B. Tech. Computer Science and Engineering, NIT Jamshedpur

Semester 3

Sl. No.	Subject Code	Subject Name	L-T-P	Credits
1	HS1301	Introduction to Soft Skills	2-1-0	3
2	MA1301	Engineering Mathematics - III	3-0-0	3
3	CS1301	Digital System Design	3-1-0	4
4	CS1302	Design and Analysis of Algorithms	3-1-0	4
5	CS1303	Discrete Structures	3-1-0	4
6	CS1304	Design and Analysis of Algorithms Lab	0-0-3	2
7	CS1305	Computing Lab	1-0-2	2
8	CS1306	Digital System Design Lab	0-0-3	2
			Total	**24**

Semester 4

Sl. No.	Subject Code	Subject Name	L-T-P	Credits
1	CS1401	Database Management System	3-1-0	4
2	CS1402	Theory of Computation	3-1-0	4
3	CS1403	Microprocessors and Microcontroller	3-1-0	4
4	CS1404	Operating System	3-1-0	4
5	CS1405	Computer Organization and Architecture	3-1-0	4
6	CS1406	Database Management System Lab.	0-0-3	2
7	CS1407	Microprocessors and Microcontroller Lab.	0-0-3	2
8	CS1408	Operating System Lab	0-0-3	2
			Total	**26**

Semester 5

Sl. No.	Subject Code	Subject Name	L-T-P	Credits
1	CS1501	Computer Graphics	3-1-0	4
2	CS1502	Computer Networks	3-1-0	4
3	CS1503	Soft Computing	3-1-0	4
4	CS1504	Software Engineering	3-0-0	3
5	CS1505	Professional Elective - I	3-0-0	3
6	CS1506	Computer Graphics Lab	0-0-3	2
7	CS1507	Soft Computing Lab	0-0-3	2
8	CS1508	Software Engineering Lab	0-0-3	2
9.	CS1509	Term Paper(Project)	0-0-3	2
			Total	**26**

Semester 6

Sl. No.	Subject Code	Subject Name	L-T-P	Credits
1	CS1601	Object Oriented System Design	3-1-0	4
2	CS1602	High Performance Computing	3-1-0	4
3	CS1603	Compiler Design	3-1-0	4
4	CS1604	Professional Elective - II	3-0-0	3
5	CS1605	Open Elective - I	3-1-0	4
6	CS1606	Compiler Design Lab	0-0-3	2
7	CS1607	Minor Project	0-0-3	2
8	CS1608	Industrial Training	0-0-3	2
			Total	**25**

Semester 7

Sl. No.	Subject Code	Subject Name	L-T-P	Credits
1	HS1701	Organizational Behaviour and Industrial Psychology	3-0-0	3
2	HS1702	Industrial Economics	3-0-0	3
3	CS1701	Artificial Intelligence	3-1-0	4
4	CS1702	Professional Elective - III	3-0-0	3
5	CS1703	Open Elective - II	3-1-0	4
6	CS1704	Comprehensive Viva and Seminar	0-0-3	2
7	CS1705	Open Elective - II Lab	0-0-3	2
8	CS1706	Major Project- I	3-1-0	4
			Total	**25**

Semester 8

Sl. No.	Subject Code	Subject Name	L-T-P	Credits
1	CS1801	Management Information System	3-0-0	3
3	CS1802	Professional Elective - IV	3-1-0	4
4	CS1803	Open Elective - III	3-1-0	4
5	CS1804	Open Elective - III Lab	0-0-3	2
6	CS1805	Major Project- II	0-0-17	11
			Total	**24**

Elective 1

Sl. No.	Subject Code	Subject Name
1	CS5051	Data Mining & Data Ware Housing
2	CS5052	Principle of Programming Language
3	CS5053	System Software
4	CS5054	Advance Microprocessor System
5	CS5055	Graph Theory
6	CS5056	Special Topics in CS-I
7	CS5057	Wireless Sensor Network
8	CS5058	Data Science
9	CS5059	Advanced Computer Architecture
10	CS5060	Wireless Communication
11	CS5061	Digital Signal Processing
12	CS5062	Cryptographic Foundations

Elective 2

Sl. No.	Subject Code	Subject Name
1	CS6041	Software Testing
2	CS6042	Software Architecture
3	CS6043	Software Project Management
4	CS6044	Modelling & Simulation
5	CS6045	Multimedia Applications
6	CS6046	E- Commerce
7	CS6047	Special Topics in CS-II
8	CS6048	Image Processing

Elective 3

Sl. No.	Subject Code	Subject Name
1	CS7041	Mobile Computing
2	CS7042	Internet Technology
3	CS7043	Web Technology
4	CS7044	Ethical Hacking
5	CS7045	Cryptography & Network Security
6	CS7046	Information Theory & Coding
7	CS7047	Fundamentals of Reliability Engineering
8	CS7048	Distributed Operating Systems
9	CS7049	Special Topics in CS-III
10	CS7050	Pattern Recognition
11	CS7051	Optimization Techniques
12	CS7052	Network Security
13	CS7053	Biometric Security
14	CS7054	Bioinformatics

Elective 4

Sl. No.	Subject Code	Subject Name
1	CS8031	Real-Time Systems
2	CS8032	Grid Computing
3	CS8033	Nano Technology
4	CS8034	Pattern Recognition
5	CS8035	Computer Vision
6	CS8036	Fault Tolerant Systems
7	CS8037	Special Topics in CS-IV
8	CS8038	Machine Learning

Open Elective

Sl. No.	Subject Code	Subject Name
1	CSO1	VLSI System Design
2	CSO 2	Digital Signal Processing
3	CSO 3	Digital Image Processing
4	CSO 4	Values and ethics of profession
5	CSO 5	Wireless Communications
6	CSO 6	Robotics
7	CSO 7	Embedded & Control Systems
8	CSO 8	CAD/CAM
9	CSO 9	Environmental Engineering
10	CSO 10	Internet of Things
11	CSO11	Ad-hoc and Wireless Networks
12	CSO12	Intrusion Detection Systems
13	CSO13	Information Theory and Coding
14	CSO14	Distributed Computing
15	CSO15	Cluster and Grid Computing
16	CSO16	Cloud Computing
17	CSO17	Natural Language Processing

Computer Science & Engineering Syllabus
National Institute of Technology Jamshedpur

COURSE STRUCTURE OF B. TECH IN COMPUTER SCIENCE & ENGINEERING

Third Semester

Mathematics III
Code: **MA1301**
Contact: **3L**
Credit: **3**

Probability:
Definition of probability; Finite sample spaces and equiprobable measure as special cases; Probability of Non-disjoint events (Theorems). Counting techniques applied to probability problems; Conditional probability; General Multiplication Theorem; Independent events; Bayes' theorem and related problems.

