LINGAYA'S VIDYAPEETH
SCHEME OF STUDIES
SESSION: 2018-19

School: School of Engineering & Technology	**Batch:2018-2020**
Department: CSE	**Year:1st**
Course: M.Tech	**Semester: I**

SN	Category	Course Code	Course Name	Periods			Credits	Evaluation Scheme					Subject Total Marks
								Theory			Practical		
				L	T	P		ABQ	MSE	ESE	IP	EXP	
1	PCC	CS-501A	Theory of Computations	4	0	0	4	15	25	60	-	-	100
2	PEC	CS-502A	Analysis & Design of Algorithm	4	0	0	4	15	25	60	-	-	100
3	PCC	CS-503A	Advanced Database Management System	4	0	0	4	15	25	60	-	-	100
4	PCC	CS-506A	Advanced Computer Networks	4	0	0	4	15	25	60	-	-	100
5	PCC	CS-551A	Simulations Lab	0	0	4	2				60	40	100
6	PCC	CS-553A	Advanced Database Management System Lab	0	0	2	1				60	40	100
			Total---->	**16**	**0**	**6**	**19**						

LINGAYA'S VIDYAPEETH
SCHEME OF STUDIES
SESSION: 2018-19

School: School of Engineering & Technology	**Batch: 2018-2020**
Department: CSE	**Year:1st**
Course: M.Tech	**Semester: II**

SN	Category	Course Code	Course Name	Periods			Credits	Evaluation Scheme					Subject Total Marks
								Theory			Practical		
				L	T	P		ABQ	MSE	ESE	IP	EXP	
1	PCC	CS-510A	Network Security & Management	3	0	0	3	15	25	60	-	-	100
2	PCC	CS-511A	Digital Image Processing	4	0	0	4	15	25	60	-	-	100
3	PCC	CS-515A	Data Warehousing & Data Mining	4	0	0	4	15	25	60	-	-	100
4	PCC	CS-516A	Advanced Operating system	4	0	0	4	15	25	60	-	-	100
5	PCC	CS-524A	Object Oriented Design and Analysis	4	0	0	4	15	25	60	-	-	100
6	PCC	CS-555A	Software Engineering Lab	0	0	2	1				60	40	100
7	PCC	CS-566A	Advanced Operating system Lab	0	0	2	1				60	40	100
8	PCC	CS-574A	Seminar – I	0	0	2	1					100	100
9	PROJ	CS-657A	Minor Project	0	0	6	3					100	100
			Total---->	**19**	**0**	**12**	**25**						

LINGAYA'S VIDYAPEETH
SCHEME OF STUDIES
SESSION: 2019-20

School: School of Engineering & Technology	**Batch: 2018-2020**
Department: CSE	**Year: 2nd**
Course: M.Tech	**Semester: III**

SN	Category	Course Code	Course Name	Periods			Credits	Evaluation Scheme					Subject Total Marks
								Theory			Practical		
				L	T	P		ABQ	MSE	ESE	IP	EXP	
1	PCC	CS-601A	Knowledge Base System Design	4	0	0	4	15	25	60	-	-	100
2	PEC	CS-602A	Soft Computing	4	0	0	4	15	25	60	-	-	100
3	SEC	EC - 511A	Embedded System Design	4	0	0	4	15	25	60	-	-	100
4	PCC	CS-525A	Cloud Computing	3	0	0	3	15	25	60	-	-	100
5	PCC	CS-652A	Soft Computing & AI Lab	0	0	2	1				60	40	100
6	PCC	CS-652A	Dissertation Preliminary	0	0	12	6	-	-	-		100	100
7	PCC	CS-657	Seminar II	0	0	4	2	-	-	-	-	100	100
			Total---->	**15**	**0**	**18**	**24**						

LINGAYA'S VIDYAPEETH
SCHEME OF STUDIES
SESSION: 2019-20

School: School of Engineering & Technology	**Batch: 2018-2020**
Department: CSE	**Year: 2nd**

Course: M.Tech								Semester: IV					
SN	**Category**	**Course Code**	**Course Name**	**Periods**			**Credits**	**Evaluation Scheme**					**Subject Total Marks**
								Theory			**Practical**		
				L	**T**	**P**		**ABQ**	**MSE**	**ESE**	**IP**	**EXP**	
1	AECC	CS-509A	**Elective (Cryptography and Data Compression)**	3	0	0	3	15	25	60	-	-	100
2	CC	CS-659A	Dissertation	0	0	46	23	-	-	-	-	100	100
3	CC	CS-658A	Seminar III	0	0	4	2	-	-	-	-	100	100
			Total---->	**3**	**0**	**50**	**28**						

DETAILED SYLLABUS

CS-501A	THEORY OF COMPUTATIONS	L T P	Cr
		3 1 0	4

1. **INTRODUCTION**: Regular grammar and finite automata; NDFA and DFA; NDFA to DFA conversion; Pumping Lemma to checking the regularity of regular grammars; reduction of states and design of equivalent finite automata
2. **CONTEXT-FREE GRAMMARS**: Possible defects in CFG and their removal; Chomsky Normal Form (CNF), Greibach Normal Form (GNF).
3. **PUSH DOWN AUTOMATA**: Push down automata; design of CFG corresponding to PDA and vice versa; design of parser using PDA; Linear bound automata, Chomsky classification of a language.
4. **TURING MACHINES**: Turing machines as language recognizer; Computer for positive integers; enumerator and universal Turing machine; halting problem, Multi-tape and multi-head Turing machine;
5. **SOLVABILITY AND UN-DECIDABILITY:** Rice"s theorem; equivalence of general recursive and Turing computable function; primitive recursive function; Post-correspondence problem. Introduction to complexity theory and finding the time complexity of Turing Machine

REFERENCE BOOKS

1. Hopcroft and Ullman O. D., Mothwani R., "Introduction to Automata Theory, Language & Computations", Addison Wesley, 2001
2. Mishra K. L. P. and Chandrasekaran N., "Theory of Computer Sc. (Automata, Languages and Computations)", Prentice Hall of India, 2000
3. Peter LinZ, "Introduction to Formal Languages & Automata", Narosa Publ., 2001
4. Greenlaw Ramond and Hoover H. James, "Fundamentals of the Theory of Computation – Principles and Practice", Harcourt India Pvt. Ltd., 1998
5. Lewis H. R. and Papaditriou C. H., "Elements of Theory of Computation", Prentice Hall of India, 1998
6. Martin John C., "Introduction to Languages and the Theory of Computation", Tata McGraw Hill, 2003

CS-502A	ANALYSIS & DESIGN OF ALGORITHMS	L T P	Cr
		3 1 0	4

1. **INTRODUCTION TO ALGORITHMS AND SORTING :** Introduction to algorithms; correctness and efficiency; expressing algorithms; keeping score; the RAM model of computation; best, worst, and average-case complexity; the Big Oh notation; growth rates; logarithms; modeling the problem, sorting; applications of sorting; approaches to sorting: data structures; incremental insertion;, Fundamental data types; containers; dictionaries; priority queues; specialized data structures;

2. **BREAKING PROBLEM DOWN:** Dynamic programming; Fibonacci numbers; the partition problem; approximate string matching; longest increasing sequence; minimum weight triangulation; limitations of dynamic programming, divide and conquer, randomization, bucketing techniques, binary search trees.

3. **GRAPH ALGORITHMS:** The friendship graph; data structures for graphs; war story: getting the graph; traversing a graph: breadth-first search, depth-first search; applications of graph traversal: connected components, tree and cycle detection, two-coloring graphs, topological sorting, articulation vertices; modeling graph problems; minimum spanning trees: Prim's algorithm; Kruskal's algorithm; shortest paths: Dijkstra's algorithm; All-Pairs shortest path. Data structures; numerical problems; combinatorial problems; graph problems - polynomial-time problems; graph problems - hard problems; computational geometry; set and string problems

4. **COMBINATORIAL SEARCH AND HEURISTIC METHODS:** Backtracking: constructing all subsets, constructing all permutations, constructing all paths in a graph; search pruning; bandwidth minimization; heuristic methods; simulated annealing: traveling salesman problem, maximum cut, and independent set; circuit board placement; neural networks; genetic algorithms; parallel algorithms.
5. **INTACTABLE PROBLEMS AND APPROXIMATIONS:** Problems and reductions; simple reductions: Hamiltonian Cycles, Independent set and vertex cover, clique and independent set; satisfiability: the theory of NP-Completeness, 3-satisfiability; difficult reductions: integer programming, vertex cover; other NP-complete problems; the art of proving hardness; approximation algorithms: approximating vertex cover, the Euclidean traveling salesman

REFERENCE BOOKS

1. Sahni Sartaj, Horowitz Ellis, “Fundamentals of Computer Algorithms”, Galgotia
   Publications, 1993
2. Skiena Steven S., “The Algorithm Design Manual”, Department of Computer Science, State University of New York, Stony Brook, NY 11794-4400, 2nd Edition, Springer, 2008
3. Aho A.V., Hoproft J. E. and Ullman J. D., “Design & Analysis of Algorithms”,
   Addison Wesley, 1974
4. Dasgupta, “Algorithms”, 1st Edition, Tata McGraw Hill, 2006
5. Knuth Donald E., “Fundamental Algorithms (The Art of Computer

