COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

1st Semester

Theory:

Sl. No.	CODE	Paper	Contacts periods Per weeks			Total Contact Hrs	Credits
			L	T	P		
1	MATH5102	Advanced Discrete Mathematics	3	1	0	4	4
2	CSEN5102	Algorithms and Complexity	4	0	0	4	4
3	CSEN5103	Advanced Database Management Systems	4	0	0	4	4
4	CSEN5104	Advanced Programming and Problem Solving	3	1	0	4	4
5	CSEN5105	Advanced Computer Architecture	4	0	0	4	4
		Total of Theory	18	3	0	21	20

Practical / Sessional:

Sl. No.	CODE	Paper	Contacts periods Per weeks			Total Contact Hrs	Credits
			L	T	P		
1	CSEN5113	Database Management Systems Laboratory	0	0	3	3	2
2	CSEN5114	Advanced Programming and Problem Solving Laboratory	0	0	3	3	2
3	CSEN5197	Seminar I	0	0	2	2	1
		Total of Practical / Sessional	0	0	8	8	5
TOTAL OF SEMESTER:			18	3	8	29	25

2nd Semester

Theory:

Sl. No.	CODE	Paper	Contacts periods Per weeks			Total Contact Hrs	Credits
			L	T	P		
1	CSEN5201	Theory of Computation	4	1	0	5	4
2	CSEN5202	Advanced Operating Systems	4	0	0	4	4
3	CSEN5203	Advanced Computer Networks	4	0	0	4	4
4	CSEN5221-CSEN5228	Elective I	4	0	0	4	4
5	CSEN5231-CSEN5237	Elective II	4	0	0	4	4
		Total of Theory	20	1	0	21	20

Practical / Sessional:

Sl. No.	CODE	Paper	Contacts periods Per weeks			Total Contact Hrs	Credits
			L	T	P		
1	CSEN5212	Operating Systems Laboratory	0	0	3	3	2
2	CSEN5213	Computer Networks Laboratory	0	0	3	3	2
3	CSEN5214	Term Paper Leading to Thesis	0	0	0	0	1
		Total of Practical / Sessional	0	0	6	6	5
TOTAL OF SEMESTER:			20	1	06	27	25

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

3rd Semester

Theory:

Sl. No.	CODE	Paper	Contacts periods Per weeks			Total Contact Hrs	Credits
			L	T	P		
1	CSEN6101	Software Engineering	4	0	0	4	4
2	CSEN6141-CSEN6149	Elective III	4	0	0	4	4
	CSEN6151-CSEN6159	Elective IV	4	0	0	4	4
		Total of Theory	12	0	0	12	12

Sessional:

Sl. No.	CODE	Paper	Contacts periods Per weeks			Total Contact Hrs	Credits
			L	T	P		
1	CSEN6195	Thesis(Progress) and Seminar	0	0	0	12	8
		Total of Sessional	0	0	0	12	8
TOTAL OF SEMESTER:			8	0	0	24	20

4th Semester

Sessional:

Sl. No.	CODE	Paper	Contacts periods Per weeks			Total	Credits
1	CSEN6295	Thesis(Final)	0	0	0	18	12
2	CSEN6296	Thesis Viva-voce	0	0	0	0	4
3	CSEN6297	Grand - Viva	0	0	0	0	4
		Total of Sessional	0	0	0	18	20
TOTAL OF SEMESTER:			0	0	0	18	20

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Detailed Syllabus:

Subject Name: ADVANCED DISCRETE MATHEMATICS					
Paper Code: MATH5102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

***Mathematical Foundations*: (10L)**
Set Cardinality: Countable and Uncountable Sets;
Relations: Partial & Total Orderings, Hasse Diagrams, Partially Ordered Sets (POSETs), Minimal, Maximal, Greatest, Least Elements; Properties of Lattices, Distributive and Complemented Lattices, Boolean Algebras.

***Properties of Integers* (10L)**
Well Ordering Principle, Weak & Strong Principles of Mathematical Induction, Fundamental Theorem of Arithmetic, Euclidean Algorithm, Properties of GCD, Linear Congruences, Residue Classes; Fermat's little Theorem, Euler's Phi Function, Euler's Theorem on Congruences & Related Results, Chinese Remainder Theorem.

***Topics in Combinatorial Mathematics*: (10L)**
Pigeon Hole Principle, Permutations & Combinations, Binomial Coefficients, Recurrence Relations & Generating Functions, Properties of Fibonacci Numbers, Principle of Inclusion & Exclusion, Polya's Theory of Counting, Ramsey's Theorem.

***Advanced Graph Theory*: (10L)**
Tree, Binary Tree, Spanning Tree, Walk, Path, Cycle, Hamiltonian Graph ,The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem , Planar Graph, Euler's Formula for Planar Graph and Related Problems, Examples of Non-Planar Graphs, Kuratowski's Theorem, Matching and Augmenting Paths, Hall's Marriage Theorem and Related Problems, Vertex Colouring, Chromatic Polynomials.

***References*:**
[1] Discrete Mathematics & Its Applications (6th Ed), K H Rosen, McGraw Hill, 2007
[2] Introduction to Graph Theory (2nd Ed), D G West, Prentice-Hall of India, 2006
[3] Concrete Mathematics, R. L. Graham, D. E. Knuth and O. Patashnik: Addison Wesley, 1994.
[4] Introduction to Combinatorial Mathematics, C L Liu, McGraw-Hill, 1967
[5] Discrete Mathematics for Computer Scientists and Engineers (2nd Ed), J L Mott, A Kandel and T P Baker, PHI, 2002
[6] A Friendly Introduction to Number Theory: J.H. Silverman (Pearson Education)

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ALGORITHMS AND COMPLEXITY					
Paper Code: CSEN5102					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**1**	**0**	**5**	**4**

Module I

Basic Concepts: Review of basic data structures and algorithms, worst-case and average-case analyses, direct computation of running time of insertion sort, asymptotic complexity, Big-O, Big-Theta, Big-Omega and small-o notations and their properties.

Amortized Analysis: Aggregate, Accounting and Potential Method

Module II

Sorting and Selection: Sorting by mergesort, quicksort, heapsort and other methods, priority queues, lower bounds for comparison-based sorting, median and order statistics, selection of k^{th} largest element.

Searching and Binary Trees: Binary search in static tables, insertion and deletion in binary search trees, total path length of binary trees, weighted binary search trees, AVL trees and other balanced trees, randomly built binary search trees.

Module III

Graph Algorithms: Graph traversal: BFS and DFS, topological sorting of cycle-free graphs, connected and bi-connected components, shortest path algorithms, minimum spanning trees.

Algebraic Operations: Integer multiplication, GCD, polynomial evaluation, Strassen's matrix multiplication algorithm, introduction to FFT, simple lower bounds results.

Module IV

***String Processing*:** String searching and pattern matching, KMP algorithm.

***Flows in Networks**:* Basic Concepts, maxflow-mincut theorem, Ford-Fulkerson augmenting path method, integral flow theorem, maximum capacity augmentation, Edmond-Karp method, Dinic's method and its analysis, Malhotra Kumar-Maheswari method and its analysis, better time bounds for simple networks.

***NP-completeness*:** Informal concepts of deterministic and non-deterministic algorithms, P and NP, NP-completeness, Cook's theorem, examples of NP-complete problems, approximation algorithms.

References:

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, C Stein: *Introduction to Algorithms* (2nd Ed), MIT Press, 2001.
2. G Brassard, P Bratley: *Introduction to Algorithmics*, Pearson Prentice Hall, 1996
3. D. E. Knuth: *The Art of Computer Programming* (2nd Ed or later), vol 1-3, Addison-Wesley
4. J Kleinberg, E Tardos: *Algorithm Design*, Pearson, 2006

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ADVANCED DATABASE MANAGEMENT SYSTEMS					
Paper Code: CSEN5103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module-I:

Levels of Distributed Transparency

Reference Architecture for Distributed Databases, Types of Data Fragmentation, Distributed Transparency for Read-Only Applications, Distributed Transparency for Update Applications, Distributed Database Access Primitives, Integrity Constraints in Distributed Databases.

Module-II:

The Management of Distributed Transactions

Equivalence Transformations of Distributed Queries, A framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions.

Module-III:

Concurrency Control and Reliability

Serializability Theory, Locking-based Concurrency Control, Timestamp-based Concurrency Control, Deadlock Management, Reliability Concepts and Measures, Failures and Fault Tolerance in Distributed Databases, Local Reliability Protocols, Distributed Reliability Protocols, Dealing with Site Failures, Network Partitioning.

Module-IV:

Parallel Databases: Architecture, Query processing, Join algorithms, Performance

Object Oriented Databases:Objects and Types, Specifying the behavior of objects, Implementing Relationships, Inheritance.

