SYLLABII OF B. TECH.

COMPUTER SCIENCE AND ENGINEERING

		L	T	P	C
CS 101	Introduction to Computing	3	1	0	8

First Semester
(All Branches)

Prerequisites: None
Syllabus

What is a program; Digital computer fundamentals; What is a language; How program executes.
C programming: Data types; Operators; Expressions; Scope resolution and variable types; Control flow structures; Functions; Arrays and pointers; Structures and Unions; Stream data processing (File operations).

C++ Programming: Introduction to objects and classes; Object hierarchy; Inheritance; Polymorphism; Operator overloading; Templates; Virtual class and Friend class.

Books:

1. Programming in C – Gottfried B.S. (TMH).
2. Let us C – Kanetkar Y. (BPB).
3. The C Programming Language - Kernighan B.W., Ritchie D.M. (PHI).
4. C++: The Complete Reference (4th Ed) – Schildt H. (TMH).
5. The C++ Programming Language – Stroustrup B. (Addison-Wesley)

		L	T	P	C
CS 102	Computation Laboratory	0	0	3	3

First Semester
(All Branches)

Prerequisites: None
Syllabus

Laboratory Classes will be based on the following topics and / or as assigned by the course instructor.

Topics for C programs: Basic arithmetic operations, control statements, functions, arrays and pointers, structures and unions, file handling etc.

Topics for C++ programs: Creation of classes and objects, Inheritance, Operator overloading, Polymorphism, Implementation of Virtual class and Friend class.

Books:

1. Programming in C – Gottfried B.S. (TMH).
2. Let us C – Kanetkar Y. (BPB).
3. The C Programming Language - Kernighan B.W., Ritchie D.M. (PHI).
4. C++: The Complete Reference (4th Ed) – Schildt H. (TMH).
5. The C++ Programming Language – Stroustrup B. (Addison-Wesley)

		L	T	P	C
CS 201	Data Structures	3	1	2	10

Third Semester
(ET & CS Branch)

Prerequisites: Introduction to Computing
Syllabus
Theory:

Introduction: Introduction to data types, Data structures and Abstract Data Types (ADT), Complexity analysis of algorithms.
Lists: Linked list, Stack, Queue and Recursion, their implementation.
Trees: Introduction, Binary tree, BST, AVL trees, B Trees, B^+ Trees; Implementation of dictionary and binary search tree; hashing and hash table.
Graphs: Basic concepts; Representation schemes.
Sorting & Searching: Different sorting techniques; Tree searching and graph searching techniques.
Memory management issues: Introduction, storage allocation, garbage collection, compaction.

Laboratory:

Laboratory Classes will be based on the topics covered in the lecture classes and / or as assigned by the course instructor.

Books:

1. Data Structures using C / C++ – Tanenbaum A.S., Langsam Y., Augenstein M. J. (PHI).
2. Data Structure – Aho V., Ullman J.D. (Addision-Wesley).
3. The Art of Computer Programming (Vol. 1, 2, 3) – Knuth D.E. (Addision-Wesley).Fundamentals of Data Structures – Horowitz E., Sahni S. (Galgotia Pub.).
4. Algorithms, Data Structures, Programs – Wirth N. (PHI).

CS 202	Introduction to Switching Theory	L	T	P	C
		3	0	0	6

Third Semester
(CS Branch)

Prerequisites: Linear Electronic Circuit

Syllabus

Brief introduction to Switching Algebra: Sets, relations, cosets, lattices; Switching algebra, switching functions and isomorphic systems; Boolean algebra.

Minimization of Switching functions: Minimization using map method; minimal function; prime implicant and prime implicant chart.

Functional decomposition: Function decomposition; Symmetric networks; Identification of symmetric functions.

Fault diagnosis: Hazards; Fault detection in combinatorial circuits; Fault locating experiments; Boolean differences; Fault detection by path sensitization; Detection of multiple faults.

Introduction to Sequential circuits: Introduction; Finite state model; Memory elements and their excitation functions; Synchronous sequential circuits.

Minimization and transformation of Sequential machines: Finite state model; Capabilities and limitations of FSM; Machine minimization; Incompletely specified machine.

Asynchronous sequential circuits: Fundamental mode circuits; Synthesis; State assignment; Pulse mode circuits.

Books:

1. Switching and Finite Automata Theory – Kohavi Z. (TMH).

CS 204	Principles of Programming Languages	L	T	P	C
	Fourth Semester	3	0	0	6
	(CS Branch)				

Prerequisites: Introduction to Computing

Syllabus

Introduction – Syntax, semantics and pragmatics; Formal translation models.

Variables, Expressions & Statements – Binding time spectrum; Variables and expressions; Assignment; I-values and r-values; Environments and stores; Storage allocation; Constants and initialization; Statement-level control structures.

Types – Primitive types; Pointers; Structured types; Coercion; Notion of type equivalence; Polymorphism: overloading, inheritance, type parameterization.

Data Encapsulation (C++/JAVA concepts will be used) – Abstract data types; Information hiding and abstraction; Visibility, Procedures, Modules, Classes, Packages, Objects and Object-Oriented Programming

Storage management – Static and dynamic, stack-based, and heap-based storage management.

Sequence control – Implicit and explicit sequencing with arithmetic and non-arithmetic expressions; Sequence control between statements.

Subprogram control – Subprogram sequence control, data control and referencing environments; parameter passing; static and dynamic scope; block structure.

Concurrent Programming - Concepts, Communication, Deadlocks, Semaphores, Monitors, Threads, Synchronization.

Logic programming – Introduction; Rules, Structured Data and Scope of the variables; Operators and Functions; Recursion and recursive rules; Lists, Input and Output; Program control; Logic Program design.

Case Studies – Block structured programming: C/Pascal; Object oriented programming language: C++/JAVA; Logic programming languages: PROLOG.

Books:

1. Programming Languages – Pratt T.V. (Pearson Ed).
2. Introduction to Programming Languages: Programming in C, C++, Scheme, Prolog, C# and SOA – Chen Y., Tsai W-T. (Kendall).
3. Programming Languages: Design & Implementation – Pratt T.W., Zelkowski M.V. (PHI).
4. Programming Languages: Principles and Practice – Louden K.C. (Addision-Wesley).
5. Programming languages – Grover P.S. (S. Chand).
6. Programming Languages: Principles and Paradigms - Tucker A., Noonan R. (TMH).
7. Core Java (Vol. I and II) – Hortsmann C. S.

