Almasi and Alan Gottlieb
2. "Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang, McGraw Hill 1993
3. "Parallel Computer Architecture: A hardware/Software Approach", by David Culler Jaswinder Pal Singh, Morgan Kaufmann, 1999.
4. "Scalable Parallel Computing", by Kai Hwang, McGraw Hill 1998.

5. "Principles and Practices on Interconnection Networks", by William James Dally and BrianTowles, Morgan Kauffman 2004.
6. GPU Gems 3 --- by Hubert Nguyen (Chapter 29 to Chapter 41)
7. Introduction to Parallel Computing, AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey, © 2003.
8. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007.
9. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
10. Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, John Wiley.
11. R. E. Bryant and D. R. O'Hallaron, Computer Systems: A Programmer's Perspective, Prentice Hall.
12. John Levesque (Author), Gene Wagenbreth (Author), High Performance Computing: Programming and Applications (Chapman & Hall/CRC Computational Science)

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

Advanced Computer Algorithms

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	TW & OR : 50 Marks	01 Credit

UNIT – I	**Introduction:**	**(08 Hours)**
	Asymptotic notation, Models of Computation, Algorithm & their complexity, Random Analysis machines, Computational complexity of RAM programs, A stored program model, Abstractions of the RAM, A primitive model of computation(Turing Machines),Relational between Turing machine & RAM model ,Pidgin ALGOL A high level lang.	
UNIT - II	**Algorithm Analysis and Algorithm Design techniques:**	**(08 Hours)**
	Algorithm Analysis: Analyzing Algorithm, Designing Algorithm, Time & Space Complexity, Average & Worst case analysis, Lower Bounds. **Algorithm Design techniques:** Divide & Conquer, Search Traversals, Dynamic Programming, Backtracking, Branch & Bound, Greedy Algorithm	
UNIT - III	**Sorting and Searching Algorithm :**	**(08 Hours)**
	The Sorting problem, Radix Sorting, Sorting by comparison, Heap sort-an O(n logn) comparison sort, Quick Sort-an O(n log n) expected time sort, Expected time for Order statistics, Binary Search, binary search trees, optimal binary search tree, B-Trees Algorithms on graph: Elementary graph Algorithm, Minimum spanning tree, Single Source shortest Path, All pairs shortest path	
UNIT – IV	**String Processing Algorithm and Divide and conquer method and Greedy method:**	**(08 Hours)**
	String Processing Algorithm: The naïve string matching, The Robin-Karp algorithm, String matching with Finite Automata, Knuth Morris Pratt Algorithm **Divide and conquer method:** Binary search, Mergesort, Quick sort, Strasen's matrix multiplication. **The Greedy method:** Knapsack problem, job sequencing, optical merge patterns, minimal spanning trees.	
UNIT – V	**Dynamic Programming, Back Tracking, Branch & Bound:**	**(08 Hours)**
	Dynamic Programming: Multistage graphs, OBST, 0/1 Knapsack, traveling sales man problem. **Back Tracking:** Eight Queens problem, graph coloring, Hamiltonian cycles, Knapsack problem, Maze problem. **Branch & Bound:** 0/1 Knapsack, Traveling salesman problem lower bound theory-comparisons trees for sorting/searching, lower bound on parallel computation.	
UNIT – VI	**NP-hard and NP-complete problems:**	**(08 Hours)**
	Algorithms, Complexity- intractability, Non-Deterministic Polynomial time (NP) Decision problems, cooks Theorem, NP-Complete problems- statisfiability problem, vertex cover problem. NP-Hard problems-graph, scheduling, code generation problems, Simplified NP Hard Problems, Approximation Algorithm for NP Hard Problem.	

Reference Books:

1. Bressard, “Fundamental of Algorithm”
2. Horowitz, Sahani, “Fundamentals of Computer Algorithms”, Galgotia
3. Thomas H. Cormen and Charles E. L. Leiserson, “Introduction to Algorithm”, PHI
4. V. Aho and J. D. Ullman, “Design and Analysis of Algorithms”, Addison Wesley

5. E. V. Krishna Murthy, “Introduction to Theory of Computer”	
Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Web Technologies

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
	Continuous Assessment: 40 Marks	

UNIT – I	**Web Environment:**	**(08 Hours)**
	WWW, HTTP, Web Server and its deployment, N-Tier Arch., Services of Web Server – Mail server, News server, Proxy server, Multimedia server. **XML Primer :** Mark-up languages, XML, Uses of XML. WELL-FORMED XML: Parsing XML, Tags, text, elements, attributes, comments and empty elements. XML Declaration, Processing, Instructions, Errors in XML XML NAMESPACES: Need for namespaces, How XML namespaces work, URIs, When to use, namespace. **VALIDATION:** Document type definitions (DTD), Sharing vocabularies, Anatomy of DTD, Developing DTDs, DTD Limitations. **XML SCHEMAS:** Benefit of XML schemas, Elements of XML Schema Definition, Creating a Schema from multiple documents. XPATH, XSLT, Xquery	
UNIT – II	**JSP :**	**(08 Hours)**
	JSP overview, JSP language basics, JSP translation and compilation directives, Standard java objects from JSP, JSP configuration and deployment, actions and tags of JSP; Java servlets – Arch, servlet interface, applications of servlets.	
UNIT – III	**ASP :**	**(08 Hours)**
	Objects and Components, Handling databases, Data Retrieval from Databases, applications of ASP, session management, ASP with .NET	
UNIT – IV	**Web Technologies :**	**(08 Hours)**
	Server side programs. CGI programs. Client side scripts. The Applet Concept. Search Engine Optimization: Strategies, Optimizing Search strategies, Robots, Spiders and Crawlers, Mobile Search Engine Optimization.	
UNIT – V	**The Web as an example of client server computing :**	**(08 Hours)**
	Characteristics of web servers: handling permissions. File Management Capabilities of common server architectures , Role of client Computer. Nature of Client server relationship. Web protocols Support tools for website creation and management. Developing Internet Information servers. Publishing information and application.	

UNIT – VI	**Building Web applications :**	**(08 Hours)**
	Protocols at the application layer. Principles of Web engineering. Database driven websites. RPC. Lightweight distributed objects. The role of the middleware. Support tools. Security issues in Distributed object systems. Enterprise- wide web base.	

Reference Books:

1. Information Architecture for the World Wide Web, Peter Morville and Louis Rosenfied, O'REILLY, 2007
2. Internet and World Wide Web: How to Program, Deitel and Deitel, 4th Edition, Prentice Hall, 2009
3. Beginning XML, David Hunter et al, 4th Edition, Wrox/John Wiley, 2007
4. Herbert Schildt, "Complete Reference JAVA 2", TMH
5. Jerri L. Ledford, "Search Engine Optimization",2nd Edition, Wiley Publication

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Wireless Communication And Security

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
	Continuous Assessment: 40 Marks	

UNIT - I	**Introduction :**	**(08 Hours)**
	A Short history of wireless communication. A market for mobile communication. Some research topics. A simplified reference model. Wireless Transmission. **Frequencies for Radio Transmission:** Signal antennas, signal propagation. Multiplicity, modulation, spread spectrum, cellular systems.	
UNIT - II	**Medium Access Control:**	**(08 Hours)**
	Motivation for a specialized MAC. SDMA, FDMA, TDMA, CDMA, Comparison of S/T/F/CDMA. **Telecommunication Systems:** GSM, DECT, TETRA, UMTS.	
UNIT - III	**Satellite Systems :**	**(08 Hours)**
	Basics, Routing, Localization, Handover. **Broadcast Systems :** Cyclic repetition of data, digital audio broadcasting, digital video broadcasting	
UNIT - IV	**Wireless LAN:** Infrared vs. radio transmission, Ad-Hoc networks, IEEE802.11, Bluetooth, Case Study on WLAN. **Wireless ATM :** Motivation for WATM, WATM services reference model, functions, radio access layer, handover, location management, addressing, mobile quality of service, access point control protocol, Case Study on WATM.	**(08 Hours)**
UNIT - V	**Mobile Network Layer:**	**(08 Hours)**
	Mobile IP, Dynamic host configuration protocol, Ad-hoc Networks. **Mobile Transport Layer :** Traditional TCP, Indirect TCP, Mobile TCP.	
UNIT - VI	**Performance Issues :**	
	QOS issues, Security issues, Non line of sight issues, Power control issues. **Security** Encryption and Authentication, Key pre-distribution and management, Secure Ad-Hoc Networks, Denial-of-Service Attacks, Energy-aware Security Mechanisms	**(08 Hours)**

References:

[1] Jochen Schiller, “Mobile Communication”, Pearson Education, Asia

[2] Mallick, “Mobile and Wireless Design Essentials”, Wiley computer publication

[3] Andy Dornan, “The Essential Guide of Wireless Communications Applications”, Pearson Education Asia

[4] Weisman, “The Essential guide to RF and wireless”, Pearson Education Asia

[5] Lee, “Mobile Cellular Telecommunications”, MGH

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

E-Commerce and ERP

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	Term Work: 50 Marks	01 Credit

UNIT - I	**Ecommerce business models and concepts, EC infrastructure, Ecommerce:**	**(06 Hours)**
	Ecommerce business models and concepts, EC infrastructure, Ecommerce -Frame work, anatomy of E-Commerce applications E-Commerce Consumer applications, E-Commerce organization. Applications. Consumer Oriented Electronic commerce - Mercantile Process models	
UNIT - II	**E-Security and payment systems, Electronic payment systems :**	**(06 Hours)**
	ESecurity and payment systems, Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems. Inter Organizational Commerce - EDI, EDI Implementation, Value added networks.	
UNIT - III	**Concepts and communications, ethical, social and political EC issues, Intra Organizational Commerce:**	**(06 Hours)**
	Concepts and communications, ethical, social and political EC issues, Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management. Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses. Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research. Marketing, online retailing, services, content and media, social networks.	
UNIT - IV	**Introduction To ERP:**	
	Introduction To ERP: Evolution of ERP, What is ERP? Reasons for the growth of ERP, Scenario and Justification of ERP in India, Evaluation of ERP, Various Modules of ERP, Advantage of ERP.	
UNIT - V	**Overview of Enterprise:**	
	An overview of Enterprise, Integrated Management Information, Business Modeling, ERP for Small Business, ERP for make to order companies, business Process Mapping for ERP Module Design, Customized ERP, Hardware Environment and its Selection for ERP Implementation.	**(06 Hours)**
UNIT - VI	**ERP Market:**	**(06 Hours)**
	ERP Market: Introduction, SAP AG, Baan Company, Oracle Corporation, People Soft, JD Edwards World Solutions Company, System Software Associates, Inc. (SSA) QAD, A Comparative Assessment and Selection of ERP Packages and Modules.ERP implementation lifecycle, issues in implementing Vendors, Consultants and users, In-House Implementation - pros and cons, vendors, consultants, end user.	

Reference Books:

1. Laudon K., C. G. Traver, E-Commerce Prentice Hall, 2010
2. William S. Davis, John Benamati, E-Commerce Basics: Technology Foundations and E-Business Applications, Prentice Hall.
3. Enterprise Resource Planning – Alexis Leon
4. ERP Ware: ERP Implementation Framework – V.K. Garg & N.K. Venkitakrishnan

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Information Storage and Management

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04Hours / Week	End Semester Examination: 60 Marks	04Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	PR & OR : 50 Marks	01 Credits

UNIT - I	**Introduction to Storage Technology:**	**[8Hrs]**
	Data proliferation and the varying value of data with time & usage, Sources of data and states of data creation, Data center requirements and evolution to accommodate storage needs, Overview of basic storage management skills and activities, Traditional file storage and it's pitfalls. The five pillars of technology, Overview of 12 storage infrastructure components, Evolution of storage, Information Lifecycle Management concept, Data categorization within an enterprise, Storage and Regulations.	
UNIT - II	**Storage Systems Architecture:**	**[8Hrs]**
	Intelligent disk subsystems overview, Contrast of integrated vs. modular arrays, Component architecture of intelligent disk subsystems, Disk physical structure components, properties, performance, and specifications, Logical partitioning of disks, RAID & parity algorithms, hot sparing, Physical vs. logical disk organization, protection, and back end management, Array caching properties and algorithms, Front end connectivity and queuing properties, Front end to host storage provisioning, mapping, and operation, Interaction of file systems with storage, Storage system connectivity protocols.	
UNIT - III	**Introduction to Networked Storage:**	**[8Hrs]**
	JBOD, DAS, SAN, NAS, & CAS evolution, Direct Attached Storage (DAS) environments: elements, connectivity, & management, Storage Area Networks (SAN): elements & connectivity, Fibre Channel principles, standards, & network management principles, SAN management principles, Network Attached Storage (NAS): elements, connectivity options, connectivity protocols (NFS, CIFS, ftp), & management principles IP SAN elements, standards (SCSI, FCIP, FCP), connectivity principles, security, and managementprinciples, Content Addressable Storage (CAS): elements, connectivity options, standards, and management principles, Hybrid Storage solutions overview including technologies like virtualization & appliances.	
UNIT - IV	**Introduction to Information Availability:**	**[8Hrs]**
	Business Continuity and Disaster Recovery Basics, Local business continuity techniques, Remote business continuity techniques, Disaster Recovery principles & techniques. Case study: Storage Network for Business Continuity.	
UNIT - V	**Managing &Monitoring**:	**[8Hrs]**
	Management philosophies (holistic vs. system & component), Industry management standards (SNMP, SMI-S, CIM), Standard framework applications, Key management metrics (thresholds, availability, capacity, security, performance), Metric analysis methodologies & trend analysis, Reactive and pro-active management best practices, Provisioning & configuration change , Problem reporting, prioritization, and handling techniques, Management tools overvie	
UNIT - VI	**Information storage on cloud:**	**[8Hrs]**
	Concept of Cloud, Cloud Computing, storage on Cloud, ClouVocabulary, Architectural Framework, Cloud benefits, Cloud computing Evolution, Applications & services on cloud, Cloud service providers and Models, Essential characteristics of cloud computing, Cloud Security and integration.	

References:

1) Information Storage and Management Storing, Managing, and Protecting Digital Information , by EMC, Hopkinton and Massachusetts, Wiley, ISBN:9788126521470
2) G. Somasundaram & Alok Shrivastava (EMC Education Services) editors; Information Storage and Management: Storing, Managing, and Protecting Digital Information; Wiley India.

3) Ulf Troppens, Wolfgang Mueller-Friedt, Rainer Erkens, Rainer Wolafka, Nils Haustein; Storage Network explained: Basic and application of fiber channels, SAN, NAS, iSESI, INFINIBAND and FCOE, Wiley India.
4) John W. Rittinghouse and James F. Ransome; Cloud Computing : Implementation , Management and Security, CRC Press, Taylor Frances Pub.