Random variables (discrete and continuous); Probability mass function; Probability density function and distribution function. Distributions: Binomial, Poisson, Uniform, Exponential, Normal, t and χ^2. Expectation and Variance (t and χ^2 excluded); Moment generating function; Reproductive Property of Binomal; Poisson and Normal Distribution (proof not required). Transformation of random variables (One variable); Chebychev inequality (statement) and problems.

Binomial approximation to Poisson distribution and Binomial approximation to Normal distribution (statement
only); Central Limit Theorem (statement); Law of large numbers (Weak law); Simple applications.

Statistics:
Population; Sample; Statistic; Estimation of parameters (consistent and unbiased); Sampling distribution of sample mean and sample variance (proof not required).
Point estimate: Maximum likelihood estimate of statistical parameters (Binomial, Poisson and Normal distribution). Interval estimation.

Testing of Hypothesis:
Simple and Composite hypothesis; Critical Region; Level of Significance; Type I and Type II Errors; Best Critical Region; Neyman-Pearson Theorem (proof not required); Application to Normal Population; Likelihood Ratio Test (proof not required); Comparison of Binomial Populations; Normal Populations; Testing of Equality of Means; χ^2—Test of Goodness of Fit (application only).

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Reference Books:

1. Gupta S.C., Kapoor V.K – "Fundamentals of Mathematical Statistics"– Sultan Chand & Sons.
2. H. C Saxena – "Statistical inference" – Sultan Chand & Sons.

Digital System Design
Code:CS1301
Contacts: 3L + 1T
Credits: 4

Binary Number System & Boolean Algebra; BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Venn diagram, Boolean algebra (recapitulation); Representation in SOP and POS forms; Minimization of logic expressions by algebraic method.

Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator.

Sequential Circuits - Basic Flip-flop & Latch, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO), Ring counter, Johnson counter, Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded), [2L], Design of Mod N Counter

A/D and D/A conversion techniques – Basic concepts (D/A:R-2-R only, A/D: successive approximation), Logic families- TTL, ECL, MOS and CMOS - basic concepts.

Text Books:

1. J. F. Wakerly, Digital Design Principles and practices, PHI, 4th Ed, 2005.
2. M. Mano, Digital Logic and Computer Design, 1st Ed, Pearson, 2002.

Reference Books:

1. M. Mano and M. D. Cilette, Digital Design, Pearson education, 4th Ed. 2008.
2. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 3rd Ed, 2007.

Design & Analysis of Algorithm
Code:CS1302
Contacts: 3L + 1T
Credits: 4

Models of computation: RAM, TM etc. time and space complexity

Asymptotic Notation Big-O, omega, theta etc.; finding time complexity of well known algorithms like- heapsort, search algorithm etc.

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Algorithm Design techniques

Recursion- Definition, Use, Limitations, Examples: Hanoi problem. Tail Recursion

Divide and Conquer
Basic method, use, Examples: Merge sort, Quick Sort, Binary Search

Dynamic Programming
Basic method, use, Examples: matrix-chain multiplication, All pair shortest paths, single-source shortest path, Travelling Salesman problem

Branch and Bound
Basic method, use, Examples: The 15-puzzle problem

Backtracking
Basic method, use, Examples: Eight queens problem, Graph coloring problem, Hamiltonian problem

Greedy Method
Basic method, use, Examples: Knapsack problem, Job sequencing with deadlines, minimum spanning tree(Prim's and Kruskal's algorithms)

Lower Bound Theory
Bounds on sorting and sorting techniques using partial and total orders.

Disjoint Set Manipulation
Set manipulation algorithm like UNION-FIND, union by rank, Path compression.

Properties of graphs and graph traversal algorithms [3L]: BFS and DFS

Matrix manipulation algorithms
Different types of algorithms and solution of simultaneous equations, DFT & FFT algorithm; integer multiplication schemes

Notion of NP-completeness
P class, NP-hard class, NP-complete class, Circuit Satisfiability problem, Clique Decision Problem.

Approximation algorithms
Necessity of approximation scheme, performance guarantee, Polynomial time approximation schemes: 0/1 knapsack problem

Text Books:

1. M. Weiss, Data Structures and Algorithm Analysis in C++, Pearson, 4th Ed, 2008.
2. S. K. Basu, Design methods and Analysis of Algorithms, Prentice Hall of India, 1st Ed, 2005.

Reference:

1. E. Horowitz, S. Sahni and S. Rajasekaran, Fundamentals of Computer Algorithms, University Press, Indian reprint, 2008.
2. T. Cormen, C. Leiserson, and R. Rivest and C. Stain, Introduction to Algorithms Prentice Hall of India, 3rd Ed, 2006.

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Discrete Structures
Code: CS1303
Contacts: 3L + 1T
Credit: 4

Algebraic Structure

Sets, Relation, Equivalence Relation, Equivalence Class & Partition; Congruence Relation.

Mapping; Inverse Mapping (Proof of Necessary and Sufficient Condition Excluded) .

Semigroup and Monoid; Group ; Subgroup and Coset ; Normal Subgroup ; Quotient Group ; Cycle Group, Permutation Group; Dihedral Group (upto D_4); Symmetric Group S_3 , Homomorphism and Isomorphism ; Modulo Group ; Elementary Applications in Coding.

Ring and Field : Ring ; Subring ; Morphism of Ring ; Ideals and Quotient Ring.

Integral Domain and Field ; Finite Field ; Statement of Relevant Theorems and Examples.

Lattice and Recurrence Relation :
Basic Idea; Sequence and Discrete function. Generating functions and application.

Graphs:
Representation of Graphs, operations on graphs, paths and circuits, graph traversals, shortest path in weighted graphs, Eulerian paths and circuits, Hamiltonian paths and circuits, Traveling sales persons problem, Planar graphs, Graph Coloring, Application of Graphs, Tress and Cut-Sets: Rooted trees, Binary search trees, Spanning trees, Minimum spanning trees, Kruskal's Algorithm, Prims Algorithm.

