Course Structure and Syllabus

Of

M Tech (IT)

Department of Computer Sciences & Engineering

School of Engineering

Tezpur University

Course Structure

Time Duration:

Minimum duration:	2 years (4 semesters)
Maximum duration:	4 years (8 semesters)

Credit Requirements:

Minimum Credit requirement	: 64
Core Courses	: 43
Electives	: 12
IDC	: 09

COURSE STRUCTURE

Core Courses

Course Code	Title	Credit Structure L-T-P			Total Credit
	1st Semester				
CS 531	Object Oriented Programming & Design	3	1	1	5
IT 611	Distributed Systems	3	0	0	3
CS 634	Selected Topics in Computer Networks	3	0	1	4
	Elective 1				3
	IDC				3
	2nd Semester				
CS 601	Design Analysis of Algorithms	3	0	0	3
IT 610	Advanced Database System	3	0	1	4
	Elective 2				3
	Elective 3				3
	IDC				3
	3rd Semester				
IT 604	Term Project I	0	0	8	8
	Elective 4				3
	IDC				3
	4th Semester				
IT 605	Term Project II	0	0	0	16

Elective Courses

Course Code	Title	Credit Structure	Total Credit
CS 509	Data Communication	3-0-1	4
CS 505	Software Engineering	3-0-1	4
CS 525	Artificial Intelligence	3-0-0	3
CS 424	Formal Language and Automata	3-0-0	3
IT 518	Graph Theory	3-0-0	3
CS 529	Embedded Systems	3-0-1	4

CS 621	Mobile Computing	4-0-0	4
CS 625	Web Technology	3-0-1	4
IT 517	Pattern Recognition	4-0-0	4
IT 509	Data Mining & Data Warehousing	3-0-1	4
IT 507	Computer Security & Cryptography	3-0-0	3
CS 606	Computer Architecture and Parallel Processing	3-0-0	3
CO 504	Natural Language Processing	3-0-0	3
CS 610	Bioinformatics	3-0-0	3
CS 725	Knowledge Representation and Reasoning	4-0-0	4
CS 731	Data Mining in Security	3-0-1	4
CS 538	Computational Geometry	3-0-0	3
CO 503	Fuzzy Logic and Neural Networks	3-0-0	3
IT 523	Discrete Mathematics	3-0-0	3
CS 522	Computer Graphics	3-0-2	4
CS 523	Enterprise Resource Planning	3-0-0	3
CS 524	Theory of Computation	3-0-0	3
CS 502	System Software	2-0-2	3
CS 507	Computer Networks	3-0-1	4
CS 508	Database Management Systems	2-1-2	5
IT 503	Multimedia Systems	3-0-2	4
IT 504	E-Commerce	3-0-0	3
IT 506	Logic Programming	3-0-0	3
IT 510	Advanced Operating Systems	3-0-1	4
CS 532	Compiler Design	3-0-1	4
CS 602	Image Processing	3-0-0	3
CS 607	Optimization Technique	3-0-0	3

Detailed Syllabi

CS 531	Object Oriented Programming and Design	3-1-1	5

Part I : Object Oriented Programming
Structured Programming and Object Oriented Programming paradigms.
Key Concepts :
Data Abstraction : Class, object, constructors, destructors, memory allocations for objects, member functions, friend functions, templates.
Inheritance : Single & multiple inheritance, virtual base class.
Polymorphism : Compile time polymorphism : operator overloading, function overloading, static binding.
Run-time polymorphism : Virtual function, pure virtual function, abstract class, dynamic binding.
Exception handling.
Part - II Object Oriented Design
Object Oriented Design Approaches: Object Model, Dynamic Model, and Functional Model. (Objet Diagram, State Diagram, and DFD).
Phases of Object Oriented Development: Object Analysis, System Design, Object Design.

Books/References:

1. Herbert Schild : The Complete Reference to C++, Osborne McGrawHill.
2. Bjarne Stroustrup: The C++ Programming Language, Addison Wesley
3. Rambaugh et al. : Object Oriented Modeling and Design, PHI(EEE).
4. Grady Booch: Object Oriented Analysis and Design, Pearson Education.

IT 611	Distributed System	3-0-0	3

Characterization of Distributed Systems, Design issues and user requirements. Interprocess Communication-Synchronous and Asynchronous, Client-server communication, Group communication.
Remote procedure Call-Design issues & Implementation. Distributed S-Design issues & Implementation. File Services Design issues, Implementations and case studies. Name Service-Design issues and case studies. Time and Co-ordination Physical & Logical Clocks, Distributed Co-ordination. Replication issues and implementations. Shared data and Transactions, Distributed transactions, concurrency control. Recovery and Fault Tolerance. Security-Design issues and case studies

Books/References:

Coulouris, Dollimore and Kindberg, Distributed Systems-Concepts and Design, Pearson Education Asia
P K Sinha, Distibuted Operating System, PHI, IEEE Press
Singhal and Shivaratri, Advanced Concepts in Operating Systems, TMH
Tanenbaum, Distributed Systems: Principles and Paradigms, Pearson Education

CS 634	Selected Topics in Computer Networks	3-0-1	4

General congestion Control & Queuing, TCP Congestion Control, Random Early detection(RED) Gateways for Congestion Avoidance, Tuning RED for Web Traffic, Core Stateless Fair Queuing, The war between Mice & Elephants, Promoting the Use of End-to-End Congestion Control in the Internet, A study of Active Queue Management for Congestion Control, Analysis and Design of an Adaptive Virtual Queue (AVQ) Algorithm for Active Queue Management, Congestion Control for High bandwidth-Delay Product Networks, Improving the Performance of Reliable Transport protocols in Mobile Computing Environments, End-to-End Bandwidth Estimation in TCP to Improve Wireless Link Utilization, Discriminating Congestion Losses from Wireless Losses using Inter-Arrival Times at the Receiver.

SCTP ï Multi-homing, Multi-streaming features, Application in High Availability, Mobility, Multimedia and Web Data Transport, Congestion Control and Security Issues.