CS-503A	ADVANCED DATABASE	L T P	Cr

	MANAGEMENT SYSTEMS		
		3 1 0	4

1. **INTRODUCTION:** database concept and architecture, advantages; disadvantages; data independence, data abstraction, database languages, database administrator; database users, data models; Entity relational model, entity set, relationship sets, mapping cardinalities, keys, E-R diagrams,
2. **RELATIONAL MODEL, DATABASE DESIGN & SQL:** Relational model, database schema, relational algebra, outer join and manipulation of databases. SQL: Query processing and optimization, set operations, aggregate functions, data definition language and views. Relational database design, various normal forms, functional dependencies, canonical cover, lossless join, dependency preservation, multi value dependency and higher normal forms,
3. **RECOVERY AND CONCURRENCY:** transaction management, ACID property. Serializability and testing for serializability, concurrency control schemes, lock-based protocols, two-phase locking protocols, graph-based protocols, time stamp-based protocols, deadlocks Recovery systems, log-based recovery, deferred and immediate database modification,
4. **OOD DEVELOPMET AND IMPLEMENTATION THROUGH ORACLE:** Introduction; object definition language; creating object instances; object query language; object relational databases: basic concepts; enhanced SQL; advantages of object relational approach; basic concepts of PL SQL
5. **DISTRIBUTED DATABASES AND DATA WAREHOUSING:** Basic concepts; options for distributing a database; distributed DBMS. Introduction basic concepts of data wharehousing; data warehouse architecture; data characteristics; reconciled data layer data transformations; derived data layer user interface

REFERENCE BOOKS

1. Ramakrishnan Raghu, "Database Management System", McGraw Hill, 3rd Edition, 2003
2. Elmasri R. and Navathe S. B., "Fundamentals of Database Systems", 3rd edition, Addison Wesley, Low Priced Edition, 2000.
3. Tamer M. and Valduricz, "Principles of Distributed Database Systems", 2nd edition, Pearson Education, 1999
4. Silbershatz A., Korth H. F. and Sudarshan S., "Database System Concepts", 5th edition, McGraw-Hill, International Edition, 2005.
5. Desai Bipin C., "An Introduction to Database Systems", 11th Edition, Galgotia Publications/West Group, 1990
6. lioffer Feffray A., Prescotl Mary B., and McFadden Fred R., "Modern Database Management", 9th edition, Pearson Education/Prentice Hall, 2008

CS-506A	ADVANCED COMPUTER NETWORKS	L T P	Cr
		3 1 0	4

1. **BASIC CONCEPTS:** Network architecture: protocol hierarchies, layered model, services, interface reference models underlying technologies LAN"s (Ethernet, token ring, wireless); point-to-point WANs; switched WANs (X.25, frame relay, ATM); connecting devices; addressing (physical, network, transport); the internet layer protocols IP: datagram, fragmentation and reassembly; ICMP: types of messages, error reporting, ICMP package, BOOTP and DHCP
2. **ROUTING PROTOCOLS:** Interior and exterior routing: RIP, OSPF, BGP; multicast routing: unicast, multicast and broadcast, multicasting, multicast trees
3. **THE TRANSPORT LAYER:** The transport service: services provided, service primitives; sockets; process-to-process communication: port addresses; elements of transport protocols: addressing, connection establishment, connection release, flow control and buffering, multiplexing, crash recovery; UDP: introduction, remote procedure call; TCP: service model, protocol, frame format, connection establishment, release, connection management; silly window syndrome; error control; congestion control; state transition diagram
4. **THE APPLICATION LAYER:** DNS; Protocols: Telnet and Rlogin, FTP, TFTP, SNMP, SMTP; world wide web (client and server side, cookies, wireless web); Java and the Internet; multimedia (streaming audio, internet radio, voice over IP - RTP, video standards); real time traffic over the internet
5. **INTRODUCTION TO NETWORK SECURITY:** Cryptography; symmetric key algorithms; public key algorithms; digital signatures; certificates, IPSec; firewalls; virtual private networks; network address translation; authentication protocols; social issues

REFERENCE BOOKS

1. Forouzan Behrouz, "TCP/IP Protocol Suite", 2nd Edition, Tata McGraw Hill
2. Forouzan Behrouz A., "Data Communications and Networking", 4th Edition, Tata McGraw Hill, 2006
3. Smith and Collins, "3G Wireless Networks", Tata McGraw Hill, 2007
4. Rappaport Theodore S., "Wireless Communication- Principles and Practices", 2nd Edition, Pearson Education, 2003.
5. Stallings William, "Data and Computer Communications", 7th Edition, Pearson Education
6. Stallings William, "Cryptography and Network Security – Principles and Practices", 3rd Edition, Prentice Hall of India, 2003.
7. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.
8. Pfleeger Charles B., Pfleeger Shari Lawrence, "Security in Computing", Third Edition, Pearson Education, 2003.
9. Tanenbaum Andrew S., "Computer Networks", 4th Edition, Pearson Education/ Prentice Hall of India, 2002
10. Gallo Michael A. and Hancock William M., "Computer Communications and Networking Technologies", 1st Edition, Thomson Publication, 2001

CS-524A	OBJECT ORIENTED Analysis and Design	L T P	Cr
		3 1 0	4

1. **REVIEW OF OBJECT ORIENTED SYSTEMS:** Design objects;, class hierarchy; inheritance; polymorphism; object relationships and associations; aggregations and object containment; object persistence; meta classes; object oriented systems development life cycle; software development process; object oriented systems development: a use case driven approach
2. **OBJECT ORIENTED ANALYSIS:** Analysis process; use case driven object oriented analysis; use-case model; object classification; theory; different approaches for identifying classes, classes, responsibilities and collaborators; identifying object relationships; attributes and methods; super sub class relationships; A- part of relationships aggregation; class responsibilities; object responsibilities

   OBJECT ORIENTED DESIGN: Object oriented design process; corollaries; design axioms; design patterns; object oriented design philosophy
3. **METHODOLOGY FOR OBJECT ORIENTED DESIGN**: Object modeling technique as software engineering methodology; Rumbaugh methodology; Jacobson Methodology; Booch Methodology

   UNIFIED APPROACH FOR OBJECT ORIENTED DESIGN: Patterns, frameworks; the unified approach, unified modeling language (UML).
4. **UML:** Why we model; types of models; principles of modeling; object oriented modeling; object oriented concepts; UML notation; object oriented analysis: use case diagrams, interaction diagrams, activity diagrams; object oriented design: class diagrams, object diagrams, state diagrams; collaboration diagrams, post-testing: deployment diagrams, patterns, frameworks
5. **USING UML FOR OOD:** UML object constraint language; designing classes: The process, class visibility, refining attributes, designing methods ad protocols; packages and managing classes; designing interface objects; view layer interface design; macro and micro level interface design process

REFERENCE BOOKS:

1. Jacobson Ivar, “Object Oriented Software Engineering”, Addison Wesley, 1995
2. Bennett, “Object Oriented System Analysis and Design using UML”, Tata McGraw Hill, 3rd edition, 2005
3. Bahrami Ali, “Object Oriented Systems Development”, McGraw Hill, 1999
4. Rumbaugh et al, ”Object Oriented Modeling and Design”, Prentice Hall of India, 1997
5. Booch Grady, “Object Oriented Analysis and Design”, 3rd Edition, Addison Wesley, 2007
6. Mehta Subhash and Basandra Suresh K., “Object Oriented Software Engineering”, Galgotia Publications

CS-511A	DIGITAL IMAGE PROCESSING	L T P	Cr
		3 0 0	3

1. **INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS:** The origins of digital image processing; examples of fields that use digital image processing; fundamentals steps in image processing; elements of digital image processing systems; image sampling and quantization;, some basic relationships like neighbors; connectivity; distance measures between pixels; linear and non linear operations.
2. **IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN:** Some basic gray level transformations; histogram processing; enhancement using arithmetic and logic operations; basics of spatial filters; smoothening and sharpening spatial filters; combining spatial enhancement
3. **IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN:** Introduction to Fourier transform and the frequency domain; smoothing and sharpening frequency domain filters; homomorphic filtering; image restoration: a model of the image degradation / restoration process, noise models; restoration in the presence of noise only spatial filtering; periodic noise reduction by frequency domain filtering; linear position-invariant degradations; estimation of degradation function; inverse filtering; Wiener filtering, constrained least square filtering; geometric mean filter; geometric transformations.
4. **IMAGE COMPRESSION & IMAGE SEGMENTATION:** Coding; inter-pixel and psycho visual redundancy; image compression models; elements of information theory, error free comparison; lossy compression; image compression standards.

   Detection of discontinuities; edge linking and boundary detection; thresholding; region oriented segmentation; motion based segmentation
5. **REPRESENTATION AND DESCRIPTION AND RECOGNISIONB:** Representation; boundary descriptors; regional descriptors; use of principal components for description; introduction to morphology; some basic morphological algorithms**.**

   Patterns and pattern classes; decision-theoretic methods; structural methods.

