Course Structure and Syllabus of MCA

Department of Computer Sciences & Engineering

School of Engineering

Tezpur University

Course Structure

Time Duration:

Minimum duration:	3 years (6 semesters)
Maximum duration:	5 years (10 semesters)

Credit Requirements:

Minimum Credit requirement	: 110
Core Courses	: 72
Electives	: 20
IDC	: 18

COURSE STRUCTURE

(Notional Semester-wise Distribution of Courses)

Course Code	Title	Credit Structure L-T-P			Total Credit
	1st Semester				
CS 404	Programming & Problem Solving	3	1	1	5
CS 405	Discrete Mathematics	2	1	0	3
CS 406	Digital Logic	3	0	1	4
CS407	Information and Communication Technology	3	0	1	4
	IDC				3
	2nd Semester				
CS 403	File Structures	2	0	0	2
CS 408	Data Structures	3	1	1	5
CS 409	Comp. Organization & Architecture	3	1	1	5
	Elective				
	Elective				
	IDC				3
	3rd Semester				
CS 502	System Software	2	0	1	3
CS 508	Database Management	3	1	1	5
CS 509	Data Communication	3	0	1	4
	Elective				
	Elective				
	IDC				3
	4th Semester				
CS 504	Operating System	2	1	1	4
CS 505	Software Engineering	3	0	1	4
CS 507	Computer Networks	3	0	1	4
	Elective				
	Elective / IDC				
	IDC				3
	5th Semester				

	Elective				
	Elective				
	IDC				3
	IDC				3
CS 514	Minor Project	0	0	8	8
	6th Semester				
CS 515	Major Project	0	0	0	16

Elective Courses

Course Code	Title	Credit Structure	Total Credit
CS 525	Artificial Intelligence	3-0-0	3
CS 424	Formal Language and Automata	3-0-0	3
CS 421	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 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
CS 610	Bioinformatics	3-0-0	3
CS 533	Computational Geometry	3-0-0	3
CS 522	Computer Graphics	3-0-1	4
CS 523	Enterprise Resource Planning	3-0-0	3
CS 524	Theory of Computation	3-0-0	3
IT 504	E-Commerce	3-0-0	3
CS 532	Compiler Design	3-0-1	4
CS 602	Image Processing	3-0-0	3
CS 422	Numerical Methods	3-0-1	4
CS 601	Design & Analysis of Algorithms	3-0-0	3
CS 605	Simulation & Modeling	3-1-0	4
CS 609	Geographic Information Systems	3-0-0	3
CS 526	Management Information Systems	3-0-0	3
CS 528	Digital Signal Processing	3-0-1	4
CS 531	Object Oriented Programming & Design	3-1-1	5
IT 611	Distributed Systems	3-0-0	3
BM 421	Accounting & Financial Management	2-1-0	3
MS 509	Probability & Statistics	2-1-0	4
BM 504	Managerial Economics	2-0-0	2
BM 501	Foundation of Management	3-0-0	3

Detailed Syllabi

CS 404	Programming and Problem Solving	3-1-1	5

Notion of an algorithm, tools for design and analysis of algorithms - Flow chart, Decision table, Pseudocode. Major hardware and software components of a digital computer; Concepts of m/c language and high level language. Features of a high level language : Assignment statement, input-output statements; Expressions; data types; conditional statements, Iterative statements; Array data type and use of arrays; character data type and text processing; functional and procedural abstraction; Recursion; Pointer data type and simple applications of pointers. Example algorithms: string processing, root finding, matrix operations, record processing, searching, sorting etc. Documentation, Debugging.

Text Book:

1. Gottfried B: Programming with C , Schaum's Outline Series, McGraw-Hill; 2 edition (June 22, 1996

Books/References:

1. Dromey, G: How to solve it by computer, PHI (EEE), 1985.
2. Kanitkar: Let us C
3. Karnighan and Ritchie: The C Programming Language

CS 405	Discrete Mathematics	2-1-0	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, Fermat s Theorem, Euler s Theorem, Multiplicative Inverse, Reminder Theorem, FFT, Discrete Logarithm.