Text :

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill, 5thed, 2003.
2. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications, to Computer Science, TataMc-Graw Hill, 2001.
3. Joe L. Mott, A. Kandel, and T. P. Baker, Discrete Mathematics for Computer Scientists & Mathematics, Prentice Hall of India, 2nded, 2006.
5. N. Deo, Graph Theory with applications to Engineering & Computer Science, Prentice Hall of India, 2006.
6. S. Lipschutz, Discrete Mathematics, Tata McGraw Hill, 2005.

Reference :

4. C. L. Liu, D. P. Mohapatra, Elements of Discrete Mathematics: A computer Oriented Approach, Tata-McGraw Hill, 3rd Ed, 2008.
5. B. Kolman and R. C. Busby, Discrete Mathematical Structures for Computer Science, Prentice Hall of India, 5th Ed, 2002.

Computer Science & Engineering Syllabus

Database Management System
Code: CS1401
Contacts: 3L+1T
Credits: 4

Introduction
Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Entity-Relationship Model
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Relational Model
Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.

SQL and Integrity Constraints
Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Relational Database Design
Functional Dependency, Different anamolies in designing a Database., Normalization using funtional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Nomalization using multi-valued depedencies, 4NF, 5NF

Internals of RDBMS
Physical data structures, Query optimization : join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management : transaction model properties, state serializability, lock base protocols, two phase locking.

File Organization & Index Structures
File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree .

Text Books:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Ramakrishnan: Database Management System , McGraw-Hill
4. Gray Jim and Reuter Address, “Transaction Processing : Concepts and Techniques”, Moragan Kauffman Publishers.
5. Jain: Advanced Database Management System CyberTech
6. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
7. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

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Reference:

1. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
2. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
3. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

Theory of Computation
Code: CS1402
Contacts: 3L + 1T
Credit: 4

Finite State Machines : Definition, concept of sequential circuits, state table & state assignments, concept of synchronous, asynchronous and liner sequential machines.
Finite State Models : Basic definition, mathematical representation, Moore versus Mealy m/c, capability & limitations of FSM, state equivalence & minimization, machine equivalence, incompletely specified machines, merger graph & compatibility graph, merger table, Finite memory, definite, information loss less & inverse machines : testing table & testing graph.
Structure of Sequential Machines : Concept of partitions, closed partitions, lattice of closed partitions, decomposition : serial & parallel.
Finite Automation : Preliminaries (strings, alphabets & languages, graphs & trees, set & relations), definition, recognition of a language by an automata - idea of grammar, DFA, NFA, equivalence of DFA and NFA, NFA with e- moves, regular sets & regular expressions : equivalence with finite automata, NFA from regular expressions, regular expressions from DFA, two way finite automata equivalence with one way, equivalence of Moore & Mealy machines, applications of finite automata.
Closure Properties of Regular Sets : Pumping lemma & its application, closure properties minimization of finite automata : minimization by distinguishable pair, Myhill-Nerode theorem.

Context Free Grammars : Introduction, definition, derivation trees, simplification, CNF & GNF.

Pushdown Automata : Definition, moves, Instantaneous Descriptions, language recognised by PDA, deterministic PDA, acceptance by final state & empty stack, equivalence of PDA and CFL.

Closure Properties of CFLs : Pumping lemma & its applications, ogden's lemma, closure properties, decision algorithms.

Introduction to Z. Regular language properties and their grammars. Context sensitive languages.

***Text books* :**

1. Hopcroft JE. and Ullman JD., "Introduction to Automata Theory, Languages & Computation", Narosa.
2. K.L.P Mishra & N. Chandrasekharan – "Theory of Computer Science", PHI
3. Ash & Ash – "Discrete Mathematics",TMH

4. Martin—Introduction
5. Lewis H. R. and Papadimitrou C. H., "Elements of the theory of Computation", P.H.I.
6. Kain, "Theory of Automata & Formal Language", McGraw Hill.

***References* :**

1. Kohavi ZVI, "Switching & Finite Automata", 2nd Edn., Tata McGraw Hill.

2. Linz Peter, "An Introduction to Formal Languages and Automata", Narosa
3. "Introduction to Formal Languages", Tata McGraw Hill, 1983.

Microprocessor and Microcontrollers
Code: CS1403
Contacts: 3L + 1T Credits:4

Introduction to 8085A CPU architecture-register organization, addressing modes and their features. Software instruction set and Assembly Language Programming. Pin description and features.

Instruction cycle, machine cycle, Timing diagram.

Hardware Interfacing: Interfacing memory, peripheral chips (IO mapped IO & Memory mapped IO).

Interrupts and DMA.

Peripherals: 8279, 8255, 8251, 8253, 8237, 8259, A/D and D/A converters and interfacing of the

same. Typical applications of a microprocessor.

16 bit processors: 8086 and architecture, segmented memory has cycles, read/write cycle in min/max mode. Reset operation, wait state, Halt state, Hold state, Lock operation, interrupt processing. Addressing modes and their features. Software instruction set (including specific instructions like string instructions, repeat, segment override, lock prefizers and their use) and Assembly Language programming with the same.

Brief overview of some other microprocessors (eg. 6800 Microprocessor).

References:

1. An introduction to micro computers Vol. 2 – some real Microprocessor – Galgotia Book Source, New Delhi by Adam Osborne and J. Kane
2. Advanced Microprocessors by Ray and Bhurchandi - TMH
3. Intel Corp. Micro Controller Handbook – Intel Publications, 1994.
4. Microprocessors and Interfacing by Douglas V. Hall, McGraw Hill International Ed. 1992
5. The Intel Microprocessors: 8086/8088, 80186, 80286, 80386 & 80486, Bary B. Brey, Prentice Hall, India 1996.

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Operating System
Code: CS1404
Contacts: 3L+1T
Credits: 4

Introduction
Introduction to OS. Operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-programmed, time-sharing, real-time, distributed, parallel.

System Structure
Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), O/S services, system calls.

Process Management

Processes: Concept of processes, process scheduling, operations on processes, co-operating processes, inter- process communication.

Threads : overview, benefits of threads, user and kernel threads.

CPU scheduling: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.

Process Synchronization: background, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.
Deadlocks: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Storage Management

Memory Management: background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual Memory: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.

File Systems: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.

I/O Management : I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and nonblocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Disk Management : disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN) , disk reliability, disk formatting, boot block, bad blocks.