REFERENCE BOOKS

1. Jayaraman S., Esakkirajan S. and Veerakumar T., "Digital Image Processing", Tata McGraw Hill, 2009
2. Jain A. K., "Digital Image Processing", Prentice Hall of India, 1995
3. Gonzalez Rafael C. and Woods Richard E., "Digital Image Processing", 2nd edition, Pearson Education, 2002
4. Jahne Bernd, "Digital Image Processing", 5th Edition, Springer, 2000
5. Pratt William K., "Digital Image Processing: Piks Inside", John Wiley & Sons, 2001.
6. Forsyth D. A. and Ponce J., "Computer Vision: A Modern Approach", Prentice Hall, 2003
7. Jain R., Kasturi R. and Schunck B.G. , "Machine Vision", McGraw Hill, 1995

CS-515A	DATA WAREHOUSING AND DATA MINING	L T P	Cr
		3 1 0	4

1. **INTRODUCTION:** Fundamentals of data warehouse and mining; features of data warehouse; 2Tier data warehouse architecture; 3Tier data warehouse architecture; data warehouse components; data warehouse process; 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.
2. **DATA PROCESSING MINING PRIMITIVES:** Data preprocessing: needs preprocessing the data, data cleaning; data integration and transformation; data reduction; discretization and concept hierarchy generation; online data storage
3. Data mining primitives, languages, and system architectures: data mining primitives; data mining query languages; designing GUI based on a data mining query language architectures of data mining systems.
4. **DATA GENERALIZATION:** 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; 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.
5. **CLASSIFICATION AND PREDICTION:** Classification and prediction: issues regarding classification and prediction; classification by decision tree induction; Bayesian classification; classification by back propagation; classification based on concepts from association rule mining; other classification methods; prediction; classifier accuracy
6. **CLUSTER ANALYSIS AND MINING COMPLES:** Cluster analysis introduction: types of data in cluster analysis; categorization of major clustering methods; partitioning methods; density-based methods; grid-based methods; model-based clustering methods; outlier analysis
7. **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.

REFERENCE BOOKS

1. Han Jiawei and Kamber Micheline, "Data Mining – Concepts and Techniques", Harcourt India, 2006
2. Pujari Arun K., "Data Mining Techniques", University Press
3. Dunham Margaret H., "Data Mining Introductory and Advanced Topics", 1st Edition, Pearson Education/Prentice Hall, 2002
4. Hand D. J., Mannila H., and Smyth P., "Principles of Data Mining", MIT Press, 2001
5. Fayyad U. M., Piatetsky-Shapiro G., Smyth P., and Uthurusamy R., "Advances in Knowledge Discovery and Data Mining", AAAI/MIT Press, 1996
6. Hastie T., Tibshirani R., and Friedman J., "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", 2nd Edition, Springer Verlag, 2009
7. Inmon W. H., "Building the Data Warehouse", 4th Edition, Wiley Dreamtech, 2005
8. Ponnaiah Paulraj, "Data Warehousing Fundamentals", 1st Edition, Wiley Student, 2001
9. Kimball Ralph, "The Data Warehouse Life Cycle Tool Kit", 1st Edition, Wiley Student, 2008.

CS-516A	ADVANCED OPERATING SYSTEMS	L T P	Cr
		3 1 0	4

1. **INTRODUCTION:** Introduction to history of operating systems; early batch systems; multiprogramming; timesharing; distributed OS and multiprocessor OS; processes; files; system calls; shell; layered structure v/s monolithic structure of OS
2. **MEMORY MANAGEMENT:** Multiprogramming with fixed partition; variable partitions; virtual memory; paging; demand paging; design and implementation issues in paging such as page tables; inverted page tables; page replacement algorithms; page fault handling; working set model; local v/s global allocation; page size; segmentation; segmentation with paging
3. **FILE SYSTEMS AND DEADLOCKS:** File types; attributes, access and security; file operations; directory structures; path names; directory operations; implementation of file systems; implementation of file and file operation calls; implementation of directories; sharing of files; disk space management; block allocation; free space management

   Conditions; modelling; detection and recovery; deadlock avoidance; deadlock presentation
4. **DISTRIBUTED SYSTEMS AND DISTRIBUTED SHARED MEMORY:** Introduction; communications in distributed systems; layered protocols; ATM networks; Client Server model; RPC What is shared memory; consistency models; page-based distributed shared memory; shared variables; case studies: MACH and CHORUS

5. **SYNCHRONIZATION AND MUTUAL EXCLUSION:** Synchronization in distributed systems; clock synchronization; mutual exclusion; election algorithms; atomic transactions; deadlocks in distributed systems; distributed file system design and implementation

REFERENCE BOOKS

1. Bach M., "The Design of the UNIX Operating System", Prentice-Hall, 1986
2. Bayer et. al .(eds.), "Operating Systems An Advanced Course", Springer Verlag, 1979
3. Chow R. and Johnson T., "Distributed Operating Systems and Algorithms", Annotated Edition, Addison-Wesley, 1997
4. Stallings W., "Operating Systems - Internals and Design Principles", 6th Edition, Prentice Hall, 2008
5. Stallings W., "Operating Systems", Macmillian Publishing, 1991
6. Tanenbaum Andrew. S., "Operating Systems Design and Implementation", 3rd Edition, Prentice-Hall, 2006
7. Tanenbaum Andrew. S., "Distributed Operating Systems", Pearson Education Asia, 1994
8. Singhal M. and Shivarathi N. G., "Advance Concepts in Operating Systems", McGraw Hill, 2001.

CS-507A	INFORMATION STORAGE & MANAGEMENT	L T P	Cr
		3 0 0	3

1. **INTRODUCTION:** Meeting today's data storage needs - data creation, data creation: Individuals; data creation: Business; categories of data; data storage models; common data storage media and solutions: tape storage systems, optical data storage, disk based storage
   DATA CENTER INFRASTRUCTURE : Example; key requirements of storage systems management activities
2. **STORAGE SYSTEMS ARCHITECTURE**: Storage system environment; components of a host; connectivity; physical disks; raid array; disk storage systems; data flow exercise
3. **NETWORKED STORAGE**: Direct Attached Storage (DAS); Network Attached Storage (NAS); Fiber Channel Storage Area Network (FC SAN); IP Storage Area Network (IP SAN); Content Addressed Storage (CAS)
   BUSINESS CONTINUITY: Introduction; overview; backup and recovery; local replication; remote replication.
4. **MONITORING AND MANAGING THE DATA CENTER**: Areas of the data center to monitor; considerations for monitoring the data center; techniques for managing the data center.

5. **SECURING STORAGE AND STORAGE VIRTUALIZATION:** Securing the storage infrastructure; virtualization technologies.

REFERENCE BOOKS

1. Osborne Marc Farley, “Building Storage Networks”, 2nd Edition, Tata McGraw
   Hill, 2001
2. Spalding Robert, “Storage Networks: The Complete Reference“, 1st Edition, Tata McGraw Hill, 2003
3. Gupta Meeta, “Storage Area Network Fundamentals”, Illustrated Edition, Pearson Education/Cisco Press, 2002
4. Kowalski Gerald J. and Maybury Mark T., “Information Storage & Retrieval Systems Theory & Implementation”, 1st Edition, Springer, 1999
5. Thejendra B. S., “Disaster Recovery & Business Continuity”, Shroff Publishers
   & Distributors, EMC – Students Kit

CS-508A	BLUETOOTH TECHNOLOGY	L T P	Cr
		3 0 0	3

1. **INTRODUCTION TO WIRELESS TECHNOLOGIES**: WAP services; serial and parallel communication; asynchronous and synchronous communication; FDM;TDM; TFM; spread spectrum technology
   INTRODUCTION TO BLUETOOTH: Specification; core protocols; cable replacement protocol; Bluetooth radio: type of antenna; antenna parameters; frequency hoping
2. **BLUETOOTH NETWORKING**: Wireless networking; wireless network types; devices roles and states; ad-hoc network; Scatternet; connection establishment procedure; notable aspects of connection establishment; mode of connection; Bluetooth security; security architecture; security level of services; profile and usage model: generic access profile (GAP); SDA; serial port profile; secondary Bluetooth profile
3. **HARDWARE**: Bluetooth implementation; baseband overview; packet format; transmission buffers; protocol implementation: link manager protocol; logical link control adaptation protocol; host control interface; protocol interaction with layers
   PROGRAMMING WITH JAVA: Java programming; J2ME architecture; Javax; Bluetooth package Interface; classes; exceptions; Javax.obex package: interfaces, classes
4. **BLUETOOTH SERVICES**: registration and search application; Bluetooth client and server application.
5. **OVERVIEW OF IRDA, HOMERF, WIRELESS LANS, JINI**

REFERENCE BOOKS

1. Prabhu C. S. R. and Reddi A. P., “Bluetooth Technology”, Prentice Hall of India, 2006
2. Labiod H., Afifi H., and De Santis C., “Wi-Fi, Bluetooth, Zigbee and WiMax”, 1st Edition, Springer, 2007
3. Bakker Dee, Gilster Diane McMichael, and Gilster Ron, “ Bluetooth End to End”, 1st Edition, Wiley, 2002
4. Harte Lawrence, “Introduction to Bluetooth: Technology, Market, Operation, Profiles, and Services”, Althos, 2004