Text Book:

1. Kenneth H. Rosen : Discrete Mathematics and Its Applications, Mcgraw-Hill College; 6th edition (January 5, 2006)

Books/References:

1. Liu, C. L. : Introduction to Discrete Mathematics. McGraw Hill Education (India) Private Limited (2008)
2. Trembley, Manohar : Discrete Mathematical Structures. McGraw Hill Education (India) Private Limited (2 February 2001)
3. L. Lovász, J. Pelikán , K. Vesztergombi : Discrete Mathematics: Elementary and Beyond (Undergraduate Texts in Mathematics), Springer; 2003 edition (17 February 2003)
4. Jiri Matousek, Invitation to Discrete Mathematics, Clarendon Press (23 July 1998)

CS 406	Digital Logic	3-0-1	4

Representation of Information :
Number System : Binary, octal, hexadecimal; Positive and negative numbers; fixed point and floating point quantities.
Arithmetic operations : Addition, subtraction.
Character codes: ASCII and EBCDIC, Redundant coding for error detection and correction : Concept of Hamming distance, parity codes, Hamming code.
Logic Design : Boolean algebra, Boolean variables and functions - canonical and standard forms, truth table, minimization of Boolean functions - Karnaugh map.
Combinational logic circuits - AND, OR, NAND, NOR and NOT gates and tristate buffer; Implementation of Boolean functions using logic gates; Multiplexers, decoders; encoders, simple arithmetic and logic circuits.
Sequential circuits - flip-flops, shift registers and counters-synchronous and asynchronous. Concept of bus and register transfer language.

Memory Devices : Semiconductor memory - RAM, ROM; Magnetic core and surface memory - disk, drum, tape; Access time and cost considerations: Concepts of volatility, random access, serial access, direct access, on-line and backup storage.

Text Book:

1. Mano, M.M. : Digital Logic and Computer Design, Pearson; First edition (2008)

Books/References:

1. Rajaraman, V.Radhakrishnan : An introduction to Digital Computer Design.-PHI (EEE)
2. Mano, M.M. ; Computer System Architecture, PHI (EEE)
3. Hamacher, Vranesic, Zaky : Computer organization, McGraw Hill.

4. David Money Harris and Sarah Harris, "Digital Design and Computer Architecture," Morgan Kaufmann Publ, 2007

CS 407	Information and Communication Technology	3-0-1	4

Information: Concept of Information and Information Processing; Information Gathering, Storage, Processing, Retrieval, and Dissemination; Evolution of Information Processing.
Elements of Modern Information Processing System:
Hardware: Processor, Input/ output devices, Storage devices & media, Data Communication equipment.
Software: System and Application.
Programming Languages: Machine, Assembly, HLL; Generation of Languages.
Operating Systems: Singleuser/ Multiuser, Batch/ Interactive, Real-time, Network OS, File server, Distributed OS; Command Shell, GUI- Windows; Examples : DOS, UNIX, Windows 95/ NT, Novell Netware.
Classification of Computers: Desk-top Workstations/ PCs, Mainframe, Super-Computer, Parallel computer; Client-Server Architecture.
Computer & Communication : Computer Networks- LAN, WAN, Communication services across network protocols, e-mail, Internet facilities through World Wide Web; Communication devices.
Security and Integrity Issues: Information integrity definition, Ensuring integrity; Computer and communication security, Perverse software, Concepts and component of security, Preventive measures and treatment.
Information Technology Application: Scientific, Business, Educational, Industrial, Medical, Entertainment, Communication etc.
Information Technology Projects in India.
Laboratory: Word processing, Spreadsheet, Graphics, Web page creation.
Text Book:

1. Rajaraman V., Adabala N. : Fundamentals of Computers, PHI; 6th Revised edition edition (17 December 2014)

Books/References:

1. Trainer T.N., Computers, 4th Edn, McGrawHill.

CS 403	File Structures	2-0-0	2

CS 403 2-0-0 2

Storage device structures and input output mechanisms.
Concepts of record, block, and file.
File Structures: Pile, Sequential, Indexed Sequential, Direct access, Inverted files; Indexing structures- B-tree and its variations.
Text Book:

1. Folk M. J. , Zoellick B., Riccard G. : File Structures : An Object-Oriented Approach with C++

Books/References:

1. Loomis, Marry; Data Management and File Structures, Prentice-Hall; 2 edition (1990)
2. Horowitz E., Sahni S., Anderson-Freed S., Fundamentals of Data Structures in C, Universities Press; Second edition (2008), .