Active Networks, P2P networks and Overlay Networks design issues, Network Performance and modeling, Wireless networks, ad-hoc networks and sensor networks.

Security issues in different networks.

Books/References:

1. Computer Networks, A Systems Approach, Third Edition, L. Peterson and B.S. Davie, Morgam Kaufmann, 2003.
2. Computer Networking, A Top-Down Approach Featuring the Internet, Second Edition, J.F. Kurose and K.W. Ross, Adition-Wesely, 2002.
3. Computer Networks, Fourth Edition, A. Tanenbaum, Prentice-Hall, 2002.

CS 601	Design and Analysis of Algorithms	3-0-0	3

Review of basic data structures such as stack, queue, linked list, trees and graphs.
Concepts in algorithm analysis, Asymptotic complexity.
Domain independent algorithm design techniques such as divide and conquer, greedy method, dynamic programming, back tracking, branch and bound. Basic ideas about neural network, genetic algorithms and simulated annealing.
Example algorithms for sets, graphs, text processing, internal and external sorting, height balanced trees, B-trees, hashing, dynamic storage allocation, garbage collection.
Lower bound theory and NP-hard problems.

Books/References:

1. Corman et al., Introduction to Algorithms, McGrawHill.
2. Aho A, Hopcroft J., Ullman J., The Design and Analysis of Algorithms, Addison-Wesley.

IT 601	Advanced Database System	3-0-1	4

Review of ER/EER and other semantic data models; Network, Hierarchical and Relational Data Models.
Query Processing: Various Operations such as Join, Selection, sorting, expression evaluation, etc
Concurrency Control Mechanism: Protocols, Multiple Granularity, Multi-version schemes, Deadlock handling,
Recovery: Recovery and atomicity, various techniques, buffer management, Advanced Recovery Techniques;
Database Security: Authentication, Various Access Control Mechanisms, etc
Distributed Databases: Distributed Query Processing, Transaction Model, deadlock handling, multi-database systems;
Object Oriented Database: OO Data Model e.g. UML, OO DBMS architectures, Client-Server Approach, Query Processing, Object Relational Databases
Spatial Databases: Data Models, various representation schemes, architectures, Query Processing, Storage Structures; Image and Multimedia Databases

Books/References:

1. Silberschatz and Korth, Database system concepts, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of database systems; Narosa Publishing Co.
3. John G Hughes, Object Oriented Databases; Prentice Hall Int nl Series in Computer Science
4. Andleigh and Thakrar, Multimedia Systems Design, Prentice Hall PTR
5. R Raghuramakrishnan & J Gehrke, Database Management System
6. Alhir, UML: In A Nutshell, O Reilly

CS 509	Data Communication	3-0-1	4

Overview : Objectives and Applications of Computer Communication.
Computer Communication Network Architecture : ISO-OSI reference model, design philosophy, layer, protocol, interface, and service concepts. Layer-wise functionality.
Physical Layer : Concepts of data transmission, modulation and multiplexing methods, modem, encoding methods, communication media, standard protocols, RS-232C, RS-449, X.21.
Medium Assess Control in broadcast networks :ALOHA, CSMA, CSMA/CD, token ring, token bus, Standard LAN Protocols (IEEE 802.X), FDDI, satellite networks.
Data link layer: Framing, error control techniques, datalink protocols and their performance, SDLC protocol.
Network layer : Routing, Congestion and deadlock control Algorithms, Internetworking issues and devices, gateways, bridges and routers, IP & X.25 protocols.

Books/References:

1. Tanenbaum A.S., Computer Network, PHI (EEE)
2. Stalling, Data and Computer Communication, PHI (EEE)

CS 505	Software Engineering	3-0-1	4

Introduction to software engineering, concept of a software project, size factor, quality and productivity factor, different phase of a software development life cycle, managerial issues.

Software project planning: Problem definition, development of a solution strategy, development process planning, software development models and their comparative study; Organizational structure planning, project formats and team structures; Planning for quality assurance and configuration management; Planning for verification and validation.
Software economics: Cost estimation and evaluation techniques, cost estimation based on COCOMO model and Raleigh model.
Software requirements analysis and specifications techniques- their notations & languages .
Software design: Concept of fundamental design; Design approaches- top-down & bottom-up, structured, object-based & object oriented design; Design specification and notations.
Software implementation: Structured coding techniques, coding styles, and standards; Guidelines for coding and documentation.
Software verification and validation: Theoretical foundation, black box and white box approaches; Integration and system testing.
Software reliability: Definition and concept of reliability, software faults, errors, repair and availability, reliability and availability models.
Case studies.

Books/References:

1. Pressman, R.S., Software Engineering: A Practitionerôs Approach, McGraw Hill.
2. Shooman, M, Software Engineering, McGraw Hill.
3. Fairley, R.E., Software Engineering Concepts, McGraw Hill.

CS 525	Artificial Intelligence	3-0-0	3

Introduction: AI problem; AI techniques, problem as a state space search, Production Systems, Issues in design of search programs.
Heuristic Search Techniques : Generate and test, Hill Climbing, Best-First Search, Problem reduction, Means- Ends analysis.
Knowledge representation & Reasoning: Knowledge representation issues, Ontological commitments. Predicate logic, knowledge representation using rules, weak slot-and-Filler structure.
Natural Language Processing : Syntactic processing, semantic analysis, Discourse and pragmatic processing.
Expert Systems : Representation using domain knowledge, Expert System shell, knowledge acquisition.

Books/References:

1. Artificial Intelligence : E. Rich & K. Knight : Tata McGraw Hill.
2. Principles of Artificial Intelligence : N.J. Nilson; Narosa Pub. House.

CS 424	Formal Language and Automata	3-0-0	3

Alphabets, Languages, Grammars.
Finite automata: regular expressions, regular languages.
Context free languages: pushdown automata, DCFLs, LL(k) and LALR grammars.
Context sensitive languages: linear bound automata.
Turing machines: recursively enumerable languages.
Operations on formal languages and their properties.
Decision questions on languages, Undecidable problems.