CS-509A	CRYPTOGRAPHY AND DATA COMPRESSION	L T P	Cr
		3 0 0	3

1. **COMPRESSION**: Packing; Huffman coding; run length encoding; Lempel-Ziv-
   Welch; Phil Katz‟s PKZIP; Delta modulation; JPEG.
2. **ERROR DETECTION AND CORRECTION**: Parity; 1, 2, n-dimensions, Hamming codes; p-out-of-q codes
3. **CRYPTOGRAPHY:** Vocabulary; history, steganography – visual, textual; cipher hiding; false errors; public key cryptography - authentication, signatures, deniability
4. **MATHEMATICS**: Information; confusion; diffusion; modular arithmetic; inverses; Fermat‟s little theorem, Chinese remainder theorem; factoring; prime numbers; discrete logarithms
5. **ALGORITHMS**: DES; AES (Rijndael); IDEA; one time pad; secret sharing and splitting; RSA; elliptic curves; modes; random numbers
6. **ATTACKING SYSTEMS**: Recognition; destroying data; cryptanalysis - differential cryptanalysis; cracking DES

REFERENCE BOOKS

1. IEEE, “Integration of Data Compression and Cryptography: Another Way to Increase the Information Security”, IEEE Computer Society
2. Schneier B., “Applied Cryptography: Protocols, Algorithms and Source Code in C”, 2nd edition, Wiley, 1996.
3. Desai Suhag, “Security in Computing”, Pearson Education
4. Trappe W. and Washington L., “Introduction to Cryptography”, 2nd edition, Pearson Education, 2006

CS-510A	NETWORK SECURITY & MANAGEMENT	L T P	Cr
		3 0 0	3

1. **INTRODUCTION:** Codes and ciphers; some classical systems; statistical theory of cipher systems: complexity theory of crypto systems; stream ciphers; block ciphers.
2. **STREAM CIPHERS:** Rotor based system; shift register based systems; design considerations for stream ciphers; crypt-analysis of stream ciphers; combined encryption and encoding; block ciphers; DES and variant; modes of use of DES; public key systems; Knapsack systems; RSK; Diffie Hellman exchange; authentication and digital signatures; elliptic curve based systems.
3. **SYSTEM IDENTIFICATION AND CLUSTERING:** Cryptology of speech signals; narrow band and wide band systems; analog and digital systems of speech encryption.
4. **SECURITY: HASH FUNCTION – AUTHENTICATION:** Protocols: digital signature standards; electronics mail security: PGP (Pretty Good Privacy)MIME; data compression technique; IP Security: architecture, authentication leader; encapsulating security payload: key management; web security: secure socket layer and transport layer security; secure electronic transactions; firewalls design principle; established systems.
5. **TELECOMMUNICATION NETWORK ARCHITECTURE:** TMN management layers; management information model; management servicing and functions; structure of management information and TMN information model; SNMPv1, SNMPv2 & SNMPv3; RMONv1 & v2; broadband network management (ATM, HFC, DSL); ASN
6. **SECURITY IN NETWORKS:** Threats in networks; network security control; firewalls, intrusion detection systems; secure e-mail; networks and cryptography; example protocols: PEM, SSL, IPSec; ADMINISTRATING SECURITY: Security planning, risk analysis, organizational security policies, physical security.
7. **LEGAL, PRIVACY, AND ETHICAL ISSUES IN COMPUTER SECURITY:**

   Protecting program and data; information and law; rights of employees and employers; software failures; computer crime; privacy; ethical issues in computer society; case studies of ethics

REFERENCE BOOKS

1. Stallings William, "Cryptography and Network Security: Principal & Practices",
   4th Edition, Prentice Hall of India, 2005
2. Kauffman C., Perlman R. and Spenser M., "Network Security", 2nd Edition, Prentice Hall, Englewood Cliffs, 2002.
3. Mani Subramanian, "Network Management Principles & Practices", Addison Wesley, 1999
4. Burke J. Richard, "Network Management concepts and Practice A Hand-on Approach", Pearson Education/Prentice Hall of India, 2003
5. Stalling William, "SNMP", 3rd Edition, Addison Wesley, 1999
6. Wang H. H., "Telecom Network Management", McGraw Hill, 1999
7. Menezes Alfred, van Oorschot Paul, and Vanstone Scott, "Handbook of Applied Cryptography", 1st Edition, CRC Press, NY., 1996
8. Bellovin S. and Chesvick W., "Internet Security and Firewalls", 2nd Edition, Addison-Wesley, Reading, 2003.
9. Schneier Bruce, "Applied Cryptography", Wiley Student Edition, 2nd Edition,

CS-512A	COMPUTER VISION	L T P	Cr
		3 0 0	3

1. **RECOGNITION METHODOLOGY:** Conditioning; labeling; grouping; extracting; matching; edge detection; gradient based operators; morphological operators; spatial operators for edge detection. thinning, region growing; region shrinking; labeling of connected components.
2. **BINARY MACHINE VISION:** Thresholding; segmentation; connected component labeling; hierarchal segmentation; spatial clustering; split & merge; rule-based segmentation; motion-based segmentation
3. **AREA EXTRACTION:** Concepts; data-structures, edge, line-linking, Hough transform, line fitting; curve fitting (least-square fitting), REGION ANALYSIS: region properties; external points; spatial moments; mixed spatial; gray-level moments; boundary analysis: signature properties, shape numbers.
4. **FACET MODEL RECOGNITION:** Labelling lines, understanding line drawings; classification of shapes by labelling of edges; recognition of shapes; consisting labelling problem; back-tracking; perspective projective geometry; inverse perspective projection; photogrammetry – from 2D to 3D; image matching: intensity matching of ID signals; matching of 2D image; hierarchical image matching.
5. **OBJECT MODELS AND MATCHING**: 2D representation; global vs. local features; general frame works for matching: distance relational approach; ordered structural matching; view class matching; models database organization
6. **GENERAL FRAME WORKS:** Distance – relational approach; Ordered – Structural matching; view class matching; models database organization
7. **KNOWLEDGE BASED VISION:** Knowledge representation; control-strategies; information integration

REFERENCE BOOKS

1. Forsyth David A. and Ponce Jean, “Computer Vision: A Modern Approach”, US Edition, Prentice Hall, 2002
2. Jain R., Kasturi R., and Schunk B. G., “Machine Vision”, McGraw Hill.
3. Sonka Milan, Hlavac Vaclav, Boyle Roger, “Image Processing, Analysis, and Machine Vision”, 3rd Edition, Thomson Learning, 2007
4. Haralick Robert and Shapiro Linda, “Computer and Robot Vision”, Vol. I and II, Addison Wesley, 2002

CS-513A	ROBOTICS	L T P	Cr
		3 0 0	3

1. **ROBOTIC MANIPULATION**: Automation and robots; classification; application; specification; notations.
2. **DIRECT KINEMATICS**: Dot and cross products; co-ordinate frames; rotations; homogeneous; co-ordinates; link co-ordination arm equation; (five-axis robot, four axis robot, six axis robot).
3. **INVERSE KINEMATICS**: General properties of solutions tool configuration; five axis robots, three-four axis; six axis robot (inverse kinematics).
4. **WORKSPACE ANALYSIS AND TRAJECTORY PLANNING WORK:** envelop and examples; workspace fixtures; pick and place operations; continuous path motion; interpolated motion; straight-line motion.
5. **ROBOT VISION:** Image representation; template matching, polyhedral objects; Shane analysis; segmentation (thresholding, region labelling, shrink operators; swell operators; Euler numbers; perspective transformation; structured illumination; camera calibration).
6. **TASK PLANNING**: Task level programming; uncertainty; configuration; space; gross motion; planning; grasp planning; fine-motion planning; simulation of planer motion; source and goal scenes; task planner simulation.
7. **MOMENTS OF INERTIA, PRINCIPLES OF NC AND CNC MACHINES.**

REFERENCE BOOKS

1. Shilling Robert, "Fundamentals of Robotics-Analysis and Control", Prentice Hall of India, 1990
2. Fu, Gonzales and Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1980
3. Craig J.J., "Introduction to Robotics", 3rd Edition, Prentice Hall of India, 2004
4. Ghoshal, "8051 Micro controller & Interfacing", Pearson Education
5. Staughard, "Robotics and Artificial Intelligence", Prentice Hall of India, 1993
6. Grover, Wiess, Nagel and Oderey, "Industrial Robotics", McGraw Hill, 1986
7. Stdder Walfram, "Robotics and Mechatronics", Tata McGraw Hill, 1995
8. Klafter, Chmielewski and Negin, "Robot Engineering", Prentice Hall of India
9. Mittal R. K. and Nagrath I. J., "Robotics and Control", Tata McGraw Hill, 2003