CS 408	Data Structures	3-1-1	5

Basic Concepts: Data Structures, Algorithms, Complexity of algorithms.

Basic data types, Lists, Stacks, Queues.
Trees: Definition and Implementation; Binary trees, Tree traversal, Postfix, Prefix notations.
Sets: Implementation; Dictionary, Hash table, Priority queues; Advanced Set Representation Methods - Binary search tree, AVL tree, Balanced tree, Sets with Merge and Find operation.
Directed graphs: Representation; Single source shortest path problem, All pair shortest path problem, Transitive closure.
Undirected graph : Minimum spanning tree
Sort Algorithms: Quick-sort, Heap-sort, Bin-sort, Selection,
Memory management, Garbage Collection.
Text Book:

1. Horowitz E., Sahni S., Anderson-Freed S., Fundamentals of Data Structures in C, Universities Press; Second edition (2008),

Books/References:
1. Aho, Hopcroft and Ullman, Data Structures and Algorithms, Addison Wesley; 1st edition (1 January 1983),
2. Horowitz and Sahni, Fundamentals of Algorithms, Universities Press; Second edition (2008)
3. Knuth. D., The Art of Computer Programming, Vol.-I & II, Dorling Kindersley Pvt Ltd; 3rd edition edition (1 December 2005).

CS 409	Computer Organization & Architecture	3-1-1	5

Overview: Block diagram of a computer system, Instruction execution model.
Processor Organization:
Instruction set architecture- types, formats, addressing modes; Register set; Assembly language programming.
Data path organization, Control unit design - Hardwired control, Microprogramming.
CISC and RISC architecture, Instruction pipelining.
Computer arithmetic- Review of addition and subtraction; Multiplication- Booth s, Array; Division- Restoring and non-restoring; Floating point arithmetic.
Memory Organization:
Interfacing of memory with processor, Memory hierarchy, Multiple-module memory, Cache memory, Virtual memory.
Input/ output Organization:
Synchronization of data transfer- strobed and handshaking;
I/O mapping and control- Program controlled, Interrrupt driven, DMA, Interrupt and DMA mechanisms and controllers.

Text Book:

1. Stallings W., Computer Organization and Architecture, Pearson (2010)

Books/References:

1. Hamacher, Vranesic, and Zaky, Computer Organization, McGraw Hill Education (India) Private Limited; 5 edition (4 November 2011)
2. Mano M.M., Computer System Architecture, Pearson; Third edition (2008)
3. John L. Hennessy, David A. Patterson : Computer Architecture: A Quantitative Approach, Elsevier; Fifth edition (2011)

CS 502	System Software	2-0-1	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.

Text Book:

1. Leland L. Beck **:** System Software: An Introduction to Systems, Pearson Education; Third edition (1997)

Books/References:

1. Dhamdhere D. M., System programming, McGraw Hill Education (India) Private Limited (27 July 2011)
2. Sumitabha Das, Unix System V.4 Concepts and Applications, McGraw Hill Education (India) Private Limited; 4 edition (10 May 2006)
3. Linux Manuals.
4. Windows Manuals.

CS 508	Database Management	3-1-1	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.

Text Book:
1. Elmasri and Navathe, Fundamentals of database systems; Pearson (1 May 2008)

Books/References:

1. Silberschatz and Korth, Database system concepts, Mc Graw Hill (1 January 2011)
2. C. J. Date, A. Kannan, S. Swamynathan: An Introduction to Database Systems, Pearson Education; eighth edition (1 January 2012)

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.