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

Cyber Security

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04Hours / Week	End Semester Examination: 60 Marks	04Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	PR & OR : 50 Marks	01 Credits

UNIT - I	**Cyber Security Fundamentals:**	**(08 Hours)**
	Network and Security Concepts, Authentication, Authorization, Non repudiation, Confidentiality, Integrity, Availability, Basic Cryptography, Symmetric Encryption, Public Key Encryption, The Domain Name System, Firewalls, Virtualization, Microsoft Windows Security Principles	
UNIT - II	**Attacker's Techniques:**	**(08 Hours)**
	Types of Proxies, Tunneling Techniques, Phishing, Smishing, Vishing, and Mobile Malici Threat Infrastructure.	
UNIT - III	**Exploitation:**	**(08 Hours)**
	Shell code, Stack-Based Buffer Overflows, Format String Vulnerabilities, Malicious PDF Web Exploit Tools, Brute Force and Dictionary Attacks, Misdirection, Reconnaissance, a Cross-Site Scripting, DNS Amplification Attacks.	
UNIT - IV	**Malicious Code:**	**(08 Hours)**
	Self-Replicating Malicious Code, Virtual Machine Obfuscation, Persistent Software Tech Privileged User Accounts and Escalation of Privileges, Token Kidnapping, Man-in-the-Middle Attack.	
UNIT - V	**Defense and Analysis Techniques:**	**(08 Hours)**
	Memory Forensics, Capabilities of Memory Forensics ,Memory Analysis Frameworks, In and Using Volatility, Honey pots, Malicious Code Naming, Automated Malicious Code Analysis Systems	
UNIT - VI	**Cyber Security Real World Impact:**	**(08 hours)**
	Cyber security and internal political security, International conflict in cyberspace, Nation-state cyber attack mitigation strategies, IP V6 address space, Improved security, privacy concerns, uneven world wide deployment. Case study	

Reference Books:

1. Cyber security essentials by James Graham, Richard Howard,Ryan Olson
2. Strategic Cyber Security by Kenneth Geers

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

Big Data Analytics

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04Hours / Week	End Semester Examination: 60 Marks	04Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	PR & OR : 50 Marks	01 Credits

UNIT - I	**Introduction:**	**(08 Hours)**
	Introduction to Big data, Data Exposition, Types of data, Need for big data, Big data & its sources, Three Characteristics of big data, Challenges of Conventional Systems – Big data Problem, Traditional IT Analytics Approach, Big data use cases, Handling limitations of Big data, big data platform. Evolution of Analytic Scalability.	
UNIT - II	**Big Data Storage and Computing Platforms:**	**(08 Hours)**
	Big Data Storage and Computing Platforms: Traditional RDBMS, NoSQL, NewSQL, and Hadoop, Parallel computing systems, Programming models for batch, interactive, and streaming applications, Trade-offs between programming models, Survey of new emerging database and storage systems for Big Data, Tradeoffs between reduced consistency, performance, and availability, MangoDB: Introduction, overview, Design Goals for MangoDB, MangoDB shell, MangoDB applications, Multimedia database application.	
UNIT - III	**Regression Modeling - Multivariate Analysis:**	**(08 Hours)**
	Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Neural Networks: Learning And Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees - Stochastic Search Methods	
UNIT - IV	**Introduction To Streams Concepts:**	**(08 Hours)**
	Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	
UNIT - V	**Mining Frequent Itemsets:**	**(08 Hours)**
	Market Based Model – Apriori Algorithm – Handling Large Data Sets in Main Memory – Limited Pass Algorithm – Counting Frequent Itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering High Dimensional Data – CLIQUE And PROCLUS – Frequent Pattern based Clustering Methods – Clustering in Non-Euclidean Space – Clustering for Streams and Parallelism	
UNIT - VI	**MapReduce:**	**(08 Hours)**
	MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association-Intelligence from unstructured information-Text analytics-Understanding of emerging trends and technologies-Industry challenges and application of Analytics.	

Text Books:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
2. Ohlhorst, Frank J. Big Data Analytics: Turning Big Data into Big Money. Copyright © 2012 SAS Institute Inc., Cary, North Carolina, USA.
3. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced

Analytics", John Wiley & sons, 2012.	
5. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007	
6. Pete Warden, "Big Data Glossary", O'Reilly, 2011	
7. Jiawei Han, MichelineKamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.	
Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Cryptography and Network Security

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04Hours / Week	End Semester Examination: 60 Marks	04Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	PR & OR : 50 Marks	01 Credits

UNIT - I	**Introduction:**	**(08 Hours)**
	Services, Mechanisms and Attacks, The OSI Security Architecture, A Model for Network Security. Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography. Block Ciphers and the Data Encryption Standard: Simplified DES, Block Cipher Principles, The Data Encryption Standard, Differential and Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation.	
UNIT - II	**Introduction to Finite Fields:**	**(08 Hours)**
	Introduction to Finite Fields: Groups, Rings, Fields, Modular Arithmetic, Euclid's Algorithm, Finite Fields of the Form GF, Polynomial Arithmetic, Finite Fields of the Form GF. Advanced Encryption Standard: Evaluation Criteria for AES, The AES Cipher. Contemporary Symmetric Ciphers: Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, RC4 Stream Cipher. Confidentiality Using Symmetric Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation	
UNIT - III	**Public-Key Encryption and Hash Functions:**	**(08 Hours)**
	Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms. Public-Key Cryptography and RSA, Principles, The RSA Algorithm, Key Management, Diffie Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography	
UNIT - IV	**Message Authentication and Hash Functions:**	**(08 Hours)**
	Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions. Hash Algorithms: MD5 Message Digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC, Digital Signatures, Authentication Protocols, Digital Signature Standard.	
UNIT - V	**Authentication Applications:**	**(08 Hours)**
	Kerbos, X.509 Authentication Service, E-mail Security, Preety Good Privacy, S/MIME, IP Security, Architecture, Authentication Header, Encapsulation Security Payload, Combining Security Associations, Key Management Web Security: Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.	
UNIT - VI	**System Security:**	**(08 Hours)**
	Intruders, Intrusion Detection, Password Management. Malicious Software, Firewalls: Firewall Design Principles, Trusted Systems.	

1. William Stallings, "Cryptography and Network Security", Principles and Practices, Pearson Education, Sixth Edition.
2. Behrouz A. Forouzan, "Cryptography and Network Security", McGraw Hill Publication
3. Atul Kahate, "Cryptography and Network Security", McGraw Hill(India)Publication, Third Edition.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Parallel Computing

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	Term Work: 50 Marks	01 Credit

UNIT - I	**Introduction to Parallel Programming Paradigms:**	**(08 Hours)**
	Types of Parallelism , Parallel Computation Models, Memory less Parallel Computers, Parallel Computers with Memory, Flynn's Taxonomy, The Data-Parallel Model, Networked Computers, The Performance of Parallel Algorithms, Amdahl's Law, Gustaf son Barsis's Law, Karp-Flatt Metric, Multidimensional Meshes, Hypercube-Based Machines, Routing in Networks, The PRAM Model.	
UNIT - II	**Convergence of Parallel Architecture:**	**(08 Hours)**
	Communication Architecture, Shared Address Space, Message Passing, Convergence, Data parallel processing, Other Parallel Architectures, A Generic parallel architectures, shared memory systems and cache coherence, distributed-memory systems, interconnection networks and routing, Architectural Trends, Application Trends, Technology Trends, Supercomputers case study: Param.	
UNIT - III	**Programming scalable systems:**	**(08 Hours)**
	The message-passing model, the message-passing interface, MPI standard basic concepts of MPI: MPI_Init, MPI_Comm_size, MPI_Comm_rank, MPI_Send, MPI_Recv, MPI_Finalize, timing the MPI programs: MPI_Wtime, MPI_Wtick, collective communication: MPI_Reduce, MPI_Barrier, MPI_Bcast, MPI_Gather, MPI_Scatter, case studies: the sieve of Eratosthenes, Floyd's algorithm, Matrix-vector multiplication.	
UNIT - IV	**Shared-Memory Programming:**	**(08 Hours)**
	Shared-memory model, OpenMP standard, Parallel for loops, Parallel for pragma, private variables, critical sections, reductions, parallel loop optimizations, general data parallelism, functional parallelism, case studies: the sieve of Eratosthenes, Floyd's algorithm, matrixvector multiplication – distributed shared-memory programming, DSM primitives.	
UNIT - V	**Implications for Programming Models and Case Study:**	**(08 Hours)**
	Naming, Replication, Overhead and granularity of communication, Block Data transfer, Synchronization, Hardware Cost and Design Complexity, Case Study: Ocean, Ray trace, Data mining.	
UNIT - VI	**Fundamental Design issues:**	**(08 Hours)**
	Partitioning of data, Mapping of data onto the processors, Reproducibility of results, Synchronization, Scalability and Predictability of performance, Performance & Scalability, Performance Requirements, Types of performance requirements, Performance Metrics of Parallel Systems, Communication Abstraction, Programming model requirements, Communication and Replication, Starssen's Matrix multiplication to compute complexity less than O(n3).	

References:

1. Parallel Programming – Techniques and applications Using Networked Workstations and Parallel Computers, Barry Wilkinson and Michael Allen, Prentice Hall, 1999

2. Multi-Core Programming - Increasing Performance through Software MultiThreading, Shameem Akhter and Jason Roberts, Intel Press 2006.	
3. Parallel Programming in C with MPI and OpenMP, Michael J. Quinn, McGraw Hill 2003.	
4. Introduction to Parallel Computing by AnanthGrama, George Karypis, Vipin Kumar, and Anshul Gupta.	
5. Programming Massively Parallel Processors by D.Kirk and W. Hwu	
Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Wireless Sensor Networks

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	Term Work: 50 Marks	01 Credit

UNIT - I	**Introduction & Characteristics of Wireless Sensor Networks :**	**(08 Hours)**
	Introduction, Brief Historical Survey of Sensor Networks. Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.	
UNIT - II	**Medium Access Control Protocols:**	**(08 Hours)**
	Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol, **Case Study:** IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling, ZigBee.	
UNIT - III	**Routing And Data Gathering Protocols:**	**(08 Hours)**
	Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Point-to-Point VPN Tunneling Protocol and Challenges- Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GAF, GPSR – Real Time routing Protocols – APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB,	
UNIT - IV	**Embedded Operating Systems:**	**(08 Hours)**
	Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS –OSPM - EYES OS. Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.	
UNIT - V	**Transport Control Protocols and Middlewares for Wireless Sensor Networks :**	**(08 Hours)**
	Traditional Transport Control Protocols: TCP (RFC 793), UDP (RFC 768), MobileIP, Introduction, WSN Middleware Principles, Middleware Architecture: Existing Middleware: MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive Sensor Networks Services)	
UNIT - VI	**Applications of WSN:**	**(08 Hours)**
	WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications.	

References:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.
3. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.

4. Philip Levis, " TinyOS Programming".
5. Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd.
6. Wireless sensor networks Edited by C. S. Raghavendra Pub: Springer.
7. Fundamentals of Sensor Network Programming: Applications and Technology By Sridhar S. Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley.
8. Ad Hoc Wireless Networks: Architectures And Protocols By Murthy Pub: Pearson Education

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Storage Area Network

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Theory: 04 Hours / Week	End Semester Examination: 60 Marks	04 Credits
Practical: 02 Hours / Week	Continuous Assessment: 40 Marks	
	Term Work: 50 Marks	01 Credit

UNIT - I	**Information Storage and Data Centre Environment:**	**(08 Hours)**
	Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing, Application, Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Disk I/O Controller Utilization, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application Requirements and Disk Performance, Data Protection: RAID.	
UNIT - II	**Data and Information in SAN**:	**(08 Hours)**
	Data organization: File vs. Block, Object, Data store, Searchable models, File Systems, Volume Managers, Caches, Prefetching, Storage Networking Technologies, What Storage Networking Is, What to Expect from SANs, Leading up to SANs, Killer Apps for SANs	
UNIT - III	**SAN Hardware Ecosystem:**	**(08 Hours)**
	Components of an Intelligent Storage System, Front End, Cache, Back End, Physical Disk, Storage Provisioning, Virtual Storage Provisioning,Types of Intelligent Storage Systems – DAS, SAN, NAS, Comparing DAS, SAN & NAS, Host Bus Adapters, SFPs, FC Cables and Connectors, SCSI/SATA/SAS Cables and Connectors, JBODs, RAID Arrays, RAID Controllers, External Storage Boxes, Tape Drive, Tape Library, NAS Device, NAS Head, Fiber Channel Switches, Bridges, FC Appliances.	
UNIT - IV	**Storage Virtualization:**	**(08 Hours)**
	Storage Virtualization, Disk Virtualization, Block Virtualization, File Virtualization, File system Virtualization, Tape Virtualization, Tape Library Virtualization, Host Based Virtualization, Network Based Virtualization, Storage Device Virtualization.	
UNIT - V	**Protocols in SAN:**	**(08 Hours)**
	ATA and SATA, SPI – Parallel SCSI, SAS – Serial Attached SCSI, SAS Topology, SAS Devices, FC Topologies, FC Ports, FC Protocol Layers, FC WWNs, FC Addresses, FC Frame, FC Flow Control, Zoning, Lun Masking, iSCSI Topology, iSCSI Initiators and Targets, iSCSI Namesand Addresses, Speeding Up iSCSI, iSCSI Advantages, iSCSI Limitation, Comparing Storage Protocols.	
UNIT - VI	**SAN Managements and Storage Systems:**	**(08 Hours)**
	Storage Management, Storage Vs. Data Classification, Information Lifecycle Management, Hierarchical Storage Management, RTO and RPO, Backup and Restore, Snapshot & CDP, De-duplication, Storage Provisioning, Storage Migration, SRM, Case study - Google FS/BigTable, Programming models: Hadoop, NAS.	

References:

[1] Storage Area Network Essentials:A complete Guide to Understanding and Implementing SANs(HardCover) By Richard Barker, Paul Massigliar By Wiley 2001.

[2] Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS iSCSI and InfiniBandBy Ulf Troppens, Rainer Erkens, Wolfgang Miiller Wiley 2004.

[3] Using SANs and NAS By W.Curtis Preston, Mike Loukides.

[4] Information Storage and Management, 2nd Edition, Edited by Somasundaram Gnanasundaram, Alok

Shrivastava	
Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Paper:-I

Enterprise Resource Planning

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT:-I **(09Hours)**

Introduction To ERP: Evolution of ERP, What is ERP? Reasons for the growth of ERP, Scenario and Justification of ERP in India, Evaluation of ERP, Various Modules
Of ERP, Advantage of ERP.

UNIT:-II **(08Hours)**

An overview of Enterprise, Integrated Management Information, Business Modelling, ERP for Small Business, ERP for make to order companies, Business Process Mapping for ERP ModulDesign, Hardware Environment and its Selection for ERP Implementation.

UNIT:-III **(10Hours)**

3) ERP Market, Introduction, SAP AG, Baan Company, Oracle Corporation, People Soft, JD Edwards World Solutions Company, System Software Associates, Inc. (SSA) QAD, A Comparative Assessment and Selection of ERP Packages and Modules.ERP implementation lifecycle, issues in implementing Vendors, Consultants and users, In-House Implementation - pors and cons, vendors, consultants, end user.

UNIT:-IV **(08Hours)**

4) ERP packages, pre-evaluation screening, package evaluation, project planning phase, gap analysis, reengineering, configuration, implementation, team training, testing, going live, end-user training, post implementation (Maintenance mode).

UNIT:-V **(08Hours)**

Future Directions in ERP, New markets, new channels, faster implementation methodologies, business modules and BAPIs, convergence on windows NT, Application platform

UNIT: - VI **(08Hours)**

2) ERP and Related Technologies, Business Process Reengineering (BPR), Management Information System (MIS), Executive Information System (EIS), Decision support System

(DSS), Supply Chain Management (SCM), ERP Modules, Introduction, Finance, Plant Maintenance, Quality Management, Materials Management

References

1. Enterprise Resource Planning – Alexis Leon
2. ERP Ware: ERP Implementation Framework – V.K. Garg & N.K. Venkitakrishnan
3. ERP: By Leon,
4. ERP Concepts and Planning – Garg & Venkitakrishnan

BIOINFORMATICS

Teaching Scheme | Examination Scheme

Lectures:-4 Hours/Week | Theory:-60 Marks

Internal assessment:-40 Marks

Credits:-04

UNIT I: (6 Hrs]

Introduction to Bioinformatics

Definition and History of Bioinformatics, biological databases, Gene Information Resources, Introduction to Statistical Bioinformatics, Pharmacogenomics, Computer aided drug design, basic principles, docking, QSAR.

UNIT II (14Hrs]

MATHEMATICS & PROGRAMMING IN BIOINFORMATICS

Mathematics: Principles of sampling from a population: Random sampling, Standard Probability Distributions: Correlation and regression analysis,Vector algebra - Addition and subtraction of vectors, Dot and cross product, Scalar, triple product, Matrix algebra, Solution of equation by bisection method, Iteration method, Newton Raphson method, numerical differentiation, Numerical integration- Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Runga Kutta method of nth order. Fast Fourier transformation.