CS-514A	ADVANCED COMPUTER ARCHITECTURE	L T P	Cr
		3 0 0	3

1. **PARALLEL COMPUTER MODELS:** The state of computing; multiprocessors and multicomputers; multivector and SIMD computers; architectural development tracks.
2. **PROGRAM AND NETWORK PROPERTIES:** Conditions of parallelism; data and resource dependences; hardware and software parallelism; program partitioning and scheduling; grain size and latency; program flow mechanisms; control flow versus data flow; data flow architecture; demand driven mechanisms; comparisons of flow mechanisms
3. **SYSTEM INTERCONNECT ARCHITECTURES:** Network properties and routing; static interconnection networks; dynamic interconnection networks; multiprocessor system interconnects; hierarchical bus systems; crossbar switch and multiport memory; multistage and combining network.
4. **PROCESSORS AND MEMORY HIERARCHY:** Advanced processor technology; instruction-set architectures; CISC scalar processors; RISC scalar processors; superscalar processors; VLIW architectures; vector and symbolic processors; memory technology: hierarchical memory technology, inclusion, coherence and locality, memory capacity planning, virtual memory technology
5. **BACKPLANE BUS SYSTEM:** Backplane bus specification; addressing and timing protocols; arbitration transaction and interrupt; cache addressing models; direct mapping and associative caches.
6. **PIPELINING:** Linear pipeline processor; nonlinear pipeline processor; instruction pipeline design; mechanisms for instruction pipelining; dynamic instruction scheduling; branch handling techniques; arithmetic pipeline design; computer arithmetic principles; static arithmetic pipeline; multifunctional arithmetic pipelines.
7. **VECTOR PROCESSING PRINCIPLES:** Vector instruction types; vector-access memory schemes; synchronous parallel processing: SIMD architecture and programming principles, SIMD parallel algorithms, SIMD computers and performance enhancement

REFERENCE BOOKS

1. Hwang Kai and Briggs A., "Advance Computer Architecture", Tata McGraw Hill, 1993
2. Hwang Kai and Briggs A., "Computer Architecture and Parallel Processing", International Edition, McGraw-Hill, 1984
3. Hennessy John L. and Patterson David A., "Computer Architecture: A Quantitative Approach", 4th Edition, Morgan Kaufmann (An Imprint of Elsevier), 2006
4. Flynn Michael J., "Pipelined and Parallel Processor Design", 1st Edition, Narosa Publications, 1995.
5. Sima Dezso, Fountain Terence and Kacsuk Peter, "Advanced Computer Architectures", 1st Edition, Pearson Education/Addison Wesley, 1997

CS-517A	DISTRIBUTED COMPUTING	L T P	Cr
		3 0 0	3

1. **DISTRIBUTED COMPUTING:** History; forms of computing; strengths and weaknesses of distributed computing; OS basics; network basics; software engineering basics
2. **CLIENT SERVER PARADIGM:** Issues; software engineering for a network service; connection oriented and connectionless servers; Iterative server and concurrent server; stateful servers.
3. **INTERPROCESS COMMUNICATION:** Archetypal IPC program interface; event synchronization; timeouts and threading; deadlock and timeouts; data representation; data encoding; text based protocols; request response protocols; event and sequence diagram; connection vs. connectionless IPC.
4. **DISTRIBUTED COMPUTING PARADIGMS AND SOCKET API:** Paradigms; abstraction; socket metaphor; diagram socket API; stream mode socket API; sockets with non-blocking I/O; secure socket API; GROUP COMMUNICATION: Unicasting; multicasting; archetypal multicast API; connection oriented and connectionless; reliable; unreliable multicast; Java basic multicast API.
5. **DISTRIBUTED OBJECTS:** Message passing vs. distributed objects, archetypal distributed object architecture, distributed object systems, remote procedure calls, Java RMI architecture, API for Java RMI, Advanced RMI: client callback, stub downloading, RMI security manager, allowing for Stub downloading
6. **SIMPLE OBJECT ACCESS PROTOCOL:** SOAP request; SOAP response; Apache SOAP; invoking web service; implementing web service
7. **ADVANCED DISTRIBUTED COMPUTING PARADIGMS:** Message queue system paradigm; mobile agents; network service; object spaces

REFERENCE BOOKS

1. Tannenbaum Andrew S. and van Steen Maarten, “Distributed Systems: Principles and Paradigms”, Prentice Hall, 2002.
2. Coulouris George, Dollimore Jean, Kindberg Tim, “Distributed Systems: Concepts and Design”, 4th Edition, Addison Wesley, 2005
3. Garg Vijay K., “Elements of Distributed Computing”, Wiley, 2002.

CS-518A	MOBILE COMPUTING	L T P	Cr
		3 0 0	3

1. **INTRODUCTION TO WIRELESS TRANSMISSION:** Applications; short history of wireless communication; frequency for radio transmission; signals; antennas; signal propagation; multiplexing; modulation; spread spectrum; cellular systems.
2. **MEDIUM ACCESS CONTROL:** Motivation for a specialized MAC: hidden and exposed terminals; near and far terminals; SDMA; FDMA; TDMA: fixed TDM, classical Aloha; slotted Aloha; carrier sense multiple access; demand assigned multiple access; PRMA packet reservation multiple access, reservation TDMA; multiple access with collision avoidance; polling; inhibit sense multiple access; CDMA: spread Aloha multiple access
3. **TELECOMMUNICATION SYSTEMS:** GSM: mobile services; system architecture; radio interface; protocols; localization and calling; handover; security; new data services; DECT: system architecture, protocol architecture; TETRA, UMTS and IMT-2000: UMTS basic architecture, UTRA FDD mode, UTRA TDD mode **SATELLITE & BROADCAST SYSTEMS:** History, applications; basics: GEO, LEO, MEO; routing; localization; handover; examples; cyclic repetition of data; digital audio; broadcasting: multimedia object transfer protocol; digital video broadcasting
4. **WIRELESS LAN:** infrared vs. radio transmission; infrastructure and ad hoc networks; IEEE 802.11: system architecture, protocol architecture; physical layer; medium access control layer; MAC management; future development; HIPERLAN: protocol architecture, physical layer, channel access control sub layer, medium access control sub layer, information bases and networking; Bluetooth: user scenarios, physical layer, MAC layer, networking; security; link management; WIRELESS ATM: motivation for WATM, wireless ATM working group, WATM services; Reference model: example configurations; generic reference model; functions: wireless mobile terminal side, mobility supporting network side; radio access layer: requirements, BRAN; handover: handover reference model, handover requirements, types of handover, handover scenarios, backward handover, forward handover; location management: requirements for location management, procedures and entities; addressing, mobile quality of service, access point control protocol
5. **MOBILE NETWORK LAYER:** Mobile IP: goals, assumptions and requirements, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunnelling and encapsulation, optimizations, reverse tunnelling, IPv6; dynamic host configuration protocol, ad hoc networks: routing, destination sequence distance vector,

dynamic source routing, hierarchical algorithms, alternative metrics, MOBILE TRANSPORT LAYER: traditional TCP: congestion control, slow start, fast retransmit/fast recovery, implications on mobility; indirect TCP, snooping TCP, mobile TCP, fast retransmit/fast recovery, transmission/ time-out freezing, selective retransmission, transaction oriented TCP

6. **SUPPORT FOR MOBILITY:** File systems: consistency, examples; world wide web: hypertext transfer protocol, hypertext markup language, some approaches that might help wireless access, system architectures; wireless application protocol: architecture, wireless datagram protocol; wireless transport layer security; wireless transaction protocol; wireless session protocol; wireless application environment; wireless markup language; WML script; wireless telephony application; examples: stacks with WAP, mobile databases, mobile agents

REFERENCE BOOKS

1. Schiller Jochen, "Mobile Communications", 2nd Edition, Addison Wesley/Pearson Education, 2003
2. Agrawal Dharma Prakash and Zeng Qing-An, "Introduction to Wireless and Mobile Systems", 2nd edition, 2006
3. Talukder Asoke K. and Yavagal R. R., "Mobile Computing", Tata McGraw-Hill, New Delhi, 2005.
4. Hansman Uwe, Merk Lothar, Nicklous Martin S. and Stober Thomas, "Principles of Mobile Computing", 2nd Edition, Springer Verlag, 2003
5. Stallings William, "Wireless Communications and Networks", 2nd Edition,
   Prentice Hall of India, 2004
6. Lin Yi-Bing and Chlamtac Imrich, "Wireless and Mobile Network Architectures", John Wiley & Sons, 2004
7. Rappaport, "Wireless Communications Principles and Practices" , 2nd Edition,
   Prentice Hall of India, 2002
8. Nicopolitidis P., "Wireless Networks", John Wiley, 2003
9. Richharia M., "Mobile Satellite Communication: Principles and Trends", 1st Edition, Addison Wesley/Pearson Education, 2001