Protection & Security
Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

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***Text Books / References* :**

1. Milenkovie M., "Operating System : Concept & Design", McGraw Hill.
2. Tanenbaum A.S., "Operating System Design & Implementation", Practice Hall NJ.
3. Silbersehatz A. and Peterson J. L., "Operating System Concepts", Wiley.
4. Dhamdhere: Operating System TMH
5. Stalling, William, "Operating Systems", Maxwell McMillan International Editions, 1992.
6. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

Computer Organization and Architecture
Code: CS1405
Contacts: 3L + 1T
Credits: 4

Concepts and Terminology: Digital computer components Hardware & Software and their dual nature, Role of Operating Systems (OS).

The ALU: ALU organization, Integer representation, Serial and Parallel Adders, is 1s and 2s complement arithmetic, Multiplication of signed binary numbers, floating point number arithmetic, Overflow detection, Status flags.

Memory Unit: Memory classification, Bipolar and MOS storage cells. Organization of RAM, address decoding, Registers and stack, ROM and PROM-basic cell. Organization and erasing schemes, Magnetic memories-recording formats and methods. Disk and tape Units. Concept of memory map. Timing diagrams, T-States, Timing diagram Controlling arithmetic and logic instructions. Instruction sequencing with examples. Introduction to Micro- programming, Variations in Micro-programming configuration.

General Organization: Instruction work formats, Addressing modes registers, Von-Neumann concept, interconnecting system components, Interfacing buses, Timing diagrams, Examples from popular machines.

***Text books* :**

1 Hayes J. P., "Computer Architecture & Organisation", McGraw Hill,
2 Hamacher, "Computer Organisation",
3 Computer Organization and System Software, EXCEL BOOKS
4 Chaudhuri P. Pal, "Computer Organisation & Design", PHI,
5 Computer Organization & Architecture, Ghosh & Pal, TMH

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Computer Graphics
Code:CS1501
Contacts: 3L + 1T
Credits: 4

Module I

Introduction to computer graphics & graphics systems Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.

Scan conversion

Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Module II

2D transformation & viewing
Basic transformations: translation , rotation, scaling ; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear;
Transformation of points, lines , parallel lines, intersecting lines. Viewing pipeline, Window to viewport co-ordinate transformation , clipping operations , point clipping , line clipping, clipping circles , polygons & ellipse.

3D transformation & viewing

3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3D viewing.

Module III

Curves
Curve representation, surfaces , designs , Bezier curves , B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.

Hidden surfaces
Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal - geometry.

Color & shading models
Light & color model; interpolative shading model; Texture;

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Text Books:

3. Hearn, Baker – " Computer Graphics (C version 2nd Ed.)" – Pearson education
4. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
5. D. F. Rogers, J. A. Adams – " Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
6. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI
7. Mukherjee Arup, Introduction to Computer Graphics, Vikas
8. Hill,Computer Graphics using open GL, Pearson Education

Reference Books:

3. Foley, Vandam, Feiner, Hughes – "Computer Graphics principles (2nd Ed.) – Pearson Education.
4. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – TMH.

Computer Network Code:CS1502
Contact: 3L + 1T
Credits: 4

Module I

Overview of data communication and Networking:

Introduction; Data communications: components, data representation(ASCII,ISO etc.),direction of data flow(simplex, half duplex, full duplex); Networks: distributed processing, network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN);Internet: brief history, internet today; Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Physical level:

Overview of data(analog & digital), signal(analog & digital), transmission (analog & digital)& transmission media (guided & non-guided); TDM, FDM, WDM; Circuit switching: time division & space division switch, TDM bus; Telephone network;

Module II Data link layer:

Types of errors, framing(character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;

Medium access sub layer:

Point to point protocol, LCP, NCP, FDDI, token bus, token ring; Reservation, polling, concentration; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, FDMA, TDMA, CDMA; Traditional Ethernet, fast Ethernet;

Module III

Network layer:

Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : Internet address, classful address, subnetting; Routing : techniques, static vs. dynamic routing , routing table for classful address; Routing algorithms: shortest path algorithm, flooding, distance vector routing, link state routing; Protocols: ARP, RARP, IP, ICMP, IPV6; Unicast and multicast routing protocols.

Transport layer:

Process to process delivery; UDP; TCP; Congestion control algorithm: Leaky bucket algorithm, Token bucket algorithm, choke packets; Quality of service: techniques to improve Qos.

Module IV Application layer:

DNS; SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography, user authentication, security protocols in internet, Firewalls.

Modern topics:

ISDN services & ATM ; DSL technology, Cable modem, Sonet.
Wireless LAN: IEEE 802.11; Introduction to blue-tooth, VLAN's, Cellular telephony & Satellite network.

Text Books:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Miller, data Communication & Network, Vikas
7. Miller, Digital & Data Communication, Jaico
8. Shay, Understanding Data Communication & Network, Vikas

Reference Books:

1. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

Soft Computing Code:CS1503
Contact: 3L + 1T
Credits: 4

Introduction to Neorofuzzy and Soft Computing, Fuzzy set theory, Fuzzy Rules, Fuzzy Reasoning, Fuzzy inference System, Neural Networks; Radial basis and recurrent neural networks, Hopfield Networks, Comparison of RBF and MLP Network, Running Algorithms, NeuroFuzzy Modeling, Applications of Soft Computing to Signal Processing, Image Processing, Forecasting, XOR Problem-traveling salesman problem, Image compression suing MLPs-character retrieval using Hopfield networks, Introduction to Genetic Algorithm hybrid Systems etc.

Text Books:

1. B. Kosko, Neural Network and fuzzy systems, Prentice Hall of India, 2006.
2. S. Goonatilake & S. Khebbal, Intelligent Hybrid Systems, Wiley, 1995.

Reference Books:

1. V. Kecman, Learning and Soft Computing, Pearson, 1st Ed, 2001.
2. D. E. Goldberg, Genetic Algorithms in Search Optimization and Machine Learning, Addison Wesley, 3rd Ed.

Software Engineering
Code:CS1504
Contact: 3L Credits: 3

Module I

Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.

Module II

System Requirement Specification – DFD, Data Dictionary, ER diagram, Process Organization & Interactions.

System Design – Problem Partitioning, Top-Down And Bottop-Up design ; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.

Module III

Coding & Documentation - Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation.

Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment . , Validation & Verification Metrics, Monitoring & Control.