Temporal Databases:Language issues, Storage and Transaction management

Statistical Databases: Elementary operations, Security in Statistical Database, Linear Queries, Limits on the Structure of queries.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Text Books:

1. Silberschatz Korth, Sudarshan: Database System Concepts, TMH
2. Ramakrishnan, Gehrke: Database Management Systems, TMH
3. Connolly and Begg: Database Systems: A practical approach to design, implementation and management, Pearson
4. Elmasri & Navathe: Fundamentals of Database Systems, Pearson
5. Ceri & Pellagetti: Distributed Database: Principles & Systems, TMH

Reference Books:

1. Ullman: Principles of Database Systems, Pearson
2. Ozsu, Valduriez: Principles of Distributed Database Systems, Pearson
3. Date: An Introduction to Database Systems, Pearson

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ADVANCED PROGRAMMING AND PROBLEM SOLVING					
Paper Code: CSEN5104					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Module I
Basic Data Structures
Arrays, Lists, Circular Lists, Doubly Linked Lists
Stacks, Queues, Heaps, Array and linked implementations of heaps
Data Structures for Searching
Binary Search Trees, Red-Black Trees, AVL Trees, Tries, Skip Lists
Hash Tables
Hash functions, hash tables. Collision resolution by chaining, Open addressing, Linear probing, Quadratic probing, double hashing.

Module II
Advanced Data Structures
B Trees, Binomial Heaps, Fibonacci Heaps, Quad Trees
Recursion and Recursion Removal
Recursive and non-recursive implementations of Towers of Hanoi, Inorder, Preorder and Postorder Traversals

Module III
Graph Search
DFS using stacks, BFS using queues
Shortest path algorithm using Heaps and Fibonacci Heaps

Module IV
Object Oriented Programming
Objects, Classes**,** Inheritance, Polymorphism.
Review of C++ and Java.

References:

1. **Kruse on Data Structures**
2. **Pratt on Programming Languages**

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ADVANCED COMPUTER ARCHITECTURE					
Paper Code: CSEN5105					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I:
Pipelined Architecture - Brief Introduction, Performance Measures - speed up, efficiency, performance - cost ratio etc.

Static pipelines - reservation tables, scheduling of static pipelines, definitions - minimum average latency, minimum achievable latency, greedy strategy etc., Theoretical results on latency bounds with proof, Hardware intra-pipeline controller and scheduler, Theoretical results on Reservation Table optimization to support given latency cycle.

Dynamic pipelines - reservation tables, optimal scheduling strategy, Theoretical results on scheduling and reservation table optimization, hardware scheduler/controller design.

Module II:
Vector Processing - use of pipelines, detailed case study. Instruction pipelines, performance measures.

SIMD Architectures - brief introduction, various concepts illustrated by studying detailed SIMD algorithms, viz., Matrix multiplication, Sorting on Linear array, Mesh and Hypercube.
Detailed study of Interconnection Network - Boolean cube, Mesh, Shuffle-exchange, Banyan, Omega, Butterfly, Generalized Hypercube, Delta etc. - illustration of use in actual SIMD algorithms.

Array Processors - simple case study.

Module III:
MIMD Architectures - brief introduction, Classification LCS, TCS, Memory access contention - reasons, Cache coherence problem - Solution and implementation, MIMD algorithms & implementation, viz., Matrix multiplication & Searching.

Systolic Architecture - introduction, Kung's method - illustration by an actual algorithm example, possible implementation using Transputers.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module IV:

Dataflow Architectures – study and Classification, implementation (Dennis & Arvind), case study with actual algorithms, extension of architecture to accommodate non-primitive data types.

Text Books:

1. P. Kogge: Architecture of pipelined computers.
2. K. Hwang: Computer Arithmetic - Principles, Architecture and Design, John Wiley.
3. Hwang & Briggs: Advanced Computer Architecture and Parallel processing, MH.
4. Quinn: Designing Efficient Algorithms for Parallel Computers, MH.

Reference Books:

1. S.G. Akl: The Design & Analysis of Parallel Algorithms, Prentice Hall.
2. K.Hwang & D. Degront: Parallel processing for Super Computers & Artificial Intelligence, MH.
3. G.J. Meyers: Advances in Computer Architecture.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: THEORY OF COMPUTATION					
Paper Code: CSEN5201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**1**	**0**	**5**	**4**

Module I

Finite State Machines: Definition, concept of sequential circuits, state table and state assignments.

Finite State Models: Basic definition, mathematical representation, Moore vs. Mealy machines, capabilities and limitations of FSM.

Finite Automaton: Central concepts of automata theory: alphabets, strings, languages, problems. Definition, Recognition of a language by an automaton.

Finite Automata: Deterministic Finite Automata. Extending Transition, Function to strings. The language of a DFA.

Non-deterministic Finite Automata: Equivalence of DFA and NFA. Subset construction. Finite automata with epsilon-transitions. Epsilon Closures. Extended Transitions and languages for epsilon-NFAs. Eliminating epsilon-transitions.

Module II

Regular Expressions and Languages. Operators of regular expressions. Building the regular expression for a DFA. Converting regular expressions to automata.

Algebraic laws for regular expressions. Properties of regular languages.

The pumping lemma and its applications. Closure properties of regular languages. Decision properties of regular languages. Applications of finite automata.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module III

Context-free Grammars. Parse Trees. Ambiguity in Grammars and Languages. Pushdown Automata. Languages of a PDA. PDA and CFG equivalence. Deterministic pushdown automata. Normal forms of Context-Free Grammars.

Pumping Lemma for CFLs. Closure properties of CFLs. Decision Properties of CFLs.

Regular Languages and their grammars. Church's Thesis.

Module IV

Turing machines: Extensions to the basic Turing Machine. Restricted Turing Machines. Undecidability. Languages that are not recursively enumerable. Undecidable Problems. Post's Correspondence Problem.

Introduction to Computational Complexity Theory: Intractable Problems. P and NP. NP complete problems. Polynomial-time reductions.

References:

1. Introduction to Automata Theory, Languages and Computation.
by Hopcroft, Motwani and Ullman.

2. Switching and Finite Automata Theory by Zvi Kohavi and Niraj Jha.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ADVANCED OPERATING SYSTEMS					
Paper Code: CSEN5202					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I

Theoretical Foundation: Architecture of distributed OS, Global Knowledge, Naming, Scalability, Compatibility, Process Synchronization, Resource Management, Security, Communication Networks, Communication Primitives, The Message Passing model, Remote Procedure Call.

Distributed Operating Systems: Inherent Limitations of a distributed system, Chandy-Lamport's Global State Recoding System, Distributed Mutual Exclusion, Lamport's, Ricart-Agrawala, and Mackawa algorithms, Suzuki-Kasami's Broadcast, and Singhal's Heuristics algorithms,

Module II

Distributed Deadlock Detection: The system model, Resource vs Communication Deadlocks, Wait-for Graphs, Deadlock Handling Strategies in Distributed systems, Issues in Deadlock detection & Resolution, Control organizations for distributed deadlocks, Ho-Ramamoorthy's Centralized deadlock detection algorithm, Distributed deadlock detection algorithms, Obermark's, Chandy-Sinha-Natarajan, Chandy-Misra-Haas algorithms.

Distributed Scheduling: Queuing Theory, Load Distributing, Load Balancing, Load Sharing, Preemptive vs Non-Preemptive transfers

Module III

Distributed File System: Architecture, Mounting, Caching, Naming and Name Resolution, Name Server, Cache Consistency, SUN Network File System, Stateful and Stateless Server, the SPRITE File System, the X-Kernel Logical File System

Distributed Shared Memory: Central server, Migration, Multiple Read-Single Write, Multiple Read-Multiple Write, Memory Coherence and Consistency, Coherence Protocols, Design Issues, Case Studies (IVY)

Multiprocessor Operating Systems: Difference between Multiprocessing and Distributed environments, Tightly coupled vs Loosely Coupled systems, UMA, NUMA, NORMA architectures, Interconnection networks for multiprocessor systems, BUS, Crossbar Switch, Multistage, Hypercube

architectures, the separate supervisor, master slave, symmetric configuration, Threads, User-level and Kernel Level threads, Case Studies (MACH OS, MACH Kernel).

Example Distributed Operating Systems: Major design decisions in typical systems such as Mach, Chorus, Amoeba and the OSF Distributed Computing Environment.

Module IV

Real Time Operating System: Definition, types of RTOS, A reference model of Real Time System, Commonly used approaches to Real Time Scheduling.