CS-519A	PERVASIVE COMPUTING	L T P	Cr
		3 0 0	3

1. **INTRODUCTION:** The Computer for the 21st Century; wireless technologies: signal propagation, multiplexing, modulation and spread spectrum techniques; challenges and Issues in ubiquitous computing: disconnected operation; update propagation; update conflicts; synchronization; replication; bandwidth adaptation; power adaptation; context awareness; location tracking; migration; system support; security; smart spaces; invisibility; localized scalability; uneven conditioning
2. **DEVICE TECHNOLOGY:** Compaq iPAQ 5400 Series; iPAQ 5450 Specs; Tiqit Eightythree; Eighty three Specs; Palm Tungsten-T; Tungsten-T Specs; Bluetooth qualified products.
3. **WIRELESS NETWORKING AND SATELLITE SYSTEMS:** Overview of IEEE 802.11b wireless Ethernet standard; Bluetooth radio system; Wi-Fi (802.11b); General Packet Radio Service in GSM, 802.11 a, b & g comparison; 802.11 a & b comparison; 802.11a official standard, WAP and WML; satellite systems: basic routing, localization, and handoff issues
4. **MOBILE NETWORKING**: Mobile IP; ad-hoc networks: AODV, DSR, DSDV routing; wireless TCP: indirect TCP, snooping TCP, mobile TCP
5. **SENSOR NETWORKS AND AD HOC ROUTING:** System architecture for networked sensors; making sharing pervasive: ubiquitous computing, multi-hop wireless ad hoc network routing protocols; TAG: Tiny aggregation service.
6. **LANGUAGES, PROTOCOLS AND INFORMATION MANAGEMENT:** Jini; Sync; UDDI; Universal Plug-and-Play (UPnP); Simple Object Access Protocol (SOAP) 1.1; MobileIP and TCP over wireless; Information Management: Location-Independent and Location-dependent computing models
7. **USER INTERFACES AND APPLICATION EXAMPLES:** Coordination Infrastructure for Interactive Workspaces; ICrafter: a service framework for ubiquitous computing environments; the interactive workspaces project; ubiquitous computing rooms; context-aware design and interaction; fluid interaction; overview of the PARCTAB ubiquitous computing experiment.

REFERENCE BOOKS

1. Agrawal Dharma Prakash and Zeng Qing-An, "Introduction to Wireless and Mobile Systems", 2nd edition, 2006
2. Talukder Asoke K. and Yavagal R. R., "Mobile Computing", Tata McGraw-Hill, New Delhi, 2005.
3. Burkhardt Jochen, Henn Horst, Hepper Stefan, Schaec Thomas and Rindtorff Klaus, "Pervasive Computing: Technology and Architecture of Mobile Internet Applications", Pearson Education, New Delhi, 2007.
4. Adelstein Frank, Gupta S. K. S., Richard G. G. and Schwiebert L., "Fundamentals of Mobile & Pervasive Computing", Tata McGraw-Hill, 2005.
5. Foster Ian and Kesselman Carl, "The Grid 2: Blueprint for a New Computing Infrastructure", Morgan Kaufmann Publishers, 2004
6. Amor Daniel, "Internet Future Strategies: How Pervasive Computing Services Will Change the World", Prentice-Hall PTR, 2008.
7. Lin Yi-Bing and Chlamtac Imrich, "Wireless and Mobile Network Architectures", John Wiley & Sons, 2004
8. Nicopolitidis P., Obaidat M. S., Papadimitriou G. I. and Pompportsis A. S., "Wireless Networks", John Wiley & Sons, 2003
9. Graham Steve, Simeonov Simeon, Boubez Toufic, Daniels Glen, Davis Doug, Nakamura Yuichi and Neyama Ryo, "Building Web Services with Java: Making Sense of XML, SOAP, WSDL and UDDI", 2001

CS-520A	SPEECH RECOGNITION & GENERATION	L T P	Cr
		3 0 0	3

1. **FUNDAMENTALS OF SPEECH RECOGNITION:** Introduction; the paradigm for speech; recognition; out line; brief history of speech recognition research; SPEECH GENERATION: formant frequencies in speech, parametric source-filter synthesis, formant synthesizers, pitch detection, amplitude analyzer, vocabulary, text-to-speech conversion, vocoders
2. **THE SPEECH SIGNAL:** Production, reception, and acoustic-phonetic characterization: the speech production system; representing speech in time and frequency domains; speech sounds and features; approaches to automatic speech recognition by machine.
3. **SIGNAL PROCESSING AND ANALYSIS METHODS FOR SPEECH RECOGNITION:** The bank of filters; front-end processor; Linear predictive model for speech recognition; vector quantization; auditory based spectral analysis model.
4. **PATTERN COMPARISON TECHNIQUES:** Speech detection; distortion measures: mathematical considerations; distortion measures: perceptual considerations; spectral: distortion measures; incorporation of spectral dynamic features into distortion measures; time alignment and normalization.
5. **SPEECH RECOGNITION SYSTEM DESIGN AND IMPLEMENTATION ISSUES:** Application of source coding techniques to recognition; template training methods; performance analysis and recognition enhancements; template adoption to new talkers; discriminative methods in speech recognition; speech recognition in adverse environment.
6. **THEORY AND IMPLEMENTATION OF HIDDEN MARKOV MODELS:**
   Discrete time Markov processes; extensions to hidden Markov Models; three basic problems for HMMs; types of HMMs; implementation issues for HMMs; HMM system for isolated word recognition
7. **SPEECH RECOGNITION BASED ON CONNECTED WORDS MODELS:**

   General notations for the connected word-recognition problem; two level dynamic programming algorithm; level building algorithm; one pass algorithm; multiple candidate strings; grammar networks for connected digit recognition; segmental K-means training procedure; connected digit recognition implementation; task oriented applications of automatic speech recognition and generation.

REFERENCE BOOKS

1. Gold Bernard and Morgan Nelson, “Speech and Audio Signal Processing”, John Wiley & Sons, 2004
2. Rabiner Lawrence R. and Juang B., “Fundamentals of Speech Recognition”, Pearson Education/Prentice Hall of India, 1993
3. Rabiner Lawrence R. and Schafer R. W., “Digital Processing of Speech Signals”, Pearson Education/Prentice Hall of India, 1978
4. Rabiner Lawrence R. and Gold Bernard, “Theory and Application of Digital Signal Processing”, Prentice Hall of India, 1975
5. Jurafsky D. and Martin J. H., “Speech and Language Processing”, 2nd Edition, Pearson Education/Prentice Hall of India, 2008

CS-521A	NATURAL LANGUAGE PROCESSING	L T P	Cr
		3 0 0	3

1. **INTRODUCTION TO NATURAL LANGUAGE UNDERSTANDING**: The study of language, applications of NLP, evaluating language understanding systems, different levels of language analysis, representations and understanding, organization of natural language understanding systems, linguistic background: an outline of English syntax.
2. **GRAMMARS AND PARSING:** Grammars and sentence structure, top-down and bottom-up parsers, transition network grammars, top-down chart parsing. feature systems and augmented grammars: basic feature system for English
3. **MORPHOLOGICAL ANALYSIS AND THE LEXICON**: Brief review of regular expressions and automata, finite state transducers, parsing with features, augmented transition networks
4. **GRAMMARS FOR NATURAL LANGUAGE**: Auxiliary verbs and verb phrases, movement phenomenon in language, handling questions in context-free grammars, hold mechanisms in ATNs.
5. **HUMAN PREFERENCES IN PARSING**: Encoding uncertainty, deterministic parser, word level morphology and computational phonology; basic text to speech; introduction to HMMs and speech recognition, parsing with CFGs; probabilistic parsing. representation of meaning.
6. **AMBIGUITY RESOLUTION**: Statistical methods, estimating probabilities, part-of- speech tagging, obtaining lexical probabilities, probabilistic context-free grammars, best first parsing.
7. **SEMANTICS AND LOGICAL FORM**: Word senses and ambiguity, encoding ambiguity in logical form, semantic analysis; lexical semantics; word sense; disambiguation; discourse understanding; natural language generation, Indian language case studies.

REFERENCE BOOKS

1. Siddiqui Tanveer and Tiwary U. S., "Natural Language Processing and Information Retrieval", Oxford University Press, 2008
2. Allen James, "Natural Language Understanding", 2nd edition, Pearson Education, 2003.
3. Winograd Terry, "Language as a Cognitive Process", Addison Wesley, 1983
4. Gazder G., "Natural Language Processing in Prolog", Addison Wesley, 1989
5. Jurafsky D. and Martin J. H., "Speech and Language Processing", Pearson Education, 2002.

CS-522A	EXPERT SYSTEMS	L T P	Cr
		3 0 0	3

1. **ARTIFICIAL INTELLIGENCE:** History and applications; AI problems and techniques; concept of AI; approaches: acting and thinking like humans and rationally; brief history of AI; foundations of AI; underlying assumptions; application areas.
2. **PRODUCTION SYSTEMS, STRUCTURES AND STRATEGIES FOR STATE SPACE SEARCH:** Data driven and goal driven search; depth first and breadth first search; DFS with iterative deepening.
3. **HEURISTIC SEARCH:** Best first search; A* algorithm; AO* algorithm; constraint satisfaction; using heuristics in games: Minimax search, alpha beta procedure; state space theory/representation.
4. **KNOWLEDGE REPRESENTATION:** Simple relational knowledge; inheritable knowledge; inferential knowledge; procedural knowledge propositional calculus; predicate calculus; theorem proving by resolution; answer extraction; AI representational schemes: semantic nets, conceptual dependency, scripts, frames; introduction to agent based problem solving.
5. **MACHINE LEARNING:** Symbol based and connectionist; social and emergent models of learning; the genetic algorithm: genetic programming; overview of expert system technology: rule based expert systems; introduction to natural language processing; neural networks.
6. **LANGUAGES AND PROGRAMMING TECHNIQUES FOR AI:** Introduction to PROLOG and LISP; search strategies and logic programming in LISP; production system examples in PROLOG.
7. **KNOWLEDGE BASED SYSTEMS:** Expert systems; components; characteristic features of expert systems; applications; rule based system architecture; representing and using domain knowledge; expert system shell; explaining the reasoning and knowledge acquisition; applications.