UNIT III (10Hrs]

Programming in bioinformatics:Programming in C: Pointers, pointers to functions, macro programming in C, graphs, data structure - linked list, stack, queue, binary trees, threaded binary trees, Introduction to JAVA, variables, constants, control structures, input output, classes. Jar and Java applets.

UNIT IV (10Hrs]

Databases:Data mining, Biological databases, database hierarchies, sequence and structure databases, Pairwise sequence alignment and database similarity searching: global and local alignments, matrices, gap penalties and statistical significance PDB, CSD, RELIBASE, REBASE, File Format Converter Tools: BABEL, ReadSeq, NCBI Resources.

UNIT V: (10Hrs]

BIOINFORMATICS TOOLS

Visualization tools – RasMol, QMol, Swiss PDB, Pymol. Modelling Tools: MODELLER, SwissPDB, Geno3D. Docking Tools: Chimera, Dock, AutoDock, GRAMM, Hex, Argus Lab. Softwares: Clustal V, Clustal W 1.7, RasMol, Oligo, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip.

(10Hrs]

UNIT VI

BIOLOGICAL MEMBRANES

Introductions, Biological roles, Structural features, Membrane lipids, General structures, Aggregation states, Polymorphism, Thermal transitions, Electrostatic effects, Molecular dynamics, Membrane proteins, MD simulation of Membrane proteins.

References Books:

Sethi, R.,1996, Programming Languages, Addison-Wesley.

Ewens, W.J. and Grant, 2001 Statistical Methods in Bioinformatics: An Introduction. Springer-Verlag.

Chung, Kai Lai, Elementry Probability Theory with Statistical Processes (Student Edition) Springer International

Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.

Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2004 Bioinformatics: Concepts, Skills & Applications. CBS Publishers & Distributors, New Delhi.

Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.

Lipshutz, Data Structure, McGrawa Hill.

Standish, Data Structure, Addison-Wesley.

Aho, A., Hopcroft, J. and Ullman, J., The Design and Analysis of Computer Algorithms, Addison Wesley.

Date, C.J. An Introduction to Database Systems, Vol I & II. Addison Wesley.

Payer, T.A., Introduction to Simulation,

Manuals for SIMULA/SIMSCRPIT

Law, A.M. and Kelton, W.D., 1991 Simulation Modeling and Analysis, McGraw Hill.

INFORMATION RETRIVAL AND WEB SEARCH

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT:-I (12 Hours)

Introduction: Goals and history of IR. The impact of the web on IR. The role of artificial intelligence (AI) in IR. Basic IR Models: Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.

UNIT:-II (08 Hours)

Basic Tokenizing Indexing, and Implementation of Vector-Space Retrieval: Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors; Java implementation.

UNIT:-III **(10 Hours)**

Text Representation: Word statistics; Zapf's law; Porter stemmer; morphology; index term selection; using thesauri. Metadata and markup languages (SGML, HTML, XML).

Web Search:

Search engines; spidering; metacrawlers; directed spidering; link analysis (e.g. hubs and authorities, Google PageRank); shopping agents.

UNIT:-IV **(14 Hours)**

Experimental Evaluation of IR: Performance metrics: recall, precision, and F-measure; Evaluations on benchmark text collections.

Query Operations and Languages: Relevance feedback; Query expansion; Query languages.

UNIT: - V **(14 Hours)**

Text Categorization and Clustering: Categorization algorithms: naive Bayes; decision trees; and nearest neighbor. Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM). Applications to information filtering; organization; and relevance feedback.

UNIT: - VI **(10 Hours)**

Recommender Systems: Collaborative filtering and content-based recommendation of documents and products.

Information Extraction and Integration: Extracting data from text; XML; semantic web; collecting and integrating specialized information on the web.

References:-

1. Introduction to Information Retrieval by C. Manning, P. Raghavan, and H. Schütze.
2. Cambridge
3. Retrieval: Algorithms and Heuristics by D. Grossman and O. Frieder.
4. Modern Information Retrieval, by R. Baeza-Yates and B. Ribeiro-Neto.
5. Finding Out About, by R. Belew.\
6. Mining the Web, by S. Chakrabarti.
7. Foundations of Statistical Natural Language Processing, by C. Manning and H. Schütze.

SPEECH PROCESSING

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT - I **(10 Hours)**

Nature of Speech signal Classification of speech, sounds, nature of speech signal, models of speech production.Digital models for the speech signal- mechanism of speech production - acoustic theory - lossless tube models.

UNIT – II **(10 Hours)**

DIGITAL MODELS - Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains. Linear predictive coding of speech - auto correlation.

UNIT - III **(13 Hours)**

Analysis of Speech signalSpectral analysis of speech - short time Fourier analysis - filter bank design - speech coding - subband coding of speech - transform coding – channel vcoder - formant vocoder - cepstral vocoder - vector quantizer coder.

UNIT - IV **(13 Hours)**

Speech Synthesis Speech synthesis - pitch extraction algorithms - Gold Rabiner pitch trackers - autocorrelation pitch trackers - voice/unvoiced detection - homomorphic speech processing - homomorphic systems for convolution - complex cestrum - pitch extraction using homomorphic speech processing.

UNIT - V **(13 Hours)**

Speech Recognition Automatic speech recognition systems - isolated word recognition - connected word recognition - large vocabulary word recognition systems.

UNIT – VI **(10 Hours)**

PATTERN CLASSIFICATION - DTW, HMM - speaker recognition systems - speaker verification systems - speaker identification systems. Automatic recognition of speech: dynamic time warping, hidden Markov models.

Text Books

1. Rabiner L.R. & Schafer R.W., "Digital Processing of Speech Signals", Prentice Hall Inc.
2. Thomas Parsons, "Voice and Speech Processing" , McGraw Hill Series
3. Saito S. & Nakata K., "Fundamentals of Speech Signal Processing" , Academic Press, Inc.
4. J.L Flanagan : Speech Analysis Synthesis and Perception - 2nd Edition - Sprenger Vertag, 1972.
5. I.H.Witten :Principles of Computer Speech , Academic press, 1983.

Reference Books

1. Owens F.J., "Signal Processing of Speech" , Macmillan New Electronics.
2. Papamichalis P.E., "Practical Approaches to Speech Coding" , Texas Instruments, Prentice Hall.
3. Rabiner L.R. & Gold, "Theory and Applications of Digital Signal Processing" , Prentice Hall of India.

SENSOR NETWORK & EMBEDED SYSTEMS

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT -I **(10 Hours)**

OVERVIEW & ARCHITECTURE OF WIRELESS SENSOR NETWORKS

Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks. Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT – II **(08 Hours)**

NETWORKING SENSORS

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT – III **(08 Hours)**

Programming Challenges

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Sensor Node Hardware – Berkeley Motes, Node-level software platforms, Node-level Simulators, State-centric programming.

UNIT – IV **(10 Hours)**

Embedded Architecture:

Embedded Computers, Characteristics of Embedded Computing
Applications, Challenges in Embedded Computing system design, Embedded
System design process- Requirements, Specification, Architectural Design,
Designing Hardware and Software Components, System Integration,
Formalism for System Design- Structural Description, Behavioral Description,
Design Example: Model Train Controller

UNIT – V **(08 Hours)**

Embedded Processor And Computing Platform :
ARM processor- processor and memory organization, Data operations,
Flow of Control, SHARC processor- Memory organization, Data operations,
Flow of Control, parallelism with instructions, CPU Bus configuration, ARM
Bus, SHARC Bus, Memory devices, Input/output devices, Component
Interfacing, designing with microprocessor development and debugging,
Design Example: Alarm Clock.

UNIT - VI **(10 Hours)**

Networks For Embedded Systems
I2C, CAN Bus, SHARC link ports, ethernet, Myrinet, Internet.
Programming concepts, Embedded System Programming, C /C++/Java programming concepts, Assembly language V/s High Level Language and its suitability for applications development, C program elements – Micros and functions, data types, data structures, modifiers, statements, loops and pointers, queues and stacks, List & Order List and their use in the implementation of Embedded System software. Brief overview of Embedded System Programming In C++ & Java.

TEXT BOOKS:

1. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.

2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

3 Wayne Wolf, Computers as Components: Principles of Embedded Computing

System Design, Morgan Kaufman Publishers, 2001.

REFERENCES:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007.

2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

Computer Graphics and visualization

COMPUTER GRAPHICS AND VISUALIZATION

Teaching Scheme | Examination Scheme

Lectures:-4 Hours/Week | Theory:-60 Marks

Internal assessment:-40 Marks

Credits:-04

UNIT-I (08 Hours)

INTRODUCTION: Applications of computer graphics, A graphics system, Images: Physical and synthetic, Imaging systems, The synthetic camera model, The programmer's interface, Graphics architectures, Programmable pipelines, Performance characteristics. Graphics Programming: The Sierpinski gasket, Programming two-dimensional applications.

UNIT-II (08 Hours)

THE OPENGL: The OpenGL API, Primitives and attributes, Color, Viewing, Control functions, The Gasket program, Polygons and recursion, The three-dimensional gasket, Plotting implicit functions.

UNIT-III (08 Hours)

INPUT AND INTERACTION: Interaction, Input devices, Clients and servers, Display lists, Display lists and modeling, Programming event-driven input, Menus, Picking, A simple CAD program, Building interactive models, Animating interactive programs, Design of interactive programs, Logic operations.

UNIT-IV (08 Hours)

GEOMETRIC OBJECTS AND TRANSFORMATIONS – 1: Scalars, points, and vectors,Three-dimensional primitives, Coordinate systems and frames, Modeling a colored cube, Affine transformations, Rotation, translation and scaling.

GEOMETRIC OBJECTS AND TRANSFORMATIONS – 2: Transformations in homogeneous coordinates, Concatenation of transformations, OpenGL transformation matrices, Interfaces to three-dimensional applications, Quaternion.

UNIT-V (08 Hours)

VIEWING: Classical and computer viewing, Viewing with a computer, Positioning of the camera, Simple projections, Projections in OpenGL, Hidden-surface removal, Interactive mesh displays, Parallel-projection matrices, Perspective-projection matrices, Projections and shadows.

UNIT-VI (13 Hours)

Lighting and shading Light and matter, Light sources, The Phong lighting model, Computation of vectors, Polygonal shading, Approximation of a sphere by recursive subdivisions, Light sources in OpenGL, Specification of materials in OpenGL, Shading of the sphere model, Global illumination.

Implementation Basic implementation strategies, The major tasks, Clipping, Line-segment clipping, Polygon clipping, Clipping of other primitives, Clipping in three dimensions, Rasterization, Bresenham's algorithm, Polygon rasterization, Hidden-surface removal, Antialiasing, Display considerations.

Reference books

1. Interactive Computer Graphics A Top-Down Approach with OpenGL -Edward Angel, 5th Edition
2. Computer Graphics Using OpenGL – F.S. Hill, Jr. 2nd Edition, Pearson
    a. Education, 2001
3. Computer Graphics – James D Foley, Andries Van Dam, Steven K Feiner

CLOUD COMPUTING

Teaching Scheme | Examination Scheme

Lectures:-4 Hours/Week | Theory:-60 Marks

Internal assessment:-40 Marks

Unit I (08 Hours)

Cloud computing basics: Cloud computing overview, Applications, Intranets and the cloud.

Cloud computing issues: Benefits, Limitations, Security concerns, regulatory issues.

Unit II (08 Hours)

Virtualization Technology: Virtual machine technology, Virtualization applications in enterprises, pitfalls of virtualization.

Cloud storage: Overview, Cloud storage providers.

Hardware and Infrastructure: Clients, Security, Network, Services, Cloud Storage Providers.

Unit III (08 Hours)

Ways to Collaborate Online: Collaborating on Project Management, Contact Management, Word Processing, Spreadsheets, Databases, Sharing files and other online Contents. Using Mobile Cloud. Controlling with Web based Desktops.

Cloud- Based IT Audit Process: Control Frameworks for the cloud, ENISA Cloud Risk Assessment, FedRAMP, Entities using COBIT, CSA Guidance, Cloud Audit/A6, Risk Management and Risk Assessment, Cloud-Based IT Governance: Managing Service Agreements, Implementation and Maintenance.

Unit IV (08 Hours)

System and Infrastructure Lifecycle Management for the Cloud: Mapping Control Methodologies onto the Cloud, Consideration for Cross-Cloud Deployments, The Cloud Provider's Perspective. Cloud-Based IT Service Delivery and Support, Protecting and Privacy of Information Assets in the Cloud: The Cloud Security Continuum and a Cloud Security Reference Model. Cloud Characteristics, Data classification and Information Lifecycle Management, Regulatory and Compliance Implications.

Unit V (08 Hours)

MapReduce and extensions: Parallel computing, The MapReduce Model, Parallel efficiency of MapReduce, Relational operations using MapReduce, Enterprise Batch Processing using MapReduce.

Unit VI (08 Hours)

Cloud Technologies: Web services, SOAP versus REST, AJAX, Mashups.

Cloud Computing Case Studies: Google, EMC, NetApp, Microsoft, Amazon, Salesforce.com, IBM, Service Architecture, Protocol Architecture.

Case Study: Amazon Web Services(AWS)

PREVASIVE COMPUTING

Teaching Scheme | Examination Scheme

Lectures:-4 Hours/Week | Theory:-60 Marks

Internal assessment:-40 Marks

Credits:-04

UNIT I (10 Hours)

Pervasive Computing Application - Pervasive Computing devices and Interfaces - Device technology trends, Connecting issues and protocols Pervasive Computing and web based Applications - XML and its role in Pervasive Computing - Wireless Application Protocol (WAP) Architecture and Security – Wireless Mark-Up language (WML) –Introduction

UNIT II (13 Hours)

Mobile Device Technologies Mobile Computing devices characteristics - Adaptation – Data dissemination and Management - Heterogeneity – Interoperability - – Context awareness - Language localization issues - User Interface design issues – Difference between UI design for mobile devices and conventional systems - Mobile Agents - Mobile Device technology overview - Windows CE – Symbian – J2ME – Pocket PC – BREW.

UNIT III (10 Hours)

Sensor Networks and RFIDsIntroduction to Sensor networks - Sensor Node Architecture Sensor Network Architecture - Types of sensor networks – Platforms for Wireless sensor networks – Applications of Wireless Sensor networks.

UNIT IV (10Hours)

Introduction to RFID – transponder and reader architecture - Types of tags and readers - Frequencies of operation – Application of RFID Technologies.

UNIT V (10 Hours)

Voice Enabling Pervasive Computing - Voice Standards - Speech Applications in Pervasive Computing and security. PDA in Pervasive Computing – Introduction - PDA software Components, Standards, emerging trends - PDA Device characteristics - PDA Based Access Architecture

UNIT VI (10 Hours)

User Interface Issues in Pervasive Computing, Architecture - Smart Card- based Authentication Mechanisms - Wearable computing Architecture

References

1. Burkhardt, Henn, Hepper, Rintdorff, Schaeck. “Pervasive Computing”, Addison Wesley, 2002.

2. F. Adelstein, S.K.S. Gupta, “Fundamentals of Mobile and Pervasive Computing” Tata McGraw-Hill, 2005.

3.Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaec & Klaus Rindtorff. --- Pervasive Computing Technology and Architecture of Mobile Internet Applications, Addision Wesley, Reading, 2002.

4. Uwe Ha nsman, Lothat Merk, Martin S Nicklous & Thomas Stober: Principles of Mobile Computing, Second Edition, Springer- Verlag, New Delhi, 2003.

5. Rahul Banerjee: Internetworking Technologies: An Engineering Perspective, Prentice –Hall of India, New Delhi, 2003. (ISBN 81-203-2185-5)

6.. Rahul Banerjee: Lecture Notes in Pervasive Computing, Outline Notes, BITS-Pilani, 2003.