Text Book:

1. Stalling W.: Data and Computer Communication, Pearson; Nineth edition (2013)

Books/References:

1. Tanenbaum A.S., Computer Network, Pearson; Fifth edition (9 January 2010)
2. William J Beyda: Data Communications: From Basics to Broadband, Pearson Education; Fourth edition (1 January 2012)

CS 504	Operating System	2-1-1	4

Overview : Evolution, current status and future trends. Structural overview.
Process concepts : Process states, process control block, process scheduling algorithms.
Support for concurrent processes : Mutual exclusion, shared data, critical sections, busy form of waiting, lock and unlock primitives, synchronization, block and wakeup.
Interprocess communication issues, primitives.
System Deadlock : Prevention, detection and avoidance.
Memory management : Contiguous and non-contiguous allocation, virtual memory, segmentation, paging, page scheduling and replacement algorithms.
File Systems : Management, protection mechanisms.
I/O management, disk scheduling.
Design of UNIX - a case study.
An overview of network and distributed operating systems.

Text Book:
1. 1. Silberschatz A, Galvin P: Operating system concepts, Wiley; Eighth edition (20 April 2009)

Books/References:
1. Milenkovic M.: Operating System - Concepts and Design, McGraw Hill Education (India) Private Limited; 2 edition (23 March 2001)
2. Tanenbaum A.S.: Operating System - Design and Implementation, PHI (EEE).
3. Bach, M. : Design of the UNIX operating system, PHI (EEE).
4. Stalling W. : Operating Systems: Internals and Design Principles, Pearson; Seventh edition (2013)

5. Daniel P. Bovet, Marco Cesati: Understanding the Linux Kernel, Shroff; Third edition (10 November 2006)

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.

Text book:

1. Pressman, R.S., Software Engineering: A Practitioner's Approach, McGraw Hill.

Books/References:

1. Rajib Mall**:** Fundamentals of Software Engineering, Prentice Hall India Learning Private Limited; Fourth edition (2 April 2014)

2. Ian Sommerville: Software Engineering, Pearson Education; Nineth edition (2013)

3. Fairley, R.E., Software Engineering Concepts, McGraw Hill Education (India) Private Limited (23 April 2001)

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.

Text Book:

1. Behrouz A Forouzan, DeAnza CollegeFirouz Mosharraf: Computer Networks: A Top-Down Approach, McGraw Hill Education (India) Private Limited (11 November 2011)

Books/References:

1. Tanenbaum A.S., David J. Wetherall : Computer Network, Pearson; Pearson; 5 edition (17 January 2012)
2. Stalling W.: Data and Computer Communication, Pearson; Nineth edition (2013)
3. Peterson L L, Davie B S, Computer Networks: A Systems Approach, Morgan Kaufmann Publishers In; 5th Revised edition edition (20 April 2011)
4. Stevens, UNIX Network Programming, Pearson Education; 1ST edition (2003)
5. Comer D E., Internetworking With TCP/IP Principles, Protocols, And Architecture, PHI (2013)

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.

Text Book:

1. Grady Booch: Object Oriented Analysis and Design, Pearson; Third edition (2009)

Books/References:

1. Herbert Schild : The Complete Reference to C++, Osborne McGrawHill. McGraw Hill Education (India) Private Limited; 4 edition (2 April 2003)
2. Bjarne Stroustrup: Programming: Principles and Practice Using C++, Addison Wesley; 2 edition (15 May 2014)
3. James R Rumbaugh, Michael R. Blaha, William Lorensen, Frederick Eddy , William Premerlani. : Object Oriented Modeling and Design, Prentice Hall; 1 edition (1 October 1990)

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

Text Book:
1. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair: Distributed Systems-Concepts and Design, Addison Wesley; 5 edition (27 April 2011)
Books/References:

1. P K Sinha, Distributed Operating Systems: Concepts and Design, PHI; 1st edition (1998)
2. Tanenbaum Andrew S., Steen Maarten Van: Distributed Systems: Principles and Paradigms, Prentice-Hall; 2 edition (2008)

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.