CS 203	Graph Theory	L	T	P	C
		3	1	0	8

Fourth Semester
(CS Branch)

Prerequisites: Data Structure

Syllabus

Introduction – Introduction to graphs and their representation; Finite and infinite graphs; Incidence and degree; Path.

Types of graphs – Directed graph; Single source shortest path; all pair shortest path; Directed acyclic graph; Euler's graphs; Hamiltonian paths and circuits.

Trees – Basic concepts; Minimum cost spanning tree.

Cut-sets – Introduction to cut-sets and cut-vertices; Connectivity and separability.

Vector space of graph – Basic concepts; Sets with one or two operations; Basis vector; Circuit and cut-set subspaces; Orthogonal vectors and spaces.

Matrix representation of graph – Basic concepts; Incidence matrix, Circuit matrix, Path matrix, Cut-set matrix and Adjacency matrix.

Books:

1. Graph theory with applications to engineering and computer science – Deo N. (PHI).
2. Introduction to Algorithms – Cormen T. H., Leiserson C. E., Rivest R. L., Stein C. (PHI).
3. Algorithmic graph theory – Gibbons A. (Cambridge Univ. Press).
4. Schaum's outline of theory and problems of Graph theory – Balakrishnan V.K. (TMH).
5. Fundamentals of Data Structures – Horowitz E., Sahni S. (Galgotia Pub.).
6. Handbook of Graph Theory – Gross J. L., Yellen J. (CRC Press).

CS 205	Formal Language and Automata Theory	L	T	P	C
		3	1	0	8

Fourth Semester
(CS Branch)

Prerequisites: Data Structures, Principles of Programming Languages

Syllabus

Introduction – Basic concepts, Alphabets and Languages, Closure property.

Finite Automata (FA) – Definition and Description, Non-deterministic finite automata, FA with $\in$-move, Two-way FA, FA with output.

Regular Set – Regular Expression and regular set, Closure properties of regular sets, Pumping lemma, Decision algorithms for regular sets, Myhill-Nerode theorem.

Context-free Grammar – Definition, Derivation tree, Simplification, Chomsky Normal Form and Greibach Normal Form, Ambiguity.

Push Down Automata (PDA) – Definition and description, PDA and Context Free Language (CFL), Properties of CFL, Pumping lemma, closure properties and decision algorithms.

Books:

1. Introduction to Automata Theory, Languages, and Computation – Hopcroft J. E., Motwani R., Ullman J. D. (Pearson Ed.).

2. Theory of Computer Science (Automata, Languages and Computation) – Mishra K. L. P., Chandrasekharan N. (PHI).
3. Elements of the Theory of Computation – Lewis H. R., Papadimitriou C. H. (Pearson Ed).
4. Introduction to Languages and the Theory of Computation – Martin J. C. (TMH).

CS 301	System Programming	L	T	P	C
	Fifth Semester	3	1	0	8
	(ET & CS Branch)				

Prerequisites: Data Structures

Syllabus

Introduction – Basic concept of system programming.

Assembler Design – Basic concepts of assembler; Design procedures and data structures required; Algorithms.

Macro-Processor Design – Basic concepts of macros and its utilization; Design principles of macro-processors; Algorithms; Implementation of macro calls within macros; Implementation of macros within assembler.

Loader and Linker – Basic concepts about a loader; Different loader schemes; Design principles of loader; Overview of linker and linker schemes; Design principles of linkers.

Books:

1. System Programming and Operating Systems - Dhamdhere D.M. (TMH).
2. System Programming - Donovan J.J. (McGraw-Hill).
3. System Software - Beck L.L. (Addison-Wesley).

CS 302	Computer Graphics	L	T	P	C
	Fifth Semester	3	1	2	10
	(CS Branch)				

Prerequisites: Data Structures

Syllabus

Theory:

Introduction - Introduction to Computer Graphics & Graphics Systems, Input & Output primitives, Input & Output Graphical devices and graphics software packages.

2D Transformation – Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates system; Composite transformations: Reflection & shear; Transformations between coordinate systems; Affine transformation.

3D Transformation & Viewing - 3D transformations: translation, rotation, scaling & other transformations.

Scan Conversion - Points & lines, Line drawing algorithms; Circle drawing algorithms; Ellipse generating algorithms; Area filling algorithms: scan line polygon fill, boundary fill and flood fill algorithms.

Viewing & Clipping - Viewing procedure, 2D Window to Viewport coordinate transformation; Clipping operations, Point clipping, Line clipping algorithms; Polygon clipping algorithms; Viewport clipping, 3D viewing, Depth cueing.

Curves and Fractals - Curve representation, surfaces, designs, Bezier curves, B-Spline curves, rational B-Spline curves.

Hidden Surfaces - Hidden line elimination: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, Painter's algorithm.

Color & Shading Models - Introduction, Modeling Light Intensities and Sources, Diffuse Reflection, Lambert's Cosine Law, Specular Reflection, Halftoning; Color Models - RGB, CMYK etc.

Laboratory:

Laboratory Classes will be based on the topics covered in the lecture classes and/or as assigned by the course instructor. Programming languages include C/C++ with OpenGL.

Books:

1. Procedural elements of Computer Graphics – Rogers D. F. (TMH)
2. Computer Graphics (C version) – Hearn D., Baker M. P. (Pearson Ed).
3. Computer Graphics: Principles and Practice – Foley J. D., Van Dam A., Feiner S. K., Hughes R. L. P. (Pearson Ed).

4. Schaum's outline series: Computer Graphics (2nd Ed) - Xiang Z., Plastock R. (TMH).
5. Mathematical elements for Computer Graphics – Rogers D. F., Adams J. A. (TMH).
6. Computer Graphics Using OpenGL – Hill F. S. (PHI).

		L	T	P	C
CS 303	Computer Organization and Architecture				
	Fifth Semester	3	1	0	8
	(ET & CS Branch)				

Prerequisites: Digital System Design

Syllabus

Introduction – Fundamental concepts of design methodologies; Basic organization of computer.

Processor Design – Basic organization; Instruction set; ALU organization; Fixed-point and Floating-point arithmetic.