DATA WAREHOUSING AND DATA MINING

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT-I **(**11 Hrs)

Introduction:

Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Data Warehouse and OLAP Technology for Data Mining Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining

UNIT-II (8 Hours)

Data Preprocessing:

Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretralization and Concept Hierarchy Generation, Online Data Storage.

Data Mining Primitives, Languages, and System Architectures:

Data Mining Primitives, Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems.

UNIT-III **(11 Hours)**

Concepts Description: Characterization and Comparison:

Data Generalization and Summarization- Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Descriptive Statistical Measures in Large Databases.

UNIT-IV **(10 Hours)**

Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from

Transactional Databases, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses,

From Association Mining to Correlation Analysis, Constraint-Based Association Mining.

UNIT-V (12Hours)

Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction,Bayesian Classification, Classification by Back propagation, Classification Based on Conceptsfrom Association Rule Mining, Other Classification Methods Prediction, Classifier Accuracy.Cluster Analysis Introduction :Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning
Methods, Density-Based Methods, Grid-Based Methods, Model- Based Clustering Methods, Outlier Analysis.

UNIT-VI (11 Hours]

Mining Complex Types of Data:
Multidimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web.

References::

1. Data Mining – Concepts and Techniques - JIAWEI HAN & MICHELINE KAMBER Harcourt India.
2. Data Mining Techniques – ARUN K PUJARI, University Press
3. Building the DataWarehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd..
4. Data Warehousing in the Real World – SAM ANAHORY & DENNIS MURRAY. Pearson Edn Asia.
5. Data Warehousing Fundamentals – PAULRAJ PONNAIAH WILEY STUDENT EDITION
6. The Data Warehouse Life cycle Tool kit – RALPH KIMBALL WILEY STUDENT EDITION
7. Data Mining Introductory and advanced topics –MARGARET H DUNHAM, PEARSON EDUCATION

PAPER II

GRID COMPUTING

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT I **(10 Hours)**

CONCEPTS AND ARCHITECTURE OF GRID : Parallel and Distributed Computing, Cluster Computing, Grid Computing-Definition and Scope of grid computing,

UNIT II **(10 Hours)**

GRIDE REVIEW OF WEB SERVER: Anatomy and Physiology of Grid-Review of Web Services-OGSA-WSRF. Grid Monitoring Architecture (GMA)

UNIT III **(12 Hours)**

GRID SECURITY AND RESOURCE MANAGEMENT :A Brief Security Primer,PKI-X509 Certificates, Grid Scheduling and Resource Management-Scheduling Paradigms, Working principles of Scheduling , A Review of Condor, SGE, PBS and LSF

UNIT IV **(12 Hours)**

DATA MANAGEMENT AND GRID PORTALS: Data Management, Categories and Origins of Structured Data, Data Management Challenges, Architectural Approaches, Collective Data Management Services, FederationServices,

UNIT V **(05 Hours)**

First and Second-Generation Grid Portals. Clouds International Grid Trust Federation

UNIT VI **(06 Hours)**

GRID MIDDLEWARE: List of globally available Middleware, Globus GT 3 Toolkit Architecture, Programming model, High level services – OGSI .Net middleware Solutions.

TEXT BOOK:

1. Maozhen Li, Mark Baker, The Grid Core Technologies, John Wiley & Sons, 2005.

REFERENCES:

1. Ian Foster & Carl Kesselman, The Grid 2 – Blueprint for a New Computing Infrascture Morgan Kaufman – 2004.
2. Joshy Joseph & Craig Fellenstein, “Grid Computing”, Pearson Education 2004.
3. Fran Berman, Geoffrey Fox, Anthony J.G.Hey, “Grid Computing: Making the Global Infrastructure a reality”, John Wiley and sons, 2003.

RESEARCH METHODS IN COMPUTER SCIENCE

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT – I **(10Hours)**

Research Overview

Meaning of Research – Objectives of Research – Motivation in Research – Types of Research – Research Approaches – Significance of Research – research Methods versus Methodology – Research and Scientific Method – Importance of Knowing How Research is done

UNIT – II **(10Hours)**

Research Process – Criteria of good Research – Necessity of Defining the Problem – Technique involved in Defining the Problem – Meaning of Research Design – Need for Research Design – Features of a Good Design – Important Concepts Relating to Research Design – Different Research Design – Data

UNIT – III **(12Hours)**

Data Analysis

Mathematical and statistical analysis using software tools like MAT Lab, SPSS or free wares tools.

Report writing and analyzed data representation - Significance of Report Writing – Different Steps in writing Report – Layout of the Research Report – Types of Reports – Oral Presentation – Mechanics of Writing a research Report – Precautions for Writing Research Reports.

UNIT – IV **(08Hours)**

Quality Research Strategies

Building expertise in the areas of interest, generating the base content in the selected area, literature survey for research work- already done, being done by others and arriving at directions of research.

Formulation of research title, development of criteria based research proposal, Presentation for the research proposal and review of the proposal base on the feedbacks by evaluation experts.

Planning for the research work with outcomes/achievable and time targets. Research monitoring publication of research outcomes in referred journals. Documentation of research **work to generate thesis with norms and standards.**

UNIT – V **(08Hours)**

Computer Applications:

Spreadsheet Tool: Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features.

UNIT - VI **(10Hours)**

Tools used may be Microsoft Excel, Open office or similar tool.

A. Presentation Tool: Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool.

B. Web Search: Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo etc, and Using advanced search techniques.

References:

1. Montgomery, Douglas C. (2007), 5/e, Design and Analysis of Experiments, (Wiley India)

2. Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley India)

3. Kothari C.K. (2004), 2/e, Research Methodology- Methods and Techniques (New Age International, New Delhi)

4. Krishnaswamy, K.N., Sivakumar, Appa Iyer and Mathiranjan M. (2006), Management Resarach Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

5. The complete reference Office Xp – Stephan L. Nelson, Gujulia Kelly (TMH)

6. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH)

7. Book for Open Office.

MIDDLE WARE TECHNOLOGIES

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT- I **(14Hours)**

Introduction to Middleware Technologies, importance of middleware & its integral role in the software life cycle. Introduction to client server computing: Evolution of corporate computing models from centralized to distributed computing, client server models.

General Middleware, Communications Middleware, Service Specific Middleware, Client/Server Building blocks – RPC Messaging – Peer – to – Peer, Java RMI.

Introduction to Distributed Objects

Computing standards, OMG, Overview of CORBA, Overview of COM/DCOM, and Overview of EJB.

UNIT –II **(10Hours)**

EJB Architecture

Overview of EJB software architecture, View of EJB Conversation, Building and Deploying EJBs, Roles in EJB.

EJB Applications

EJB Session Beans, EJB entity beans, Lifecycle of Beans, EJB clients, Steps in developing an application with EJB, EJB Deployment.

UNIT-II I **(08Hours)**

CORBA

Introduction and concepts, distributed objects in CORBA, CORBA components, architectural features, method invocations, static and dynamic: IDL (Interface Definition Language) models and interfaces. Structure of CORBA IDL, CORBA's self-describing data; CORBA interface repository. Building an application using CORBA.

CORBA Services and CORBA Component Model

Overview of CORBA Services, Object location Services, Messaging Services, CORBA Component Model. CORBA with Java: Review of Java concept like RMI, RMI API, JDBC.

UNIT-IV **(10Hours)**

COM and .NET

Evolution of DCOM, Introduction to COM, COM clients and servers, COM IDL, COM Interfaces, COM Threading Models, Marshalling, Custom and standard marshalling, Comparison COM and CORBA, Introduction to .NET, Overview of. NET architecture, Remoting.

UNIT – V **(10Hours)**

Service Oriented architecture (SAO) Fundamentals

Defining SOA, Business value of SOA, SOA characteristics, Concept of a service, Basic SOA , Enterprise Service Bus (ESB), SOA enterprise Software Models.

UNIT-VI **(08Hours)**

Web Services Technologies

XML Technologies - XML, DTD, XSD, XSLT< XQUERY, XPATH, Web Services and SOA, WSDL, SOAP, UDDI, WS Standards (WS-*), Web Services and Service Oriented Enterprise (SOE), WS _ Coordination and Transaction, Business Process Execution Language for Web Services (BPEL4WS). Study of different middleware tools.

Text Books

1. G. Sudha Sadasivam “Distributed Component Architecture”, Wiley India edition.

2. Thomas Erl “Service Oriented Architecture: Concepts , Technology & Design”, Prentice Hall

3. G. Brose, A Vogel and K. Duddy, “Java programming with CORBA”, 3rd Edition, Wiley-dreamtech, India John Wiley and sons

References

1. Robert Orfali, Dan Harkey, “Client/server Programming with Java & Corba W/cd”, Wiley India Pvt. Ltd.

2. Clemens Szyperski, “Component Software: Beyond Object-Oriented Programming”, Pearson Education.

3. A. Tanenbaum, M. Van Steen: Distributed Systems (II Edition), Pearson Education, 2007

4. Bill Burke, “Enterprise JavaBeans 3.0”, 5th Edition, O’Reilly Publications.

5. Sudha Sadasivam “Component Based technology” , Wiley India
6. Ed Roman, “Mastering Enterprise Java Beans”, John Wiley & Sons Inc.,
7. Mowbray, “Inside CORBA”, Pearson Education.
8. Jason Pritchard, "COM and CORBA side by side”, Pearson Education
9. Introduction to C# Using .NET Pearson Education
10.C# How to program, Pearson Education
11.Andrew Troelsen, “C# and the .NET Platform”, Apress Wiley-dreamtech, India Pvt. Ltd.
12. Don Box, "Essential COM", Pearson Education.

KNOWLEDGE REPRESENTATION AND REASONING

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT:-I **(14 Hours)**

Key concepts – Why knowledge Representation and Reasoning – Language of first order Logic – Syntax, Semantics Pragmatics – Expressing Knowledge – Levels of Representation – Knowledge Acquisition and Sharing –Sharing Ontologies – Language Ontologies.

UNIT:-II

Language Patterns – Tools for Knowledge Acquisition Proportional Case – Handling Variables and Qualifies – Dealing with Intractability – Reasoning with Horn Clauses-Procedural Control of Reasoning – Rules in Production – Description Logic – Vivid Knowledge – Beyond Vivid.

UNIT:-III **(10 Hours)**

Representation: Object Oriented Representations – Frame Formalism – Structured Descriptions – Meaning and Entailment.

UNIT:-IV

Taxonomies and Classification – Inheritance – Networks –Strategies for Defeasible Inheritance – Formal Account of Inheritance Networks.

UNIT:-V **(10 Hours)**

Defaults, Uncertainanty, Expressiveness:Defaults – Introduction – Closed World Reasoning – Circumscription – Default Logic Limitations of Logic – Fuzzy Logic – Nonmontonic Logic – Theories and World – Semiotics – Auto epistemic Logic Vagueness – Uncertainty and Degrees of Belief – Non-categorical Reasoning – Objective and Subjective Probability.

UNIT:-VI **(10Hours)**

Actions and Planning: of Context – First Order Reasoning – Modal Reasoning Actions and Planning: in Context – Encapsulating Objects in Context – Agents – Actions – Situational Calculus – Frame Problem – Complex Actions – Planning – Strips – Planning as Reasoning – Hierarchical and Conditional Planning.

References:-

1. Ronald Brachman, Hector Levesque “Knowledge Representation and Reasoning “, the Morgan Kaufmann Series in Artificial Intelligence 2004

2. John F. Sowa, “Knowledge Representation: Logical, Philosophical, and Computational Foundations”, 2000

3. Arthur B. Markman, “Knowledge Representation”, Lawrence Erlbaum Associates,1998

COMPUTATIONAL INTELLIGENCE

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT-I **(12Hours)**

Biological Basis for Neural Networks, Computational Intelligence application Areas, Adaptation, Computational Intelligence: Adaptation versus Learning, Types of Adaptation, Spaces of Adaptation, Self-Organization and Evolution, Computational Intelligence and Soft Computing, Artificial Intelligence and Hard Computing.

UNIT-II **(06Hours)**

Evolutional Computation Concepts and Paradigms, Genetic Algorithms and Programming, Particle Swarm Optimization: Developments, Resources, Evolutionary Programming: Overview, Schemata and Schema Theorem, Finite State Machine Evolutionary Programming, Evolutionary Computation Implementations: Homogenous and Heterogeneous Representation, Static and Dynamic Adaption, Error Checking.

UNIT-III **(10Hours)**

Neural Network Concepts and Paradigms, Neural Network Components and Terminology, Topologies, Hebbian Adaptation, Stochastic Approximation, Correlation, Bayes Classification, Preprocessing, Post Processing, Neural Network Implementations, Back-propagation, Kohonen Network.

UNIT-IV **(08Hours)**

Fuzzy systems Concepts and Paradigms: Approximate Reasoning, Developing a Fuzzy Controller, Fuzzy System Implementations, Computational Intelligence Implementations, Applying Computational Intelligence to Data Mining.

UNIT-V **(12Hours)**

Performance Metrics: Selecting Gold Standards, Partitioning the Patterns for Training, Testing and Validation, Cross Validation, Fitness and Fitness Functions, Parametric and Nonparametric Statistics.

UNIT-VI **(08Hours)**

Cryptography and Cryptanalysis through Computational Intelligence, Multimedia content Protection Based on Chaotic Neural Networks.

References:

[1] Computational Intelligence, Concepts to implementations, Dr. Russell Eberhart, Dr. Yuhui Shi, By Elsevier Inc.

[2] Computational Intelligence, Andries P. Engelbrecht, Second Edition, John Wiley & Sons Ltd.

[3] Computational Intelligence in Information Assurance and Security, Nadia Nedjah, Ajith Abraham, Luiza de Macedo Mourelle, Springer.

[4] Computational Intelligence, Methods and Techniques, Leszek Rutkowski.

SOFT COMPUTING

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT-I **(08 Hours)**

Introduction to Soft Computing

Introduction, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Applications.

UNIT-II **(08 Hours)**

Neural Networks:Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions,Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

UNIT-III **(10 Hours)**

Neural Networks – I Architecture: perception model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting back propagation training, applications.

UNIT-IV **(08 Hours)**

Fuzzy Set Theory Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion, Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

UNIT-V **(06 Hours)**

Genetic Algorithm(GA)

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation,

Generational Cycle, applications.

UNIT-VI **(08 Hours)**

Hybrid Systems Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms, GA Based Back Propagation Networks, Fuzzy Back Propagation Networks, Fuzzy Associative Memories, Simplified Fuzzy ARTMAP.

Reference Books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.
2. Fakhreddine karray and Clarence de Silva, "Soft Computing and Intelligent Systems Design - Theory, Tools and Applications", (2004), Addison Wesley
3. J. S. R. Jang, C. T. Sun, and E. Mizutani "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", (1996), Prentice Hall
3. N.P.Padhya,"Artificial Intelligence and Intelligent Systems" Oxford University Press.
5. Siman Haykin, "Neural Networks", Prentice Hall of India
6. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
7. Kumar Satish, "Neural Networks" Tata Mc Graw Hill

E-COMMERCE AND PAYMENT SYSTEM

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT - I **(12Hours)**

Ecommerce business models and concepts, EC infrastructure, Ecommerce -Frame work, anatomy of E-Commerce applications,

UNIT-II

E-Commerce Consumer applications, E-Commerce organization applications.
- Consumer Oriented Electronic commerce - Mercantile Process models.

UNIT - III **10Hrs**

ESecurity and payment systems, Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems.
- Inter Organizational Commerce - EDI, EDI Implementation, Value added networks.

UNIT - IV **13Hrs**

Concepts and communications, ethical, social and political EC issues, Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management.

UNIT-V

- Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses. Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research. Marketing, online retailing, services, content and media, social networks

UNIT - VI **13Hrs**

Consumer Search and Resource Discovery – Information search and Retrieval, Commerce Catalogues, Information Filtering.

- Multimedia - key multimedia concepts, Digital Video and electronic Commerce, Desktop video processing, Desktop video conferencing.