Text Book:

1. Jon Kleinberg and Éva Tardos: Algorithm Design, Pearson; First edition (2013)

Books/References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein: Introduction to Algorithms, MIT; 3rd edition (2010)
2. Aho A, Hopcroft J., Ullman J., Design And Analysis Of Computer Algorithms, Pearson Education; First Edition edition (2011)
3. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, Algorithms, Pearson; First edition (2013)
4, Knuth. D., The Art of Computer Programming, Vol.-I & III, Dorling Kindersley Pvt Ltd; 3rd edition edition (1 December 2005).

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.

Text:

1. Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence ,McGraw Hill Education (India) Private Limited; 3 edition (15 October 2008)

Books/References:

1. Nils J. Nilsson, Principles of Artificial Intelligence (Symbolic Computation / Artificial Intelligence), Springer; Softcover reprint of the original 1st ed. 1982 edition (23 August 2014)
2. George F. Luger, Artificial Intelligence, Pearson Education; Fifth edition (2008)
3. Stuart Russell and Peter Norvig: Artifical Intelligence: A Modern Approach, Pearson; Third edition (2013)

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.

Text:

1. Michael Sipser, Introduction to Theory of Computation, Cengage; 03 edition (1 October 2014)

Books/References:

1. Hopcroft J. E., Ullman J. D., Automata Theory Language & Computation, Pearson; Third edition (2008)
2. Martin J. C., Introduction to Languages and the Theory of Computation, McGraw-Hill 3rd edition (6 June 2007)
3. Buchi A., Finite Automata, Their Algebras and Grammars: Towards a Theory of Formal Expressions, Springer; 1989 edition (12 October 1989)

CS 421	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.

Text:

1. West Douglas B., Introduction to Graph Theory, PHI; 2nd Edition (2002)

Books/References:

1. Deo, N.: Graph Theory with Applications to Engineering and Computer Science.
2. Harary : Graph Theory, PHI (EEE)
3. Adrian Bondy, U.S.R. Murty, Graph Theory (Graduate Texts in Mathematics), Springer; 27 September 2011
4. Reinhard Diestel, Graph Theory, Springer (India) Pvt. Ltd. (2008)

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 – Caches, Memory Management Units and Address Translation; I/O subsystem – input and output devices, busy-wait I/O, interrupt driven I/O; Interrupts – Basics, interrupt latency; Co-processors; Processor Performance Enhancement – Pipelining, Superscalar execution, caching.

The Embedded Computing Platform: Board Buses – Bus Arbitration and Timing; The CPU Bus; Memory Devices and their Characteristics – Random-Access memories, Read-Only memories; I/O devices – Timers and Counters, Watchdog timers, GPIO, A/D, D/A, Displays, Keyboards; Component Interfacing – Memory interfacing, device interfacing, interfacing protocols; Designing with processors – System architecture, Hardware design; Target Devices – 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 – Cooperative multitasking, Preemptive multitasking; Scheduling Policies – 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 – Why Accelerators, Accelerator Design; Accelerated System Design – 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.Frank Vahid, Tony Givargis: Embedded System Design: A Unified Hardware/Software Introduction, Wiley; Student edition (21 July 2006)

2. Mazidi M. Ali , Mazidi J. G., and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems; Pearson; Second edition (2008)

References:

1. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufmann; 2 edition (June 16, 2008)
2. David E. Simon, Embedded Software Primer,, Addison-Wesley Professional; 1 edition (August 15, 1999)
3. Raj Kamal: Embedded Systems ; McGraw-Hill Education (India); 2nd Edition (March 9, 2009)

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

Text Book:

1. Mobile Communications by Jochen Schiller, 2nd Edition, Pearson Education Limited

Reference Book:

1. T. S. Rappaport: Wireless Communications: Principles and Practice, 2nd Edition, PHI
2. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic: Mobile Ad Hoc Networking: The Cutting Edge Directions, Wiley-IEEE Press; 2 edition (March 4, 2013)

,

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 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;

Text Book:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson; 1 edition (May 12, 2005)

Books/References:

1. Jiawei Han and Micheline Kamber: Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers In; 3rd Revised edition edition (25 July 2011)

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;

Text Book:

1. M. Subramanian, Network Management, Principles and Practice, Prentice Hall; 2 edition (May 17, 2012)
2. C. Kaufman, R. Perlman,Network Security: Private Communication in a Public World, Prentice Hall; 2 edition (May 2, 2002)

Books/References:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson; 6 edition (March 16, 2013)
2. Manezes, Oorschot and Vanstone: Handbook of Applied Cryptography, CRC Press; 1 edition (October 16, 1996)
3. Alexander Clemm: Network Management Fundamentals, Cisco Press; 1 edition (2006)

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 – PRAM, Shared Variable, Message Passing, Data Parallel.
Classification of Computer Architectures – Flynn's Classification – Classification of Parallel Architectures.
Instruction Level Parallel (ILP) Processors – Pipelined, VLIW, Super Scalar Processors – Instruction Dependencies, their Effect on Performance and Techniques to overcome them.
Basic Concepts and Techniques in Vector, Systolic and Dataflow architectures.
Multiprocessor Architectures – Synchronization and Cache Coherence Issues.
Multicomputer Architectures – Interconnection Networks, Routing and Data Communication Algorithms.

Text Book:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Pearson; 2 edition (January 26, 2003)
2. Kai Hwang, Faye A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill Education (India) Private Limited (20 July 2012)

Books/References:

1. Kai Hwang, Naresh Jotwani, Advanced Computer Architecture, McGraw Hill Education (India) Private Limited; 2 edition (23 July 2010)
2. Hesham El-Rewini, Mostafa Abd-El-Barr: Advanced Computer Architecture and Parallel Processing, Wiley-Interscience; 1 edition (January 18, 2005)
3. John L. Hennessy, David A. Patterson : Computer Architecture: A Quantitative Approach, Elsevier; Fifth edition (2011)

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.

Text Book:

1. Phillip Compeau, Pavel Pevzner, Bioinformatics Algorithms: an Active Learning Approach
2. Neil C. Jones, Pavel Pevzner, Introduction to Bioinformatics Algorithms, ANE Books, 1st Edition edition (1 December 2009)

Books/References:

1. Molecular Cell Biology by Daid Baltimar
2. Aurther M. Lesk, Introduction to Bioinformatics, Oxford University Press, 4th edition (2014)
3. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bioinformatics Krane and Raymer, DORLING KINDERSLEY (RS); First edition (2003)
4. David Mount : Bioinformatics: Sequence and Genome Analysis, CBS; 2 edition (2005)

CS 533	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 – an introduction, 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.

CS 522	Computer Graphics	3-0-1	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.

Text Book:
1. Hearn D., Baker P.M. : Computer Graphics, Prentice-Hall, 1986.

Books/References:
1. Akenine-Moller, Tomas, Eric Haines and Naty Hoffman. Real-Time Rendering. 3rd ed. A K Peters/CRC Press, 2008
3. Peter Shirley, Michael Ashikhmin, Steve Marschner : Fundamentals of Computer Graphics , A K Peters/CRC Press; 3 edition (21 July 2009)
4. James D. Foley, Andries van Dam, Steven K. Feiner and John HughesComputer Graphics: Principles and Practice, Addison-Wesley Professional; 3rd edition (2013)
5. Jason L. McKesson, Learning Modern 3D Graphics Programming ***(Online Book)***

CS 523	Enterprise Resource Planning	3-0-0	3

UNIT I

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

UNIT II

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

UNIT III

Personnel administration: Application management – benefits – personnel administration – incentive wages – payroll – time management – travel expenses. Personnel development: Organizational management – Personnel development – Room reservation planning – Seminar and Convention management – Workforce planning. Logistic applications: General logistics: Engineering change management – Environment, health and safety – logistics information system – logistics master data – forecast – variant configuration**.** Material management: Consumption based planning – electronic data interchanges – inventory management – information system – Invoice verification – Purchasing – Warehouse management. Plant maintenance: Equipment and technical objects – Plant maintenance – Maintenance projects – Service management – Maintenance order management.

UNIT IV

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

UNIT V

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

Books/References:

1. Michael Hsmmer, "Enterprise Resource Planning", 1998.
2. K.Nagappan, "Digital Computers and Data Processing ", 1996.
3. J.A.Hernandez, "The SAP R/3 Handbook", 1998.