Module IV

Software Project Management – Project Scheduling , Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.

CASE TOOLS : Concepts, use and application.

Text Books:

1. R. G. Pressman – Software Engineering, TMH
2. Pankaj Jalote – An Integrated Approach to oftware Engineering, NAROSA.
3. Object Oriented & Classical Software Engineering(Fifth Edition),SCHACH,TMH
4. Vans Vlet, Software Engineering, SPD
5. Uma, Essentials of Software Engineering, Jaico
6. Sommerville, Ian – Software Engineering, Pearson Education

Reference:

1. IEEE Standards on Software Engineering.
2. Kane, Software Defect Prevention, SPD

Computer Science & Engineering Syllabus

Object Oriented System Design
Code:CS1601
Contact: 3L + 1T
Credits: 4

Introduction
Introduction, Modeling Concepts, class Modeling What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.

Advanced Class Modeling, State Modeling

Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips.

Advanced State Modeling, Interaction Modeling

Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Practical tips. Interaction Modeling: Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models.

Process Overview, System Conception, Domain Analysis

Process Overview: Development stages; Development life cycle. System Conception: Devising a system concept; Elaborating a concept; Preparing a problem statement. Domain Analysis: Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis.

Application Analysis, System Design

Application Analysis: Application interaction model; Application class model; Application state model; Adding operations. Overview of system design; Estimating performance; Making a reuse plan; Breaking a system in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of data storage; Handling global resources; Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example.

Class Design, Implementation Modeling, Legacy Systems

Class Design:Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recursing downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example. Implementation Modeling: Overview of implementation; Fine-tuning classes; Fine-tuning generalizations;

Realizing associations; Testing. Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance.

Design Patterns – 1

What is a pattern and what makes a pattern? Pattern categories; Relationships between patterns; Pattern description Communication Patterns: Forwarder-Receiver; Client-Dispatcher-Server; Publisher-Subscriber.

Design Patterns – 2, Idioms

Management Patterns: Command processor;View handler. Idioms: Introduction; what can idioms provide? Idioms and style; Where to find idioms; Counted Pointer examplestudy.

Text Books:

1. Object-Oriented Analysis and Design with Applications, Third Edition by Grady Booch, RobertA. Maksimchuk, Michael W. Engle,Bobbi J.Young, Jim Conallen, and Kelli Houston, 2007.
2. Learning UML2.0 by Russ Miles & Kim Hamilton (O'Reilly), 2006.

Reference:

1. Design Patterns:Elements of Reusable Object-Oriented Software with Applying UMLand Patterns:An Introduction to Object-Oriented Analysis and Design and the Unified Process, Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, 2003.

High Performance Computing
Code: CS1602
Contacts: 3L + 1T Credits: 4

The von-Neumann Computer concept. Flynn's Taxiometry (SISD, SIMD, MISD, MIMD). Topologies of computer/processor networks. Concurrency and Correctness (data races, atomic operations, deadlock, live lock). Shared memory; semaphores/mutex; distributed memory; hybrid environments .Partitioning; Communications; Synchronization; Data Dependencies; Granularity. Limits and Coast of Parallel Programming. Speedup, weak speedup, efficiency; Amdahl's law; Gustavson's law. Review of recent Multi–core processors. Concurrent and distributed programming based on C/C++/Java. Parallel processing based on Open source tools. Parallel processing based on OpenMP for shared memory systems. Parallel processing based on MPI for distributed memory systems. Grid and Cloud computing. Recent parallel programming standards as OpenCL (CUDA).

Text Books:

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series, 2011.

Computer Science & Engineering Syllabus

Reference:

1. Charles Severance, Kevin Dowd, High Performance Computing, O'Reilly Media, 2nd Edition, 1998.

Compiler Design
Code: CS1603
Contact 3L+1T
Credit 4

Module I

Introduction to Compiling
Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.

Module II

Lexical Analysis
The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

Module III

Syntax Analysis
The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.

Module IV

Syntax directed translation
Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Module V

Type checking
Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions

Module VI

Run time environments
Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing(call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques

Module VII

Intermediate code generation

Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Module VIII

Code optimization
Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.

Module IX

Code generations
Issues in the design of code generator, a simple code generator, Register allocation & assignment.

Text books:
1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" - PHI.

Artificial Intelligence

Code: CS1701
Contact: 3L+1T
Credits: 4

Module I

Introduction
Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem.

Intelligent Agents
Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Module II

Problem Solving
Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Search techniques
Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search comparing uniform search strategies.

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Module III

Heuristic search strategies
Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems.

Adversarial search
Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning additional refinements, iterative deepening.

Module IV

Knowledge & reasoning
Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.

Using predicate logic
Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction.

Module V

Representing knowledge using rules
Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

Probabilistic reasoning
Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Module VI

Planning
Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

Natural Language processing
Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Learning
Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.

Books:
1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS
7. Artificial Intelligence, Russel, Pearson

Management Information System

Code: CS1801
Contact: 3L
Credits: 3

Module I

Organisations and Computing: Introduction, Modern Organisation-IT enabled- Networked-Dispersed- Knowledge Organisation, Information Systems in Organisations- what are information systems?, Brief history of computing- ENIAC: Way to commercial computers- Advent of artificial intelligence- advent of personal computing-Free Software Movement- Advent of Internet, The role of internet- Internet and Web: they are different-the internet changes everything

Module II

Managing Information Systems in Organisations: Introduction, Managing in the Internet Era, Managing Information Systems in Organisation-the IT interaction model, Challenges for the manager-what information to build?-how much to spend on information systems?-what level of capabilities should be created with information systems?-how centralized should the services be?-what security levels are required?-what is technology road map for the organization?

Module III

Data and Information: Introduction, data and information- measuring data, information as a resource, information in organisational functions, types of information technology, types of information systems- transaction processing systems-management information systems

Module IV

Decision making and communication: Introduction, Decision making with MIS-Tactical decisions-operational decisions-strategic decisions, communication in organisations- types of communication- examples of communications in organisations- decision making with communication technology

Module V

Unit 5- Competing with IT: Introduction, The competitive environment of business- partnering for mutual benefit- bargaining power of suppliers-bargaining power of buyers and customers-barriers to entry-threat of substitutes-industry regulations, Using IT for competing-competing on low cost-competing on differentiation

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Module VI

IT strategy: Introduction, Information goods-properties-technology lock-in and switching costs-network externalities-positive feedback-tippy markets, information systems and competitive strategy- value chain, the Role of CIO-information system's plan-vendor coordination-technology updates-return on investment on technology.