REFERENCE BOOKS

1.Mauss Rex and Keyes Jessica, “Handbook of Expert Systems in Manufacturing”, McGraw Hill, 1991

2.Gonzalez, Fu and Lee, “Robotics: Control, Sensing, Vision and Intelligence”, McGraw Hill,1987

3.Nilsson N. J., “Principles of Artificial Intelligence”, Narosa Publishing House, 1990.

4.Patterson Dan W., “Introduction to Artificial Intelligence & Expert Systems”, Seventh Indian Reprint, Eastern Economy Edition, Prentice Hall of India, 1999

5.Winston P. H., “Artificial Intelligence”, 3rd Edition, Pearson Education, 2000

6.Schalkoff R. J., “Artificial Intelligence – An Engineering Approach”, McGraw Hill Int. Ed. Singapore, 1992.

7.Sasikumar M. and Ramani S., “Rule Based Expert Systems”, Narosa Publishing House, 1994.

CS-523A	BIOINFORMATICS	L T P	Cr
		5 0 0	3

1. **INTRODUCTION TO MOLECULAR BIOLOGY:** Gene structure and information content; molecular biology tools; genomic information content
2. **COMPUTATIONAL BIOLOGY:** Data searches and pairwise alignments; gaps; scoring matrices; Needleman and Wunsch algorithm; global and local alignments; database searches.
3. **PHYLOGENETICS:** Molecular phylogenetics; phylogenetic trees; distance matrix methods; character-based methods of phylogenetics; parsimony.
4. **GENOMICS:** Patterns of substitution within genes; estimating substitution numbers, molecular clocks; ancestral sequences; searches; consensus trees; tree confidence; genomics; prokaryotic gene structure; gene density; eukaryotic genomes; gene expression.
5. **PROTEOMICS:** Protein and RNA structure prediction;, polypeptic composition; secondary and tertiary structure; algorithms for modeling protein folding; structure prediction; proteomics; protein classification; experimental techniques; ligand screening; post-translational modification prediction.
6. **GENE EXPRESSION DATA:** Microarrays and gene expression data; microarray design; analysis of data; application; microarray standards; clustering (SOM, PCA/SVD, k-means, Hierarchical); classification (LVQ, SVM); processing gene expression data using decision tree based methods (ID3, ASSISTANT, C5.0)
7. **NEW AREAS OF BIOINFORMATICS:** Metabolmics – metabolic pathways; drug target identification; biological systems – systems of molecular network; eco-systems, elements of systems modeling; nutrigenomics; palenteoinformatics; toxicogenomics; systems biology; pharmacogenomics; synthetic biology; bio-terrorism; biological and chemical warefare; data security issues in bioinformatics; bio-ethics: cloning, transgenic organisms, bio-ethics in agriculture; ontology; standards

REFERENCE BOOKS

1. Mount David, “Bioinformatics: Sequence and Genome Analysis”, 3rd Edition, Cold Spring Harbor Laboratory, 2008
2. Krane D. E. and Raymer M. L., “Fundamental Concepts of Bioinformatics”, Pearson Education, 2003.
3. Gibas Cynthia and Jambeck Per, “Developing Bioinformatics Computing Skills”, O‟Reilly, 2001
4. Attwood T. K. and Parry-Smith D. J., “Introduction to Bioinformatics”, Pearson Education, 2003
5. Zar J. H., “Biostatistical Analysis”, 4th edition, Pearson Education, 1999.
6. Baldi Pierre and Brunak Søren, “Bioinformatics: The Machine Learning Approach”, 2nd edition, MIT Press, 2001
7. Westhead D. R. et al, “Instant Notes Series: Bioinformatics”, Viva Books, 2003 Baxenavis Andreas, Francis Ouellette B. F. (eds), “Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins”, John Wiley, 1998

CS-551A	SIMULATION LAB	L T P	Cr
		0 0 4	2

The students are advised to take up at least two experiments from each Unit from both course CS-501 and CS-502.

CS-553A	ADVANCED DATABASE MANAGEMENT SYSTEMS LAB	L T P	Cr
		0 0 2	2

The students are advised to take up at least four experiments from each Unit of the course CS-503

CS-555A	SOFTWARE ENGINEERING LAB	L T P	Cr
		0 0 2	1

The students are advised to take up at least two experiments from each Unit covering courses CS-524A

LIST OF EXPERIMENTS

The students are advised to take up at least four experiments from each Unit, such as the following:

1. Write a program to implement classes and objects.
2. Write a program to implement constructor and destructor
3. Write a program to implement dynamic initialization of objects with the help of new and delete operator.
4. Write a program to implement bubble sort template or swapping template.
5. Write a program to implement friend function.
6. Write a program to implement operator overloading.
7. Write a program to implement virtual function.
8. Write a program to implement multilevel inheritance and multiple inheritances.
9. Create a data flow diagram for book shop management system

10. Create a collaboration diagram for elevator system
11. Create a sequence diagram for elevator system
12. Create a class diagram for elevator system
13. Use case diagram for elevator system
14. Write a program to perform read and write functions in a file
15. Write a program to maintain the inventory of super market using File Handling.
16. Make a class **Employee** with a name and salary. Make a class **Manager** inherits from **Employe**e. Add an instance variable, named department, of type string. Supply a method to **toString** that prints the manager‟s name, department and salary. Make a class **Executive** inherits from **Manage**r. Supply a method **to String** that prints the string **Executive** followed by the information stored in the **Manager** super class object. Supply a test program that tests these classes and methods.
17. Create a generic class to create a list of int, float or char also include number to perform various operations on list i.e. traverse, insert and delete
18. Create a class Matrix and overload +, - , * operator to perform addition, subtraction, multiplication of two matrices.
19. Modify class Matrix to overload +, - , * operator with the help of friend function.
20. Write a program to implement following:
    - A function to reverse a string ("spam" gets turned into “maps”).
    - Function to reverse and uppercase a string
    - Function to reverse and lowercase a string.
    - An encrypt function. Invent your own encryption algorithm.

CS-566A	ADVANCED OPERATING SYSTEMS LAB	L T P	Cr
		0 0 2	1

The students are advised to take up at least four experiments from each Unit of the course CS-509.

CS-574A	SEMINAR – I	L T P	Cr
		0 0 2	1

The student has to undertake extensive literature survey on a topic with the approval of the course coordinator. The course coordinator shall not be below the rank of Assistant Professor. The work may involve extensive search of print, audio-video materials, internet surfing etc.
The work of monitoring will be done by the course coordinator and evaluation by the course coordinator and the HOD or his nominee.

CS-601A	KNOWLEDGE BASED SYSTEM DESIGN	L T P	Cr
		3 1 0	4

1. **INTRODUCTION TO AI AND SEARCH TECHNIQUES**: Foundation and history of AI; Data, Information and Knowledge; AI problems and techniques – AI programming languages, problem space representation with examples, blind search strategies; breadth first search; depth first search; heuristic search techniques: Hill climbing; best first search, A * algorithm AO* algorithm; Means-ends analysis
2. **KNOWLEDGE REPRESENTATION ISSUES:** predicate logic; logic programming; constraint propagation; representing knowledge using rules
3. **REASONING UNDER UNCERTAINITY:** Reasoning under uncertainty; Non monotonic reasoning; review of probability; Bayes‟ probabilistic interferences and Dampster Shafer theory; Heuristic methods; symbolic reasoning under uncertainty; statistical reasoning, fuzzy reasoning
4. **PLANNING & GAME PLAYING:** Minimax search procedure; goal stack planning; Non linear planning; hierarchical planning; Planning in situational calculus; representation for planning; partial order planning algorithm
5. **LEARNING:** Basic concepts; rote learning; learning by taking advices; learning by problem solving; learning from examples; discovery as learning; learning by analogy; explanation based learning; neural nets; genetic algorithms.
6. **OTHER KNOWLEDGE STRUCTURES:** semantic nets; partitioned nets; parallel implementation of semantic nets; frames; common sense reasoning and thematic role frames, architecture of knowledge based system; rule based systems; forward and backward chaining; frame based systems
7. **APPLICATIONS OF ARTIFICIAL INTELLIGENCE:** Principles of natural language processing; rule based systems architecture; expert systems; knowledge acquisition concepts; AI application to robotics and current trends in intelligent systems; Parallel and Distributed AI: Psychological modeling, parallelism in reasoning systems; Distributed reasoning systems and algorithms

REFERENCE BOOKS

1. Rich Elaine, Knight Kevin and Nair Shivshankar B., "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2006
2. Konar Amit, "Artificial Intelligence and Soft Computing – Behavioural and Cognitive Modeling of the Human Brain", Special Indian Edition, CRC Press, 2008
3. Barnes Stuart (ed.), "Knowledge Management Systems – Theory and Practice", Indian Edition, Cengage Learning, 2002
4. Nilson Nils J., "Artificial Intelligence", Harcourt Asia Pte. Ltd.
5. Russell Stuart and Norvig Peter, "Artificial Intelligence: A Modern Approach", Prentice Hall of India, 1998
6. Patterson O. W., "Introduction to Artificial Intelligence & Expert Systems", Prentice Hall of India
7. Clockson and Mellish, "Programming PROLOG", Narosa Publications.