CS 524	Theory of Computation	3-0-0	3

Turning Machine(TM) - Model, Computable Languages and Functions, TM construction technique, Modification of TM, Church's Hypothesis; Undecidability – The Problem, Properties of Recursive & Recursively Enumerable Languages, Universal TM, Rice's Theorem, Post's 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 Cook's Theorem, Some NP-Complete problems.

Text Book:

1. Lewis & Papadimitriou, Elements of The Theory of Computation, Prentice-Hall; Second edition (1 January 2002)

Books/References:

1. Michael Sipser, Introduction to the theory of computation, Cengage; 03 edition (1 October 2014)
2.

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, O'Reilley & Associates
2. P Greenspun, Phillip and Alexe's Guide to Web Publishing, Ap Professional

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.

Text Book:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman: Compilers Principles Techniques & Tools, Pearson; Second Edition edition (2008)

Books/References:

1. Andrew W. Appel, Maia Ginsburg : Modern Compiler Implementation in C, Cambridge University Press; "First Paperback Edition." edition (8 July 2004)
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;

Text Book:

1. R.C. Gonzalez & R./E. Woods, Digital Image Processing : Addison - Wesley Pub. comp.

Books/References:

1. Ralph Gonzalez, Richard Woods, Steven Eddins, Digital Image Processing Using MATLAB, McGraw Hill Education (India) Private Limited; 2 edition (8 June 2010)
.

CS 422	Numerical Methods	3-0-1	4

Basic Concepts: Limit, continuity, derivative, convergence, difference equations; Absolute error, relative error, round off errors, numerical stability, conditioning;

Solutions of nonlinear and linear equations- Bisection method, Newtons method, Secant method, Gaussian method, Gauss Seidel, Steepest descent, Conjugate gradient.

Matrix eigen value problem, matrix factorization and least square problem. Interpolation and extrapolation.

Numerical differentiation and integration; Numerical solutions of ordinary and partial differential equations.

Text Book:

1. R. L. Burden and J. D. Faires: Numerical Analysis, Cengage Learning India; 09 edition 2012

Books/References:

1. David Kincaid & Ward Cheney : Numerical Analysis, American Mathematical Society; Third edition (2010)
2. J. Stoer and R. Bulirsch : Introduction To Numerical Analysis , Springer (sie) (2009)

CS 605	Simulation and Modeling	3-1-0	4

Definition of System: Types of systems- continuous and discrete; Modelling process and definition of a model; Verification and validation of a modeling procedure; Comparing model data with real system data; Differential and partial differential equation models; Combining discrete event and continuous models.
Simulation process; Discrete and continuous simulation methods.
Use of database and AI techniques in the area of modeling and simulation.

Text Book:

1. Gordon, G: System Simulation, Prentice-Hall; 2 edition (1979)

Books/References:

1. Nandini Prasad: Introduction to Systems Modelling and Simulation, Elsevier; First edition 2012
2. Reitman, J: Computer Simulation Application, Wiley.
3. Boris Nemanjic, Navenka Svetozar: Computer Simulations: Technology, Industrial Applications and Effects on Learning, Nova Science Publishers Inc (2013)

CS 609	Geographical Information System	3-0-0	3

Maps cartography, Automated Cartography of GIS.
GIS (or Spatial Database) as an extension of database techonol;ogy.
Characteristics of spatial database Coordinate systems, Digitization, Primitives of spatial data types.
Spatial data representation and operations vector, raster, chain code, quad tree, KD tree, R-tree etc.(comparative study), Computing Area, perimeter etc using above structure.
Surface representation - DEM, DTM, Wire frame model, TIN, Advanced techniques of DEM such as Fractals, Stereo.
Spatial Query, Extension of SQL for spatial query, Extension of OODBMS for spatial query, Spatial Join, Query processing in spatial database.
Hardware & Software support digitizer, Scanner, plotter, Data Output, Display, Map Generalization, Name Placement etc.