Controller Design – Basic concepts; Design of Hardwired control and Micro-programmed control units.

Memory Organization – Basic organization; Virtual memory; Memory hierarchical structure; Page, Segment and File concept; Memory interleaving; Cache & Associative memories.

Peripheral processing & devices – I/O accessing and data transfer techniques; I/O channel and processor; Overview of different I/O devices.

Books:

1. Computer System Architecture - Mano M.M. (Pearson Ed.).
2. Digital Design - Mano M.M. (Pearson Ed.).
3. Computer Architecture and Organization - Hayes J.P. (McGraw-Hill).
4. Computer Organization - Hamacher V.C., Vrasenic Z.G., Zaky S.G. (McGraw-Hill).
5. Computer Organization - Tanenbaum A.S. (PHI).
6. Computer Organization and Design - Pal Chaudhuri P. (PHI).

		L	T	P	C
CS 304	Design and Analysis of Algorithms				
	Sixth Semester	3	1	0	8
	(CS Branch)				

Prerequisites: Graph Theory

Syllabus

Introduction – Basic concepts about algorithms.

Analysis of Algorithms – About different asymptotic notations and cases; Idea about time and space analysis; Concept of loop invariants. Importance of sorting algorithms in analysis; Analysis of bubble sort, insertion sort, selection sort algorithms.

Design of Algorithms – Introduction to different design approaches; Concept of divide-and-conquer approach; Recurrence relation and different ways to solve such relations. Analysis of merge sort algorithm; Analysis of quick sort and concept of randomized algorithms; Analysis of heap sort, radix sort, shell sort algorithms.

Dynamic Programming – Basic concept; Matrix chain multiplication; Characteristics of dynamic programming; Longest common subsequence; Binary search trees and optimal binary search trees.

Greedy Algorithms – Basic concepts; Huffman coding scheme; Task scheduling problem. Knapsack problem.

Graph Algorithms – Study of the following algorithms: Bread-first-search and depth-first-search algorithms; Kruskal's and Prim's algorithms; Dijkstra's algorithm; Bellman-Ford algorithm; Ford-Fulkerson algorithm.

NP-completeness – Basic concepts.

Books:

1. Introduction to Algorithms – Cormen T. H., Leiserson C. E., Rivest R. L., Stein C. (PHI).
2. The Art of Computer Programming (Vol. 1, 2 & 3) - Knuth D. E. (Addison-Wesley).
3. The Design and Analysis of Computer Algorithms – Aho V., Ulman J.D., Hopcroft J. E. (Addison-Wesley).

CS 305	Compiler Design	L	T	P	C
	Sixth Semester	3	1	0	8
	(CS Branch)				

Prerequisites: Data Structures, Formal Language and Automata Theory, Computer Organization and Architecture

Syllabus

Introduction – Overview of Language and implementations, Analysis and synthesis model of compilation, Tool based approach to compiler construction, Retargetability and portability, Trends in compiler construction.

Operation of a Compiler – Phases and passes of a compiler, Single-pass and multi-pass compilers.

Lexical Analysis – Basic concept, Design Issues (PL and LA), Implementation issues (Symbol table, input buffering etc.), Building a simple LA (Pseudo and *lex* code), RE/FSA based LA, Lexical error recovery, From REs to *lex* generator, other implementation issues.

Syntax Analysis – Basic concept, Overview of CFG and PDA, Eliminating ambiguities from CFG, Basic Parsing techniques, Shift-reduced Parser, Operator-Precedence Parser, Predictive Parser, Top-down and Bottom-up parsing, LL(1) grammars, Recursive decent parsers, Predict-predict conflicts and Error-recovery, DFAs and Parsers for LR(0), SLR(1), LR(1), LALR(1), Parser tools: *yacc*, ANTRL etc.

Semantic Analysis – Basic idea, Syntax-directed definitions, Attribute grammar (Synthesized and Inherited), Evaluation order, Attribute computation for synthesized, inherited and L-attributes of Bottom-up compilation, Support from *yacc* tool-set.

Type Checking – Getting type attributes, Type matching and conversion.

Run-time Environment – Symbol Table management, Memory management, Activation record and parameter passing.

Intermediate Code Generation – Basic concept, Three-address codes, quadruples and triples, Arithmetic expression and assignment statements, Boolean expression, Control flow and backpatching (Conditional and iterative statements), Method calls, list of statements etc.

Target Code Generation – Registers and runtime data structures, Method invocation and bookkeeping.

Code Improvement – Phases of code improvement, Peephole optimization, Control flow and basic-blocks, Redundancy and data flow analysis, Value numbering, Static single assignment (SSA) and global numbering, Flow analysis (Reachability analysis and Define-use chains), Register allocation.

Books:

1. Principles of Compiler Design – Aho A. V., Ullman J. D. (Narosa Pub.)
2. Compilers: Principles, Techniques and Tools – Aho A. V., Sethi R., Ullman J. D. (Addison-Wesley)
3. The Theory and Practice of Compiler Writing – Tremblay J. P., Sorenson P. G. (McGraw-Hill)
4. Advanced Compiler Design & Implementation – Muchnick S. S. (Narosa)
5. Lex and Yacc – Levine J. R., Mason T., Brown D. (O'Reilly)

CS 306	Computer Networks	L	T	P	C
	Sixth Semester	3	1	0	8
	(ET & CS Branch)				

Prerequisites: Data Communication

Syllabus

Data Link layer – Data Link layer Services; wired / wireless case studies.

Network layer – Network layer services; Routing principles; Internet protocol (IP); Introduction to Quality of Service (QoS).

Transport layer – Transport layer services; Protocols of transport layer: TCP.

Application layer – Study of Application layer protocols (Http, Ftp, Telnet, Smtp).

Network Management – Basic concept; Study of SNMP protocol.