Reference Book

1. Laudon K., C. G. Traver, E-Commerce Prentice Hall, 2010
2. William S. Davis, John Benamati, E-Commerce Basics: Technology Foundations and E-Business Applications, Prentice Hall

AGILE SYSTEMS

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT I

Traditional Software Development **(5 Hrs)**

History of Project Management, Waterfall Approach, Requirements, Design Phase, Implementation, Testing, Support, Advantages and Disadvantages, Project Management, Modified Waterfall Models Milestone and Regular Integration, Incremental Development

UNIT II

Overview of Agile Software Development **(11Hrs)**

Lean Software Development, Project Management 2.0, Agile Manifesto, Scrum, Test Driven Development, Extreme Programming, Rational Unified Process, Best Practices, The Phases, The Process, Agile Unified Process, Agile Model Driven Development.

Agile requirements strategies: Active stakeholder participation, Functional requirements management, Initial requirements envisioning, Iteration modelling, Just in time (JIT) model storming, Non-functional requirements management, Who is doing this?, The implications for testing.

UNIT III **(11Hrs)**

Tooling

Project Management Tools: Microsoft Solutions Framework for Agile Development, Jazz and Rational Team Concert (RTC), Collaboration Tools, Development Infrastructure and Environment, Source Control and Version Management, Automated Test Environment, ‘‘Code-Build-Test’’

Installing Rails: Installing on Windows, Installing on Linux, Setting Up Your Development Environment, Rails and Databases. The Architecture of Rails Applications: MVC, The Depot Application: Incremental Development, What Depot Does.

UNIT IV **(11 hours)**

Agile testing strategies Project initiation, The whole team, The independent test team, Test environment setup, Development team testing, Continuous integration, Test-driven development (TDD), Test-immediately after approach, Parallel independent testing, Defect management, End-of-lifecycle testing, Who is doing this?, Implications for test practitioners.

An Agile Approach to Test Automation, Automation Test Categories, Test Automation Pyramid, What Can We Automate?, Continuous Integration, Builds, and Deploys, Unit and Component Tests, API or Web Services Testing, Testing behind the GUI, Testing the GUI, Load Tests, Comparisons, Repetitive Tasks, Data Creation or Setup.

UNIT V: **(5Hrs)**

Agile quality strategies Refactoring, Non-solo development, Static code analysis, Reviews and inspections, Iteration/sprint demos, All-hands demos, Light-weight milestone reviews, Short feedback cycles, Standards and guidelines, Implications for quality practitioners.

UNIT VI **(5Hrs)**

Mix and Match

The Tragedy of Being Successful, About WebSphere Portal, Which Projects are suitable for Agile Software Development?, Moving Towards Agile, Tiger Teams in WebSphere Portal, Budget-based Prioritization, Cross-Organizational Teaming Structure, Evolving the Product in Iterations, Integrating Test and Development, Designs and Documentation, Managing Tiger Teams, The Benefits and Pain Points, The Essence of Agile, Comparing once again, Case study: Agile unified process based tools.

REFERENCES

1. AgileSoftwareDevelopment.com http://agilesoftwaredevelopment.com/
   This is a community website where you can post ideas, comments, or articles around Agile Software Development. Some of them highlight interesting aspects and good evolutions
2. Agile Unified Process http://www.ambysoft.com/unifiedprocess/agileUP.html
   This is Scott Ambler's homepage. He derived the Agile Unified Process (AUP) from the Rational Unified Process and his website contains extensive of information and details on the Agile Unified Process

3. Ambler S (2002) Agile modeling – effective practices for extreme programming and the unified process. Wiley, New York
4. Beck K, Beedle M, van Bennekum A, Cockburn A, Cunningham W, Fowler M, Grenning J, Highsmith J, Hunt A, Jeffries R, Kern J, Marick B, Martin RC, Mellor S, Schwaber K, Sutherland J, Thomas D. The Agile Manifesto: 2001 , http://agilemanifesto.org/
5. Chrysler Comprehensive Compensation System: http://calla.ics.uci.edu/histories/ccc/
   Here you can find a good summary on the Chrysler Comprehensive Compensation System, including some numbers about its size
6. Herela H. Case study: The chrysler comprehensive compensation system 2005 http://calla.ics.uci.edu/histories/ccc/
7. ImaiM(1986)Kaizen:TheKeytoJapan'sCompetitiveSuccess.RandomHouse,NewYork,NY 8. Cohn M. Mountain goat software:
   http://www.mountaingoatsoftware.com/
   Mike Cohn is an active promoter of scrum and has published a number of books on the subject. This website contains interesting papers and presentations on Agile Software Development. You can also order planning poker cards or can play planning poker online
9. Poppendieck, Mary, and Tom: http://www.poppendieck.com/
   Lean Development Software - An Agile Toolkit for Software Development Managers. Addison-Wesley Longman 2003 Implementing Lean Software Development: From Concept to Cash. Addison-Wesley Longman 2006 Mary & Tom Poppendieck's homepage and books are a good place to start if you want to learn more about Lean Development. In addition, a collection of their essays are provided that you can read online
10. Rational Unified Process: Best Practices for Software Development Teams:
    http://www.ibm.com/developerworks/rational/library/content/03July/1000/1251/1251_bestpractices_TP026B.pdf
    This is a very good paper summarizing The Rational Unified Process (RUP)
11. Schwaber K, Beedle M (2001) Agile software development with scrum. Prentice Hall, Englewood Cliffs, NJ
12. Scott Ambler: Agile Modeling Homepage:
    http://www.agilemodeling.com/

Scrum Alliance:
http://www.scrumalliance.org/

The Scrum alliance is trying to build a community around scrum as well as a good resource for articles, list of courses, and news on scrum

13. Scrum et al. – by Ken Schwaber:
    http://video.google.co.uk/videoplay?docid=-72301
    44396191025011&ei=T811SYrJOonojgLngsm5BQ&q=scrum
    This is a good video of a session Ken Schwaber did for Google. The video is about an hour long and Ken Schwaber gives a good and entertaining introduction to Scrum and talks about potential problems and how you can avoid them
14. Toyota – Toyota Production System:
    www.toyota.co.jp/en/vision/production_system/
    This Toyota website gives a good overview of the history of the Toyota Production System (TPS), and a very good introduction to the basic concepts of TPS. There is a small quiz you can use to test what you learned
15. Womack J, Jones D, Roos D (1990) The machine that changed the world: The story of Lean Production – Toyota's secret weapon in the global car wars that is now revolutionizing world industry. Rawson, New York
16. XProgramming:
    http://www.xprogramming.com/

SOFTWARE SECURITY

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT I **(11Hrs)**

SOFTWARE SECURITY FUNDAMENTALS

The Security Problem: The Trinity of Trouble: Why the Problem Is Growing, Basic Science, Security Problems in Software: Bugs and Flaws and Defects, Oh My!, The Range of Defects, The Problem with Application Security, Software Security and Operations, Solving the Problem: The Three Pillars of Software Security, Pillar I: Applied Risk Management, Pillar II: Software Security Touch points, Pillar III: Knowledge, The Rise of Security Engineering, Software Security Is Everyone's Job. Experience, Expertise, and Security, Security Knowledge: A Unified View, Security Knowledge and the Touch points, The Department of Homeland Security Build Security In Portal, Knowledge Management Is Ongoing, Software Security Now.
Applying Security in Software Development Lifecycle (SDLC), Growing Demand of Moving Security Higher in SDLC, Effective Application Security Model, Application Classification, Application Security Requirements, Secure Application Design, secure coding & Testing.

UNIT II **(8Hrs)**

REQUIREMENTS ENGINEERING FOR SECURE SOFTWARE

Introduction, The Importance of Requirements Engineering, Quality Requirements, Security Requirements Engineering, Misuse and Abuse Cases, Security Is Not a Set of Features, Thinking About What You Can't Do, Creating Useful Misuse Cases, An Abuse Case Example, The SQUARE Process Model, A Brief Description of SQUARE, Tools, Expected Results, SQUARE Sample Outputs, Output from SQUARE Steps, SQUARE Final Results, Requirements Elicitation, Overview of Several Elicitation Methods, Elicitation Evaluation Criteria,

Requirements Prioritization, Identify Candidate Prioritization Methods,Prioritization Technique Comparison, Recommendations for Requirements Prioritization.

UNIT III **(6Hrs)**

SECURE SOFTWARE ARCHITECTURE AND DESIGN

The Critical Role of Architecture and Design, Issues and Challenges, Software Security Practices for Architecture and Design: Architectural Risk Analysis, Software Characterization, Threat Analysis, Architectural Vulnerability Assessment, Risk Likelihood Determination, Risk Impact Determination, Risk Mitigation Planning, Recapping Architectural Risk Analysis, Software Security Knowledge for Architecture and Design: Security Principles, Security Guidelines, and Attack Patterns, Security Principles, Security Guidelines, Attack Patterns.

UNIT IV **(6Hrs)**

CODE ANALYSIS

Common Software Code Vulnerabilities, Source Code Review, Coding Practices, Sources of Additional Information on Secure Coding, Software Security Testing, Contrasting Software Testing and Software Security Testing, Functional Testing, Risk-Based Testing, Security Testing Considerations Throughout the SDLC, Unit Testing, Testing Libraries and Executable Files, Integration Testing, System Testing, Sources of Additional Information on Software Security Testing.

UNIT V **(6 Hrs)**

CODE REVIEW WITH A TOOL

Catching Implementation Bugs Early (with a Tool), Aim for Good, Not Perfect, Ancient History, Approaches to Static Analysis, The History of Rule Coverage, Modern Rules, Tools from Researchland, Commercial Tool Vendors, Commercial Source Code Analyzers, Key Characteristics of a Tool, Three Characteristics to Avoid, The Fortify Source Code Analysis Suite, The Fortify Knowledge Base, Using Fortify, Touchpoint Process: Code Review, Use a Tool to Find Security Bugs

UNIT VI **(11Hrs)**

A TAXONOMY OF CODING ERRORS On Simplicity: Seven Plus or Minus Two, Input Validation and Representation, API Abuse, Security Features, Time and State, Error Handling, Code Quality, Encapsulation, Environment, The Phyla, More Phyla Needed, A Complete Example, Lists, Piles, and Collections, Nineteen Sins Meet Seven Kingdoms, Seven Kingdoms and the OWASP Ten, Go Forth (with the Taxonomy) and Prosper.

Security Failures, Categories of Errors, Attacker Behavior, Functional and Attacker Perspectives for Security Analysis: Two Examples, Web Services: Functional Perspective, Web Services: Attacker's Perspective, Identity Management: Functional Perspective, Identity Management: Attacker's Perspective, Identity Management and Software Development, System Complexity Drivers and Security, Wider Spectrum of Failures, Incremental and Evolutionary Development, Conflicting or Changing Goals Complexity, Deep Technical Problem Complexity.

REFERENCES

- Thirteen principles to ensure enterprise system security (January 17, 2013)
- Twelve common software security activities to lift your program (December 10, 2012)
- Proactive defense prudent alternative to cyberwarfare (November 1, 2012)
- Ten commandments for software security (October 4, 2012)
- Data supports need for security awareness training despite naysayers (September 4, 2012)
- Congress should encourage bug fixes, reward secure systems (August 1, 2012)
- Mobile security: It's all about mobile software security (July 2, 2012)
- Cloud computing pros and cons for security (June 19, 2012)
- Eliminating badware addresses malware problem (May 7, 2012)
- Software security assurance: Build it in, build it right (April 10, 2012)
- Lost Decade or Golden Era: Computer Security since 9/11, (IEEE Security & Privacy, January/February 2012)
- Technology Transfer: A Software Security Marketplace Case Study (IEEE Software, September/October 2011)
- Separating the Threat from the Hype: What Washington Needs to Know About Cyber Security in AMERICA'S CYBER FUTURE: SECURITY AND PROSPERITY IN THE INFORMATION AGE VOLUMES I AND II, Center for a New Amercian Security (June 2011).
- Interview: Software Security in the Real World, Computer (September 2010).
- Real-World Software Security, Dr. Dobbs (August 6, 2010); see also: InformationWeek.
- Lifestyle Hackers, CSO Online (November 2, 2009).

- Securing Online Games: Safeguarding the Future of Software Security, IEEE Security & Privacy (May/June 2009).
- How Things Work: Automated Code Review Tools for Security, Computer (December 2008).
- Online Games and Security, IEEE Security & Privacy (October/September 2007)
- Software Security and SOA: Danger, Will Robinson! (January/February 2006)
- Seven Pernicious Kingdoms: A Taxonomy of Software Security Errors (November/December 2005)
- Bridging the Gap Between Software Development and Information Security (September/October 2005)

ADVANCED WEB TECHNOLOGIES

Teaching Scheme
Lectures:-4 Hours/Week

Examination Scheme
Theory:-60 Marks
Internal assessment:-40 Marks
Credits:-04

UNIT- I **(08 Hours)**

Introduction to Web Design:
Introduction to TCP/IP, FTP, UDP, N-Tier, Markup Languages – HTML, DHTML, XHTML – simple XHTML pages style sheets – CSS, DNS, URL, Browsers.

UNIT-II **(08 Hours)**

Introduction to J2EE:
MVC Design Pattern, What Is J2EE?, J2EE Architecture, J2EE Components & Containers, Specification, Application servers, Struts as case study of MVC, Open system Vs Closed system of web and web language related to this.

UNIT- III **(08 Hours)**

Client side programming: Java Applets, Java script language – java script objects – host objects : Browsers.
Server side programming: Java Servlets – basics Servlets, Servlet Life cycle, C#, simple program – separating programming and presentation – JSP - JSP basics, JSP objects – simple JSP pages, JSTL.

UNIT- IV **(08 Hours)**

Representing Web data : data base connectivity – JDBC and database connection pooling Basic step in using JDBC – Dynamic Web pages – XML – DTD – XML schema
DOM Document object Model : Defining DOM, DOM core level-I, creating document object, Node interface, Document interface, Element Interface, Attr interface, additional interfaces, Dom level –II XSL extensible stylesheet Language – SAX – Xquery. Java beans, Introduction to EJBs

UNIT- V **(08 Hours)**

Web Services: What is WSDL?, Web services invocation & WSDL, Web services Description details, Service Description through WSDL. Registers Universal description, Discovery and Inteqratron, UDDI.
Building Web applications - cookies – sessions – open source environment – PHP – MYSQL – case studies. SOAP: Web services application opportunities, service oriented architecture

UNIT-VI **(08 Hours)**

Java Mail API, JNDI, JMS, Introduction and evolution of Portals, Portal Application Development, Overview of IBM Portlet API, Overview of JSR 168 API, Developing Sample JSR 168 portlet, Overview of Internationalization and localization.

REFERENCE BOOKS:

1. Jeffrey C Jackson, " Web Technology – A computer Science perspective", Persoson Education, 2007.
2. Chris Bates, "Web Programming – Building Internet Applications, "Wiley India, 2006.
3. Ravi Kalakota and Andrew B Whinston, "Frontiers of Electronic commerce", Addison Wesley,
4. Eric Ladd, Jim O' Donnel, " Using HTML 4, XML and Java", Prentice Hall of India – QUE,
5. Jeffy Dwight, Michael Erwin and Robert Niles, "Using CGI", prentice Hall of India – QUE,
6. Scot Johnson, Keith Ballinger, Davis Chapman, "Using Active Server Pages", Prentice Hall of India,
7. Jeffy Dwight, Michael Erwin and Robert Niles, "Using CGI", prentice Hall of India – QUE,
8. Michal Daconta '"XML development with Java 2", AI saqanich SAMS Tech media Publication
9. Core Servlet and Java Server Pages ", Marrty Hall, sun publication

HIGH PERFORMANCE INFORMATION SYSTEM

Teaching Scheme | Examination Scheme

Lectures:-4 Hours/Week | Theory:-60 Marks

Internal assessment:-40 Marks

Credits:-04

UNIT: I **6(Hrs]**

Introduction : IS measurement, Performance index, Parallel System Architecture, Parallel Execution Scheme, System Software, Parallelizing Compiler, Load Distribution, Parallel Programming, Grid architecture **Overview of Performance Evaluation:** Introduction, Selection of Techniques and Metrics, measuring the reporting performance, Benchmark suites, Amdahl's law, SPEC CPU benchmarks, SPEC 95, 2000, server, memory, I/P Performance Types of workloads, art of workload selection, workload characterization and techniques. Program execution monitors, Analytical modeling for performance.