Module VII

Business Process Integration with IT: Introduction, Business Process Integration- Business processes-example of a complex process, Motivation for Enterprise Systems, Enterprise Resource Planning systems- finance and accounting module-human resource management module-manufacturing and operations module- sales and marketing module

Module VIII

SCM, CRAM and International Systems: Introduction, Supply Chain Management Systems, Customer Relationships Management Systems, Challenges of Enterprise Systems Implementations-Managing the implementation, International Information Systems-Outsourcing and off-shoring

Module IX

Electronic Commerce: Introduction, E-commerce Technology, doing business over internet-networks-electronic data interchange (EDI)-online payment technology- Mobile commerce-ecommerce-portals- search engines-direct selling- auctions- aggregators, E-business

Module X

Decision Support Systems: Introduction, Understanding DSS- MIS and DSS-Decision making-types of decisions, Analytics and Business Intelligence- BI techniques

Module XI

Managing Data Resources: Introduction , The Need for Data Management- History of data use, Challenges of Data Management- data independence- reduced data redundancy- data consistency-data access- data administration- managing concurrency-managing security- recovery from crashes-application development, Database Concepts- fields, records and files- basic architecture, Data Warehouses- data mining uses

Module XII

Managing Social Media: Introduction, Social Dynamics of the Internet, Services of the Internet-Blogs-Social Networks, Technology of the Internet- Twitter-Rating-Tagging/folk sonomies, Social issues-Media impact-Collaboration-Emergence of order, Social Networks in the Enterprise

Books:

1. "Management Information Systems" by A O'Brien.
2. "Management Information System" by W S Jawadekar.
3. "Management Information Systems" by Laaudon and Ludon.

Elective 1

Data Mining and Data Warehousing
Code: CS5051
Contact: 3L
Credits: 3

Introduction to Data mining: Motivation for Data Mining, its importance, Role Data in Data Mining, Data Mining functionalities, patterns in data mining, Type of patterns, Classification of Data Mining Systems, Major issues in Data Mining; Data Warehousing and OLTP technology for Data Mining, Data Mining Languages, and System Architectures, Concept Description: Characterization and Comparison, Mining Association Rules in Large Databases, Classification and Prediction, Cluster Analysis, Mining Complex Data, Applications and Trends in Data Mining Characteristics of data warehouse, Data Mart, Online Analytical Processing, OLAP tools, Data warehouse Architecture, Organizational Issuer, Tools for Data warehousing, Performance consideration, case studies.

Essential Reading:

1. J. Han & M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Ed, 2006.
2. M. J. A. Berry and G. Linoff, Mastering Data Mining: The Art and Science of Customer Relationship Management, Wiley Computer Publishing, 2000.

Supplementary Reading:

1. P. Adriaans & D. Zantinge, Data Mining, Addison Wesley, 1996.
2. R. Mattison, Data Warehousing: Strategies, Tools and Techniques, McGraw Hill, 1996.
3. P. Ponniah, Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Wiley, 2001.

Principles of Programming Language
Code: CS 5052
Contact: 3L
Credits: 3

The Role of Programming Languages: Toward Higher-level Languages, Problems of Scale, Programming Paradigms, Language Implementation Bridging the Gap Language Description: - Syntactic Structure: Expression Notations, Abstract Syntax Trees, Lexical Syntax, Context -Free Grammars, Grammars for Expressions, Variants of Grammars; Statements: Structured Programming, Types: Data Representation, Procedure Activations; Object Oriented Programming: Groupings of Data and Operations: - Constructs fro Program Structuring, Information Hiding, Program Design with Modules, Modules and Defined Types, Class Declarations in C++, Dynamic Allocation I C++, Templates: Parameterized Types, Implementation of Objects in C++. 7. Object-Oriented Programming: - What is an Object?, Object-Oriented Thinking, Inheritance, Object-Oriented Programming in C++, An extended C++ example, Derived Classes and information Hiding, Objects in Smalltalk, Smalltalk Objects have self; Functional programming: Elements of Functional Programming, functional Programming in a Typed Languages, functions as First-Class Values, ML, Functional Programming with Lists.

Other Paradigms: Logic Programming, an Introduction to Concurrent Programming.

Essential Reading:

1. R. Sethi, Programming Languages – Concepts & Constructs, 2nd Ed, Pearson Education.

Supplementary Reading:

1. R. W. Sebesta, ***Concepts of Programming Languages***, 8th edition, Addison-Wesley, 2007.
2. M. L. Scott, ***Programming Language Pragmatics***, 2nd edition, Morgan Kaufmann, 2005.
3. T. W. Pratt & M. V. Zelkowitz, ***Programming Languages: Design and Implementation***, 4th edition, Prentice-Hall, 2001.

System Software
Code: CS 5053
Contact: 3L
Credits: 3

System Software and Machine Architecture, IBM 360 Instruction Set Architecture and Assembly language programs, The simplified Instructional Computer, traditional (CISC) Machine, RISC Machines; Language Processing; Assemblers, Cross assemblers, Macro processor, Single pass and multi pass, Linkers, Loaders, Relocating loaders and direct linking loaders, Compilers and Interpreters, Cross compilers, Lexical analyzer, Syntax analyzer, Intermediate and Machine code generation, Implementation Examples; Formal grammars and languages, Software Tools for program Development, Editors, Debug Monitors, Programming Environments, user Interface. Introduction to Operating Systems.

Essential Reading:

1. B. B. Brey, *The Microprocessor 8086/8088, 80186/188, 80286, 80386, 80486 and Pentium and Pentium Pro Processors, Pentium 2, Pentium 3 and Pentium 4: Architecture, Programming and Interface*, Prentice Hall of India, 7th Ed, 2007.
2. M. A. Mazidi, JG Mazidi and RD Mckinlay, *The 8051 Microcontroller and Embedded System*, Prentice Hall of India, 2nd Ed, 2006.