Books:

1. Computer Networking: A Top-Down Approach Featuring the Internet (3rd Ed.) – Kurose J.F., Ross K.W. (Pearson Ed.).

2. Computer Networking with Internet Protocols – Stallings W. (Pearson Ed.)
3. TCP/IP Protocol Suite – Forouzen B.A. (TMH).
4. Internetworking with TCP/IP (Vol. 1, 2 & 3) (5th Ed.) – Comer D.E. (Perason Ed.)
5. Computer Network – Tanenbaum A.S. (PHI).
6. Computer Networking and the Internet (5th Ed.) – Halsall F. (Pearson Ed.)
7. Handbook of Computer Communication Standard (Vol 1: The OSI Model) – Stallings W. (Pearson Ed.)
8. SNMP, SNMPv2, SNMPv3, and RMON 1 and 2 (3rd Ed) – Stallings W. (Pearson Ed.)
9. Network Management, MIBs and MPLS: Principles, Design and Implementation – Morris S. (Pearson Ed.)

CS 307	Database Management Systems Sixth Semester (CS Branch)	L	T	P	C
		3	0	2	8

Prerequisites: Data Structures, Discrete Mathematics

Syllabus

Theory:

Introduction – File System versus DBMS; Data Models; Levels of Data Abstraction; Entity Relationship (ER) Model; Features of ER Model; Relational Algebra and Relational Calculus.

SQL – Queries, Constraints and Triggers; Functional Dependency, Decomposition of Relational Schemes.

Normalisation – Normal Forms: 1NF, 2NF, 3NF, BCNF; Multi-valued Dependency and 4NF; Join Dependency and 5NF; Inclusion Dependency.

Implementation – Database Application Development; Internet Applications.

Query Optimization – File Organization; Properties of Indexes, B^+ Tree and its application; Hashing; Introduction to Relational Query Optimization.

Transaction – Concept of Transaction; Concurrency Control and Database Consistency; Incomplete Transaction; Serializibility; Two-Phase Lock: Serializibility & Recoverability; Lock Management and its application in Concurrency Control; Concurrency Control without Lock; Object–Database Systems.

Laboratory:

Laboratory Classes will be based on the topics covered in the lecture classes and/or as assigned by the course instructor.

Books:

1. Database Management Systems – Ramakrishnan R., Gehrke J. (McGraw-Hill).
2. Database Management Systems – Silberschatz, A., Korth H. F., Sudarshan S. (McGraw-Hill).
3. Fundamentals of Database Systems – Elmasri R., Navathe S. B. (Addison-Wesley).
4. Database Systems Using Oracle – Shah N. (Pearson Ed./PHI)
5. Oracle Essentials (10g) – Greenwald R., Robert etc. (O'reilly).
6. Core Java (Vol. 1 & 2) – Horstmann C. S, Cornell G. (Pearson Ed.).

CS 308	Operating Systems Sixth Semester (CS Branch)	L	T	P	C
		3	0	2	8

Prerequisites: Computer Organization and Architecture, Data Structures, System Programming

Syllabus

Theory:

Introduction to OS: Process management, Memory management, File system management, System calls.

Process management: Process, Scheduling levels, quantities to be optimized , preemptive/non preemptive, interrupting clock, FIFO , shortest job first, shortest remaining job first, round robin, priority, multilevel queues, multilevel feedback queues, Threads.

Concurrent processes: Mutual exclusion and Bernstein's conditions, Fork/Join construct; semaphores; critical section problem; 2 process critical section problems and solution, both H/W

and S/W; monitors; message passing; case studies: dining philosophers' problem, reader writer problem and disk head scheduler problem.

Memory management: Single user contiguous: protection; fixed partition multiprogramming; protection, fragmentation, relocation; variable partition multiprogramming: compaction, storage placement strategies; multiprogramming with storage swapping; paging: segmentation; paging and segmentation together; virtual memory: page replacement and strategies, locality, working sets, page fault frequency, demand paging, optimization technique.

File systems : directory organization, functions, data hierarchy, blocking and buffering, file organization, free space management, allocation techniques: contiguous, non contiguous; sector oriented linked; block: block chaining , index block chaining, block oriented file mapping.

Dead locks: Resource concepts, necessary conditions, resource allocation graph, deadlock prevention: three strategies of Havender, deadlock avoidance: Bankers algorithm, deadlock detection: reduction of resource allocation graph, deadlock recovery.

Disk scheduling: operations of disks, quantities to be optimized, seek optimization : FCFS, SSTF, SCAN, C-SCAN, M-STEP SCAN, Eschenbach; rotation optimization, system consideration, disk caching and other optimizations.

Laboratory:

Laboratory Classes will be based on the topics covered in the lecture classes and/or as assigned by the course instructor.

Books:

1. Operating system concepts – Silberschatz A., Galvin P. B., Gagne G. (Wiley)
2. Operating Systems – Stallings W. (Pearson Ed.)
3. Modern Operating Systems – Tanenbaum A.S. (PHI)
4. Operating systems: a Design-oriented approach – Crowley C. (TMH)
5. Operating Systems – Dhamdhere D. M. (TMH)

CS 401	Software Engineering Seventh Semester (CS Branch)	L	T	P	C
		3	0	2	8

Prerequisites: None

Syllabus

Theory:

Introduction to Software Engineering: Role of Software Engineering, Concept of process.

Software Process: Different process models, Discussion of different models: Waterfall, Prototype, Iterative, TimeBox, Comparison among the models.

Requirement Analysis: Basic concepts of requirement analysis and specification, Analysis models, Specification language, Use case concept.

Software Architecture: Analysis of different architectures (pipe and filter, shared data style, client-server style), comparison among them.

Project Planning: Overview, Effort Estimation and COCOMO, Project scheduling and team structure, Risk management, Monitoring plan and SCM.

Object-Oriented Design: Basic concepts, Overview of UML, Design methodologies.

Detailed Design: Detailed design and verification, different metrics.

Coding: Concept of structured programming, Coding process, Unit testing with Junit, Verification approaches, Analysis metrics.

Testing: Overview, Black-Box and White-Box techniques, Testing process, Defect analysis and prevention.

Laboratory:

Laboratory Classes will be based on the topics covered in the lecture classes and/or as assigned by the course instructor.

Books:

1. An integrated approach to software engineering (3rd ed.) – Jalote P., (Narosa Pub)
2. Software engineering: a practitioners approach – Pressman R. S. (McGraw-Hill)

3. Object-oriented system analysis and design using UML – Bennett S., McRobb S., Farmer R. (TMH).
4. Open / Rational Unified process documentation.