References:

- Tanenbaum, A. S. Distributed Operating Systems, (ISBN 0-131-439-340), Prentice Hall 1995.
- Tanenbaum, A. S. Modern Operating Systems, 2nd Edition (ISBN 0-13-031358-0), Prentice Hall 2001.
- Bacon, J., Concurrent Systems, 2nd Edition, (ISBN 0-201-177-676), Addison Wesley 1998.
- Silberschatz, A., Galvin, P. and Gagne, G., Applied Operating Systems Concepts, 1st Edition, (ISBN 0-471-36508-4), Wiley 2000.
- Coulouris, G. et al, Distributed Systems: Concepts and Design, 3rd Edition, (ISBN 0-201-61918-0), Addison Wesley 2001.
- Galli, D.L., Distributed Operating Systems: Concepts and Practice (ISBN 0-13-079843-6), Prentice-Hall 2000.
- Operating Systems Concepts & design - Milan Milenkovic, TMH
- Operating System - H.M. Deitel, Pearsons .
- Advanced Concepts in operating Systems - Mukesh Singhal and Niranjan G. Shivaratri, TMH
- Real-Time Systems-Jane W. S. Liu, Pearson Education

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COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ADVANCED COMPUTER NETWORKS					
Paper Code: CSEN5203					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Data Communication Fundamentals: (10L)

A) Transmission Media and its properties; (1L)
B) Modulation & demodulation – Modems; (1L)
C) Error detection & correction ; CRC codes; (1L)
D) Concept of Computer Networks: Two-level hierarchy – Hosts & subnet; Protocols & Standards: Reference Model; OSI seven layer reference model; TCP/IP reference model; (2L)
E) Physical Layer: Multiplexing; Switching; Data transmission over Telephone Line – PCM/T1 etc; **High Speed Modem concepts (DSL / Cable Modems); Spread Spectrum / CDMA based communication;** (2L)
F) Queuing Models**:** M/M/1 & M/G/1 Queuing system – average queue length, delay and waiting times. (3L)

Module II: Computer Networking (`12L)

A) **Data Link Layer**: Framing / Stuffing; Flow Control Protocols: Stop-and-Wait / Go-Back-N / Selective Repeat; (2L)
B) **Networking Layer**:
i) **Internetworking & devices**: Transparent Bridges / Source-Route Bridges / Ethernet Switches ; Backward Learning Algo; Construction of Spanning Trees; (2L)
ii) **Routing protocols**: Desired attributes; Centralized routing; Distributed routing : Distance vector / Link state algo; (2L)
C) **MAC sub-layer**:
i)**Ethernet** (IEEE 802.3) : Pure ALOHA / Slotted ALOHA / CSMA-CD / Ethernet protocol; Hub based architecture; Frame format; Collision Resolution; (2L)
ii)**Token Ring**(IEEE 802.5): Ring architecture; Role of Token; Frame format for various types of Frames; Delay calculations; (2L)
D) **Transport Layer**: (1L)
Process to process delivery / multiplexing;
Congestion control algo: Leaky bucket / Token bucket;
E) Application Layer: (1L)
Cryptography & Network security elements; Firewalls;

Module III: Internetworking: **(12L)**

A) Network Layer protocols: **(8L)**

IP: Packet format ; Classful addressing / subnetting / subnet mask; CIDR / supernetting / masks; Forwarding algorithms;
Address scarity problem & solution; (3L)

IPv6: addressing / packet format / differences with IP (v4); (1L)

ARP/RARP/DHCP : MAC and IP address conversion;
ProxyARP (2L)

Routing: RIP / OSPF / BGP (2L)

B) Transport Layer protocols: **(2L)**

TCP: Flow control mechanism; UDP; Difference between UDP and TCP;

C) Application Layer: **(2L)**

DNS / WWW /E-Mail / FTP; Telnet details; Security in the Internet; Secured Telnet using SSL / TLS;

Module IV: Recent Topics: **(11L)**

A) ISDN, Frame Relay & ATM (2L)

B) Wireless Technologies: Cellular Telephony / Wi-Fi (IEEE 802.11amily) / BlueTooth ; **WSN**; (4L)

C) **Mobile IP & TCP protocols; Ad Hoc Routing**; (2L)

D) **High Speed Packet Processing in the Internet**: High speed router architecture; High Speed IP packet processing; High Speed Routing algorithms and its architecture implications;
Real Time Protocol; (Basic ideas only) (2L)

E) Multimedia networking protocols; (1L)

Text Books:

1. Andrew S. Tanenbaum: Computer Networks, Pearson Education , fourth edition.
2. Peterson & Davie: Computer Networks (check)..
3. Bertsekas and Gallagher: Data Networks, Prentice hall, Second Edition.
4. William Stallings: Data and Computer Communication, Prentice hall, Seventh edition.
5. Fred Halsall: Data Communications, Computer Networks and Open Systems, Pearson Education , Fourth edition.
6. William Stallings: High speed Networks and Internets, Pearson education, second edition.

Reference Books:

1. Leon- Garcia and Widjaja: Computer Networks TMH, Second edition
2. William Stallings: Cryptography and Network security PHI, Third edition.
3. William Shay: Understanding data Communication and Networks, Thomson, Second edition.
4. William Stallings: ISDN and Broadband ISDN with Frame Relay and ATM

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

PROPOSED LIST OF ELECTIVES

1. **SEMESTER II ELECTIVE I (CSEN 5221 to CSEN 5228)**

CSEN 5221	**Graph algorithms**
CSEN 5222	**Web Intelligence and Algorithms**
CSEN 5223	**Advanced Soft Computing**
CSEN 5224	**Mobile Computing**
CSEN 5225	**Computational Biology**
CSEN 5226	**Operations Research and Optimization Techniques**
CSEN 5227	**Probability & Statistics**
CSEN 5228	**Algorithms for VLSI CAD**

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: GRAPH ALGORITHMS					
Paper Code: CSEN5221					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I

Introduction: Graphs, Sub graphs, Degree Sequences, Connectivity, Cut-Vertices and Bridges, Digraphs.
Trees, Minimum Spanning Trees.
Paths and Distances in Graphs. Distance in Weighted Graphs. Center and Median in a Graph.

Module II

Depth First Search. DFS for undirected graphs, non-separable components and directed graphs. Activity Digraphs and Critical Paths. Error Correcting Codes. Shortest Path Algorithms.

Eulerian Graphs. Characterization. De Bruijn Sequences. Eulerian Digraphs.

Hamiltonian Graphs and the Travelling Salesman Problem.

Module III

Networks. Max-Flow Min-Cut Algorithm. Connectivity and Edge Connectivity.
Matching and Factorizations. Maximum Matchings in Bipartite and General Graphs.
Graph Factorizations.

Module IV

Planar Graphs. Planarity Testing, Crossing Number, Genus.
Graph Colorings. Vertex Colorings. Chromatic Polynomials. Edge Colorings.
The Four Colour Theorem.

References:

1. Graph Algorithms By Shimon Even and Guy Even Cambridge University Press, 2nd Edition 2012.

2. Applied and Algorithmic Graph Theory Gary Chartrand and O.R. Oellermann. McGrawHill International Series in Pure and Applied Mathematics.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: WEB INTELLIGENCE AND ALGORITHMS					
Paper Code: CSEN5222					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1: Introduction to Web Searching

Introduction: Historical Perspective, Evolution of Web 2.0.

Intelligent Web Applications: Examples.

Web Searching. Indexing. Improving search results based on link analysis. Introduction to PageRank. Improving search results based on user clicks. Ranking documents. Precision

and Recall. Intelligent web crawling. Implementing a web crawler.

Module 2: Intelligent Information Retrieval

Learning from user interactions. Rating and voting, emailing and link forwarding, bookmarking, purchasing items, reviews.

Extracting intelligence from tags. Tag related metadata. Tag generation. Leveraging tags: dynamic navigation, using tag clouds, targeted search, recommendations based on tags.

Extracting intelligence from content: Blogs, Wikis, Message boards.

Module 3: Clustering, Classification and Recommendations

Clustering and web intelligence. Overview of clustering algorithms.

Classification and Web Intelligence. Need for classification. Overview. Automatic categorization of emails and spam filtering. Classification and fraud detection. Combining classifiers.

Creating Suggestions and Recommendations. Concepts of distance and similarity. Recommendations based on similar users. Recommendations based on similar items. Recommendations based on content.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module 4: Data Mining & Web 3.0 and Predictive Analysis Tools

Collaborative Filtering. Data mining and Association Rule

Mining techniques in recommender systems. Information retrieval and hybrid techniques. Recommender systems in e-Commerce.

Web 3.0 and the semantic web: Concepts, components, solutions.

Tools for Predictive Analysis: Big ML, Google Predict, Weka, Mahout, Vowpal Wabbit.

Text Books:

1. Algorithms of the Intelligent Web.

H. Marmanis and D. Babenko. Manning Publishers, 2009.

2. Collective Intelligence in Action.

S. Alag. Manning Publishers, 2009.

Reference Books:

3. Mining the Web: Discovering Knowledge from Hypertext Data.

S. Chakrabarti, Morgan-Kaufmann Publishers, 2002.

4.Recommender Systems Handbook: Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Springer, 2011.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ADVANCED SOFT COMPUTING					
Paper Code: CSEN5223					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I:

***Fuzzy Logic*:**

Conventional and fuzzy sets, fuzzy relations, fuzzy operators, realisation of fuzzy systems using fuzzy relations, application of fuzzy logic in vision, pattern recognition, robotics and linguistics.

Module II:

Neuro-computing:

Models of Neuro-computing: (a) PerceptronTraining, (b) Back propagation learning, (c) Hopfield nets, (d) Adaptive resonance theory I & II, (e)Self-organising feature map, (f) ADALINE. Applications in pattern classification and image understanding.

Module III:

Genetic Algorithms:

The basic operators, Schema theorem, convergence analysis, stochastic models, applications in search and optimization.

Module IV:

Learning with GA & NN:

Composite use of fuzzy logic, neural network and genetic algorithms.

Chaos Theory, Fusion of neuro, Fuzzy, GA & Chaos theory & applications.