UNIT: II (**6Hrs)**

Digital Networks: X.25 based networks / ISDN, B-ISDN and ATM Technology, protocol stack, ATM switches architecture, ADSL. IP based network, IP addressing, routing IP traffic over ATM n/w, MPLS, GMPLS technology, Voice over IP, applications for HPIS

UNIT: III **(6Hrs)**

Probability Theory and use for evaluation: Notion of probabilities and basic properties, Continuous random variables, Bayes theorem, conditional probabilities, Discrete and Continuous random variables, Probabilities Generation function & Laplace transform, Transformation generation methods. Use for performances evaluation in networking. Linear regression models **Stochastic Processes:** Stochastic processes, first and second order statistics, stationery stochastic processes, spectral densities, Brownian Motion Process, use of Prob for HPIS

UNIT: IV **(6Hrs)**

Queuing Theory and Models: Queuing models, Little theorem application, Markov chain formulation. Discrete time and Continuous time Markov Chains (DTMC, CTMC), MMD, Queuing system M/M/1, M/M/1/K, M/M/S/, M/M/¥ queue analysis m-server case. Multimensional Markov chain application in Circuit Switching. **Queuing Theory and Application:** M/G/1 Queue, generalization of M/G/1 theory application to ATM. Imbedding instants in the M/G/1 theory M/G/1 with geometrically distributed messages. Chain imbedded to cell transmission, message transmission completion. Queue balance equation, Finite buffer case, Mean Value Analysis, applying queuing theory for HPIS

UNIT: V **(6Hrs)**

Network Analysis: Local area Network analysis, standard comment based analysis, contention based protocols, demand assignment protocols, nodes in packet switches networks, performance analysis of data link layer, Network layer. Traffic control and congestion in ATM networks, TCP/IP Traffic control, Network Performance measurement and tracking tools

UNIT: VI **(6Hrs)**

Simulation: Introduction to simulation, simulation modeling and analysis in computer systems and networks, analysis of simulation results, Random Number generation, Statistical analysis of simulation, simulation CASE tool

Reference books

1. The Art of Computer Systems Performance Analysis, by Raj Jain, Wiley, New York, NY, April 1991.
2. Queuing Theory and Telecommunication by Giovanni Grambene, Springer 2005
3. High Speed Networks and Internets, Performance and Quality of Service, W. Stallings, 2nd Ed., Prentice Hall, 2002.
4. Performance Evaluation of Communication Networks, G.N. Higginbottom, Artech House, 1998.
5. Computer Systems Performance Modelling, C.H. Sauer and K.M. Chandy, Prentice Hall.
6. Simulation Modelling and Analysis by Law and Kelton, McGraw Hill.
7. “The Practical Performance Analyst”, Neil J. Gunther, McGraw Hill, 1998

8. “ Queueing Networks and Markov Chains”, G. Bolch, et al., Wiley 1998.
9. “ Queueing Theory Vol. I and Vol. II”, L.Klenrock.
10. “ Introduction to Computer System Performance Evaluation”, K. Kant, McGRAW Hill, 1992.
11. “ Probability, Stochastic Processes, and Queuing Theory”, Randolph Nelson, Springer Verlag, 1995.
12. High Performance Networking, Computing, Communication Systems, and Mathematical Foundations : Wu, Yanwen; Luo, Qi (Eds.) Springer
13. An architecture for high performance engineering information systems : IEEE

BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE

Faculty of Engineering And Technology
M.Tech. - Computer Engineering
Old Syllabus

Bharati Vidyapeeth

(Deemed to be University)

Pune, India

College of Engineering, Pune

M.Tech. (Computer Engineering)

Program Curriculum

(2015 Course)

VISION OF UNIVERSITY:

Social Transformation through Dynamic Education

MISSION OF UNIVERSITY:

- To make available quality education in different areas of knowledge to the students as per their choice and inclination
- To offer education to the students in a conducive ambience created by enriched infrastructure! and academic facilities in its campuses
- To bring education within the reach of rural, tribal and girl students by providing them substantive fee concessions and subsidized hostel and mess facilities
- To make available quality education to the students of rural, tribal and other deprived sections of the population

VISION OF THE INSTITUTE:

To be World Class Institute for Social Transformation Through Dynamic Education.

MISSION OF THE INSTITUTE:

- To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

VISION OF THE DEPARTMENT:

To pursue and excel in the endeavour for creating globally recognized Computer Engineers through Quality education.

MISSION OF THE DEPARTMENT:

- To impart engineering knowledge and skills confirming to a dynamic curriculum.
- To develop professional, entrepreneurial & research competencies encompassing continuous intellectual growth.
- To produce qualified graduates exhibiting societal and ethical responsibilities in working environment.

PROGRAM OUTCOMES:

- PO1: An ability to independently carry out research /investigation and development work to solve practical problems
- PO2: An ability to write and present a substantial technical report/document
- PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PROGRAM OUTCOMES:

- PO1: An ability to independently carry out research /investigation and development work to solve practical problems
- PO2: An ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Program Specific Outcomes (PSO)

PSO1: Design software programs to meet identified needs within economic, environmental and social constraints.

PSO2: Ability to apply mathematical foundations and algorithmic principles for modeling and simulation of engineering problems.

PSO3: Use research-based knowledge and tools for the analysis and interpretation of data to synthesize information for obtaining valid conclusions.

Semester I

Sr.no	Course Code	Course Title	L	T	P	Contact hrs/wk	Theory	Unit Test	TA & Assignments	Practical	Oral	Total Marks	Total Credits
1		Advanced Database Management System	4	-	2	6	60	20	20	25	25	150	5
2		Advanced Software Engineering	4	-	2	6	60	20	20	25	25	150	5
3		Mobile Operating System	4	-	-	4	60	20	20	-	-	100	4
4		Distributed Computing	4	-	-	4	60	20	20	-	-	100	4
		TOTAL	16		4	20	240	80	80	50	50	500	18

Semester II

Sr.no	Course Code	Course Title	L	T	P	Contact hrs/wk	Theory	Unit Test	TA & Assignments	Practical	Oral	Total Marks	Credits
1		High Performance Computing	4	-	2	6	60	20	20	25	25	150	5
2		Advanced Computer Algorithms	4	-	-	4	60	20	20	-	-	100	4
3		Web Technologies	4	-	-	4	60	20	20	-	-	100	4
4		Wireless Communication and Security	4	-	2	6	60	20	20	25	25	150	5
		TOTAL	16	-	4	20	240	80	80	50	50	500	18

Semester III

Sr.no	Course Code	Course Title	L	T	P	Contact hrs/wk	Theory	Unit Test	TA & Assignments	Term Work	Oral	Total Marks	Credits
1		Elective - I	4	-	2	6	60	20	20	25	25	150	5
2		Elective - II	4	-	2	6	60	20	20	25	25	150	5
3		Self Study Paper I	4	-		4	60	20	20	-	-	100	4

4		Seminar		-	5	5				25	25	50	5
5		Dissertation Stage I			7	7				25		25	21
		TOTAL	**12**	**-**	**16**	**28**	**180**	**60**	**60**	**75**	**50**	475	**40**

Semester IV

Sr.no	**Course Code**	**Course Title**	**L**	**T**	**P**	**Contact hrs/wk**	**Theory**	**Unit Test**	**TA & Assignments**	**Term Work**	**Oral**	**Total Marks**	**Credits**
1		Self Study Paper II	4			4	60	20	20	-	-	100	4
2		Dissertation Stage I			10	10				150	75	225	30
		TOTAL	**4**	**0**	**10**	**14**	**300**	**100**	**100**	**150**	**75**	325	**34**

Elective I:
- E-Commerce and ERP
- Information Storage Management
- Cyber Security
- Big Data & Analytics

Elective II:
- Cryptography and Network Security
- Parallel Computing
- Wireless Sensor Network
- Storage Area Network

Self study paper I Sem-III	Self study paper II Sem-IV
Bioinformatics	Grid Computing
Information Retrieval and Web search	Research methods in Computer Science
Speech Processing	Middle ware Technologies
Sensor Network and Embedded System	Agile Systems

Computer Graphics and Visualization	Soft Computing
Cloud Computing	Knowledge Representation and Reasoning
Pervasive Computing	Computational Intelligence
Data Warehousing and Data Mining	High performance Information Systems
Software Security	Advanced web Technologies
Enterprise Resource Planning	E-commerce and Payment Systems

Advanced Database Management System

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I **Parallel and Distributed Databases :** [08 Hrs]

Architectures for parallel database, Parallel query Evaluation, Parallelizing individual operation, Parallel Query Optimization, Distributed DBMS Architecture, Storing data in distributed DBMS, Distributed Catalog Management, Distributed query processing, Updating distributed data,
Distributed concurrence control, Distributed recovery.

Unit II **Web databases :** [08 Hrs]

Web search engines, web search architecture, Inverted indexes the IR way, Inverted indexes for web search engines, web crawling, web search statistics.

Unit III **Data Warehousing:** [08 Hrs]

Introduction Data Warehousing OLAP, Implementation Techniques for OLAP, Views and decision support.

Data Mining:

Introduction, Counting Co-occurrences, Mining for rules, Tree structured rules, Clustering, Similarity search over sequences, Additional data mining tasks.

Unit IV **Object Database Systems:** [08 Hrs]

User defined abstract data types, Structured types, Objects, Objects Identity and Reference types, Inheritance, database design for an ORDBMS, Comparing RDBMS with OODBMS and ORDBMS.

XML:

Introduction, Structure of XML Data, XML Document Schema, Querying and Transformation, API to XML, Storage of XML Data, XML Applications.

Unit V **Spatial Data Management :** [08 Hrs]

Types of Spatial Data and Queries Application involving Spatial data, Introduction to spatial Indexes, Indexing based on space filling Curves, Grid files, R trees, High command Indexing.

Unit VI **Deductive Databases:** [08 Hrs]

Recursive Queries, Theoretical foundation, Recursive Queries with Negation, Efficient evaluation of Recursive Queries, Additional Transaction Processing, Advance transaction processing Integrated access to Multiply data sources, Mobile database, multiplying database, Geographic Information systems, Temporal and Sequence database, Information Visualization.

Advanced Transaction Processing:

Transact ion-Processing Monitors, Transactional Workflows, Main- Memory Databases, Real-Time Transaction Systems, Long-Duration Transactions and Transaction Management in Multi-databases.

References:

[1] Rob & Colonel, “Database System Design Implementation & Management”, Thomson Learning
[2] Date, “An Introduction to database system”, Addison Wesley Pub.
[3] Desai “Principles of Repagination database”, Galgotia Publications
[4] Mallach, “Decision Support and Data Warehouse Systems”, TMH
[5] Raghu Ram Krishnan, “Database Management Systems”, IInd edition
[6] Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, 5th Edition , McGraw Hill International Edition.
[7] Jiawei Han, Micheline Kamber, “Data Mining: Concepts and Systems”,Morgan Kaufmann publishers

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Advanced Software Engineering

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I	Software Development Process: Software Processes, SDLC Models, Waterfall Model, The V Model, Prototyping Model, Iterative Model, Spiral Model. Agile Development, Agile Principles, XP, Scrum, AUP, Kanban, ASD, DSDM, FDD, Agile practices, Empirical Model in Software engineering.	[08 Hrs]
Unit II	Requirement Engineering: Requirements phase and its importance, Requirement Elicitation and Analysis, Process models (DFD), Data models (ERD), Software, Requirement Specification Standard and Preparation, Characteristics of good SRS Documents, traceability matrix and its importance, CASE tool, and its basic features. Black box testing: Test case design and implementation, Automated testing and limitations, debugging methods, Black box testing methods.	[08 Hrs]
Unit III	Process Improvement and Verification: Process and product quality, Process classification, Process Measurement, Process Analysis and Modelling, Process change, The CMMI process improvement framework, Configuration Management Planning, Change management, Version and release management, System building, CASE tools for configuration management.	[08 Hrs]
Unit IV	User interface Design, Maintenance and reengineering: User interface design issues: The UI design process, User analysis, User interface prototyping, Interface Evaluation. Software Maintenance: Reengineering, Business process reengineering, software reengineering, reverse engineering, restructuring, Forward engineering, The economics of reengineering.	[08 Hrs]
Unit V	Software Reuse, CBSE: The reuse landscape, Design patterns, Frameworks, Generator based reuse, Application frameworks, Application system reuse, components and component models, The CBSE process, component composition, service oriented software engineering - services as reusable components, service engineering, software development with services.	[08 Hrs]
Unit VI	Quality Management - Quality Concepts, Software Quality, The review technique, cost impact of software defects, defect amplification and removal, Review metrics and their use, Reviews: A formal spectrum, Informal spectrum, Formal technical reviews, SQA: Background issues, Elements of SQA: SQA tasks, goals and metrics, Formal approaches to SQA: statistical SQA, Software reliability. The ISO 9126 quality factors, Mc Call's quality factors, The SQA plan.	[08 Hrs]

References:

[1] Ian Sommerville, "Software Engineering: Update", 8th Edition
[2] Roger S. Pressman and Roger, "Software Engineering: A Practitioner's Approach"
[3] Shari Lawrence Pfleeger and Joanne M Atlee, "Software Engineering", 3rd Edition

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Mobile Operating Systems

Teaching Scheme:

Theory Hours: 04 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Total Credits: 4

Unit I	Brief History of Mobile Operating Systems: OS- Interfaces, Multilevel Views of OS, Categories, Small and Specialized OS, 64-Bit OS, Processes and Threads, System Performance and Models: Performance of Computer Systems, Performance Metrics, Workload and System Parameters, Simulation Models: Types, Discrete-Event Model, Stochastic Model.	[08 Hrs]
Unit II	System with Multiprogramming, Processor Scheduling, Synchronization, Deadlocks, File Management, Memory Management: Process Address Space, Contiguous Memory Allocation, Non Contiguous Memory Allocation, Virtual Memory, Paging with Virtual Memory.	[08 Hrs]
Unit III	Security and Protection Components for Security and Protection, Physical Security, User Authentication, Protection, Secure Communications, Digital Certificates, System Vulnerabilities, Invasive and Malicious Software, Defending the System and User, Intrusion Detection Management.	[08 Hrs]
Unit IV	Mobile Ecosystems: Application Framework, Developing a Mobile Strategy, Mobile Information Architecture, Mobile Design: Elements of Mobile Design, Ubiquity in the Mobile Web, Mobile Web Development.	[08 Hrs]
Unit V	Introduction to Using Linux Command Line Interface, Files and Directories, Shell Variables, Script Files, Connecting a Remote Linux Server. Java Modeling Framework, Java and Posix Threads.	[08 Hrs]
Unit VI	Case Study: Android SDK, iOS, Windows, Mobile Web Apps vs. Mobile Applications.	[08 Hrs]

References:

[1] Jose M Garrido, Richard Schlesinger, Kenneth Hoganson, Principles of Modern Operating Systems.

[2] By Brian Fling, Mobile Design and Development: Practical concepts and techniques for Creating Mobile Sites and Web Apps, O'Reilly Publications

[3] Brian Fling, Mobile Design and Development, O'Reilly Publications

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Distributed Computing

Teaching Scheme:

Theory Hours: 04 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Total Credits: 4

Unit I Distributed System Concepts: Distributed Computing Models, Software Concepts, Issues in Designing Distributed Systems Client-Server Model. Case Studies. [08 Hrs]
Network Communication: LAN and WAN Technologies, Protocols for Network Systems, Asynchronous Transfer Mode, Protocols for Distributed Systems.