CS 402	Advanced Computer Architecture	L	T	P	C
	Seventh Semester	3	1	0	8
	(CS Branch)				

Prerequisites: Operating Systems, Computer Networks

Syllabus

Introduction: Evolution of computer architecture, Flynn's Classification, Types of Parallelism, Performance Metrics, Different Parallel Computer models.

Instruction-level parallelism: Basic concept, Dependency Analysis, Partitioning and Scheduling.

Pipeline architecture: Principles & general structures of pipeline, linear & non-linear model, pipelined instruction processing (arithmetic, Boolean, load / store)

Superscalar pipeline architecture: Basic concept, design issues, shelving, register renaming, preserving sequentialities, case studies; VLIW architecture & case studies.

Code scheduling for ILP processors: Issues in processing control transfer instructions, concepts of code scheduling.

Data Parallel architectures: Basic concept, SIMD architecture (design space approach, overview of fine-grained & coarse-grained SIMD); Vector architectures (Basic concept, case studies); Concepts of data-pipelined and systolic array architectures.

Thread / process-level parallelism: Introduction to MIMD architecture, basic concept of Multi-threaded architecture, design issues related to shared-memory & distributed-memory MIMD architectures.

Books:

1. Advanced Computer Architectures: A Design Space Approach) – Sima D., Fountain T., Kacsuk P. (Pearson Ed.)
2. Advanced Computer Architecture: Parallelism, Scalability, Programmability – Hwang K. (TMH).
3. Modern Processor Design: Fundamentals of Superscalar Processors – Shen J. P., Lipasti M. H. (TMH).
4. Computer Architecture: A Quantitative Approach – Hennessy J. L., Patterson D. A. (Elsevier).
5. High performance computer architecture – Stone H. S. (Addison-Wesley).

CS 403	Theory of Computation	L	T	P	C
	Seventh Semester	3	1	0	8
	(CS Branch)				

Prerequisites: Design & Analysis of Algorithms

Syllabus

Introduction to Turing Machine – Fundamental concepts of Turing machine model, computable languages and functions; Turing machine construction technique; Modification of Turing machine and Church's hypothesis; The Problem of Undecidability; Properties of recursive and recursively enumerable languages; Universal Turing Machine; Rice's theorem; Post's correspondence problem and Intractable problems.

P and NP problems – Basic concepts; Polynomial time and space; Understanding the P-class problems; Boolean satisfiability; Understanding the NP-class problems; Polynomial time reduction; Introduction to Cook's theorem; Basic concept of NP-Complete problems.

Books:

1. Introduction to Automata Theory, Languages, and Computation – Hopcroft J. E., Motwani R., Ullman J. D. (Pearson Ed.).
2. Elements of the Theory of Computation – Lewis H. R., Papadimitriou C. H. (Pearson Ed).
3. Theory of Computer Science: Automata, Languages and Computation – Mishra K. L. P., Chandrasekharan N. (PHI).
4. Introduction to Languages and the Theory of Computation – Martin J. C. (TMH).

Electives

CS 421	Digital Image Processing – Elective Seventh Semester (ET & CS Branch)	L 3	T 0	P 0	C 6

Prerequisites: Signals and Systems

Syllabus

Introduction – Fundamental steps in image processing; digital image representation; Image acquisition and storage.

Visual Perception – Basic concepts; Structure of human eye; Image formation in eye; Discrimination of brightness and adaptation; Sampling and quantization.

Image transforms – Overview of Fourier Transform, DFT, 2D Fourier Transform, Convolution and correlation; FFT ; Inverse FFT ; Walse, Hadamard and K-L transforms ; Single value decomposition.

Image enhancement – Fundamental concepts; Enhancement by point processing; Intensity transform; Histogram processing; Spatial filtering: smoothening, median, sharpening and derivative filters; enhancement in frequency domain; Low-pass and High-pass filtering.

Image restoration – Degradation model: continuous and discrete; Inverse filtering; removal of blur caused by uniform linear motion.

Image segmentation – Edge detection techniques; edge linking and boundary detection: local and global approaches; Thresholding; Region-oriented segmentation: Region growing, split and merge techniques.

Image Compression – Lossy and loss-less compression techniques; Feature extraction.

Books:

1. Digital Image Processing – Gonzalez R. C., Woods R. E. (Addison-Wesley).
2. Fundamentals of Digital Image Processing – Jain A. K. (PHI).
3. Digital Image Processing and Analysis – Chanda B., Majumder D. D. (PHI).

CS 422	Information Theory and Coding – Elective Seventh Semester (ET & CS Branch)	L 3	T 0	P 0	C 6

Prerequisites: Discrete Mathematics, Data Communication

Syllabus

Introduction – Concept of entropy and mutual information; Application of entropy in feature extraction.

Entropy in stochastic processes – Entropy rates; Markov chains; Hidden Markov models.

Data Compression – Kraft inequality and optimal coding; Huffman codes and optimality; Shanon-Fano-Elias coding; Arithmetic codes.

Channel capacity and Coding – Different channel models; Concept of channel capacity; Channel coding theorem; Fano's inequality; Huffman codes; Channel capacity theorem; Shanon's limit; Random selection of codes.

Noiseless coding.

Error control codes – Concept of Linear Block Codes, Cyclic Codes, BCH Codes, RS Codes, Convolution Codes.

Error Correcting techniques – Short-random-error correction by error-trapping; Burst-error correction for block codes.

Coding and Digital Modulation – Trellis coded modulation.

Books:

1. Elements of Information Theory – Cover T. M., Thomas J. A. (Wiley).
2. Information Theory, Coding and Cryptography – Bose R. (TMH).

3. Error Correcting Coding Theory – Rhee M. Y. (McGraw-Hill).
4. The Art of Error Correcting Coding – Morelos-Zaragoza R. H. (Wiley).
5. Introduction to Coding and Information Theory – Roman S. (Springer).
6. Fundamentals of Error-Correcting Codes – Huffman W. C., Pless V. (Cambridge).
7. Error Control Coding for Data Network – Reed I. S., Chen X. (Kluwer).
8. Coding Techniques: an introduction to compression and error control – Wada G. (Palgrive).
9. The Mathemetics of Coding Theory – Garret P. (Pearson).

		L	T	P	C
CS 423	Distributed Systems – Elective Seventh Semester (CS Branch)	3	0	0	6

Prerequisites: Operating Systems, Computer Networks

Syllabus

Introduction – Concepts of Distributed System and its general architecture; Basic design issues in distributed system.