Supplementary Reading:

1. Liu & Gibson, Microcomputer System – The 8086/8088 Family Architecture, Programming and Design, Prentice Hall of India, 2nd Ed, 2006

Advance Microprocessor System
Code: CS 5054
Contact: 3L
Credits: 3

Introduction: Need of advance microprocessors, Difference between RISC and CISC, RISC Design philosophy, ARM Design Philosophy, History of ARM microprocessor, ARM processor family, Development of ARM architecture. The ARM Architecture and Programmers Model: The Acorn RISC Machine, ARM Core data flow model, Architectural inheritance, The ARM7TDMI programmer's model: General purpose registers, CPSR, SPSR, ARM memory map, data format, load and store architecture, Core extensions, Architecture revisions, ARM development tools. ARM Instruction set: Data processing instructions, Arithmetic and logical instructions, Rotate and barrel shifter, Branch instructions, Load and store instructions, Software interrupt instructions, Program status register instructions, Conditional execution, Multiple register load and store instructions, Stack instructions, Thumb instruction set, advantage of thumb instructions, Assembler rules and directives, Assembly language programs for shifting of data, factorial calculation, swapping register contents, moving values between integer and floating point registers. C Programming for ARM: Overview of C compiler and Optimization, Basic C data types, C Looping structures, Register allocations, function calls, pointer aliasing, structure

arrangement, bitfields, unaligned data and Endianness, Division, floating point, Inline functions and inline assembly, Portability issues. C programs for General Purpose I/O, general purpose timer, PWM Modulator, UART, I2C Interface, SPI Interface, ADC, DAC. Memory management units: Moving from memory protection unit (MPU) to memory management unit (MMU), Working of virtual memory, Multitasking, Memory organization in virtual memory system, Page tables, Translation look aside buffer, Caches and write buffer, Fast context switch extension. Advanced Microprocessor Bus Architecture (AMBA) Bus System, User peripherals, Exception handling in ARM, ARM optimization techniques

Reference Books:

1. *RM Assembly Language Programming & Architecture, Muhammad Ali Mazidi.*
2. *Arm Assembly Language, Fundamentals and Techniques, 2nd edition, William Hohl, Christppher Hinds, CRC Press.*
3. *Arm System Developer's Guide, Designing and Optimizing Software, Andrew N. Sloss, Dominic Symes, Chris Wwight, Elsevier.*
4. *Arm System-on-chip Architecture, 2nd Edition, Steve Furber, Pearson publication*

Graph Theory
Code: CS 5055
Contact: 3L
Credits: 3

Introduction: Graphs, Isomorphism, Walks, Paths, Circuits, Trees, Properties of Trees, Cotrees and Fundamental Circuits, Cut Sets, Fundamental Cut Sets and Cut Vertices, Planar and Dual Graphs, Metric Representation of Graphs, Coloring and covering and partitioning of a graph, chromatic number, chromatic partitioning, chromatic polynomials, matching, covering, four color problem, Directed graphs, some type of directed graphs, Directed paths, and connectedness, Euler digraphs, trees with directed edges, fundamental circuits in digraph, matrices A, B and C of digraphs adjacency matrix of a digraph,, enumeration, types of enumeration, counting of labeled and unlabeled trees, polya's theorem, graph enumeration with polya's theorem.

Graph Algorithms: Elementary Graph Algorithms, Representations of graphs, Breadth-first search, Depth-first search, Topological sort, strongly connected components

Minimum Spanning Trees: Growing a minimum spanning tree, The algorithms of Kruskal and Prim, Single-Source Shortest Paths: Shortest paths and relaxation, Dijkstra's algorithm, The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Difference constraints and shortest paths, All-Pairs Shortest Paths: Shortest paths and matrix multiplication, The Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs, and A general framework for solving path problems in directed graphs, Maximum Flow: Flow networks, The Ford-Fulkerson method, Maximum bipartite matching, Preflow-push algorithms, The lift-to-front algorithm

Essential Reading:

1. T. H. Cormen, C. E. Leiserson and Ronald L. Rivest, ***Introduction to Algorithms***, Prentice Hall of India, 3rd Ed, 2006.
2. N. Deo, ***Graph Theory with Applications to Engineering and Computer Science***, Prentice Hall of India, 2004.

Supplementary Reading:

1. D. B. West, ***Introduction to Graph Theory***, 2nd Ed, Prentice Hall of India, 2007.
2. R. Diestel, ***Advanced Graph Theory***, Springer Verlag Heidelberg, New York, 2005
3. M. T. Goodrich and R. Tamassia, ***Algorithm Design: Foundations, Analysis, and Internet Examples***, Wiley, 1st Ed, 2001.

Wireless Sensor Networks
Code: CS 5057
Contact: 3L
Credits: 3

UNIT I - FUNDAMENTALS OF SENSOR NETWORKS

Introduction and Overview - Overview of sensor network protocols, architecture, and applications, Challenges, Main features of WSNs; Research issues and trends, Platforms-Standards and specifications-IEEE802.15.4/Zigbee, Hardware: Telosb, Micaz motes ,Software: Overview of Embedded operating systems-Tiny OS, Introduction to Simulation tools- TOSSIM, OPNET, Ns-2.

UNIT II - COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS

Wireless Communication characteristics - Link quality, fading effects, Shadowing, Localization, Connectivity and Topology - Sensor deployment mechanisms, Coverage issues, Node discovery protocols.

UNIT III -MAC LAYER

Fundamentals of Medium access protocol- Medium access layer protocols - Energy efficiency, Power allocation and Medium access control issues.

UNIT IV - NETWORK LAYER AND TRANSPORT LAYER

Network layer protocols-Data dissemination and processing, multichip and cluster based routing protocols- Energy efficient routing- Geographic routing, Transport layer- Transport protocol Design issues- Performance of Transport Control Protocols.

UNIT V - MIDDLEWARE AND SECURITY ISSUES

Middleware and Application layer -Data dissemination, Data storage, Query processing, Security - Privacy issues, Attacks and Countermeasures.

REFERENCES:

1. Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2007.
2. Kazem Sohraby, Daniel manoli , "Wireless Sensor networks- Technology, Protocols and Applications", Wiley InterScience Publications 2010.
3. Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005.
4. C.S Raghavendra, Krishna M.Sivalingam, Taieb znati , "Wireless Sensor Networks", Springer Science 2004.

Data Science
Code: CS 5058
Contact: 3L
Credits: 3

Module I

What is Data Science? Big Data and Data Science hype – and getting past the hype
Current landscape of perspectives, Skill sets needed.

Module II

Statistical Inference, Populations and samples, Statistical modeling, probability distributions, fitting a model, Introduction to R

Module III

Exploratory Data Analysis and the Data Science Process, Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm).