Books/References:

1. Hopcroft J E, Ullman J D, Introduction to Automata Theory, Languages and Computation, Narosa.
2. Martin J C, Introduction to Languages and the Theory of Computation, McGraw-Hill International Edition.
3. Buchi A, Finite Automata, Their Algebras and Grammars: Towards a Theory of Formal Expressions, Springer-Verlag.
4. McNaughton R, Elementary Computability, Formal Languages and Automata, Prentice-Hall.

IT 518	Graph Theory	3-0-0	3

Graph : Incidence and degree; Handshaking Lemma; Isomorphism; Subgraphs and Union of graphs; Connenctedness; Walks, Paths and Circuits; Components and Connectednes; Walks, Walks, Paths and Circuits; Components and Connectednes algorithms; Shortest Path Algorithms, Eulerian graph, Fleury s algorithm and Chinese postman problem; Hamiltonian graph - necessary and sufficient conditions; Traveling salesman; Bipartite graph.
Tree : Properties of trees; Pedant vertices in a tree; Center of a tree; Rooted binary trees; Spanning trees - Spanning tree algorithms; Fundamental circuits; Spanning trees of a weighted graph; cut-sets and cut-vertices; Fundamental cut-sets; Connectivity and separativity; network flow; max-flow min-cut theorem.
Planner graph : Combinatorial and geometric dual; Kuratowski s graph; detection of planarity; Thickness and crossings.
Matrix representations of graph: Incidence; Adjacency; matrices and their properties.
Colourings: Chromatic number : Chromatic polynomial; The six and five colour theorems; The four colour problem.
Directed graphs: Binary relations; Directed graphs and connectedness; directed trees; Aborecence; Polish method; Tournaments.
Counting of labeled trees: Cayley s theorem; Counting methods; Polya theory.
Application of graphs in computer science.

Books/References:

1. Deo, N.: Graph Theory with Applications to Engineering and Computer Science.
2. Harary : Graph Theory, PHI (EEE)

CS 529	Embedded Systems	3-0-1	4

Introduction: Characteristics of embedded systems; Applications; Concept of real time systems; Challenges in embedded system design.

Embedded Processors: Review of structure of a basic computer system: CPU, memory, I/O devices on a bus; Memory System Mechanisms ï Caches, Memory Management Units and Address Translation; I/O subsystem ï input and output devices, busy-wait I/O, interrupt driven I/O; Interrupts ï Basics, interrupt latency; Co-processors; Processor Performance Enhancement ï Pipelining, Superscalar execution, caching.

The Embedded Computing Platform: Board Buses ï Bus Arbitration and Timing; The CPU Bus; Memory Devices and their Characteristics ï Random-Access memories, Read-Only memories; I/O devices ï Timers and Counters, Watchdog timers, GPIO, A/D, D/A, Displays, Keyboards; Component Interfacing ï Memory interfacing, device interfacing, interfacing protocols; Designing with processors ï System architecture, Hardware design; Target Devices ï FPGA, CPLD.

Embedded Software Architectures: Round-Robin; Round-Robin with Interrupts; Function-Queue-Scheduling Architectures; Real-Time Operating System Architecture; Selecting an Architecture.

Real-time operating systems: Tasks and Task States; Tasks and Data; Context Switching ï Cooperative multitasking, Preemptive multitasking; Scheduling Policies ï Rate-Monotonic scheduling, Earliest-Deadline-First scheduling, RMS versus EDF; Semaphores and Shared Data; Message Queues; Timer Functions; Events; Memory Management; Priority Inversion; Interrupt Routines in an RTOS Environment.

Low-power computing: Sources of energy consumption: toggling, leakage - Instruction-level strategies for power-management: functional unit management - Memory system power consumption: caches, off-chip memory - Power consumption with multiple processes - System-level power management: deterministic, probabilistic methods.

Hardware Accelerators: CPUs and Accelerators ï Why Accelerators, Accelerator Design; Accelerated System Design ï Performance Analysis, System Architecture Framework, Partitioning, Scheduling and Allocation, System Integration and Debugging.

Networked embedded systems: Why networked embedded systems - Example networked embedded systems: automobiles, factory automation systems - Types of network fabrics - Network performance analysis - Internet-enabled embedded systems.

Design and Development of Embedded Systems: Creating an Embedded System Architecture; Implementing the Design - Embedded Software Development Tools, Host and Target Machines, Linker/Loader for Embedded Software, Getting Embedded Software into Target System, Debugging Techniques and Tools, Testing on the host machine, instruction set simulators, oscilloscopes, logic analyzers, in-circuit emulators, monitors, System Boot-Up; Quality Assurance and Testing of the Design.

Text Books:

1. Computers as Components: Principles of Embedded Computing System Design, Wayne Wolf, Harcourt India Pvt. Ltd.
2. Embedded Software Primer, David E. Simon, Addison Wesley Professional.

References:

1. Embedded Systems Architecture ï Tammy Noergaard; Elsevier.
2. Designing Embedded Hardware ï John Catsoulis
3. Embedded Systems ï Raj Kamal Sarma; Tata McGraw Hill.
4. The 8051 Microcontroller and Embedded Systems ï Mazidi, Mazidi, and McKinlay; Pearson Education.
5. ARM manuals
6. Suggested Readings as mentioned in Lesson Plan.

