Computer Science and Engineering Department
M.Tech in Computer Science and Engineering (2016)

1st SEMESTER

Sl.No.	Course Number	Course Title	L	T	P	C
1	CS541	Foundations of Computer Systems	3	0	0	6
2	MA501	Probability Statistics and Stochastic Processes	3	0	0	6
3	CSXXX	Elective-I	3	0	0	6
4	CSXXX	Elective-II	3	0	0	6
5	CSXXX	Elective-III	3	0	0	6
6	CS559	Computer Systems Lab-1	0	0	3	3
7	HS5XX	HSS Elective	2	0	0	4
TOTAL			**17**	**0**	**3**	**37**

2nd SEMESTER

Sl.No.	Course Number	Course Title	L	T	P	C
1	CS511	Foundations of Theoretical Computer Science	3	0	0	6
2	CS514	Design and Analysis of Algorithms	3	0	0	6
3	CSXXX	Elective-IV	3	0	0	6
4	CSXXX	Elective -V	3	0	0	6
	CSXXX	Elective-VI	3	0	0	6
5	CS515	Computer Systems Lab-2	0	0	3	3
6	CS592	Seminar	0	0	4	4
TOTAL			**12**	**0**	**7**	**37**

3rd SEMESTER

Sl.No.	Course Number	Course Title	L	T	P	C
1	CS695	Project Thesis-I	0	0	24	24
TOTAL						**24**

4th SEMESTER

Sl.No.	Course Number	Course Title	L	T	P	C
1	CS696	Project Thesis-II	0	0	0	24
TOTAL						**24**

Total Credit	**37**	**37**	**24**	**24**	**122**

Semester-I :Core Theory

Course No.:CS-541	Name: Foundations of Computer Systems	Credits: 3-0-0-6	Prerequisites: NIL

Syllabus:

Review of concepts of computer architecture: Study of an existing CPU: architecture, instruction set and the addressing modes, assembly language programming. Control unit Design: instruction interpretation, hardwired and micro-programmed methods of design. Pipelining and parallel processing, RISC and CISC paradigms, I/O Transfer techniques: programmed, interrupt-driven and DMA; Memory organization: hierarchical memory systems, cache memories, cache coherence, virtual memory.

Review of concepts of operating systems: Processes, threads, Unix fork-exec model, Unix signals, synchronization, Interprocess communication, scheduling, memory management.

Review of concepts of computer networks: link layer protocols, local area networks (Ethernet and variants), , routing, transport layer protocols. Concepts of distributed networked systems: Virtualization, distributed file systems, mass storage systems, recovery and fault tolerance, content networking including multimedia delivery.

Texts:

1. A. Silberschatz, P. B. Galvin and G. Gagne, Operating System Concepts, 7th Ed, John Wiley and Sons, 2004.
2. J. Kurose and K. W. Ross, Computer Networking: A Top down approach, 3rd Ed, Pearson India, 2004.
3. M. Singhal and N. Shivratri, Advanced Concepts in Operating Systems, McGraw Hill, 1994.
4. A. S. Tanenbaum and Van Steen, Distributed Systems: Principles and Paradigms, Prentice Hall India, 2007.
5. David A Patterson and John L Hennessy, Computer Organisation and Design: The Hardware/Software Interface, Morgan Kaufmann, 1994. ISBN 1-55860-281-X.

Course No.:MA501	Name: Probability, Statistics and Stochastic Processes	Credits: 3-0-0-6	Prerequisites: NIL

Syllabus:

Algebra of sets, probability spaces, random variables, cumulative distribution functions, mathematical expectations, conditional probability and expectation, moments and inequalities, special discrete and continuous probability distributions, function of a random variable, random vectors and their distributions, convolutions, joint, marginal and conditional distributions, product moments, independence of random variables, bivariate distributions and properties, order statistics and their distributions, sampling distributions, Central Limit Theorem, strong law of large numbers, sequence of random variables, modes of convergence, distributions of the sample mean and the sample variance for a normal population, chi-square, t and F distributions, method of moments and maximum likelihood estimation, concepts of unbiasedness, criteria for choosing estimators, consistency and efficiency of estimates, confidence intervals, pivotal quantities, confidence intervals for proportions, simple and composite hypothesis, null and alternative hypotheses, types of error, level and size of tests, the most powerful test and Neyman - Pearson Fundamental Lemma, tests for one- and two-sample problems for normal populations, tests for proportions, likelihood ratio tests, chi-sqaure test for goodness of fit. discrete and continuous stochastic processes, markov chains, transition probability matrix, state spaces, classification of states, stationary distributions, ergodicity, poisson process, birth and death process.