References:

1. David E. Goldberg: Genetic Algorithms in Search, Optimization and Machine Learning, Addision Wesley, MA, 1989.
2. S.Haykin: Neural Networks - A Comprehensive Foundation, Macmillan College Publishing Company, New York, 1994.
3. H.J.Zimmermann: Fuzzy set theory and its application, 2nd Revised edition, Allied Publishers Ltd.
4. G.J.Klir, B. Yuan: Fuzzy sets and Fuzzy logic: Theory and Applications, PHI, 1995.
5. R.L.Devaney: An Introduction to Chaotic Dynamical Systems, 2nd Ed., Addision Wesley, 1989.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: MOBILE COMPUTING					
Paper Code: CSEN5224					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1[14L]:

Introduction to Cellular Networks, Personal Communications Services (PCS). Generations of Mobile Networks- 1G, 2G, 3G, 4G (Introduction only). Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signaling. General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA) and CDMA 2000

Module 2[12L]:

WLANs (Wireless LANs) IEEE 802.11 standard, PCF, DCF, WiMAX, Bluetooth, Zigbee. AD-HOC NETWORKS: INTRODUCTION, ROUTING CHALLENGES FOR AD-HOC NETWORKS, ROUTING PROTOCOLS (AODV, DSDV, DSR,).

Module 3[10L]:

WIRELESS INTERNET: MIPV4, MIPV6, TCP for Mobile Networks.

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML).

Module 4[10L]:

Security: Introduction To Cryptography, Symmetric Key And Public Key Algorithms, Diffie Hellman Key Exchange Algorithm, Digital Signatures, IPsec, Firewall, VPN, VLAN, Wireless Security, Authentication Protocols. Recent Applications: Cognitive Radio

Network, Wireless Sensor Network

Text Books:

1.COMPUTER NETWORKS : A.S.TANNENBAUM (4th/5th Ed)

2.Wireless Communications & Networks: Stallings

3.Mobile AdHoc Networking: Dharma P Agrawal et al

4.Cognitive Radio Networking and Communications: An Overview: Ying-Chang Liang et.el.

5. Mobile Communications: Schiller

Reference Books:

1.Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers: Charles E. Perkins

2. DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks :David B. Johnson

3.Ad_hoc On_Demand Distance Vector Routing : Charles E_ Perkins2.

Subject Name: COMPUTATIONAL BIOLOGY

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Paper Code: CSEN5225					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I:
Genes, Molecule codes, DNA Structure. DNA and Proteins. Analyzing DNA: copying, cutting and pasting, measuring, probing.
Exhaustive Search: Restriction Mapping Algorithms, Motif Finding, Finding Median String.

Module II:
Greedy Algorithms: Genome Rearrangements, Sorting by Reversals. Greedy approach to Motif Finding.
Dynamic Programming Algorithms: DNA Sequence Comparison, Edit Distance and Assignments, Longest Common Subsequence, Global Sequence Alignment, Scoring alignments, Local Sequence Alignment, Alignment with Gap Penalties, Multiple Penalties, Gene Prediction, Spliced Alignment.

Divide and Conquer Algorithms. Sorting, Sequence Alignment, Four-Russians Speedup, Constructing alignments in sub-quadratic time.

Module III:
Graph Algorithms: DNA Sequencing, Shortest Superstring Problem, DNA arrays as an alternative sequencing technique. Sequencing by Hybridization: Hamiltonian and Eulerian Path Problems. Protein sequencing and identification. Peptide sequencing problem. Spectrum Graphs: Spectral Convolution, Spectral Alignment.

Module IV:
Combinatorial Pattern Matching. Repeat Finding, Exact pattern matching, Keyword trees. Suffix trees. Heuritic similarity search, Approximate pattern matching. Sequenced databases and querying: FASTA, BLAST. Clustering and trees. Gene Expression Analysis, Hierarchical Clustering, Evolutionary trees. Distance based tree reconstruction. Reconstructing trees from additive matrices.
Evolutionary treesand hierarchical clustering. Charcter based tree reconstruction. Small and Large Parsimony problem.

References:
1. Neil C. Jones and Pavel A. Pevznel: An Introduction to
Bioinformatics Algorithms, The MIT Press, 2004.

2. Dan Gusfield: Algorithms on Strings, Trees and Sequences.
Cambridge University Press, 1999

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: OPERATIONS RESEARCH AND OPTIMIZATION TECHNIQUES					
Paper Code: CSEN5226					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I

***Advanced Linear Programming*:**

The Revised Simplex Algorithm, Complexity of the Simplex Algorithm, Bounded Variable Technique, Decomposition Principle, Karmarkar Interior Point Algorithm

***Sensitivity Analysis*:**

Introduction, Change in the Cost Vector, Changes in the Right – Hand Side Vector, Change in the Constraint Matrix, Special Cases, Parametric Programming

Module II

***Project Management*:**

Introduction, Critical Path Method, Critical Path Determination, Optimal Scheduling by CPM, Project Evaluation & Review Technique

***Dynamical Programming*:**

Introduction, Formulation, Recursive Relations, Continuous Cases, Discrete Cases, Forward Recursions, Linear Programming vs Dynamic Programming.

Module III

***Sequencing Problems*:**

Introduction, Problem of n – Jobs & 2 Machines, Problem of n – Jobs & m – Machines, 2 – Jobs on Ordered m – Machines

***Integer Programming*:**

Introduction, Branch & Bound Algorithm, Traveling Salesman Problem, Cargo Loading Problem.

***Goal Programming*:**

Introduction, Standard Form of LGPP, Partitioning Algorithm, Grouping Algorithm

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module IV

***Non – Linear Programming*:**

Introduction, Lagrange Multipliers Method, Convex Non- Linear Programming Problem, Kuhn – Tucker Theory, Quadratic Programming, Separable Programming, Duality in Non – Linear Programming

***Search Techniques*:**

Unimodal Function, Dichotomous Search Method, Fibonacci Search Method, Golden Section Method, Steepest Descent Method, Conjugate Gradient Method

***Geometric Programming*:**

Introduction, Unconstrained Posynomial Optimization, Constrained Posynomial Optimization,

***Random Number & Simulation*:**

(a) Random Number

Introduction, Random Number Generations – Methods, Generation of Pseudo Random Numbers

[a) Mid - Square Method, b) Congruential Method], Problems

(b) Simulation

Introduction, Advantages and Limitations of Simulations Techniques, Monte Carlo Simulation, Application

References:

1. H. A. Taha: Operation Research-An Introduction, Maxwell Macmillan.
2. Wayne L. Winston: Operation Research-Applications and Algorithms, Thomson.
3. Hiller Liberman: An Introduction to Operation Research, TMH
4. H. S. Kasana and K. D. Kumar: Introductory Operations Research [Theory and Application] Springer International Edition.
5. S. Bhaskar: Operations Research, Anuradha Agencies
6. K. Kannan: Operarions Research, Anuradha Agencies
7. V. K. Kapoor: Operarions Research, Anuradha Agencies
8. Kanti Swaroop: Operarions Research, Anuradha Agencies

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: PROBABILITY & STATISTICS					
Paper Code: CSEN5227					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I

Probability1: Classical definition; problem solving by elementary combinatorial methods; set theoretic definition of probability for discrete sample spaces; basic probability theorems (union of events/Boole's inequality, etc.); independence of events, conditional probability, Bayes' theorem;

Module II

Probability 2: *D*iscrete probability distributions (binomial/ Poisson/ hypergeometric/ negative binomial); continuous probability distributions (exponential/ uniform/ normal); moments and moment generating function; basic limit theorems (Chebyshev's inequality/ weak law of large numbers/ normal approximation to binomial/ central limit theorem in 2D case); joint distribution of two random variables (with more emphasis on the discrete case); conditional expectation and variance; Markov chains: examples, properties and basic results.

Module III

Statistics 1: Correlation and regression; simple random sampling with and without replacement, expectation and standard error of the sample mean and the sample proportion; maximum likelihood estimation;

Module IV

Statistics 2: Introduction to confidence intervals; concept of testing of hypothesis, notion of Type I and Type II errors, tests for mean and variance in one and two-sample cases, tests related to regression problems, test for population proportion.

References:

1. Casella, G. and Berger, R. L, *Statistical Inference*, Thomson Brooks / Cole, 2002.
2. Freund, J.E., *Mathematical Statistics with Applications* (7th Edition, I. & M. Miller), Pearson, 2010.
3. Hoel, P. G., Port, S. C. and Stone, C. J., *Introduction to Probability Theory*, Thomson Brooks, 1972.
4. Hoel, P. G., S. C. Port, S. C. and Stone, C. J., *Introduction to Stochastic Processes*, Waveland, 1986.
5. Pal, N. and Sarkar, S., *Statistics : Concepts and Applications*, Prentice-Hall, 2005.
6. Ross, S., *Introduction to Applied Probability Models* (10th Edition), Academic Press, 2010.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ALGORITHMS FOR VLSI CAD					
Paper Code: CSEN5228					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I

Introduction: Introduction to CAD flow.

Algorithms for Architectural Level Synthesis and Optimization, Area and Performance Estimation, Architectural Optimization Strategies.

Scheduling Algorithms: Scheduling without resource constraints, ALAP and ASAP scheduling, scheduling with timing constraints. Scheduling with resource constraints. Multiprocessor scheduling, Hu's Algorithm, List Scheduling, Force-directed scheduling. Scheduling with resource sharing.