Naming – Naming of entities and concept of name space; Name space implementation; Locating mobile entities.

Process Management – Basic concepts of process and thread; Threads in Distributed System; Code Migration and its models; Migration in heterogeneous environment; Introduction to RPC and RMI.

Synchronization – Basic synchronization techniques; Physical and. logical time and clocks; Clock Synchronization algorithms; Global State; Election algorithms.

Distributed Mutual Exclusion – Requirements, Types and Models of Mutual Exclusion algorithms; Discussion of algorithms.

Distributed Deadlock Handling – Introduction to Deadlock; Deadlock Prevention and Avoidance techniques; Deadlock Detection / Resolution algorithms.

Agreement Protocols – Basic concept of agreement protocols; Different agreement problems: Byzantine agreement problem, Consensus problem, Relations among agreement problems; Solution to Byzantine agreement problem; Application of agreement algorithm.

Books:

1. Distributed Systems: Principles and Paradigms – Tanenbaum A. S., Steen M. V. (Pearson Ed.)
2. Advanced Concepts in Operating System – Singhal M., Shivaratri N. G. (TMH.)
3. Distributed Operating System – Sinha P. K. (PHI.)
4. Distributed Systems: Concepts and Design (3rd Ed.) – Coulouris G., Dollimore J., Kindberg T. (Pearson Ed.)
5. Distributed Operating Systems – Tanenbaum A. S. (Pearson Ed.)

		L	T	P	C
CS 424	Mobile Adhoc Networks – Elective Seventh Semester (ET & CS Branch)	3	0	0	6

Prerequisites: None

Syllabus

Mobile Ad-Hoc networking with a View of 4G Wireless, Off-the-Shelf Enables of Ad Hoc, IEEE 802.11 in Ad Hoc Networks: Protocols, Performance and Open Issues, Scatternet Formation in Bluetooth Networks , Antenna Beamforming and Power Control for Ad Hoc Networks, Topology Control in Wireless Ad Hoc Networks, Broadcasting and Activity Scheduling in Ad Hoc Networks, Location Discovery, Routing Approaches in Mobile Ad Hoc Networks, Energy-Efficient Communication in Ad Hoc Wireless, Ad Hoc Networks Security, Self-Organized and Cooperative Ad Hoc Networking, Simulation and Modeling of Wireless, Mobile, and Ad Hoc Networks, Modeling Cross-Layering Interaction Using Inverse Optimization Algorithmic Challenges in Ad Hoc Networks

Books:

1. Mobile Adhoc Networks – Aggelou , George (McGraw-Hill).

2. Mobile Adhoc Networking – Stefano Basagni (Editor), Marco Conti (Editor), Silvia Giordano (Editor), Ivan Stojmenovi & Cacute (Editor) (Wiley-IEEE Press).
3. The course mainly based on contemporary research on sensor network and ubiquitous computing. Papers from leading journals need to be consulted.

		L	T	P	C
CS 425	Data Warehousing and Data Mining – Elective				
	Seventh Semester	3	0	0	6
	(CS Branch)				

Prerequisites: Data Structures, Database Management Systems

Syllabus

Data Warehousing – Concept of Data Warehouse, Differences between Operational Databases and Data 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, Materialization concept.

Data Mining – Association Rule Mining Techniques: Frequent Item set Generation, A priori, Horizontal Method, Sampling Approach, Hashing Approach;

Dynamic Association Rule Mining;

Data Clustering: Partitioning, Hierarchical, Density-based, Grid Based and Model Based Methods;

Classification & Prediction: Decision Tree Techniques, Bayesian Method;

Mining of Complex Types of Data: Mining of Spatial Databases, Multimedia Databases, Text Databases, WWW Data.

Books:

1. Data Mining: Concepts and Techniques – Jiawei H., Micheline K. (Elsevier).
2. Data Mining Techniques – Pujari A.K. (University Press).

		L	T	P	C
CS 426	Parallel Algorithms – Elective				
	Seventh Semester	3	0	0	6
	(CS Branch)				

Prerequisites: Design and Analysis of Algorithms

Syllabus

Introduction – Parallel Models (SIMD, MIMD, PRAMs, Interconnection Networks); Performance Measures (Time, Processors, Space, Work); Interconnection Architectures (Linear Array, Meshes, Trees, Mesh of Trees, Hypercubes, Butterfly Networks, Cube Connected Cycles, Benes Networks).

Techniques – Balanced Trees, Pointer Jumping, Divide and Conquer, Partitioning, Pipelining, Systolic Computation, Accelerated Cascading, Prefix Computation, List Ranking, Euler Tour, Tree Contraction.

Sorting, Searching and Merging – Parallel algorithms.

Matrix Operations – Parallel algorithms.

Graph Algorithms – Connected Components, Spanning Trees, Shortest Paths.

Complexity – NC Class and P-Completeness.

Books:

1. The Design and Analysis of Parallel Algorithms – Akl S.G. (PHI).
2. Analysis and Design of Parallel Algorithms: Arithmetic and Matrix Problems – Lakshmivarahan S., Dhall S.K. (McGraw-Hill).

		L	T	P	C
CS 427	Artificial Intelligence – Elective				
	Seventh Semester	3	0	0	6
	(ET & CS Branch)				

Prerequisites: None

Syllabus

Introduction – Introduction to artificial intelligence; Problems and techniques related to artificial intelligence.

Problem space – Problems, prioblem spaces and search; State space graph, production systems ; BFS and DFS.

Heuristic search – Introduction; Hill climbing; Best first search; A^* alforithm; Admissibility, AND / OR graph – AO^*, constant satisfaction; Crypto-arithmetic, Waltz-line labelling.

Knowledge representation – Predicate logic; Rule-based systems; Forward vs Backward reasoning, Non-monotonic reasoning, Statistical reasoning; Bayesion Net; Dempster Shafer theory; Fuzzy logic, semantic nets.

Game Playing – Min-Max search; Alpha-Beta cut-offs.

NLP – Syntactic processing; Semantic analysis.

Learning – Basic concept; Computational learning, inductive learning; Genetic algorithm; Neural network: Hopfield, perception, back propagation; Boltzman machine; Recurrent network.