Applications : Spatial DSS & web enabled GIS
Acquaintance with commercial GIS S/W, GRASS, Auto Cod, Mapinfo, IDRISI, Arc Info, Atlas etc.

Text Books:
1.Peter Burrough, Rachael A. McDonnell, Principles of Geographical Information Systems, OUP Oxford; 3rd edition (2015)

Books/References:
1. Burrough, P. A., Principles of GIS for land Resource Assesment, Oxford publications
2. Jeffery Star and John Estates, Geographic Information Systems, An Introductory, Prentice Hall Inc.
3. Marble D F and Calcins, H. W. , Basic Readings in Geographic Information System. Spad Systems Ltd.
4. R Ramakrisnan, Database System, McGraw Hill.

CS 526	Management Information System	3-0-0	3

UNIT I
An overview of MIS Structure of a MIS Hardware, Software and Communication technology for information systems concepts of information
UNIT II
Storage and retrieval of data transaction processing office automation and information processing - control functions Decision making process phases in the decision making process Intelligence and design phases concepts of decision making Behavioral models of the decision maker/decision making.
UNIT III
System concepts system concepts applied to management information systems concepts of planning and control Organizational structure and management concepts
UNIT IV
Decision support systems support systems for planning, control and decision making support systems for management of knowledge work Information systems requirements strategies for the determination of Information requirements.
UNIT V
Data base requirements user interface requirements developing and implementing application systems Quality assurance and evaluation of Information systems future developments and their organizational and social implications.

Text Book:
1. Gordon B. Davis, Margrethe H. Olson , Management Information Systems Conceptual foundations, Structure and Development , 2nd edition Mc-Graw Hill
Books/References:

1. James A. Senn , Analysis & Design of Information System , Second edition, McGraw Hill.

CS 528	Digital Signal Processing	3-0-1	4

Discrete-time signals and systems.
Difference equations, z-transform.
Discrete-time processing of continuous-time signals, sampling, A/D and D/A, decimation and interpolation.
Transform analysis of linear time-invariant systems.
Structures of discrete time systems.
Filter design techniques.
Discrete Fourier series, DTFT, DFT, DFT properties, efficient computation of DFT, FFT, Goertzal algorithm, Chirp transform, decimation in time and decimation in frequency, DCT.
Short-time Fourier analysis and filter banks.
Hilbert transform, Cepstral analysis, Linear prediction.

Text Book:

1. Proakis, Manolakis : Digital Signal Processing: Principles, Algorithms, and Applications, Pearson; Fourth edition (2007)

Books/References:

1. Discrete-time Signal Processing, Oppenheim, Schafer, Buck, PH, 1999.
2. Digital Signal Processing : A Computer Based Approach, TMH, 1998.
3. Computer-Based Exercises for Signal Processing using MATLAB 5, PH, 1998.

BM 421	Accounting And Financial Management	2-1-0	3

Accounting : Principles, Concepts and conventions, Double entry system of Accounting, Introduction of basis books of accounts of sole proprietry concern, Control accounts for debtors l and creditors, closing of books of accounts and preparation of Trail Balance.
Final Accounts : Trading, Profit and Loss Accounts and Balances Sheet of Sole Proprietary concern with normal closing entries, Introduction to Manufacturing accounts of partnership firms, Limited Company.
Financial Management : Meaning and role.
Ratio Analysis : Meaning advantage, limitations, types of ratios and their usefulness.
Fund Flow statements : Meaning of the terms- fund, flow and fund, working capital cycle, preparation and interpretation of the fund flow statement.
Costing : Nature, Importance and basic principles.
Budget and Budgetary Control : Nature and scope, Importance, Method of finalization of master budgets and functional budgets.
Marginal Costing :Nature scope and importance, Break Even Analysis, Its uses and limitations, construction of Break Even Chart, Practical application of marginal costing.
Introdunction to Computerised Accounting Systems : Master files, Transaction files, Intriduction to doucuments used for data collection, processing of different file and output obtained.

Books/References:

1. Maheswari S. K.: Financial Accounting
2. Khan M. Y. and Jain, P K: Financial Management, TMH