Unit II [08 Hrs]
Interprocess Communication
Message Passing, Advantages and Features of Message Passing Systems, IPC Message Format, IPC Synchronization, Message Buffering Strategies, Multidatagram Messaging, Process Addressing Techniques, Failure Handling Mechanism. Case Study: IPC in Mach

Unit III Remote Communication: Introduction, Remote Procedural Call, RPC Implementation, RPC Implementation, Parameter Passing Semantics, Server Management, RPC Call Semantics, Communication Protocols, Client Server Binding, Exception Handling and Security, RPC in Heterogeneous Environment, Failure Handling, RPC Optimization, Case Study: Sun RPC, Java RMI. [08 Hrs]

Unit IV Synchronization: Clock Synchronization, Physical Clocks, Clock Synchronization Algorithms, Logical Clocks, Global State, Mutual Exclusion, Election Algorithms, Deadlocks: Prevention, Detection Recovery, Deadlocks in Message Communication. [08 Hrs]

Unit V Distributed System Management: Resource Management, Task Assignment Approach, Load Balancing Approach, Load Sharing Approach, Process Management in Distributed Environment, Process Migration, Threads, Fault Tolerance, Component Faults, System Failures and Use of Redundancy. [08 Hrs]

Unit VI Distributed Shared Memory: Architecture, Types of DSM, Hardware DSM, and Design Issues in DSM Systems. [08 Hrs]
Distributed File Systems, Naming, Security in Distributed Systems, Real Time Distributed Operating System, Distributed Database Management System, Emerging Trends in Distributed Computing.

References:

[1] H. Attiya, J. Welch Distributed Computing - Fundamentals, Simulation and Advanced Topics, Wiley Publications.

[2] Vijay Garg, Elements of Distributed Computing, Wiley Publications.

[3] S. Mahajan, S. Shan, Distributed Computing, Oxford Publications.

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

High Performance Computing

Teaching Scheme:

Theory Hours: 04 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I	Computer organization: Memory, Registers, Instruction set architecture, Instruction processing, Pipelined processors: Pipelining, Structural, data and control hazards, Impact on programming. Cache memory: Organization, impact on programming, virtual caches, Operating systems: Processes and system calls, Process management, Program profiling.	[08 Hrs]
Unit II	Modern Computer Architectures - Memory, Floating-Point Numbers, Programming and Tuning Software - What a Compiler Does, Timing and Profiling, Eliminating Clutter, Loop Optimizations, Program execution, Program, Compilation, Object files, Function call and return, Address space, Data and its representation. Parallel Processing Concepts - Levels of parallelism instruction, transaction, task, thread, memory, and function, Models SIMD, MIMD, SIMT, SPMD, Dataflow Models, and Demand-driven Computation etc. Case Study: Cluster Computing network.	[08 Hrs]
Unit III	Parallel Algorithms: Parallel models: ideal and real frameworks, Basic Techniques: Balanced Trees, Pointer Jumping, Divide and Conquer, Partitioning, Regular Algorithms: Matrix operations and Linear Algebra, Irregular Algorithms: Lists, Trees, Graphs, Randomization: Parallel Pseudo-Random Number Generators, Sorting, Monte Carlo techniques	[08 Hrs]
Unit IV	Parallel Programming: Revealing concurrency in applications, Task and Functional Parallelism, Task Scheduling, Synchronization Methods, Parallel Primitives (collective operations), SPMD Programming (threads, OpenMP, MPI), I/O and File Systems, Parallel Matlabs (Parallel Matlab, Star-P, Matlab MPI), Partitioning Global Address Space (PGAS) languages (UPC, Titanium, Global Arrays).	[08 Hrs]
Unit V	High-End Computer Systems: Memory Hierarchies, Multi-core Processors: Homogeneous and Heterogeneous, Shared-memory Symmetric Multiprocessors, Vector Computers, Distributed Memory Computers, Supercomputers and Petascale Systems, Application Accelerators / Reconfigurable Computing, Novel computers: Stream, multithreaded, and purpose-built, Architectures: N-wide superscalar architectures, multi-core, multi-threaded.	[08 Hrs]
Unit VI	Achieving Performance: Performance metrics and measurements, Measuring performance, Identifying performance bottlenecks, Restructuring applications for deep memory hierarchies, Partitioning applications for heterogeneous resources, Using existing libraries, tools, and frameworks, CASE tools.	[08 Hrs]

References:

[1] "Highly Parallel Computing", by George S. Almasi and Alan Gottlieb
[2] "Advanced Computer Architecture: Parallelism, Scalability, Programmability", by Kai Hwang, McGraw Hill 1993
[3] "Parallel Computer Architecture: A hardware/Software Approach", by David Culler Jaswinder Pal Singh, Morgan Kaufmann, 1999.
[4] "Scalable Parallel Computing", by Kai Hwang, McGraw Hill 1998.

[5] "Principles and Practices on Interconnection Networks", by William James Dally and BrianTowles, Morgan Kauffman 2004.
[6] GPU Gems 3 --- by Hubert Nguyen (Chapter 29 to Chapter 41)
[7] Introduction to Parallel Computing, AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey, © 2003.
[8] Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, © 2007.
[9] J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
[10] Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, John Wiley.
[11] R. E. Bryant and D. R. O'Hallaron, Computer Systems: A Programmer's Perspective, Prentice Hall.
[12] John Levesque (Author), Gene Wagenbreth (Author), High Performance Computing: Programming and Applications (Chapman & Hall/CRC Computational Science)

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Advanced Computer Algorithms

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I **Introduction :** [08 Hrs]

Asymptotic notation, Models of Computation, Algorithm & their complexity, Random Analysis machines, Computational complexity of RAM programs, A stored program model, Abstractions of the RAM, A primitive model of computation(Turing Machines),Relational between Turing machine & RAM model ,Pidgin ALGOL A high level lang.

Unit II **Algorithm Analysis:** Analyzing Algorithm, Designing Algorithm, Time & Space Complexity, Average & Worst case analysis, Lower Bounds. [08 Hrs]

Algorithm Design techniques: Divide & Conquer, Search Traversals, Dynamic Programming, Backtracking, Branch & Bound, Greedy Algorithm.

Unit III **Sorting and Searching Algorithm :** [08 Hrs]

The Sorting problem, Radix Sorting, Sorting by comparison, Heap sort-an O(n logn) comparison sort, Quick Sort-an O(n log n) expected time sort, Expected time for Order statistics, Binary Search, binary search trees, optimal binary search tree, B-Trees Algorithms on graph: Elementary graph Algorithm, Minimum spanning tree, Single Source shortest Path, All pairs shortest path

Unit IV **String Processing Algorithm:** [08 Hrs]

The naïve string matching, The Robin-Karp algorithm, String matching with Finite Automata, Knuth Morris Pratt Algorithm

Divide and conquer method: Binary search, Mergesort, Quick sort, Strasen's matrix multiplication.

The Greedy method: Knapsack problem, job sequencing, optical merge patterns, minimal spanning trees.

Unit V **Dynamic Programming:** Multistage graphs, OBST, 0/1 Knapsack, traveling sales man problem. [08 Hrs]

Back Tracking: Eight Queens problem, graph coloring, Hamiltonian cycles, Knapsack problem, Maze problem.

Branch & Bound: 0/1 Knapsack, Traveling salesman problem lower bound theory-comparisons trees for sorting/searching, lower bound on parallel computation.

Unit VI **NP-hard and Np-complete problems**- Algorithms, Complexity- intractability, Non-Deterministic Polynomial time (NP) Decision problems, cooks Theorem, NP-Complete problems- statisfiability problem, vertex cover problem. NP-Hard problems-graph, scheduling, code generation problems, Simplified NP Hard Problems, Approximation Algorithm for NP Hard Problem. [08 Hrs]

References:

[1] Bressard, “Fundamental of Algorithm”
[2] Horowitz, Sahani, “Fundamentals of Computer Algorithms”, Galgotia
[3] Thomas H. Cormen and Charles E. L. Leiserson, “Introduction to Algorithm”, PHI
[4] V. Aho and J. D. Ullman, “Design and Analysis of Algorithms”, Addison Wesley
[5] E. V. Krishna Murthy, “Introduction to Theory of Computer”

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Web Technologies

Teaching Scheme:

Theory Hours: 04 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Total Credits: 4

Unit I **Web Environment:** [08 Hrs]

WWW, HTTP, Web Server and its deployment, N-Tier Arch., Services of Web Server – Mail server, News server, Proxy server, Multimedia server.

XML Primer :

Mark-up languages, XML, Uses of XML. WELL-FORMED XML: Parsing XML, Tags, text, elements, attributes, comments and empty elements. XML Declaration, Processing, Instructions, Errors in XML

XML NAMESPACES: Need for namespaces, How XML namespaces work, URIs, When to use, namespace. **VALIDATION:** Document type definitions (DTD), Sharing vocabularies, Anatomy of DTD, Developing DTDs, DTD Limitations.

XML SCHEMAS: Benefit of XML schemas, Elements of XML Schema Definition, Creating a Schema from multiple documents. XPATH, XSLT, Xquery

Unit II **JSP :** [08 Hrs]

JSP overview, JSP language basics, JSP translation and compilation directives, Standard java objects from JSP, JSP configuration and deployment, actions and tags of JSP; Java servlets – Arch, servlet interface, applications of servlets.

Unit III **ASP :** [08 Hrs]

Objects and Components, Handling databases, Data Retrieval from Databases, applications of ASP, session management, ASP with .NET

Unit IV **Web Technologies :** [08 Hrs]

Server side programs. CGI programs. Client side scripts. The Applet Concept.

Search Engine Optimization: Strategies, Optimizing Search strategies, Robots, Spiders and Crawlers, Mobile Search Engine Optimization.

Unit V **The Web as an example of client server computing :** [08 Hrs]

Characteristics of web servers: handling permissions. File Management Capabilities of common server architectures .Role of client Computer.

Nature of Client server relationship. Web protocols Support tools for website creation and management. Developing Internet Information servers. Publishing information and application.

Unit VI **Building Web applications :** [08 Hrs]

Protocols at the application layer. Principles of Web engineering. Database driven websites. RPC. Lightweight distributed objects. The role of the middleware. Support tools. Security issues in Distributed object systems. Enterprise- wide web base.

References:

[1] Information Architecture for the World Wide Web, Peter Morville and Louis Rosenfied, O'REILLY, 2007
[2] Internet and World Wide Web: How to Program, Deitel and Deitel, 4th Edition, Prentice Hall, 2009
[3] Beginning XML, David Hunter et al, 4th Edition, Wrox/John Wiley, 2007
[4] Herbert Schildt, "Complete Reference JAVA 2", TMH

[5] Jerri L. Ledford, “Search Engine Optimization”,2nd Edition, Wiley Publication,

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

WIRELESS COMMUNICATION AND SECURITY

Teaching Scheme:	**Examination Scheme:**
Theory Hours: 04 Hrs/Week	Theory: 60 Marks Internal Assessment: 40 Marks Total Credits: 5

Unit I	**Introduction :** A Short history of wireless communication. A market for mobile communication. Some research topics. A simplified reference model. Wireless Transmission. **Frequencies for Radio Transmission:** Signal antennas, signal propagation. Multiplicity, modulation, spread spectrum, cellular systems.	[08 Hrs]
Unit II	**Medium Access Control :** Motivation for a specialized MAC. SDMA, FDMA, TDMA, CDMA,Comparison of S/T/F/CDMA. **Telecommunication Systems :** GSM, DECT, TETRA, UMTS.	[08 Hrs]
Unit III	**Satellite Systems :** Basics, Routing, Localization, Handover. **Broadcast Systems :** Cyclic repetition of data, digital audio broadcasting, digital video broadcasting.	[08 Hrs]
Unit IV	**Wireless LAN:** Infrared vs. radio transmission, Ad-Hoc networks, IEEE802.11, Bluetooth,Case Study on WLAN. **Wireless ATM :** Motivation for WATM, WATM services reference model, functions, radio access layer, handover, location management, addressing, mobile quality of service, access point control protocol, Case Study on WATM.	[08 Hrs]
Unit V	**Mobile Network Layer :** Mobile IP, Dynamic host configuration protocol, Ad-hoc Networks. **Mobile Transport Layer :** Traditional TCP, Indirect TCP, Mobile TCP.	[08 Hrs]
Unit VI	**Performance Issues :** QOS issues, Security issues, Non line of sight issues, Power control issues. **Security** Encryption and Authentication, Key pre-distribution and management, Secure Ad-Hoc Networks, Denial-of-Service Attacks, Energy-aware Security Mechanisms	[08 Hrs]

References:

[1] Jochen Schiller, “Mobile Communication”, Pearson Education, Asia

[2] Mallick, “Mobile and Wireless Design Essentials”, Wiley computer publication

[3] Andy Dornan, “The Essential Guide of Wireless Communications Applications”, Pearson Education Asia

[4] Weisman, “The Essential guide to RF and wireless”, Pearson Education Asia

[5] Lee, “Mobile Cellular Telecommunications”, MGH

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective I : **E-Commerce and ERP**

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I Ecommerce business models and concepts, EC infrastructure, Ecommerce -Frame work, anatomy of E-Commerce applications [08 Hrs]

E-Commerce Consumer applications, E-Commerce organization. Applications. Consumer Oriented Electronic commerce - Mercantile Process models

Unit II ESecurity and payment systems, Electronic payment systems - Digital Token-Based, Smart Cards, Credit Cards, Risks in Electronic Payment systems. Inter Organizational Commerce - EDI, EDI Implementation, Value added networks. [08 Hrs]

Unit III Concepts and communications, ethical, social and political EC issues, Intra Organizational Commerce - work Flow, Automation Customization and internal Commerce, Supply chain Management. [08 Hrs]
Corporate Digital Library - Document Library, digital Document types, corporate Data Warehouses. Advertising and Marketing - Information based marketing, Advertising on Internet, on-line marketing process, market research. Marketing, online retailing, services, content and media, social networks.