References:

1. Rohatgi, V.K., and Saleh, A.K.Md. Ehsanes (2009). An introduction to probability and statistics. Second Edition, Wiley India.
2. Introduction to the Theory of Statistics; Alexander M. Mood, Franklin A. Graybill, Duane C. Boes, Tata McGraw Hill.
3. Milton, J.S. and Arnold, J.C. (2009) Introduction to Probability and Statistics, Fourth Edition, Tata Mcgraw-Hill.
4. Ross, S.M.(2008) Introduction to Probability Models, Ninth edition, Academies Press.
5. Statistical Inference (2007), G. Casella and R.L. Berger, Duxbury Advanced Series .

Lab:

Course No.:CS559	Name: Computer Systems Lab-1	Credits: 0-0-3-3	Prerequisites: NIL

Syllabus:

Basics of OS programming: process creation and synchronization, shared memory and semaphore, shell programming.

Socket programming, database creation and update, building large client server applications. Basics of compiler writing using lex and yacc

Semester-II: Core Theory

Course No.:CS511	Name: Foundations of Theoretical Computer Science	Credits: 3-0-0-6	Prerequisites: NIL

Syllabus:

Discrete Structures : Sets, Relations and Functions; Proof Techniques, Algebraic Structures, Morphisms, Posets, Lattices and Boolean Algebras.

Logic : Propositional calculus and Predicate Calculus, Satisfiabiliy and validity, Notions of soundness and completeness.

Automata and Languages : Finite automata and regular expressions, pushdown automata and context-free grammars, pumping lemmas and closure properties of regular and context-free languages, non-context-free languages.

Computability theory : Church-Turing thesis, Hilbert's problem, 5 decidability, halting problem, reducibility; Complexity theory: time and space complexity, Classes P, NP, NP-complete, PSPACE, and PSPACE-complete.

Texts:

1. M. Sipser, Introduction to the Theory of Computation, Thomson, 2004.

2. H. R. Lewis, C. H. Papadimitriou, Elements of the Theory of Computation, PHI, 1981.

References:

1. J. E. Hop croft, J. D. Ullman, Introduction to Automata Theory, Languages and Computation,Narosa,1979.

2. S. Arora, B. Barak, Computational Complexity: A Modern Approach, Cambridge UniversityPress,2009.

3. C. H. Papadimitriou, Computational Complexity, Addison-Wesley Publishing Company, 1994.

4. D.C.Kozen, Theory of Computation, Springer, 2006.

5. D. S. Garey, G. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, New York, 1979.

Course No.:CS514	Name: Design and Analysis of Algorithms	Credits: 3-0-0-6	Prerequisites: NIL

Syllabus:

Data structures: linked list, stack, queue, tree, balanced tree, graph; Complexity analysis: Big O, omega, theta notation, solving recurrence relation, master theorem
Sorting and searching: Quick sort, merge sort, heap sort; Sorting in linear time; Ordered statistics;
Problem solving strategies: recursion, dynamic programming, branch and bound, backtracking, greedy, divide conquer,
Graph algorithms: BFS, DFS, Shortest path, MST, Network flow;
NP-completeness
Advanced topics: string matching, FFT-DFT, basics of approximation and randomized algorithms;

References:

1. Mark Allen Weiss, "Data Structures and Algorithms in C++", Addison Wesley, 2003.
2. Adam Drozdek, "Data Structures and Algorithms in C++", Brooks and Cole, 2001.
3. Aho, Hopcroft and Ullmann, "Data structures and Algorithm", Addison Welsey, 1984.
4. Introduction to Algorithms Book by Charles E. Leiserson, Clifford Stein, Ronald Rivest, and Thomas H. Cormen

Lab:

Course No.:CS695	Name: Project I	Credits: 0-0-0-24	Prerequisites: NIL

Syllabus:

The project can span the course Project-II. Hence it is expected that the problem specification and the milestones to be achieved in solving the problem are clearly specified.

Course No.:CS696	Name: Project II	Credits: 0-0-0-24	Prerequisites: NIL

Syllabus:

The students who work on a project are expected to work towards the goals and milestones set in course Project-I. At the end there would be demonstration of the solution and possible future work on the same problem. A dissertation outlining the entire problem, including a literature survey and the various results obtained along with their solutions is expected to be produced.