CS 621	Mobile Computing	4-0-0	4

Introduction: Cellular networks, wireless LANs, application adaptation.
Cellular Overview : Cellular concepts, location management, handoffs.
Wireless LAN overview : MAC issues, mobile IP, ad hoc networks, TCP issues.
Applications overview : wireless applications, disconnected operations, data broadcasting, mobile agents.
GSM : Air-interface, channel structure, timing, architecture.
WAP: Architecture, protocol stack, application environment.
TCP: Asymmetric links, wireless errors, handoffs; i-tcp, snoop, link rxmit, m-tcp.
Ad hoc networks: MAC, routing, transport.
Routing: Virtual backbone, Kelpi, mobile-IP.
Data broadcasting : Push-pull, consistency.
Location management : HLR-VLR, hierarchical.
Access Technologies: Blue Tooth, GPRS, IEEE 802.11, CDMA.
QoS in Wireless

Books/References:

1. Schiller, *Mobile Communications*, Addison Wesley, 2003
2. Mehrotra, *GSM System Engineering.*
3. M V D Heijden, *Understanding WAP,* Artech House, 2000.
4. Charles Perkins, *Mobile IP,* Addison Wesley, 1999.
5. Charles Perkins, *Ad hoc Networks,* Addison Wesley, 2000

CS 625	Web Technology	3-0-1	4

Basics Of Internet

Client/Server Computing: What is C/S Computing, Middleware, Fat client VS Fat Servers, N-tiered Software Architecture.
Markup Languages And Their Grammers: SGML, DTD Resource; HTML, CSS; XML, XSL, Query Languages for XML W3schools xml validator script
Web Browser: Browser Architecture, Configuration of Netscape and IE
Web Server Apache Architecture: Web Server Architecture, Server Features, Configuration of Apache and IIS.
Protocols: HTTP, FTP, SMTP, POP; JAVASCRIPT CGI PROGRAMMING JAVA
Overview of Java, JAVA Applet, JAVA Servlet;
ASP & JSP Search Engines; Web Database Connectivity;
CGI interface to Database, JDBC interface to Database.

Web Security: S-HTTP, Fire Walls, Proxy Servers.
Distributed Object Models: CORBA, DCOM, EJB.

Books/References:

1. Shelly Powers et al., Dynamic Web Publishing, Techmedia, 1998.
2. Jamie Jaworski, Java 1.2 Unleashed, Techmedia, 1998.
3. Robert Niles et.al., CGI by Examples , Que, 1996.
4. Scot Johnson et.al., Using Active Server Pages , Que,, Information Technology.
5. Web Technologies by Achyut S Godbole and Atul Kahat

IT 517	Pattern Recognition	4-0-0	4

Unit 1 : Bayes Decision Rules for two Class problem, Bayes maximum likelihood rule, minimum distance classifier, error probabilities for classifier, Mahalanobis distance, Bound for error probabilities, Estimation of parameters, Learning.
Unit 2 : Single layer perceptron
Unit 3 : Clustering, Minimum within cluster distance critewrion, k-menas algorithm single linkage, complete linkage and average linkage algorithms, Isodata algorithm etc.
Unit 4 : Feature Selection
Algorithms for feature selection such as Branch and Bound, Sequential forward and backward selections, GSFS and GSBS, (L, R) algorithm.
Criterion function: Probabilistic Separability criterion, error probability based criterion, entropy based criterion, minimum within class distance based criterion, probabilistic independence.
Principal Component Analysis
Unit 5 : Fuzzy Set-theoretic Pattern Recognition
Usual Fuzzy set theoretic operations union, intersection etc.
Multitvalued Logic: Zade Compositional Rule of inference
Fuzzy C-means algorithm
Supervised Classification: Multitvalued Recognition System
Fuzzy set theoretic based feature selection criteria
Unit 6 : Applications will be dealt with appropriating classification errors such as commission and Omission.

Books/References:

1. Duda and Hart, Pattern Classification ad Scene Analysis , John Willey, 1990

2. P.A. Devijver and J. Kittler, Pattern Recognition: A Statistical Approach , 1983
3. K. Fukunga, Introduction to Statistical Pattern Recognition , Academic Press
4. S.K. Pal and DuttaMazumdar, Fuzzy Set Theroetic Methods for Patern Recognition , John Willey, 1998.

IT 509	Data Mining & Data Warehousing	3-0-1	4

Data Warehousing
Concept of Data Warehouse, Differences between Operational Databases and Date Warehouse, Multi-dimensional Data Model, Schemas for Multi-dimensional Databases, Data Cube Representations, Data Warehouse Architecture, OLTP vs OLAP, Efficient Query Processing in data Warehouses, Indexing of OLAP data, Meterialization concept;
Data Mining
Data Clustering: Partitioning, Hierarchical, Density-based, Grod Based and Model Based Methods;
Classification & Prediction: Decision Tree Techniques, Back-Propagation Method, Bayesian Method
Association Rule Mining Techniques: Frequent Itemset Generation, Apriori, Horizontal Method, Sampling Approach, Hashing Approach; Dynamic Association Rule Mining;
Mining of Complex Types of Data: Mining of Spatial Databases, Multimedia Databases, Time-series and sequence Data, Text Databases, WWW Data;

Books/References:

1. Jiawei Han and Micheline Kamber, óData Mining: Concepts and Techniques, Morgan Kaufmann, India
2. A K Pujari, óData Mining Techniques, University Press, India
3. Han, Manilla and Smyth, óPrinciples of Data Miningô, PHI, India

IT 507	Computer Security & Cryptography	3-0-0	3

Introduction to Cryptography, Mathematical Foundation of Cryptography : Information Theory, Complexity Theory, Number Theory, Probability Theory;
Secret Key Cryptosystem : Stream and Block Ciphers; Pseudo-random pattern generators, LFSR based stream ciphers, other stream ciphers; Correlation attacks and other relevant attacks for steam ciphers; DES and Its Security, other Block Ciphers; Differential Cryptanalysis, Attacks on Block Ciphers;
One-Way Hash Functions and Data Integrity: Snefru, MD4, MD5, SHA, HAVAL; Cryptanalysis of hash functions;
Public Key Cryptography: Mathematical Foundation, RSA, Security Analysis of RSA
Key Establishment Protocols: Symmetric key based and Asymmetric Key based protocols, KERBEROS, EKE, DH-EKE, PAKE, etc; Secret Sharing;
Digital Signature Schemes: RSA and other related signature schemes, Possible Attacks, DSA and other related signature schemes;

Books/References:

1. Manezes, Oorschot and Vanstone, Handbook of Applied Cryptography, CRC Press

2. B Schnier, Applied Cryptography, PHI

CS 606	Computer Architecture and Parallel Processing	3-0-0	3

Definitions of Computer Architecture - Abstract Architecture & Concrete Architecture.
Concepts in Parallel Processing - Available Parallelism and Utilized Parallelism. Parallel Programming Models ï PRAM, Shared Variable, Message Passing, Data Parallel.
Classification of Computer Architectures ï Flynnôs Classification ï Classification of Parallel Architectures.
Instruction Level Parallel (ILP) Processors ï Pipelined, VLIW, Super Scalar Processors ï Instruction Dependencies, their Effect on Performance and Techniques to overcome them.
Basic Concepts and Techniques in Vector, Systolic and Dataflow architectures.
Multiprocessor Architectures ï Synchronization and Cache Coherence Issues.
Multicomputer Architectures ï Interconnection Networks, Routing and Data Communication Algorithms.