Module IV

Three Basic Machine Learning Algorithms, Linear Regression, k-Nearest Neighbors (k-NN), k-means.

Module V

One More Machine Learning Algorithm and Usage in Applications, Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web.

Module VI

Feature Generation and Feature Selection (Extracting Meaning From Data), Motivating application: user (customer) retention, Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms, Filters; Wrappers; Decision Trees; Random Forests.

Module VII

Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.

Module VIII

Mining Social-Network Graphs, Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighborhood properties in graphs.

Module IX

Data Visualization, Basic principles, ideas and tools for data visualization

REFERENCES:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014.
3. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
4. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
5. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 0387952845. 2009.

Advanced Computer Architecture
Code: CS 5059
Contact: 3L
Credits: 3

Review of Pipelining, Examples of some pipeline in modern processors, pipeline hazards, data hazards, control hazards. Techniques to handle hazards, performance improvement with pipelines and effect of hazards on the performance.

Vector processors- Use and effectiveness, memory to memory vector architectures, vector register architecture, vector length and stride issues, compiler effectiveness in vector processors.

SISD, MISD, MIMD, Single instruction multiple data stream (SIMD) architectures. Array processors, comparison with vector processors, example of array processors such as MMX Technology.

Memory hierarchy, Cache Introduction, Techniques to reduce cache misses, techniques to reduce cache penalties, technique to reduce cache hit times. Effect of main memory bandwidth, effect of bus-width, memory access time, virtual memory, etc.

RISC architectures, addressing modes, instructions formats, effect of simplification on the performance, example processors such as MIPS, PA-RISC, SPARC, Power PC, etc.

MIMID Multiprocessors, Centralized shared architectures, distributed shared memory architectures, synchronization and memory consistency models, message passing architectures, comelier issues. Data flow architectures, Interconnection networks.

Text Books:

1. Hwang, K. "Advanced Computer architecture with parallel programming", McGraw Hill, 1993
2. Carter—Computer Architecture (Schaum Series),TMH
3. Patterson D.A. and Hennessy , J.L. "Computer architecture a quantitative approach", 2nd ed., Morgan Kaufman, 1996
4. Hwang & Briggs—Computer Architecture & Parallel Processing, TMH
5. Stone, H.S., "Advanced Computerat", Addison Wesley, 1989
6. Siegel, H.J., "Interconnection Network for Large Scale parallel Processing", 2nd Ed., McGraw Hill, 1990
7. Computer Organization & Architecture (TMH WBUT Series), Ghosh & Pal,TMH

Reference:

Quinn—Parallel Processing

Wireless Communication
Code: CS 5060
Contact: 3L
Credits: 3

WIRELESS CHANNELS: Large scale path loss – Path loss models: Free Space and Two-Ray models - Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters- Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

CELLULAR ARCHITECTURE: Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

DIGITAL SIGNALING FOR FADING CHANNELS: Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

MULTIPATH MITIGATION TECHNIQUES: Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macrodiversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

MULTIPLE ANTENNA TECHNIQUES: MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

TEXTBOOKS:

1. Rappaport,T.S., "Wireless communications", Second Edition, Pearson Education, 2010.
2. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.

REFERENCES:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
2. Upena Dalal, " Wireless Communication", Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2000.

Digital Signal Processing
Code: CS 5061
Contact: 3L
Credits: 3

SIGNALS AND SYSTEMS: Basic elements of DSP – concepts of frequency in Analog and Digital Signals – sampling theorem –Discrete – time signals, systems – Analysis of discrete time LTI systems – Z transform – Convolution– Correlation.

FREQUENCY TRANSFORMATIONS: Introduction to DFT – Properties of DFT – Circular Convolution – Filtering methods based on DFT –FFT Algorithms – Decimation – in – time Algorithms, Decimation – in – frequency Algorithms – Use of FFT in Linear Filtering – DCT – Use and Application of DCT.

IIR FILTER DESIGN: Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.

FIR FILTER DESIGN: Structures of FIR – Linear phase FIR filter – Fourier Series – Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques

FINITE WORD LENGTH EFFECTS IN DIGITAL FILTERS: Binary fixed point and floating point number representations – Comparison – Quantization noise –truncation and rounding – quantization noise power- input quantization error- coefficient quantization error – limit cycle oscillations-dead band-Overflow error-signal scaling.

TEXT BOOKS:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis. Pearson Education / PHI. 2007.

2. Discrete Time Signal Processing-A. V. Oppenheim and R.W. Schaffer. PHI, 2009

3. Fundamentals of Digital Signal Processing - Loney Ludeman. John Wiley, 2009

REFERENCE BOOKS:

1. Digital Signal Processing - Fundamentals and Applications - Li Tan, Elsevier. 2008

2. Fundamentals of Digital Signal Processing using Matlab - Robert J. Schilling. Sandra L, Harris,

Thomson. 2007

3. Digital Signal Processing - S.Salivahanan. A.Vallavaraj and CGnanapriya.TMH.2009

4. Discrete Systems and Digital Signal Processing with MATLAB -Taan S.EIAli.CRC press. 2009.

Cryptographic Foundations
Code: CS 5062
Contact: 3L
Credits: 3

Introduction to cryptography: Attacks, Services, and Mechanisms, Security Attacks, Security Services, A Model for Internet work Security. Conventional Encryption: Classical and Modern Techniques, Conventional Encryption: AlgorithmsTriple DES, International Data Encryption Algorithm, Blowfish, RC5, CAST, RC2, Characteristics of Advanced Symmetric Block Ciphers. Confidentiality Using Conventional Encryption: Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random Number Generation.; Public-Key CryptographyPrinciples of Public-Key Cryptosystems, The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication and Hash Functions: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs. Hash and Mac Algorithms (MD5 Message Digest Algorithm, Secure Hash Algorithm (SHA-l), RIPEMD, HMAC), Digital Signatures and Authentication Protocols and Web Security.

Essential Reading:

1. W. Stalling, ***Cryptography and Network Security: Principles and Practices***, 4th Ed, 2005
2. B. A. Forouzan, ***Cryptography and Network Security,*** McGraw Hill, 2nd Ed, 2004.

Supplementary Reading:

1. J. Hershey, ***Cryptography Demystified***, McGraw Hill, 2003
2. R E Smith, ***Internet Cryptography***, Addison Wesley
3. J. Knudsen, ***Java Cryptography***, O'Reilly, 1998.