Logic Synthesis: 2-Level Forms, logic minimization. Exact and heuristic approaches. Branch and Bound solution. Logic Synthesis: Multi-Level Forms. Transformations for logic networks, elimination, extraction, decomposition, simplication, substitution. Algorithmic approach to multi-level logic optimization. SIS operations, algebraic model,

Sequential Logic Optimization, State Minimization, State Encoding, Retiming. Technology Mapping, Algorithms for library binding. Covering algorithms and structural matching

Module II

Partitioning: Group migration algorithms. Kernighan-Lin algorithm, Fidducia-Mattheyes algorithm, Simulated annealing, other techniques.

Floorplanning: Constraint-based, Integer Programming based, Rectangular dualization, Hierarchical methods, Timing driven floorplanning.

Placement: Placement using simulated annealing. Force-directed placement, Sequence-Pair approach. Breuer's approach.

Module III

Routing: Global Routing. Maze Routing algorithms, Line-Probe algorithms, Shortest path based algorithms, Steiner tree based algorithms, Integer programming formulations.

Detailed Routing. Routing models. Channel and switchbox routing. Single layer routing. Single row routing, dogleg minimization. Two layer routing.

Left-edge based algorithms, Constraint graph based algorithms, Greedy channel router. Hierarchical channel router. Multi layer algorithms. Switchbox routing algorithms.

Module IV

Compaction: One-dimensional compaction. Constraint graph based compaction. Virtual grid based compaction. Two dimensional compaction. Simulated annealing, hierarchical and performance-driven approaches.

Layout Analysis and Verification. Design Rule Checking, Connectivity extraction, Device and parameter extraction, Layout versus Schematic.

Advanced Topics: Parallel CAD, Hardware Acceleration, Power Optimization.

References:

(1) Giovanni De Micheli, "Synthesis and Optimization of

Digital Circuits", Mc-Graw Hill.

(2) Naveed Sherwani, "Algorithms for VLSI Physical Design Automation",

(3) M.Sarrafzadeh & C.K.Wong:An Introduction to VLSI Physical Design,MH.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

2.**SEMESTER II ELECTIVE II (CSEN 5231 to CSEN 5237)**

CSEN 5231	**Embedded Systems**
CSEN 5232	**Parallel and Distributed Computing**
CSEN 5233	**Computational Geometry**
CSEN 5234	**Cryptography & Network Security**
CSEN 5235	**Artificial Intelligence**
CSEN 5236	**Pattern Recognition & Machine Learning**
CSEN 5237	**Data Mining & Knowledge Discovery**

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: EMBEDDED SYSTEMS					
Paper Code: CSEN5231					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module – I **2**

Introduction to Embedded System, definition of embedded systems, examples of embedded systems, Microprocessors & assembly language programming.

Module – II **8**

Embedded software programming issues, Memory management, Overview of programming practices in DSP environment.

Interrupts, Interrupts basics, Shared data problem, Latency.

Module – III **16**

Software architectures for embedded environment, Round-robin , Function-queue scheduling, RTOS. Introduction to RTOS, Tasks & States, Shared data & semaphores. Other OS services, Message queue, mailboxes, pipes, Timer and events, Interrupts in RTOS Environment. Overview of Design using a RTOS, Encapsulation of semaphores and queues, Hard Real time scheduling issues, saving memory and power. Overview of a commercial RTOS for handheld devices, Windows CE.

Module – IV **14**

Input/output devices, Connectivity and data Transfer modes. Memory-mapped and I/O Mapped input output, Interrupt and DMA fundamentals.

Interrupt processing necessities with a typical device (controller). Device controller registers, Interrupt enabling and disabling, Interrupt identification, Device Driver Initialization, Main ISR, Deferred Interrupt processing.

Display device-working concepts, Principle of CRT VDU, Bit-mapped graphics, Information exchange between graphics kernel and display controller.

Text Books:

1. Nimal Nissanke: Real time System, PHI.
2. Iyer & Gupta: Embedded realtime systems programming, TMH
3. Wilson: Embedded Systems and Computer Architecture, Newnes.
4. Vahid & Givargis: Embedded System Design: a unified hardware/software introduction, John Wiley.

Reference Books:

1. John Catsoulis: Designing Embedded Hardware, SPD/O'Reilly.
2. M. Barr: Programming Embedded Systems in C and C++, SPD/O'Reilly.
3. Simon: An Embedded Software Primer, Pearson.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: PARALLEL AND DISTRIBUTED COMPUTING					
Paper Code: CSEN5232					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module – I **8**

Parallel Computing

*Introduction***:** Parallelism in uniprocessor system, memory-interleaving, pipelining and vector processing, parallel computer structures, architectural classifications,

Parallel computer models: PRAM models, program properties: conditions of parallelism, program partitioning and scheduling, granularity and scalability.

System interconnect architectures: Static interconnection networks array, tree, mesh, hypercube, cube-connected-cycles, butterfly, Cayley graphs; Dynamic interconnection networks crossbar, Clos network, multistage interconnection networks, blocking, non-blocking and rearrangeable operations, properties and routing.

Module – II **12**

Parallel algorithms and their mapping on different architectures: Algorithmic computations (addition, multiplication, FFT, DFT, polynomial multiplication, convolution, evaluation and interpolation) -- Matrix operations (Transpose, multiplication, and inversion) -- Numerical Applications (solving systems of linear equations and finding roots of non-linear equations) -- Graph algorithms (All pairs shortest paths problem, finding connected components of a graph) – Sorting (Batcher, odd-even and Bitonic sort, sorting on mesh and mesh like architectures).

Networked computers as a multi-computer platform: Basics of message passing, computing using workstation clusters, software tools, Message Passing Interface MPI, CUDA and General Purpose GPU (GPGPU) programming.

Module – III **10**

Distributed Computing

Introduction: Why distributed computing, Parallel vs. distributed computing

Models of distributed systems: Synchronous vs asynchronous systems, interprocess communication models (shared memory and message-passing models, agent-based models), complexity measures

Program correctness: Safety and liveness properties, atomicity, non-determinism, fairness

Time and Clocks: Causality and concurrency, physical, logical and vector clocks, clock synchronization
Distributed Mutual Exclusion: Lamport's algorithm, Ricart-Agrawala's algorithm, Suzuki-Kasami's token-passing algorithm
Distributed Snapshot and Global States: Consistent snapshots, Chandy-Lamport's distributed snapshot algorithm, Termination detection: Dijkstra-Scholten's algorithm, Distributed deadlock detection

Module – IV **10**
Distributed Algorithms for Graphs: Routing algorithms (Shortest path, distance-vector, and link-state algorithms), spanning tree and minimum spanning tree, graph coloring algorithms
Faults and Fault-tolerance: Classifications of faults and fault-tolerance, triple modular redundancy, sliding window protocols, how TCP works
Distributed Consensus: The Byzantine Generals problem, fault-tolerant state machines
Replicated data management: Data consistency models: linearizability, sequential consistency, causal consistency, eventual consistency
Selected topics from Applications: Peer-to-Peer (P2P) networks, Sensor Networks, Cloud computing.

References :
[1] S.G.Akl**:** Design and Analysis of Parallel Algorithms, Prentice Hall.
[2] J. Ja Ja: Introduction to Parallel Algorithms, Addison Wesley, 1990.
[3] M.G. Quinn: Design of Efficient Algorithms for Parallel Computers, McGraw Hill, 1988.
[4] S. Lakshmivarahan and S.K.Dhall: Analysis and Design of Parallel Algorithms, McGraw Hill, 1990
[5] K. Hwang: Computer Arithmetic: Principles, Architecture and Design, John Wiley.
[6] Hwang & Briggs: Advanced Computer Architecture and Parallel processing, McGraw Hill.
[7] Peter Pacheco: Parallel Programming with MPI
[8] Jason Sanders, Edward Kandrot: CUDA by Example: An Introduction to General-Purpose GPU Programming.
[9] Sukumar Ghosh: *Distributed Systems: An Algorithmic Approach*, CRC Press, 2006
[10] Andrew Tannenbaum, Maarten van Steen: *Distributed Systems: Principles and Paradigms (Second edition)*, Prentice Hall 2006
[11] Gregory R. Andrews: Foundations of Multithreaded, Parallel, and Distributed Programming, Addison-Wesley, 2000
[12] Vijay Garg: *Elements of Distributed Computing*, John Wiley, 2002

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: COMPUTATIONAL GEOMETRY					
Paper Code: CSEN5233					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1: Preliminaries [7L]
Introduction. Historical Perspective. Applications. Convex Hulls. Graham's Scan, Jarvis' March, Quickhull, Divide and conquer algorithm for convex hulls, Chan's Algorithm.

Module 2 : Linear Programming [8L]
Line Segment Intersection, Plane Sweep, Intersections amongst orthogonal segments, Bentle-Ottman algorithm, red-blue segment intersections.

Module 3: Intersections and Triangulation[12L]

Proximity problems and Voronoi Diagrams. Closest Pairs. Bichromatic Closest Pairs. Polygon Partitioning and Triangulation. Minimal weight triangulation. Delaunay Triangulation. Orthogonal Range Searching. Range Trees. Interval Trees. Segment Trees. Priority Search Trees. van Emde Boas Trees.
Randomized Algorithms. Skip Lists. Randomized Incremental Construction.Planar Point Location. Persistent data structures.