Books/References:

1. D. Sima, T. Fountain, P. Kacsuk, Advanced Computer Architectures ï A Design Space Approach, Addision-Wesley.
2. K. Huang, F. A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill.
3. V. Kumar et el. Parallel Computing, Klewer Publishers.

CO 504	Natural Language Processing	3-0-0	3

Introduction- Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications.
Text representation in computers, encoding schemes.
Linguistics resources- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK.
Regular expressions, Finite State Automata, word recognition, lexicon.
Morphology, acquisition models, Finite State Transducer.
N-grams, smoothing, entropy, HMM, ME, SVM, CRF.
Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions.
A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.
Parsing- Unification, probabilistic parsing, TreeBank.
Semantics- Meaning representation, semantic analysis, lexical semantics, WordNet
Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary based approaches.
Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure.
Applications of NLP- Spell-checking, Summarization
Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.
Machine Translationï Overview.

Textbook:

1. Daniel Jurafsky and James H Martin. *Speech and Language Processing, 2e*, Pearson Education, 2009

Reference Books:

2. James A.. *Natural language Understanding 2e*, Pearson Education, 1994
3. Bharati A., Sangal R., Chaitanya V.. *Natural language processing: a Paninian perspective*, PHI, 2000
4. Siddiqui T., Tiwary U. S. *Natural language processing and Information retrieval*, OUP, 2008

CS 610	Bioinformatics	3-0-0	3

Evolution and inheritance. Concept of gene, genetic material and genome. Chemistry of nucleic acids - structure and chemical composition of DNA and RNA. Concept of cell-cycle and its regulation. Replication of genome, molecular basis of genome evolution. Molecular biology of gene functions (transciption and translation. Concepts of transciptome, proteome and metabolome. Genomics (genome projects, concepts of structural and functional genomics). Databases, DNA sequence analysis, protein sequence analysis. Introduction to Neurobiology, Signal Transduction. Computational tools and techniques for Bioinformatics.

Books/References:

1. Genes VII by Bonjamin Lewin.
2. Proteins, Structure and Molecular Properties by Thomas E. Creighton.
3. Bio-thysical Chemistry Part I: The Conformation of Biological Moleculer by Canntor and Schimmel.
4. Principles of Bio-Chemistry by Albert L. Lehninger, David L. Nelson and Michaal M. Cok. 5. Genetics by T. A. Brown.
6. Molecular Cell Biology by Daid Baltimar.
7. Introduction to Bioinformatics Aurther M. Lesk, Oxford University Press
8. Fundamental Concepts of Bioinformatics Krane and Raymer, Pearson Education
9. Bioinformatics (Sequence and Genome Analysis) David W. Mount, Gold Spring Harbour Laboratory Press

CS 725	Knowledge Representation and Reasoning	4-0-0	4

Review of First-order Logic: Expressing knowledge, Resolution. Horn clauses. Procedural representations. Production systems.

Review of logical foundations of knowledge representation including key properties of formal systems (such as soundness, completeness, expressiveness and tractability). Principles of Logic Programming.

Representing and reasoning about time and actions and physical changes (e.g., interval calculus, event calculus). Representing space and physical situations (topology, orientation, physical objects).

Automated inference techniques (e.g., refinements of resolution, relational composition, non-monotonic reasoning).
Formalisms for representing other aspects of knowledge e.g., vagueness, uncertainty, belief, desire. Description logics. Defaults. Probabilities. Explanation and diagnosis; Ontology representation languages and tools. Semantic web applications.

TextBook:

1. Ronald J. Brachman and Hector J. Levesque, Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.

References:

1. Daniel S. Weld, Readings in Qualitative Reasoning about Physical Systems, Morgan Kaufmann, 1990.
2. Ernest Davis, Representations of Commonsense Knowledge, Morgan Kaufmann, 1990.

CS 731	Data Mining in Security	3-0-1	4

Data mining fundamentals
Cluster Analysis, data types and proximity measures; various clustering approaches: Partitioning, Hierarchical, Density based, Model based, Grid based, distributed, ensemble, soft computing based; Cluster validity measures
Association mining: Frequent item set generation techniques; Rule generation techniques
DM in Privacy Preserving
Heuristic approaches: randomization, k-anonymity, l-diversity, t-closeness and (n,t)-closeness; Cryptographic approaches; Validity measures
Wired network security; IDS Fundamental; Generic architecture, Host based and Network based IDSs; DM in NIDS development: supervised, semi-supervised and unsupervised NIDSs
Signature/Rule based NIDS
Anomaly based NIDS development
Performance evaluation metrics for NIDS
Wireless network security; Development of security applications
Privacy preserving data clustering; privacy preserving association mining

References:

1. Cryptography and Network Security by Atul Kahate, Tata McGraw-Hill, 2007
2. Cryptography and Network Security by B. A. Forouzan, McGraw-Hill Companies, 2009
3. Data Mining and Knowledge Discovery - http://www.kluweronline.com/issn/1384-5810

CS 538	Computational Geometry	3-0-0	3

Geometric and Algorithm Basics: Fundamentals of Euclidean and Affine Geometry, Convexity; Basic concepts of Algorithms and its complexity, correctness proofs of algorithms; Paradigms of computational geometric algorithms; Degeneracies in Computational Geometry.