Expert System – Case studies: MYCIN, R1.

AI programming languages – PROLOG, LISP.

Books:

1. Artificial Intelligence – Rich, Knight (TMH).
2. Principles of Artificial Intelligence – Nilson N. J. (Narosa).
3. Paradigms of AI programming – Norvig P. (Elsevier).
4. Introduction to Expert System – Jackson P. (Addison-Wesley).

CS 431	Pattern Recognition – Elective	L	T	P	C
	Eight Semester	3	0	0	6
	(ET & CS Branch)				

Prerequisites: Formal Language & Automata Theory, Image Processing

Syllabus

Introduction – Introduction to pattern recognition; Applications of pattern recognition (OCR, speech recognition, fingerprints, signatures etc.); Statistical, neural and structural approaches.

Statistical Pattern Recognition – Patterns and classifications; Discriminant functions; Bayes decision rule; Nearest neighbour rule; Probability of error.

Linear Discriminant functions – Perceptrons and training; LMSE approaches; Unsupervised learning and clustering; Feature extraction.

Neural Approach – Introduction artificial neural networks; feed forward networks; delta rule and back propagation; Hopfield networks and unsupervised learning; Adaptive resonance architectures; Pattern associators and content addressable memories; hardware realizations.

Syntactic Pattern Recognition – Formal languages and grammars; Pattern grammars and higher dimensional grammars; Parsing; Automata realizations; Stochastic grammars; Grammatical interference; Computation learning theory; Valiant's framework.

Books:

1. Pattern Recognition: Statistical, Structural and Neural Approaches – Schalkoff R. J., (Wiley).
2. Pattern Classification and Scene Analysis – Duda R. O., Hart P. E. (Wiley)
3. Structural methods in Pattern Recognition – Miclet L. (North Oxford Academic).

CS 432	Advanced Topics in Distributed Systems – Elective	L	T	P	C
	Eight Semester	3	0	0	6
	(CS Branch)				

Prerequisites: Distributed Systems

Syllabus

Introduction.

Distributed File Systems – Basic concept; Design issues in DFS: Name resolution and Mounting, Caching and Consistency, Writing policy, Availability, Scalability, Semantics.

Distributed Shared Memory – Introduction; Algorithms for implementing DSM; Memory coherence and Coherence protocols; Design issues.

Distributed Scheduling – Basic concepts; Different load distribution (load-balancing and load-sharing) policies.

Failure and Recovery – Different Failure Models and Recovery approaches; Recovery in Concurrent and Replicated Distributed Database systems; Synchronous and Asynchronous Checkpoints.

Fault Tolerance – Basic concept; Commit protocols; Voting protocols; Failure Resilient processes; Atomic broadcast.

Books:

1. Advanced Concepts in Operating System – Singhal M., Shivaratri N. G. (TMH.)
2. Distributed Systems: Principles and Paradigms – Tanenbaum A. S., Steen M. V. (Pearson Ed.)
3. Distributed Operating System – Sinha P. K. (PHI.)
4. Distributed Systems: Concepts and Design (3rd Ed.) – Coulouris G., Dollimore J., Kindberg T. (Pearson Ed.)
5. Distributed Operating Systems – Tanenbaum A. S. (Pearson Ed.)

CS 433	Topics in Multimedia Technology – Elective Eight Semester (CS Branch)	L	T	P	C
		3	0	0	6

Prerequisites: Computer Networks

Syllabus

Introduction – Introduction to Multimedia Systems; Overview of text and character representations.

Audio - Basic Concepts; Data acquisition and digitization; Audio Formats; Audio tools; MIDI.

Image - Image Representation Formats; Color Schemes; Enhancement techniques.

Video - Analogue and Digital Video; Recording Formats and Standards; Transmission of Video Signals; Video Capture; Computer based Animation.

Multimedia Applications – Different applications (including Interactive television, Video-on-demand, Video Conferencing, Educational & Industrial Applications, Multimedia archives and digital libraries, media editors).

Multimedia Communication - Fundamentals of data communication and networking; Bandwidth requirements of different media; Real time constraints: Audio latency, Video data rate; Multimedia over LAN and WAN.

Synchronization - Temporal relationships; synchronization accuracy specification factors; Quality of service.

Image and Video Database - Image representation; segmentation; similarity based retrieval; Image retrieval by color, shape and texture; indexing k-d trees, R-trees, quad trees; Video Content and querying; video segmentation; indexing.

Content Management - Content Design and Development; General Design Principles; Hypertext Concepts; Open Document Architecture (ODA); Multimedia and Hypermedia Coding Expert Group (MHEG); Standard Generalized Markup Language (SGML); Document Type Definition (DTD); Hypertext Markup Language (HTML) in Web Publishing; Case study of Applications.

Books:

1. Multimedia Fundamentals (Vol I: Media coding & content processing) 2nd ed – Steinmetz R., Nahrstedt K. (Pearson Ed.).
2. Multimedia: Computing, Communications & Applications – Steinmetz R., Nahrstedt K. (Pearson Ed.).
3. Multimedia Communications – Halsall F. (Pearson Ed.).
4. Multimedia Systems – Buford K. (Pearson Ed.).
5. Multimedia in Practice: Technology and Application – Jeffcoate J. (PHI).
6. Multimedia Systems Design – Andleigh P.K., Thakrar K. (PHI).

CS 434	Topics in Network Security – Elective Eighth Semester (CS Branch)	L	T	P	C
		3	0	0	6

Prerequisites: Computer Networks

Syllabus

Network Security - Definition, Firewalls, Types of Attack, Public Key Cryptography Standards (PKCS), Digital Signatures, Certificate Authorities.

Cryptographic Techniques - Encryption and decryptions Techniques, Symmetric and asymmetric key cryptography, Stenography.

Cryptographic Algorithms - DES (Data Encryption Standard), IDES, AES (Advanced encryption Standard), RC5, Blowfish, RSA Algorithms.

Security Protocols - SSL, SHTTP, TSP (Time Stamping Protocol), SET, E-Money, WAP Security, Security in GSM.

Authentication Mechanism - Passwords, Kerberos, Single sign on (SSO) approaches.

Legal Issues - Electronic Contracting and Digital Signatures, Intellectual Property, Digital Copyright, Trademark, Patents, Cyber crime and Money Laundering.