Module 4 : Point Location & Range Searching[14L]
Arrangements. Construction. Complexity. Zone Theorem. Levels in an Arrangement. Davenport Schinzel sequences, Complexity of lower and upper envelopes.
Duality transformation and applications.
Simplex Range Searching, Partition Trees, Cuttings, Adding range restrictions.
Parametric search and application to geometric optimization. Art Gallery Theorems.

References:
1.Computational Geometry: Algorithms and Applications, Second Edition by Mark de Berg, Otfried Schwarzkopf, Marc van Kreveld, Mark Overmars. Springer-Verlag.

2. Computational Geometry: An Introduction by F.P. Preparata and Shamos. 2nd Edition. Springer-Verlag.

3. Computational Geometry: An Introduction through Randomized Algorithms by Ketan Mulmuley, Prentice Hall.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: CRYPTOGRAPHY & NETWORK SECURITY					
Paper Code: CSEN5234					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1: Concepts and Techniques (8L)

Plain text and Cipher text, Different type of ciphers – Shift/Substitution, Transposition techniques and performing cryptanalysis on such ciphers.

Module 2: Symmetric Key Cryptography (8L)

Block and stream ciphers and their modes of operation. DES (How confusion and diffusion is used, E-Box, P-Box, S-Box, Round key generation and MITM attack) and IDEA, AES.

Module 3: Key Generation Theorems & Procedures (12L)

Extended Euclidean Algorithm, Congruence, Fermat's Little Theorem, Chinese Remainder Theorem, Euler's Theorem. RSA algorithm, Diffie-Hellman key-exchange, El-Gamal Cryptosystem, Advanced topics in cryptography - Elliptic curve cryptography, Quantum cryptography, Identity based encryption.

Module 4: Internet Security and Authentication Protocols (17L)

Authentication techniques based on Shared Secret Key, Key Distribution Centre, Kerberos, Public Key Encryption and Public Key certificates. Digital Signatures- Secret Key Signatures. Public Key Signatures and DSS. Digital cash, Electronic voting, SET .Message Digests - Basic concepts, MD5 and SHA Functions. SSL, E-mail security – PEM, PGP, IPSec, Firewalls.

References:

1. Applied Cryptography – Bruce Schneier. 2nd ed.,Wiley ,1996.
2. Cryptograpgy: Theory and Practice – Douglas Stinson. CRC Press,1995.
3. Cryptography and Network Security Principles and Practices, 4th Ed - William Stallings

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: ARTIFICIAL INTELLIGENCE					
Paper Code: CSEN5235					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1

Introduction [2L]
Definition of AI, Intelligent Behavior, Turing Test, Typical AI Problems, Various AI Approaches, Limits of AI

Introduction to Intelligent Agents [2L]
Agents & environment, Agent Architecture, Agent Performance, Rational Agent, Nature of Environment, Simple Reflex Agent, Goal Based Agent, Utility Based Agent

Problem Solving using Single Agent Search [2L]
Introduction to State-space search, state-space search notation, search problem, Formulation of some classical AI problems as a state space search problem, Explicit Vs. Implicit State space

Uninformed Search Techniques [5L]
Basic Principles, Evaluating parameters, BFS, DFS, Depth Limited Search, Iterative Deepening DFS, Uniform Cost Search & Bidirectional Search, Properties of various search methods & their comparative studies.

Informed Search Methods [6L]
Basic Principles, Heuristics, Best First Search – Greedy Best First, A* Search, their Properties, Admissible & Consistent heuristic, Local Search Techniques – Hill climbing & Simulated Annealing, Comparison with other methods

Module 2

Problem Solving using Two Agent Search [2L]
Adversarial Search – Game Tree, MINIMAX Algorithm, Alpha-Beta Pruning, Performance Analysis

Constraint Satisfaction Problem [2L]
Definition of CSP, Representation of CSP, Formulation of Various popular problems as CSP, Solution methods of CSP – Backtracking & Forward Checking.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module 3

Knowledge Representation & Propositional Logic [2L]
Knowledge representation issues, Approaches to knowledge representation, Propositional Logic – its syntax & semantics, Inference rules, Application of those rules, Limitation of Propositional Logic.

Knowledge Representation & Predicate Logic [5L]
Syntax & Semantics of FOPL, Representation of facts using FOPL, Clauses, Resolution, Unification methods of inference, Default & Non-Monotonic reasoning

Knowledge Representation using Rules [3L]
Rule based system, Horn clauses, Procedural vs. declarative knowledge, forward & backward reasoning, Introduction of logic programming using PROLOG/ LISP

Other Representational Formalism [2L]
Inheritable knowledge, Semantic network, Inference in Semantic network, Extending Semantic Network, Frames, Slots as objects

Probabilistic reasoning [5L]
Representing knowledge in an uncertain domain, probabilistic inference rules, Bayesian networks – representation & syntax, semantics of Bayesian net, Dempster-Shafer theory, Fuzzy sets & fuzzy logic

Module 4

Planning [2L]
Introduction, Simple planning agent, Problem solving vs. planning, Logic based planning, Goal Stack planning, Planning as a search, Total-order vs. partial order planning

Learning [4L]
Overview, Taxonomy of learning system, various learning models, learning rules, inductive learning framework, Decision tree based learning, Learning using Neural Network & Genetic Algorithm

Natural Language Processing [2L]
Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing

Expert Systems [2L]
Representing and using domain knowledge, expert system shells, knowledge acquisition

References:

1. Artificial Intelligence A Modern Approach, Stuart Russell & Peter Norvig, Pearson Education
2. Artificial Intelligence, Ritch & Knight, TMH
3. Artificial Intelligence & Intelligent Systems, N.P.Padhy, Oxford University Press
4. Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, PHI
5. PROLOG Programming for Artificial Intelligence, Ivan Bratko, Pearson India

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: PATTERN RECOGNITION & MACHINE LEARNING					
Paper Code: CSEN5236					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I

Basics of Pattern Recognition: Introduction, Representations of Patterns and Classes, Metric and non-metric proximity measures, Classification, Clustering and Different Paradigms of Pattern Recognition.

Module II

Classification & clustering algorithms:

Linear and non-linear discrimination function, Bayesian Decision Theory – two category classification, Minimum error rate classification, Minimum distance classifier, K-NN classifier,
Basic hierarchical, k-means, and divide & conquer algorithm.

Feature Selection: Basics of feature selection, Principal Component Analysis, Branch and Bound. Decision Trees.

Module III

Introduction to Machine Learning: What is Machine Learning? Examples of Machine Learning Applications.

Supervised Learning:

VC-dimensions, PAC learning, Regression, Model Selection and Generalization.

Concept Learning and General-To_Specific Ordering:

Concept learning as search, General-to-specific ordering of hypotheses, Finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm,

Module IV

Parametric Methods:

Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance, Bayes' Estimator, Parametric Classification, Regression, Model selection procedures.

Multivariate Methods:

Multivariate Data, Parameter Estimation, Estimation of Missing Values, Multivariate Normal Distribution, Multivariate Classification, Multivariate Regression.

Dimensionality Reduction:

Subset Selection, Principal Component Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis.

Non-parametric Methods:
Nonparametric density estimation, Generalization to multivariate data, Nonparametric Classification. Condensed Nearest Neighbour. Nonparametric Regression: Smoothing Models.

Advanced Topics:
Hidden Markov Models. Reinforcement Learning.

References:

1. Introduction to Machine Learning by Ethem Alpaydin. Prentice Hall.
2. Machine Learning by Tom Mitchell. McGraw Hill.
3. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
4. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: DATA MINING & KNOWLEDGE DISCOVERY					
Paper Code: CSEN5237					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I. Introduction (2L):
What is Data Mining? Why do we need data mining? Differences between Data Mining and Machine Learning. Motivating challenges in Data Mining.

Module II. Classification (22L):

Decision Tree (8L):
General approach to solving a classification problem.
Decision Tree Induction – How a decision tree works, how to build a decision tree, expressing attribute test conditions, measures for selecting best split, algorithm for decision tree induction.
Model overfitting – Pre-pruning, post-pruning.

Rule-based Classifier (4L):
How a rule-based classifier works, rule-ordering schemes, how to build a rule-based classifier, direct and indirect methods for rule extraction.

Bayesian Classifier (4L):
Bayes theorem – using it for classification, Naïve Bayes classifier, Bayes error rate.

Support Vector Machines (SVM) (6L):
Maximum margin hyperplanes, Linear SVM: separable case, non-separable case, Non-linear SVM.

Module III. Association Analysis (10L):

Problem definition, Frequent itemset generation (Apriori principle, candidate generation and pruning), Rule generation, Compact representation of frequent itemsets, FP-growth algorithm, Sub-graph mining.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module IV. Cluster Analysis (12L):

What is clustering analysis? Motivations, objectives and applications of clustering. Different types of clustering. **(1L)**

Partitional Clustering (3L): K-means, Bisecting K-means, PAM.

Hierarchical Clustering (4L): Agglomerative, Divisive, MIN, MAX, dendrogram representation.