Convex Hulls Planar convex hulls definition, deterministic, randomized, output-sensitive and dynamic algorithms; applications of convex hull.
Intersection: Plane sweep algorithm for line segment intersection.
Geometric searching: Segment tree, Interval tree and Priority search tree; Point location query; Range searching -- Kd tree, range tree, fractional cascading; Proximity queries -- Nearest neighbor, closest pair; persistent data structure (if possible)
Triangulation and Partitioning: Polygon triangulation -- existence and algorithms, Art Gallery Theorem.
Voronoi Diagram and Delaunay Triangulation: Voronoi diagram, Delaunay triangulation and their dual relations; algorithms for computing Voronoi diagram and Delaunay triangulation.
Duality and Arrangement: Duality relation between points and lines; Arrangements and their applications.
Basics of Combinatorial Geometry: Unit distance problem, Point line incidences.

Text Book:

1. M. de Berg, O. Cheong, M. van Kreveld, and M. Overmars. Computational Geometry: Algorithms and Applications. Springer-Verlag, 3rd revised edition, 2008.

Reference Books:

1. Preparata and Shamos, Computational Geometry - anintroduction, Springer-Verlag (1985, revised ed., 1991).
2. J. O' Rourke, Computational Geometry in C, Cambridge University Press, second edition, 1998.
3. Jean-Daniel Boissonnat, Mariette Yvinec, Algorithmic Geometry, Cambridge University Press, 1998.

CO 503	Fuzzy Logic and Neural Networks	3 - 0 - 0	3

Overview of Crisp Sets and Fuzzy Sets:

Basic concepts of crisp sets and fuzzy sets, Types of fuzzy sets, Operation on fuzzy sets.

Fuzzy relations and fuzzy logic:

Crisp vs fuzzy relations, binary relations, equivalence relations, tolerance relations, composition of relations, fuzzy relational equations, fuzzy measure and possibility theory, classical logic and multivalued logic, fuzzy propositions and approximate reasoning.

Introduction to neural networks:

Biological and Artificial neurons, Learning in ANNs, Perceptrons ï classification and linear separability, XOR problem, Network architechtures, Multilayer feed forward networks and recurrent networks, Generalized delta rule.

Multilayer networks:

Back propagation (BP) network, BP training algorithm, Radial basis function (RBF) networks, Applications of BP and RBF networks.

Recurrent networks and unsupervised learning, Hopfiled network - energy; stability; capacity; Application to optimization problems, Counter back propagation network, Bolzman machine, Kohonenôs self organizing feature maps, Adaptive resonance theory.

Associative memory:

Matrix associative memory, Auto associative memories, hetero associative memories, Bi-directional associative memory, applications of associative memories.

Fuzzy Systems and Neuro fuzzy systems:

Relevance of Integration between fuzzy sets and neural network, Fuzzy neural network, Neuro fuzzy systems, Fuzzy associative memories.

Application of Fuzzy sets and Neural networks:

Application in pattern recognition, Image processing and computer vision, Application in control: Fuzzy controllers, neuro controllers and fuzzy neuro controllers, applications in expert systems and decision making systems, application in real world computing.

Reference books:

1. S. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall.
2. Limin Fu, Neural Networks in computer intelligence, McGraw hill Intl.
3. T Ross, Fuzzy logic with Engineering applications. ,
4. G Klir, B Yuan, Fuzzy sets and fuzzy logic : Theory and application, PHI.

IT 523	Discrete Mathematics	3-0-0	3

Part - I : Set. relation and functions :
- Set, relations, equivalence relations; mappings-one-one and on to ;
- Definition of an algebraic structure;
- Introduction to groups, subgroups, normal subgroups, isomorphism, homeomorphism; automorphism of groups; semigroups, monoids, rings, vector space.

Part - II : Logic :
- Logic operators, Truth table, Normal forms
- Theory of inference and deduction.
- Mathematical induction.
- Predicate calculus; predicates and quantifiers.
- Boolean algebra.
- Lattice.

Part - III : Combinatorics :
- Basic counting techniques.
- Recurrence relations and their solutions.
- Generating functions.

Part - IV : Modular Arithmetic :
- Congruence modulo, Fermatôs Theorem, Eulerôs Theorem, Multiplicative Inverse, Reminder Theorem, FFT, Discrete Logarithm.

Books/References:

1. Liu, C. L. : Introduction to Discrete Mathematics.
2. Trembley, Manohar : Discrete Mathematical Structures.

CS 522	Computer Graphics	3-0-2	4

Display Devices : Line and point plotting systems; raster, vector, pixel and plotters, Continual refresh and storage displays, Digital frame buffer, Plasma panel displays, Very high resolution

devices, High-speed drawing, Display processors, Character generators, Colour-display techniques (Shadow-mask and penetration CRT, colour look-up tables. analog false colours, hard-copy colour printers.)

Display Description **:** Screen co-ordinates, user co-ordinates; Graphical data structures (compressed incremental list, vector list, use of homogeneous co-ordinates); Display code generation; Graphical functions; The view algorithms, two-dimensional transformation.

Interactive Graphics : Pointing and positioning devices (cursor, light pen, digitizing tablet, the mouse, track balls). Interactive graphical techniques; Positioning, Elastic Lines, Inking, Zooming, Panning, Clipping, Windowing, Scissoring.

Graphic Languages : Primitives (constants, actions, operators, variables), plotting and geometric transformations, display subroutines.

3-D Graphics: Wire-frame perspective display, Perspective depth, Projective transformations, Hidden line and surface elimination, Transparent solids, Shading.

GKS is to be used as the standard teaching tool.

Books/References:

1. Hearn D., Baker P.M. : Computer Graphics, Prentice-Hall, 1986.
2. Foley, J.D., Van Dam A.: Fundamentals of Interactive Computer Graphics, Addison-Wesley, 1982.
3. Giloi, W.K. : Interactive Computer Graphics; Prentice-Hall, 1978.
4. Newman, W.,Sproule, R.F.: Principles of Interactive Computer Graphics, McGraw Hill, 1980.
5. Rogers, D.F. : Procedural Elements for Computer Graphics, Mc Graw-Hill, 1983.
6. Harrington, S. : Computer Graphics : A programming Approach, Tata Mc Graw Hill, 1983.