Unit IV Introduction To ERP: Evolution of ERP, What is ERP? Reasons for the growth of ERP, Scenario and Justification of ERP in India, Evaluation of ERP, Various Modules of ERP, Advantage of ERP. [08 Hrs]

Unit V An overview of Enterprise, Integrated Management Information, Business Modeling, ERP for Small Business, ERP for make to order companies, business Process Mapping for ERP Module Design, Customized ERP,Hardware Environment and its Selection for ERP Implementation. [08 Hrs]

Unit VI ERP Market: Introduction, SAP AG, Baan Company, Oracle Corporation, People Soft, JD Edwards World Solutions Company, System Software Associates, Inc. (SSA) QAD, A Comparative Assessment and Selection of ERP Packages and Modules.ERP implementation lifecycle, issues in implementing Vendors, Consultants and users, In-House Implementation - pros and cons, vendors, consultants, end user. [08 Hrs]

References:

1. Laudon K., C. G. Traver, E-Commerce Prentice Hall, 2010
2. William S. Davis, John Benamati, E-Commerce Basics: Technology Foundations and E-Business Applications, Prentice Hall
3. Enterprise Resource Planning – Alexis Leon
4. ERP Ware: ERP Implementation Framework – V.K. Garg & N.K. Venkitakrishnan

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective I : Information Storage and Management

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I	**Introduction to Storage Technology** Data proliferation and the varying value of data with time & usage, Sources of data and states of data creation, Data center requirements and evolution to accommodate storage needs, Overview of basic storage management skills and activities, Traditional file storage and it's pitfalls. The five pillars of technology, Overview of 12 storage infrastructure components, Evolution of storage, Information Lifecycle Management concept, Data categorization within an enterprise, Storage and Regulations.	[08 Hrs]
Unit II	**Storage Systems Architecture** Intelligent disk subsystems overview, Contrast of integrated vs. modular arrays, Component architecture of intelligent disk subsystems, Disk physical structure components, properties, performance, and specifications, Logical partitioning of disks, RAID & parity algorithms, hot sparing, Physical vs. logical disk organization, protection, and back end management, Array caching properties and algorithms, Front end connectivity and queuing properties, Front end to host storage provisioning, mapping, and operation, Interaction of file systems with storage, Storage system connectivity protocols.	[08 Hrs]
Unit III	**Introduction to Networked Storage** JBOD, DAS, SAN, NAS, & CAS evolution, Direct Attached Storage (DAS) environments: elements, connectivity, & management, Storage Area Networks (SAN): elements & connectivity, Fibre Channel principles, standards, & network management principles, SAN management principles, Network Attached Storage (NAS): elements, connectivity options, connectivity protocols (NFS, CIFS, ftp), & management principles IP SAN elements, standards (SCSI, FCIP, FCP), connectivity principles, security, and managementprinciples, Content Addressable Storage (CAS): elements, connectivity options, standards, and management principles, Hybrid Storage solutions overview including technologies like virtualization & appliances.	[08 Hrs]
Unit IV	**Introduction to Information Availability** Business Continuity and Disaster Recovery Basics, Local business continuity techniques, Remote business continuity techniques, Disaster Recovery principles & techniques. Case study: Storage Network for Business Continuity.	[08 Hrs]
Unit V	**Managing &Monitoring**: Management philosophies (holistic vs. system & component), Industry management standards (SNMP, SMI-S, CIM), Standard framework applications, Key management metrics (thresholds, availability, capacity, security, performance), Metric analysis methodologies & trend analysis, Reactive and pro-active management best practices, Provisioning & configuration change , Problem reporting, prioritization, and handling techniques, Management tools overvie	[08 Hrs]
Unit VI	**Information storage on cloud** :Concept of Cloud, Cloud Computing, storage on Cloud, ClouVocabulary, Architectural Framework, Cloud benefits, Cloud computing Evolution, Applications & services on cloud, Cloud service providers and Models, Essential characteristics of cloud computing, Cloud Security and integration. (08 hours)	[08 Hrs]

References:

1) Information Storage and Management Storing, Managing, and Protecting Digital Information , by EMC, Hopkinton and Massachusetts, Wiley, ISBN:9788126521470
2) G. Somasundaram & Alok Shrivastava (EMC Education Services) editors; Information Storage and Management: Storing, Managing, and Protecting Digital Information; Wiley India.
3) Ulf Troppens, Wolfgang Mueller-Friedt, Rainer Erkens, Rainer Wolafka, Nils Haustein; Storage Network explained: Basic and application of fiber channels, SAN, NAS, iSESI, INFINIBAND and FCOE, Wiley India.
4) John W. Rittinghouse and James F. Ransome; Cloud Computing : Implementation , Management and Security, CRC Press, Taylor Frances Pub.

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective I : Cyber Security

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical: 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I **Cyber Security Fundamentals** [08 Hrs]

Network and Security Concepts, Authentication, Authorization, Non repudiation, Confidentiality, Integrity, Availability, Basic Cryptography, Symmetric Encryption, Public Key Encryption, The Domain Name System, Firewalls, Virtualization, Microsoft Windows Security Principles

Unit II **Attacker's Techniques** [08 Hrs]

Types of Proxies, Tunneling Techniques, Phishing, Smishing, Vishing, and Mobile Malicious Code, Threat Infrastructure.

Unit III **Exploitation** [08 Hrs]

Shell code, Stack-Based Buffer Overflows, Format String Vulnerabilities,Malicious PDF Files, Race Web Exploit Tools, Brute Force and Dictionary Attacks, Misdirection, Reconnaissance, and Disrup Cross-Site Scripting, DNS Amplification Attacks.

Unit IV **Malicious Code** [08 Hrs]

Self-Replicating Malicious Code, Virtual Machine Obfuscation, Persistent Software Techniques, H Privileged User Accounts and Escalation of Privileges, Token Kidnapping, Man-in-the-Middle Att

Unit V **Defense and Analysis Techniques** [08 Hrs]

Memory Forensics, Capabilities of Memory Forensics ,Memory Analysis Frameworks, Installing and Using Volatility, Honey pots, Malicious Code Naming, Automated Malicious Code Analysis Sy

Unit VI **Cyber Security Real World Impact:-** [08 Hrs]

Cyber security and internal political security, International conflict in cyberspace, Nation-state cyber attack mitigation strategies, IP V6 address space, Improved security, privacy concerns, uneven world wide deployment. Case study

References:

[1] Cyber security essentials by James Graham, Richard Howard,Ryan Olson
[2] Strategic Cyber Security by Kenneth Geers.

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective I : BIG DATA ANALYTICS

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I Introduction to Big data, Data Exposition, Types of data, Need for big data, Big data & its sources, Three Characteristics of big data, Challenges of Conventional Systems – Big data Problem, Traditional IT Analytics Approach, Big data use cases, Handling limitations of Big data, big data platform. Evolution of Analytic Scalability. [08 Hrs]

Unit II Big Data Storage and Computing Platforms: Traditional RDBMS, NoSQL, NewSQL, and Hadoop, Parallel computing systems, Programming models for batch, interactive, and streaming applications, Trade-offs between programming models, Survey of new emerging database and storage systems for Big Data, Tradeoffs between reduced consistency, performance, and availability, MangoDB: Introduction, overview, Design Goals for MangoDB, MangoDB shell, MangoDB applications, Multimedia database application. [08 Hrs]

Unit III Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction - Neural Networks: Learning And Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees - Stochastic Search Methods. [08 Hrs]

Unit IV Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. [08 Hrs]

Unit V Mining Frequent Itemsets - Market Based Model – Apriori Algorithm – Handling Large Data Sets in Main Memory – Limited Pass Algorithm – Counting Frequent Itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering High Dimensional Data – CLIQUE And PROCLUS – Frequent Pattern based Clustering Methods – Clustering in Non-Euclidean Space – Clustering for Streams and Parallelism. [08 Hrs]

Unit VI MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association-Intelligence from unstructured information-Text analytics-Understanding of emerging trends and technologies-Industry challenges and application of Analytics. [08 Hrs]

TEXT BOOKS:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
2. Ohlhorst, Frank J. Big Data Analytics: Turning Big Data into Big Money. Copyright © 2012 SAS Institute Inc., Cary, North Carolina, USA.
3. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
5. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007
6. Pete Warden, “Big Data Glossary”, O’Reilly, 2011.
7. Jiawei Han, MichelineKamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective II : Cryptography and Network Security

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I Introduction: Services, Mechanisms and Attacks, The OSI Security Architecture, A Model for Network Security. [08 Hrs]
Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.
Block Ciphers and the Data Encryption Standard: Simplified DES, Block Cipher Principles, The Data Encryption Standard, Differential and Linear Cryptanalysis, Block Cipher Design Principles, Block Cipher Modes of Operation.

Unit II Introduction to Finite Fields: Groups, Rings, Fields, Modular Arithmetic, Euclid's Algorithm, Finite Fields of the Form GF, Polynomial Arithmetic, Finite Fields of the Form GF. [08 Hrs]
Advanced Encryption Standard: Evaluation Criteria for AES, The AES Cipher. Contemporary Symmetric Ciphers: Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, RC4 Stream Cipher.
Confidentiality Using Symmetric Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.

Unit III Public-Key Encryption and Hash Functions: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms. [08 Hrs]
Public-Key Cryptography and RSA, Principles, The RSA Algorithm,
Key Management, Diffie Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography

Unit IV Message Authentication and Hash Functions: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions. [08 Hrs]
Hash Algorithms: MD5 Message Digest Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC,
Digital Signatures, Authentication Protocols, Digital Signature Standard.

Unit V Authenticaton Applciations: Kerbos, X.509 Authentication Service, E-mail Security, Preety Good Privacy, S/MIME, [08 Hrs]
IP Security, Architecture, Authentication Header, Encapsulation Security Payload, Combining Security Associations, Key Management
Web Security: Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

Unit VI System Security: Intruders, Intrusion Detection, Password Management. Malicious Software, Firewalls: Firewall Design Principles, Trusted Systems. [08 Hrs]

References:

[1] William Stallings, “Cryptography and Network Security”, Principles and Practices, Pearson Education, Sixth Edition.

[2] Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw Hill Publication

[3] Atul Kahate, “Cryptography and Network Security”, McGraw Hill(India)Publication, Third Edition.

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective II : PARALLEL COMPUTING

Teaching Scheme:

Theory Hours: 04 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I **Introduction to Parallel Programming Paradigms** [08 Hrs]

Types of Parallelism , Parallel Computation Models, Memory less Parallel Computers, Parallel Computers with Memory, Flynn's Taxonomy, The Data-Parallel Model, Networked Computers, The Performance of Parallel Algorithms, Amdahl's Law, Gustaf son Barsis's Law, Karp-Flatt Metric, Multidimensional Meshes, Hypercube-Based Machines, Routing in Networks, The PRAM Model.

Unit II **Convergence of Parallel Architecture** [08 Hrs]

Communication Architecture, Shared Address Space, Message Passing, Convergence, Data parallel processing, Other Parallel Architectures, A Generic parallel architectures, shared memory systems and cache coherence, distributed-memory systems, interconnection networks and routing, Architectural Trends, Application Trends, Technology Trends, Supercomputers case study: Param.

Unit III **Programming scalable systems** [08 Hrs]

The message-passing model, the message-passing interface, MPI standard basic concepts of MPI: MPI_Init, MPI_Comm_size, MPI_Comm_rank, MPI_Send, MPI_Recv, MPI_Finalize, timing the MPI programs: MPI_Wtime, MPI_Wtick, collective communication: MPI_Reduce, MPI_Barrier, MPI_Bcast, MPI_Gather, MPI_Scatter, case studies: the sieve of Eratosthenes, Floyd's algorithm, Matrix-vector multiplication.

Unit V **Implications for Programming Models and Case Study** [08 Hrs]

Naming, Replication, Overhead and granularity of communication, Block Data transfer, Synchronization, Hardware Cost and Design Complexity,

Case Study: Ocean, Ray trace, Data mining.

Unit VI **Fundamental Design issues** Partitioning of data, Mapping of data onto the processors, Reproducibility of results, Synchronization, Scalability and Predictability of performance, Performance & Scalability, Performance Requirements, Types of performance requirements, Performance Metrics of Parallel Systems, Communication Abstraction, Programming model requirements, Communication and Replication, Starssen's Matrix multiplication to compute complexity less than O(n3). [08 Hrs]

References:

[1] Parallel Programming – Techniques and applications Using Networked Workstations and Parallel Computers, Barry Wilkinson and Michael Allen, Prentice Hall, 1999.

[2] Multi-Core Programming - Increasing Performance through Software MultiThreading, Shameem Akhter and Jason Roberts, Intel Press 2006.

[3] Parallel Programming in C with MPI and OpenMP, Michael J. Quinn, McGraw Hill 2003.

[4] Introduction to Parallel Computing by AnanthGrama, George Karypis, Vipin Kumar, and Anshul Gupta.

[5] Programming Massively Parallel Processors by D.Kirk and W. Hwu

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective II : WIRELESS SENSOR NETWORKS

Teaching Scheme:

Theory Hours: 04 Hrs/Week
Practical : 02 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I **Introduction & Characteristics of Wireless Sensor Networks :** [08 Hrs]
Introduction, Brief Historical Survey of Sensor Networks. Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Unit II **Medium Access Control Protocols:** Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol, **Case Study:** IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling, ZigBee. [08 Hrs]

Unit III **Routing And Data Gathering Protocols:** Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Point-to-Point VPN Tunneling Protocol and Challenges-Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GAF, GPSR – Real Time routing Protocols – APTEEN, SPEED, RAP **-** Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB, [08 Hrs]

Unit IV **Embedded Operating Systems:** Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS –OSPM - EYES OS. Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components - Programming in Tiny OS using NesC, Emulator TOSSIM. [08 Hrs]

Unit V **Transport Control Protocols and Middlewares for Wireless Sensor Networks** [08 Hrs]
Traditional Transport Control Protocols: TCP (RFC 793), UDP (RFC 768), MobileIP, Introduction, WSN Middleware Principles, Middleware Architecture: Existing Middleware: MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive Sensor Networks Services)

Unit VI **Applications of WSN:** WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications. [08 Hrs]

References:

[1] Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
[2] Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.
[3] K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325—349.
[4] Philip Levis, " TinyOS Programming".
[5] Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd.
[6] Wireless sensor networks Edited by C. S. Raghavendra Pub: Springer.

[7] Fundamentals of Sensor Network Programming: Applications and Technology By Sridhar S. Iyengar, NandanParameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley.

[8] Ad Hoc Wireless Networks: Architectures And Protocols By Murthy Pub: Pearson Education.

Syllabus for Unit Test

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI

Elective II : STORAGE AREA NETWORK

Teaching Scheme:

Theory Hours: 04 Hrs/Week

Examination Scheme:

Theory: 60 Marks
Internal Assessment: 40 Marks
Term Work : 25 Marks
Oral: 25 Marks
Total Credits: 5

Unit I **Information Storage and Data Centre Environment:** Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing, Application, Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Disk I/O Controller Utilization, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application Requirements and Disk Performance, Data Protection: RAID. [08 Hrs]

Unit II **Data and Information in SAN**: Data organization: File vs. Block, Object, Data store, Searchable models, File Systems, Volume Managers, Caches, Prefetching, Storage Networking Technologies, What Storage Networking Is, What to Expect from SANs, Leading up to SANs, Killer Apps for SANs [08 Hrs]

Unit III **SAN Hardware Ecosystem:** Components of an Intelligent Storage System, Front End, Cache, Back End, Physical Disk, Storage Provisioning, Virtual Storage Provisioning,Types of Intelligent Storage Systems – DAS, SAN, NAS, Comparing DAS, SAN & NAS, Host Bus Adapters, SFPs, FC Cables and Connectors, SCSI/SATA/SAS Cables and Connectors, JBODs, RAID Arrays, RAID Controllers, External Storage Boxes, Tape Drive, Tape Library, NAS Device, NAS Head, Fiber Channel Switches, Bridges, FC Appliances. [08 Hrs]

Unit IV **Storage Virtualization:** Storage Virtualization, Disk Virtualization, Block Virtualization, File Virtualization, File system Virtualization, Tape Virtualization, Tape Library Virtualization, Host Based Virtualization, Network Based Virtualization, Storage Device Virtualization. [08 Hrs]

Unit V **Protocols in SAN:** ATA and SATA, SPI – Parallel SCSI, SAS – Serial Attached SCSI, SAS Topology, SAS Devices, FC Topologies, FC Ports, FC Protocol Layers, FC WWNs, FC Addresses, FC Frame, FC Flow Control, Zoning, Lun Masking, iSCSI Topology, iSCSI Initiators and Targets, iSCSI Namesand Addresses, Speeding Up iSCSI, iSCSI Advantages, iSCSI Limitation, Comparing Storage Protocols. [08 Hrs]

Unit VI **SAN Managements and Storage Systems:** Storage Management, Storage Vs. Data Classification, Information Lifecycle Management, Hierarchical Storage Management, RTO and RPO, Backup and Restore, Snapshot & CDP, De-duplication, Storage Provisioning, Storage Migration, SRM, Case study - Google FS/BigTable, Programming models: Hadoop, NAS. [08 Hrs]

References:

[1] Storage Area Network Essentials:A complete Guide to Understanding and Implementing SANs(HardCover) By Richard Barker, Paul Massigliar By Wiley 2001.

[2] Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS iSCSI and InfiniBandBy Ulf Troppens, Rainer Erkens, Wolfgang Miiller Wiley 2004.

[3] Using SANs and NAS ByW.Curtis Preston, Mike Loukides.

[4] Information Storage and Management, 2nd Edition, Edited by Somasundaram Gnanasundaram, Alok Shrivastava

Unit Test I	Unit I, II , III
Unit Test II	Unit IV, V, VI