CS-602A	SOFT COMPUTING	L T P	Cr
		3 1 0	4

1. **INTRODUCTION:** Comparison of soft computing methods: neural networks, fuzzy logic, genetic algorithm with conventional artificial intelligence (hard computing).
2. **OPTIMIZATION:** Least-square methods for system identification, recursive least square estimator; LSE for nonlinear models; derivative based optimization: descent methods, Newton‟s method, conjugate gradient methods; nonlinear least-squares problems: Gauss Newton method, Levenberg- Marquardt method.
3. **NEURAL NETWORKS:** Different architectures; back-propagation algorithm; hybrid learning rule; supervised learning- perceptrons, adaline, back-propagation multilayer perceptrons, radial basis function networks; unsupervised learning – competitive learning network, Kohonen self-organizing networks, Hebbian learning, the Hopfield network.
4. **FUZZY SET THEORY:** Basic definition and terminology; basic concepts of fuzzy logic; set theoretic operators; membership functions: formulation and parameterization; fuzzy union, intersection and complement; fuzzy rules and fuzzy reasoning; fuzzy inference systems: Mamdani and Sugeno fuzzy models, fuzzy associative memories.
5. **NEURO-FUZZY MODELLING:** Adaptive neuro-fuzzy inference systems; neuro-fuzzy controller-feedback control; expert control; back propagation through time and real-time recurrent learning; reinforcement learning control; gradient-free optimization.
6. **NEURO-FUZZY CONTROLLER IN ENGINEERING APPLICATIONS:** Fuzzy logic in control engineering- Mamdani and Sugeno architecture for fuzzy control; analytical issues in fuzzy logic control; fuzzy logic in intelligent agents; fuzzy logic in mobile robot navigation; fuzzy logic in database systems; applications of fuzzy logic in medical image segmentation.
7. **GENETIC ALGORITHMS:** Basics of genetic algorithms; design issues in genetic algorithm; genetic modeling; hybrid approach; GA based fuzzy model identification; fuzzy logic controlled genetic algorithm, neuro- genetic hybrids and fuzzy – genetic hybrids.

REFERENCE BOOKS

1. Rajasekharan S. and Vijayalakshmi Pai S. A., "Neural Networks, Fuzzy Logic & Genetic Algorithms", Prentice-Hall of India, 2003
2. Kecman Vojislav, "Learning and Soft Computing", MIT Press, 2001
3. Konar Amit, "Artificial Intelligence and Soft Computing – Behavioural and Cognitive Modeling of the Human Brain", Special Indian Edition, CRC Press, 2008
4. Goldberg David E., "Genetic Algorithms", Pearson Education, 2003.
5. Sivanandam, "Introduction to Neural Networks with MATLAB 6.0", Tata McGraw Hill
6. Kumar Satish, "Neural Networks: Classroom Approach", Tata McGraw Hill
7. Yen John and Langari Reza, "Fuzzy Logic, Intelligence, Control, and Information", Pearson Education, 2003.
8. Zurada Jack N., "Introduction to Neural Networks", Jaico Publishers.
9. Haykin Simon, "Neural Networks", Prentice Hall, 1993/Pearson Education,
   1999.
10. Koza J., "Genetic Programming", MIT Press, 1993

CS-605A	EMBEDDED SYSTEM DESIGN	L T P	Cr
		3 1 0	4

1. **REAL TIME OPERATING SYSTEMS:** Real time operating system overview; exposure to Windows CE, QNX, Micro kernels and µc/OS of introduction to process models; Interrupt routines in an RTOs environment, encapsulating semaphores and queues; hard real-time scheduling considerations; saving memory space.
2. **MICROPROCESSORS AND MICRO-CONTROLLERS:** 16 and 32 bit microprocessor and micro-controller and DSP hardware with reference to embedded system.
3. **EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND COMPILERS:** host and target machines; linker/ locators for embedded software; cross compilers, cross assemblers and tool chairs; gce compiler; basic concept of device drivers; serial communication interface device driver.
4. **EMULATION:** System synthesis of hardware/ software co-emulation; simulation speed of emulators; JTAG OCD communication: communication protocols with special reference to embedded system; TCP/IP; VDP wireless protocols; IRDA; Blue tooth IEEE 8.8.11
5. **INTRODUCTION TO EMBEDDED SYSTEMS:** Introduction; overview; design

   process, instruction set architecture; CISC and RISC instruction set; architecture; basic embedded processor/microcontroller architecture; memory system architecture; I/O sub-system, co-processors and hardware accelerators; processor performance enhancement; DESIGNING EMBEDDED COMPUTING PLATFORM: Using CPU bus; memory devices and their characteristics; I/O devices; component interfacing, memory interfacing; I/O device interfacing; interfacing protocols; designing with processors -system architecture, hardware design, FPGA based design; implementation - development environment; debugging techniques; design examples - data compressor, alarm clock

REFERENCE BOOKS

1. Simon David E., “An Embedded System Primer”, Addison-Wesley,1999
2. Marwedel Peter, “Embedded System Design”, Springer, 2006
3. Bentham Jeremy, “TCP/IP Lean: Web servers for Embedded Systems”, 2002
4. Grehan Rick, “Real–time Programming: A Guide to 32 bit Embedded Development”, Addison-Wesley, 1999
5. De Micheli G., Ernst Rolf, and Wolf Wayne, eds., “Readings in Hardware/Software Co-Design”, Morgan Kaufmann, Systems-on-Silicon Series Embedded
6. Vahid Frank and Givargis Tony D., “System Design: A Unified Hardware/Software Introduction”, Addison Wesley, 2002.
7. Barr Michael, “Programming Embedded Systems in C and C++”, O'Reilly, 1999.
8. Ganssle Jack, “The Art of Designing Embedded Systems”, Newnes, 2000.

CS-652A	SOFT COMPUTING & ARTIFICIAL INTELLIGENCE LAB	L T P	Cr
		0 0 2	1

LIST OF EXPERIMENTS

PART A: The students should do the listed experiments from the course CS-601 Knowledge based System Design:

1. Study of Prolog programming language
2. Write at least 3 programs to use iterative structures using Prolog
3. Write at least 3 programs to demonstrate inferencing/deductive logic using Prolog
4. Write a program to solve 8 queens problem using Prolog.
5. Solve any problem using depth first search using Prolog.
6. Solve any problem using best first search using Prolog.
7. Solve 8-puzzle problem using best first search using Prolog
8. Solve robot (traversal) problem using means end analysis using Prolog.
9. Solve traveling salesman problem using Prolog.
10. Write program to exhibit the ability of building an expert system using Prolog
11. Study the properties and issues of natural language processing
12. Study the grammar mapping issues in language translation from English to Hindi and vice versa

PART B: The students are advised to take up at least two experiments from each Unit of the course CS-602 Soft Computing.

CS-653A	DISSERTATION PRELIMINARY	L T P	Cr
		0 0 8	4

See note as given under course CS-659.

CS-654A	SEMINAR – II	L T P	Cr
		0 0 4	2

The work of Dissertation Preliminary is to be presented by the student in the form of Seminars II.

The work of monitoring will be done by the guide and evaluation by the committee consisting of guide, course coordinator and the HOD or his nominee.

CS-657A	MINOR PROJECT	L T P	Cr
		0 0 6	3

The student is required to do the design/fabrication/coding/simulation of equipment/process/system of his/her choice and to be approved by the course coordinator.

The course coordinator will evolve the evaluation procedure under the guidance of HOD.

CS-658A	SEMINAR – III	L T P	Cr
		0 0 4	2

The work of Dissertation Phase-I is to be presented by the student in the form of Seminars III.

The work of monitoring will be done by the guide and evaluation by the committee consisting of guide, course coordinator and the HOD or his nominee.

CS-659A	DISSERTATION	L T P	Cr
		0 0 46	23+4

Every student will carry out dissertation under the supervision of a guide. The topic of dissertation shall be approved by a committee constituted by the HOD. The method of evaluation including intermediate assessment shall be as evaluated by the pertinent BOS.

Dissertation work is spread over three terms and coded as CS-653, CS-656 and CS-659. The distribution of amount of work in these three terms is equivalent to 5,6 and 12 credits respectively. The evaluation of work is continuous but award of grade is for 23 credits in the last term on the basis of total work.

CS-660A	TEACHING PRACTICE-I	L T P	Cr
		- - -	2

See note as given under course CS-661.

CS-661A	TEACHING PRACTICE – II	L T P	Cr
		- - -	2

Teaching practice comprises of two non-two letter mandatory courses to be done under the guidance of HOD. Here, the student is required to be engaged in teaching of two UG courses (I and II) of his/her choice during the period between IVth to IXth Terms of the M.Tech. Degree Programme. The student shall register for Teaching Practice only at the time he plans to take up teaching of UG course, but the credits earned will be counted in Term-VI for Full Time students and Term-IX for Part Time students.

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