CS 523	Enterprise Resource Planning	3-0-0	3

UNIT I

ERP Concepts ï Integrated Software ï Different models of industry ï Single data to various department ï customers satisfaction ï quality and delivery schedule, Data processing concepts to various industrial departments ï methods of data processing ï comparison of data processing methods ï data preparation ï data processing modes ï steps in computerization of data processing ï data collection methods ï data processing applications.

UNIT II

Financial accounting: Asset accounting ï Accounts payable ï Accounts receivable ï General ledger accounting ï Consolidation ï Special purpose ledger. Controlling Activity based controlling ï Overhead cost control ï sales and profitability analysis ï Product cost controlling. Enterprise controlling: Executive information system ï Management consolidation ï Profit center accounting. Capital investment management: Capital investment management programs ï Tangible fixed assets measure. Treasury: Cash management ï funds management ï treasury management.

UNIT III

Personnel administration: Application management ï benefits ï personnel administration ï incentive wages ï payroll ï time management ï travel expenses. Personnel development: Organizational management ï Personnel development ï Room reservation planning ï Seminar and Convention management ï Workforce planning. Logistic applications: General logistics:

Engineering change management ï Environment, health and safety ï logistics information system ï logistics master data ï forecast ï variant configuration**.** Material management: Consumption based planning ï electronic data interchanges ï inventory management ï information system ï Invoice verification ï Purchasing ï Warehouse management. Plant maintenance: Equipment and technical objects ï Plant maintenance ï Maintenance projects ï Service management ï Maintenance order management.

UNIT IV

Logistics application (contdé): Production planning: Assembly orders ï basic data ï capacity requirement planning- information system ï Kanban/just-in-time ï master planning ï material requirement planning ï plant data collection ï production planning for process industries. Project System: Project budgeting ï basic data ï Project execution/integration ï information system ï operative structures ï project planning- quality management ï quality certificates ï inspection processing ï planning tools ï quality control ï quality notifications. Sales and distribution: Basic function ï Billing ï Sales support ï Electronic data interchange ï Foreign trade ï Information system ï Master data ï Shipping - Sales ï Transportation.

UNIT V

Case Studies: SAP R/3, People Soft, Oracle Financials ï Architecture ï data dictionary ï development tools ï administration tools ï reporting and analysis tools ï integration tools.

Books/References:

1. Michael Hsmmer, ñEnterprise Resource Planningò, 1998.
2. K.Nagappan, ñDigital Computers and Data Processing ñ, 1996.
3. J.A.Hernandez, ñThe SAP R/3 Handbookò, 1998.

CS 524	Theory of Computation	3-0-0	3

Turning Machine(TM) - Model, Computable Languages and Functions, TM construction technique, Modification of TM, Churchôs Hypothesis; Undecidability ï The Problem, Properties of Recursive & Recursively Enumerable Languages, Universal TM, Riceôs Theorem, Postôs Correspondence Problem; Intractable Problems, Polynomial Time and Space, The class *P* and the other problems, Boolean Satisfiability, The class *NP* , Polynomial-time Reduction, Introduction to Cookôs Theorem, Some NP-Complete problems.

Books/References:

1. Lewis & Papadimitriou, Elements of The Theory of Computation, Pearson Education.
2. John C. Martin, Introduction to Languages and the Theory of Computation, TMH.

CS 502	System Software	2-0-2	3

Overview : Definition and classification of system software.

Assemblers : Assembly language, Assembly process, Assembler data structures, Assembler macros and macroprocessors.
Linkers and loaders : Basic concepts, Static and Dynamic linking, shared libraries, loaders, overlays. Case study of UNIX linking system, Windows DLL, OLE, ActiveX.
Debugger : Types, features, case study : sdb/dbx.
Editors : Types, Structure, case study of vi, sed and wordstar.
Unix Utilities: Make, RCS, sed, grep, awk, etc.
Compiler Principles.

Books/References:

1. Dhandhere, System programming and operating systems, Tata McGraw Hill.
2. Sumitabha Das, Unix System V.4 Concepts and Applications, TMH.
3. Linux Manuals.
4. Windows Manuals.

CS 507	Computer Networks	3-0-1	4

Review of Computer Network Architecture and the Subnet layers.
Data Transport: Connection management, Quality of Service, TCP/IP Protocol, ATM.
Session Management: Session establishment and maintenance, Dialogue management, Recovery.
End-to-end Data: Presentation formatting issues and methods: XDR, ASN.1, NDR; Data Compression, Lossless Compression Algorithms- Run length encoding, DPCM, Dictionary-based methods, Image compression- JPEG, Video compression- MPEG; Security and authentication techniques, Encryption algorithms.
Applications: E-mail, Remote login, File transfer, Network file system, Network management.
UNIX network programming with TCP/IP; Network File System, Novell Netware, and Windows NT installation, configuration and use.

Books/References:

1. Tanenbaum A.S., Computer Network, 3e, PHI (EEE).
2. Stalling W, Data and Computer Communication, 5e, PHI (EEE).
3. Peterson L L, Davie B S, Computer Networks: A Systems Approach, Morgan Kaufmann Publishers Inc.
4. Stevens, UNIX Network Programming, PHI (EEE).
5. Comer, TCP/IP Programming Vol.- I, II, III, PHI(EEE).

CS 508	Database Management Systems	2-1-2	5

*Overview:*Concept of database, data independence, redundancy Control; Database architecture - ANSI model.
Modeling of real world situation: Entity-relationship model; Data models: Network, Hierarchical, Ralational.
Relational data model: DDL, DML: relational algebra and calculus; functional dependencies, normal forms, decomposition, integrity rules; Query languages for relational systems: SQL, QBE, query optimization, embedded SQL.
Database transactions, concurrency control, recovery and security issues in databases.

Brief treatment of: Client-server models, distributed databases, object-oriented databases, deductive databases, multimedia databases, active databases.