Books:

1. Cryptography and Network Security – Kahate A. (TMH).
2. Introduction to Cryptography: Principles & Applications – Delfs H., Knebl H. (Springer).
3. Secure coding: Principles & Practice – Graff M. G., van Wyk K. R. (O'Reilly).
4. Handbook of Applied Cryptography – Menezes A. J., Vanstone S. A. (CRC Press).
5. Information Technology and Cyber Law (Vol 1 & 2) – Bhansali S. R.

		L	T	P	C
CS 435	System Analysis and Design – Elective Eight Semester (CS Branch)	3	0	0	6

Prerequisites: Software Engineering

Syllabus

Introduction – System development life cycle, Structural system analysis and design, Requirement analysis.

Data Description – Conceptual modeling, ER diagrams and DFD.

New System Design – System objectives, Design of new logical model, Conversion of logical to physical model, Design methodologies (HIPO, SSADM), Decumentation.

Process Description – Structured English, Decision tables.

Project Management – Project goal identification, Economic feasibility, Project plan, Project management entities organization, Tool used, Resource organization.

System Implementation – Programming, Quality assurance, Testing and training, Maintaining and managing system process, CASE tools.

Alternative design model – Evolutionary model, prototype.

Strategic planning.

Books:

1. Introduction to System Analysis and Design – Hawryszkiewycz I. T. (PHI).
2. System Analysis and Design – Kendall, Kendall (PHI).
3. System Analysis and Design – Edwards P. (TMH).
4. SAD methods – Whitten, Bentley, Barlow (Galgotia).

		L	T	P	C
CS 436	Wireless Sensor Networks – Elective Eighth Semester (CS Branch)	3	0	0	6

Prerequisites: Mobile Adhoc Networks

Syllabus

A first course in wireless networking, Introduction to sensor network, Unique constraints and challenges, Localization and Tracking, Networking Sensors, Infrastructure establishment, Sensor Tasking and Control, Sensor network databases, Sensor Network Platforms and tools, Industrial Applications and Research directions.

Books:

1. Wireless Sensor Networks: An Information Processing Approach – Feng Zhao, Leonidas Guibas (Elsevier).
2. Handbook of Sensor Networks: Algorithms and Architectures – Ivan Stojmenovi & Cacute (Wiley).
3. The course mainly based on contemporary research on sensor network and ubiquitous computing. Papers from leading journals need to be consulted.

CS 437	Enterprise Resource Planning – Elective	L	T	P	C
	Eight Semester	3	0	0	6
	(CS Branch)				

Prerequisites: Software Engineering

Syllabus

Introduction to ERP systems, Business Process Re-engineering and Workflow design; Implementation of ERPs; Supply Chain Management and Customer Relationship Management concepts and their incorporation into ERPs; ERP security issues; SAP terminology & components; hardware architecture; SAP business workflow; Introduction to current and future ERP features, directions and innovations and, in particular, those relating to the SAP software

Books:

1. Concepts in Enterprise Resource Planning – Monk E., Wagner B. (Thomson Course Technology).
2. SAP R/3 Enterprise Software: An Introduction – Hayen R. (McGraw-Hill).
3. MySAP web resources.
4. Oracle 11i ERP initiative resources.

CS 438	Distributed Algorithms – Elective	L	T	P	C
	Eight Semester	3	0	0	6
	(CS Branch)				

Prerequisites: Distributed Systems, Design and Analysis of Algorithms

Syllabus

Introduction – Motivation, Application.

Basic abstractions – Process abstraction; Communication abstraction; Timing model & time abstraction; Abstraction-based distributed system model.

Analysis of different algorithms (leader election, consensus, mutual exclusion, deadlock) in synchronous model, asynchronous model and partial synchronous model.

Reliable broadcast mechanism – Study of different techniques.

Books:

1. Distributed Algorithms – Lynch N. A. (Morgan-Kaufmann Elsevier)
2. Introduction to Distributed Algorithms – Guerraoui R.,Rodrigues L. (Springer-Verlag)

CS 441	Neural Network – Institutional Elective	L	T	P	C
	Eight Semester	3	0	0	6
	(All Branches)				

Prerequisites: None

Syllabus

Introduction – Introduction to neural networks; Biological and artificial neurons; Learning in ANN

Statistical Pattern Recognition – Patterns and classifications; Discriminant functions; Bayes decision rule; Nearest neighbour rule; Probability of error.

Linear Discriminant functions – Perceptrons and training; LMSE approaches; Unsupervised learning and clustering; Feature extraction.

Neural Approach – Introduction artificial neural networks; feed forward networks; delta rule and back propagation; Hopfield networks and unsupervised learning; Adaptive resonance architectures; Pattern associators and content addressable memories; hardware realizations.

Syntactic Pattern Recognition – Formal languages and grammars; Pattern grammars and higher dimensional grammars; Parsing; Automata realizations; Stochastic grammars; Grammatical interference; Computation learning theory; Valiant's framework.

Books:

1. Pattern Recognition: Statistical, Structural and Neural Approaches – Schalkoff R. J., (Wiley).
2. Pattern Classification and Scene Analysis – Duda R. O., Hart P. E. (Wiley)
3. Structural methods in Pattern Recognition – Miclet L. (North Oxford Academic).

CS 442	Object-Oriented System Design – Institutional Elective Eight Semester (All Branches)	L	T	P	C
		3	0	0	6

Prerequisites: None

Syllabus

Introduction – Overview of object-oriented design; Concept of classes, objects, messages, encapsulation, inheritance, polymorphism, exception handling; Object-oriented containers.

OO Life cycle – OO analysis, modeling and design; Object-oriented methodologies.

Introduction to UML – Structural modelling: Overview of classes, relationships, interfaces, class diagrams, objects diagrams; Behavioral / Functional modelling: Overview of Use cases, Use case diagrams, sequence diagrams; Dynamic modelling: State charts.

Distributed Object Model – Concepts of CORBA, RMI, IIOP, COM / DCOM.

Object-Oriented Database Systems – OO data model; storage organization and indexing techniques; Object relational databases.

Books:

1. Object-Oriented Modeling and Design – Rumbaugh et al (PH).
2. Software engineering: a practitioners approach – Pressman R. S. (McGraw-Hill)