Density-based Clustering (2L): DBSCAN.
Cluster evaluation, further reading – DENCLUE, CHAMELEON, BIRCH, CURE, ROCK **(2L)**

Text Books :

1. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach and Vipin Kuma. Pearson Publishers.
2. Machine Learning by Tom Mitchell.

Reference Books :

1. Data Mining: Concepts and Techniques by Jiawei Han and Micheline Kamber. Publisher: Elsevier.
2. Networks: An Introduction by Mark Newman. Oxford University Press.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Detailed Syllabus

Subject Name: Software Engineering					
Paper Code: CSEN6101					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Software Engineering:

<u>Module-1</u>: [12L]	1. Introduction to Software Engineering (4L)	• Define System, Software and Engineering: Representation of a System, Characteristics of Software and Attributes of good software, Types of Information Systems, Define Software Engineering and its objective, System Engineering vs. Software Engineering • Software Life Cycle and brief introduction to different phases of life cycle • Introduction to Software Analysis and Design • Software Life Cycle models (Methodology or Paradigm): Waterfall Model, Prototyping Model, Spiral Model, Briefly describe iterative and integrative approach and other methodologies used in industry
	2. Requirements Phase (5L)	• Describe different steps: Requirement Elicitation, Requirements Analysis, Requirement Specification, General Structure of SRS • Requirement Validation and Requirement Management • Various Methods of Information Capture • Case Study • Capturing the Requirement as Use Cases: Use Case Model, Different artifacts of Use Case Diagram, Use Case Specification, Some Example / Case Study
	3. Structured Analysis Modeling Techniques (3L)	• Developing Data Flow Diagram for describing Process Model: The components of a DFD, Different Notations, Guidelines for constructing DFDs, Steps to construct DFD • Case Study • Creation of Data Model using Entity-Relationship (ER) Diagram
<u>Module-2</u>: [10L]	4. Software Design (5L)	• Overview: Introduction to design and translating the analysis model into software design, Similarities and Differences between Requirement Analysis and Design, Attributes of Good Design • Classical Design Methods • Structured Design Methodology (SDM): Module design or high level design, Detail design or logical design • Functional Decomposition / Modularity: Abstraction, Various types of Cohesion, determining module cohesion,

		Various types of Coupling • Define various design approaches: Functional, Object Oriented • Functional: Functional Oriented design using DFD, Design Heuristics, Transaction Analysis, Structure Chart • Detailed Design: PDL /Structured English • Design Verification and various Metrics
	5. Object Oriented Analysis and Design (5L)	• Some basic concepts : Class & Object, Generalization, Polymorphism • Basic concepts of OOAD • UML and different types of diagrams • Class diagram, different types of relationships between classes with examples • Sequence diagram : Different artifacts of sequence diagram, drawing sequence diagram with examples
Module-3: [12L]	6. Coding or Programming Activity (2L)	• Programming Principles and Guidelines: Structured Programming, Some Programming Practices, Coding Standards • Coding Process: An Incremental Coding Process, Test Driven Development, Pair Programming • Source Code Control and Build • Refactoring – Basic Concept, Refactoring using an example, Bad Smells
	7. Software Review and Testing (8L)	• Self Review / Peer Review • Testing Overview: Objective, Definition, Static and Dynamic Testing, Functional vs. Non-functional Testing • Define Testing artifacts : Test Cases and Test Suites, Test Plan, Traceability Matrix , Test Data , Test Harness • Testing Process: Test Plan, Test Case Design, Test Case Execution • Testing Methods : White Box Testing (Different approaches of white box testing: Control Flow based criteria, Statement Coverage Criterion, Branch Coverage, Basis Path Testing, Data Flow based testing, Mutation Testing), Black Box Testing (Equivalence Class Partitioning, Boundary Value Analysis, Cause Effect Graphing) , Grey Box Testing • Testing Level: Unit Testing, Integration Testing, Regression Testing, System Testing, Acceptance Testing, Non-functional Testing • Defect Logging and Tracking • Test Automation: available tools, techniques, and metrics
	8. Software Maintenance (2L)	• Different types of maintenance • Change Management and Maintenance Process
Module-4: [10L]	9. Software Estimation (4L)	• Different technique of estimating effort and cost • Constructive Cost Model (COCOMO): Basic COCOMO, Intermediate COCOMO (COCOMO 81), Detailed COCOMO (COCOMO II) • Calculating effort required at different stages using this model with examples

		• Objectives of Function Point Analysis • What is a ``Function Point" and its benefits • A simple five step counting process • Case Study to count function points
	10. Project Management (4L)	• Goal • Project Management Process: Planning, Staffing, Execution, Monitoring and Control • Responsibilities of Project Manager • Scheduling: WBS and Activity Network, Gantt Charts, PERT/CPM, Drawing the CPM Network, Scheduling of Activities Using a Gantt Chart, Calculating the slack and finding the critical path • What is PERT (probabilistic approach) and how does it work? • Trend analysis by Earned Value Analysis: assessing the value of work scheduled, the value of work performed and value that has been earned
	11. Software Configuration Management (1L)	• Configuration Identification, Configuration Control, Configuration Status Accounting, Configuration Audits • Concept of Baseline, Versioning of CIs, Some Configuration Management Tools
	12. Risk Management (1L)	• Software Risks • Risk Management Activities: Risk Assessment, Risk Control

Text Books:

1. Roger Pressman, "Software Engineering", TMH
2. Rajib Mall," Fundamentals of Software Engineering ", PHI Learning Private Limited
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Narosa

Reference Books:

1. IEEE Standards on Software Engineering

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

List of Electives

Elective III:

1. **Cloud Computing**
2. **OOPS**
3. **Web technologies**
4. **Advanced algorithms & Data Structures**
5. **Randomized algorithms**
6. **Image Processing**
7. **Management Information System**
8. **Information Retrieval**
9. **Big Data Analysis**

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Cloud Computing					
Paper Code: CSEN6141					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

1. **Module-1: [10L]**
   - **a. Basics of Cloud Computing [5L]:**
     - i. Defining a Cloud, Cloud Types – NIST Cloud Reference Model, Cloud Cube Model, Deployment Models (Public, Private, Hybrid and Community Clouds), Service Models – Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS)
     - ii. Characteristics of Cloud Computing – a shift in paradigm
     - iii. Benefits and Advantages of Cloud Computing
   - **b. Concepts of Abstraction and Virtualization [5L]:**
     - i. Virtualization: Taxonomy of Virtualization Techniques
     - ii. Hypervisors: Machine Reference Model for Virtualization
2. **Module-2: [12L]**
   - **a. Services and Applications by Type [8L]:**
     - i. IaaS – Basic Concept, Workload, Partitioning of Virtual Private Server Instances, Pods, Aggregations, Silos
     - ii. PaaS – Basic Concept, Tools and Development Environment with examples
     - iii. SaaS - Basic Concept and Characteristics, Open SaaS, examples of SaaS Platform
     - iv. Identity as a Service (IDaaS)
     - v. Compliance as a Service (CaaS)
   - **b. Concepts of Service Oriented Architecture (SOA) and Web Service (WS) [4L]:**
     - i. Service Oriented Architecture – Basics, Terminologies, Components, Standards and Technologies, Benefits and Challenges
     - ii. Web Services – Basics, Characteristics, Terminologies, Characteristics and Scope, Business Models
3. **Module-3: [10L]**
   - **a. Cloud-based Storage [4L]:**
     - Cloud File Systems, including GFS and HDFS
   - **b. Cloud Security [3L]:**
     - i. Cloud security concerns, security boundary, security service boundary
     - ii. Overview of security mapping
     - iii. Security of data: cloud storage access, storage location, tenancy, encryption, auditing, compliance
     - iv. Identity management (awareness of identity protocol standards)
   - **c. Cloud Management [3L]:**
     - i. An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, monitoring of an entire cloud computing deployment stack – an overview with mention of some products
     - ii. Lifecycle management of cloud services (six stages of lifecycle)

4. **Module-4: [12L]**
   - **a. Google Web Services [4L]:**
     Discussion of Google Applications Portfolio – Indexed Search, Adwords, Google Analytics, Google Translate, A Brief Discussion on Google Toolkit (including introduction of Google APIs in brief), Major Features of Google App Engine Service
   - **b. Amazon Web Services [4L]:**
     Amazon Web Service Components and Services: Amazon Elastic Cloud, Amazon Simple Storage System, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service
   - **c. Microsoft Cloud Services [3L]:**
     Windows Azure Platform: Microsoft's Approach, Architecture, and Main Elements, Overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live Services
   - **d. Webmail Services [1L]:**
     Cloud Mail Services, including Google Gmail, Windows Live Hotmail, Yahoo Mail

Text Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013
3. Cloud Computing: A Practical Approach by Anthony T. Velte, Tata Mcgraw-Hill
4. Cloud Computing by Miller, Pearson.
5. Building Applications in Cloud: Concept, Patterns and Projects by Moyer, Pearson.

References:

1. Cloud Computing (2nd Edition) by Dr. Kumar Saurabh, Wiley India
2. Cloud Computing for Dummies by Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper (Wiley India Edition)
3. Enterprise Cloud Computing by Gautam Shroff, Cambridge
4. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Object Oriented Programming					
Paper Code: CSEN6142					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module-1: [10L]

Object Oriented Paradigm [2L]

Evolution of programming paradigms, Encapsulation & Data Abstraction, Elements of OOP – Classes & Objects, Message, Inheritance, Polymorphism, Popular OOP languages.