Books/References:

1. Silberschatz and Korth, Database system concepts, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of database systems; Narosa Publishing Co.

IT 503	Multimedia Systems	3-0-2	4

Concept of Multimedia Data; Various File Formats; Multimedia data Model e.g. RMDM
Compression & Decompression:
Binary Image compression: Various CCITT standards Color Image compression : JPEG Methodology, DCT, MPEG Methodology
Storage & Retrieval Merthods: Magnetic Media Technology, RAID Technology, Optical Media, Hierarchical Strage Management; Cache Management;
Architectural Issues: Specialized processor, Memory System, LAN-WAN connectivity, Client-Server approach; Distributed Multimedia System: various components;
Multimedia Authoring; Authoring Tools and their design issues, Hypermedia Application Design issues;
User Interface: Hypermedia Interface Design Issues

Books/References:

1. Andleigh and Thakrar, Multimedia Systems Design, Prentice Hall PTR

IT 504	E-Commerce	3-0-0	3

Introduction to E-Commerce; Networking; Web Tools, recommerder System, Web Auctions, Information Retrieval, Agents for E-Commerce;
Electronic Payment System: iKP Protocols and other related protocols, security analysis;

Books/References:

1. S Garfinkel, Web Security and Commerce, Oõ Reilley & Associates
2. P Greenspun, Phillip and Alexeõs Guide to Web Publishing, Ap Professional

IT 506	Logic Programming	3-0-0	3

Logic as a Language for Problem Solving, Sentence structure, Implication and Interface, General Structure and Computational Behaviour of Logic Programs, Procedural interpretation of Logic, Algorithmic view of logic program execution; Pragmatic and Stylistic considerations for structuring of program and data; Specification, Verification and synthesis of logic programs; Elementary features of typical logic implementations, Contribution of Logic Programming to Theory, practice and technology of computing.

Books/References:

1. Hogger C J, Introduction to Logic Programming, Academic Press
2. Bundy A., Computer Modelling of Mathematical Reasoning, Academic Press
3. Lloyd, J W., Foundations of Logic Programming, Springer Verlag

IT 510	Advanced Operating Systems	3-0-1	4

Multirocessor issues: Threads-usage, design issues and Implementation, synchronization primitives. Processor Management & Scheduling, Memory management.
Real-time operation System: Design issues and Implementation
Advance Programming Laboratory in UNIX: Drivers, scheduler, threads, IPC, file system.

Books/References:

1. Tanenbaum, Modern Operating Systems, PHI (EEE)
2. Milenkovic, Operating Systems: Concepts and Design, McGraw Hill.
3. Sillberschatz et. al, Operating Systems.
4. W.R. Steveans, Advanced Progamming in the UNIX Environment, Addison Wesley.
5. M.J. Bach, The Design of the UNIX Operation System, PHI(EEE).
6. Singhal and Shivaratri, Advanced Concepts in Operating Systems, TMH

CS 532	Compiler Design	3-0-1	4

Overview of phases of a compiler, Languages and grammar.
Lexical analysis : Finite automata, Lexical analyzer, Lexical analyzer generator.
Parsing : Top-down and Bottom-up parsers, shift-reduce parser, recursive descent (operator precedence) parser, LL(1); LR(0), SLR, LALR parsers, Syntax-directed translation, Parser generator.
Semantic Analysis : Declaration processing, Type checking. Symbol tables.
Intermediate Code Generation : Run-time environments, translation of language constructs.
Code Generation: Flow-graphs; Register allocation, Code-generation algorithms.
Error handling and recovery.
C*ode optimization:* An introduction to the techniques.

Books/References:

1. Aho, A.V., Sethi, and Ullman J.D: compiler design.
2. Dhandhere, System programming and operating systems, Tata McGraw Hill.

CS 602	Image Processing	3-0-0	3

Introduction : Digital Image representation; Fundamental steps in Image processing, Elements of digital Image processing systems.
Digital Image Fundamentals: Sampling and quantization, Imaging geometry.

Image Transforms: Fourier, Walsh, Hademord, discrete cosine and Hotelling transforms and their properties.
Image Enhancement: Enhancement by point processing, spatial filtering, Frequency domain enhancement, Color image processing.
Image Restoration: Unconstrained and constraint restoring, inverse filtering, Wiener Filter, Geometric transforms.
Image Compression: Image Compression models, Error-free compression, Lossy compression, Image compression standards.
Image Segmentation: Detection of discontinuities, edge linking, Thresholding.
Representations and Descriptions: Chain codes, shape numbers, moments and Fourier and other descriptors.
Recognition & Interpretations;

Books/References:

1. Digital Image Processing : R.C. Gonzalez & R./E. Woods : Addison - Wesley Pub. comp.
2. Fundamentals of Digital Image Processing : A.K. Jain : PHI.

CS 607	Optimization Technique	3-0-0	3

Linear Programming : Mathematical model, assumptions of linear programming, convex set, polytope, Basis, Basic feasible solutions, Simplex method, Revised simplex method, Applications, Duality, Dual simplex method, Primal Dual Algorithms, Ellipsoid Method, Karmakarôs algorithm.
Special type of linear programming problems: Transportation and assignment problems, Max-flow and shortest path problems, Foprd and Fulkerson algorithm, Djikstraôs algorithem, The Min-Cost Flow problem.
Integer programming : Introduction, Branch and bound techniques, Binary linear programming, Travelling salesman problems.
Dynamic programming: Deterministic and probabilistic dynamic programming.
Game Theory

Books/References:

1. Gillette, B.G. : Introduction to operations research - A Computer oriented algorithmic approach, McGraw Hill.
2. G. Hadley : Linear Programming, Narosa Publications
3. M.S. Bazaraa, John J. Jarvis and H. D. Shirali, John Wiley, Linear Programming and Network Flows
4. K. V. Mital, Optimisation Methods, Wiley Eastern
5. C. H. Papadimitriou and K. Steiglitz, Combinatorial Optimization - Algorithms and Complexity, Prentice Hall