Elective

Course No.:CS547	Name: Foundation of Computer Security	Credits: 3-0-0-6	Prerequisites: nil

Syllabus:

Introduction to Computer Security and Privacy : security and privacy; types of threats and attacks; methods of defense Program Security: Secure programs; nonmalicious program errors; malicious code; controls against program threats Operating System Security: Methods of protection; access control; user authentication Network Security: Network threats; firewalls, intrusion detection systems Internet Application Security and Privacy: Basics of cryptography; security and privacy for Internet applications (email, instant messaging, web browsing); privacy-enhancing technologies Database Security and Privacy: Security and privacy requirements; reliability, integrity, and privacy; inference;

Note: Familiarity with CS 341 Operating Systems and CS 101 Programming in C, is desirable

References:

1. Security in Computing, 4thedition. Charles P. Pfleeger and Shari Lawrence Pfleeger Prentice-Hall, 2007. Or later
2. Introduction to Computer Security Matt Bishop, Addison-Wesley 2005
3. Published papers in this area will be discussed and uploaded in the course-web

Elective

Course No.:CS503	Name: Advances in Algorithms	Credits: 3-0-0-6	Prerequisites: CS102, CS204, CS206

Syllabus:

Algorithmic paradigms: Dynamic Programming, Greedy, Branch-and-bound; Asymptotic complexity, Amortized analysis; Graph Algorithms: Shortest paths, Flow networks; NP-completeness; Approximation algorithms; Randomized algorithms; Online algorithms; Streaming algorithms; Linear programming;

Special topics: Geometric algorithms (range searching, convex hulls, segment intersections, closest pairs), Numerical algorithms (integer, matrix and polynomial multiplication, FFT, extended Euclid's algorithm, modular exponentiation, primality testing, cryptographic computations), Internet algorithms (text pattern matching, tries, information retrieval, data compression, Web caching).

References:

1. T. H. Cormen, C. L. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, 2nd edition, Prentice-hall Of India Pvt.. Ltd, (2007)
2. J. Kleinberg and E. Tardos, Algorithm Design, Addison-Wesley, (2008)
3. Rajeev Motwani and Prabhakar Raghavan, Randomized Algorithms, Cambridge University Press, (1995)
4. Vijay Vazirani, Approximation Algorithms, Springer, (2004)
5. Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Elsevier India Private Limited, (2005)
6. Technical papers from major reputed journals in the area of algorithms design

Elective

Course No.:CS505	Name: Advanced Graph Theory	Credits: 3-0-0-6	Prerequisites: nil

Syllabus:

Basic Concepts: Graphs and digraphs, incidence and adjacency matrices, isomorphism, the automorphism group;

Trees: Equivalent definitions of trees and forests, Cayleys formula, the Matrix-Tree theorem, minimum spanning trees;

Connectivity: Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger s theorem;

Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference, the Chinese Postman Problem, the Travelling Salesman problem, diameter and maximum degree, shortest paths;

Matchings: Berges Theorem, perfect matchings, Halls theorem, Tuttes theorem, Konigs theorem, Petersens theorem, algorithms for matching and weighted matching (in both bipartitie and general graphs), factors of graphs (decompositions of the complete graph), Tuttes f-factor theorem;

Extremal problems: Independent sets and covering numbers, Turans theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizings theorem; Graphs on surfaces: Planar graphs, duality, Eulers formula, Kuratowskis theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces;

Directed graphs: Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, branchings;

Networks and flows: Flow cuts, Max flow min cut theorems, perfect square;

Selected topics: Dominating sets, the reconstruction problem, intersection graphs, perfect graphs, random graphs.

References:

1. D.B.West: Introduction to Graph Theory, Prentice-Hall of India/Pearson, 2009
2. J.A.Bondy and U.S.R.Murty: Graph Theory, Springer, 2008.
3. R.Diestel: Graph Theory, Springer(low price edition) 2000.
4. F.Harary: Graph Theory, Narosa, (1988)
5. C. Berge: Graphs and Hypergraphs, North Holland/Elsevier, (1973)

List of Other Approved Electives:

- CS561: Artificial Intelligence
- CS544: Introduction to Network Science
- CS542: Software Testing
- CS543: Distributed Systems
- CS528: CAD for VLSI
- CS548: Wireless Networks
- CS549: Computer and Network Security
- CS508: Formal methods for analysis and verification
- CS743: Advanced topics on Database
- CS502: Pattern Recognition
- CS563: Natural Language Processing
- CS564: Foundations of Machine Learning