Moving from C to C++ [4L]

Stream based I/O, Scope resolution operator, Concept of reference variable, Parameters passing by Reference, Inline functions, Function overloading, Default arguments, Function templates, Runtime memory management.

Classes and Objects [4L]

Class specification, Class objects, Accessing class members, Defining member functions, Pointers within a class, Passing objects as Arguments, Returning objects from functions, Friend functions & Friend class, Static Data members & Static member functions.

Module-2: [12L]

Object Initialization and Cleanup [4L]

Constructors, Parameterized constructors, Destructor, Constructor overloading, Constructors with Default Arguments, Dynamic Initialization through Constructors, Copy Constructors, Constructors for 2-D arrays, Constant objects & constructor, Static data members with constructors & destructors.

Dynamic Objects [4L]

Pointers to Objects, Array of Objects, Array of pointers to objects, Pointers to Object Members, this Pointer, near Pointer, far Pointer.

Operator Overloading [4L]

Overloadable operators, Unary operator overloading, Binary operator overloading, Overloading of new & delete operators, Data Conversion, Overloading with Friend functions.

Module-3: [12L]

Inheritance [6L]

Overview, Derived class declaration, various forms of Inheritance, Constructors & Destructors in Derived classes, Abstract Classes, Multilevel, Multiple & Hierarchical Inheritance, Virtual Base Class, Benefits of Inheritance.

Virtual Functions [3L]

Need for virtual functions, Pointer to Derived class objects, Array of pointers to Base class objects, Pure virtual functions, Virtual destructors, Dynamic binding.

Streams Computation with Files [3L]

Hierarchy of File Stream Classes, file Modes, file pointers & their Manipulators, Sequential Access to a file, file I/O with fstream Class, Random Access to a file, Error Handling for File Manipulators.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module-4: [10L]

Generic Programming with Templates [3L]

Overview, Function Templates, Overloaded Function Templates, Multiple Arguments Function Template, Class Template, Inheritance of Class Template, Class Template with Overloaded Operators.

Exception Handling [3L]

Error Handling, Exception Handling Model, List of Exceptions, Catch All Exceptions, Exceptions in Constructors & Destructors, Exceptions in Operator Overloaded Functions, Exceptions in Class Template.

Namespaces [2L]

Need for Namespaces, Definition of a Namespace, using Declaration, using Directives, Examples.

Standard Template Library [2L]

Overview, STL components, STL Iterators, benefits of STL.

Text Books:

1. Object Oriented Programming with C++ by E Balagurusamy, 6th Edition, McGraw Hill Education

2. Mastering C++ by Venugopal, Rajkumar, Ravishankar, TMH

References:

1. C++ The Complete Reference by Schildt, 4th Edition, TMH

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Web Technologies					
Paper Code: CSEN6143					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1: Introduction
Commonly used protocols and standards.

Module 2: Technologies
Languages and technologies needed to develop software for the Internet and world-wide web (WWW) -HTML/CSS, client-side scripting language (JavaScript), server-side programming (CGI, Servlets/JSP/J2EE, ASP.net, PHP), and XML/web services (Java and .NET),

Module 3: Advanced Tools for Web Application
Advanced technologies for distributed computation, component-based systems, interoperability with legacy systems, database access and content Management Systems (CMS)

Module 4: E-commerce
Principles and technologies for electronic commerce.

References: Web Technology : A developer's Perspective by N.P. Gopalan, J.Akilandeswari(PHI)

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Advanced algorithms & DS					
Paper Code: CSEN6144					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I:
Analysis: Worst-case and Average-case analysis.

Amortized analysis: Aggregate, Accounting and Potential methods.
Efficiency measures for Data Structures: Space, Preprocessing Time and Query Time complexity.

Module II:
Binary search trees. Red-Black trees: operations and properties. Range, Segment and Interval Trees. Augmented data structures. Adding range restrictions.

Heap Structures. Binomial Trees and Heaps. Operations on binomial heaps. Fibonacci Heaps: Operations, Analysis, Applications. Priority Search Trees.

Self Adjusting Data Structures. Lists: Move to front heuristic. Splay Trees: Analysis.

Weight Balanced Trees: Analysis.

Module III:
Hashing: Hash functions and collision resolution. Double hashing.

Randomized Search Structures. Universal Hashing. Skip Lists. Analysis. Tail Estimates and Chernoff bounds.

External Memory Data Structures. EM models. B-Trees: operations and properties.

Module IV:

Persistent Data Structures. Making data structures persistent. Application to similar lists. Sarnak and Tarjan's technique. Node copying. Analysis.

Data Structures for Integer Data: Tries, van Emde Boas Trees.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Text Books:

1) Introduction To Algorithms by
Cormen, Leiserson, Rivest and Stein.
Prentice Hall.

2) Handbook of Data Structures and Applications.
Sartaj Sahni and Dinesh Mehta eds. CRC Press, 2005.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Randomized Algorithms					
Paper Code: CSEN6145					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1

Introduction. Basic Probability Theory. Moments and deviations, Markov and Chebyshev inequalities. Tail Estimates and the Chernoff Bound. Conditional Expectation and Martingales.
The Probabilistic Method. Markov Chains and Random Walks.

Module 2

Sorting: Randomized Quicksort. Analysis. Comparison with average case analysis of deterministic Quicksort. Searching: Skip Lists.

Module 3

Randomized Incremental Construction. Randomized Data Structures for dynamic data.
Randomized Graph Algorithms.

Module 4

Implementation issues. De-randomization. Applications: Algorithms for Data Streams.

Text Book:

1. Randomized Algorithms by Rajeev Motwani and Prabhakar Raghavan. (Cambridge University Press).

References::

2. Computational Geometry: An Introduction through Randomized Algorithms by Ketan Mulmuley, Prentice Hall.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Image Processing					
Paper Code: CSEN6146					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I.

Fundamentals of Image Processing

Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels, distance measures, connectivity , Image Geometry, Photographic film.

Histogram: Definition, decision of contrast basing on histogram, operations basing on histograms like image stretching, image sliding, Image classification.

Definition and Algorithm of Histogram equalization.

Image Transforms:-

A detail discussion on Fourier Transform,Wavelet transform, DFT,FFT, properties

A brief discussion on WALSH Transform , WFT, HADAMARD Transform, DCT.

Module II.

Image Enhancement: (by SPATIAL Domain Methods)

a Arithmetic and logical operations, pixel or point operations, size operations,

b. Smoothing filters-Mean, Median, Mode filters – Comparative study

c.. Edge enhancement filters – Directorial filters, Sobel, Laplacian, Robert, KIRSCH Homogeneity & DIFF Filters, prewitt filter, Contrast Based edge enhancement techniques. Comparative study

d. Low Pass filters, High Pass filters, sharpening filters. – Comparative Study

e. Comparative study of all filters

f. Color image processing.

Image enhancement (By FREQUENCY Domain Methods)

Design of Low pass, High pass, EDGE Enhancement, smoothening filters in Frequency Domain. Butter worth filter, Homomorphic filters in Frequency Domain

Advantages of filters in frequency domain, comparative study of filters in frequency domain and spatial domain.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Module III.

Image compression:
Definition, A brief discussion on – Run length encoding, contour coding, Huffman code, compression due to change in domain, compression due to quantization , Compression at the time of image transmission. Brief discussion on:- Image Compression standards.

Module IV:

Image Segmentation:
Definition, characteristics of segmentation. Detection of Discontinuities, Thresholding Pixel based segmentation method. Region based segmentation methods – segmentation by pixel aggregation, segmentation by sub region aggregation, histogram based segmentation, spilt and merge technique. Use of motion in segmentation (spatial domain technique only)

Morphology:-
Dilation, Erosion, Opening, closing, Hit-and-Miss transform, Boundary extraction, Region filling, connected components, thinning, Thickening, skeletons , Pruning Extensions to Gray – Scale Images, Application of Morphology in image processing.

Text Books:

1. Digital Image Processing , by Rafael C. Gonzalez and Richard E. Woods

Addision Wesley .

2. Digital Image Processing by S. Sridhar, Oxford University Press.

References:

1. Fundamentals of Electronic Image Processing by Arthyr –R – Weeks, Jr. (PHI)
2. Image processing, Analysis, and Machine vision by Milan Sonka vaclan Halavac
Roger Boyle, Vikas Publishing House.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Management Information Systems					
Paper Code: CSEN6147					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1: Introduction

Meaning and Role of Information System, Types of Information Systems: Operations support systems, Management Support Systems, Expert Systems, Knowledge Management Systems.

Information System for Strategic Management: Competitive strategy concepts and objectives. Strategic role of Information System. Integrating informational systems with business strategy.

Module 2: Resource Planning

Planning for Information Systems: Identification of applications-Structured and unstructured approach; Business Planning System and Critical Success Factors; Method of identifying application. Evaluation of applications and value chain analysis. Risks in information systems.

Resource Requirements for Information Systems: Hardware and capacity planning, software needs, procurement options – make or buy decision, outsourcing as an option in information system.

Module 3: Software Engineering – Methodology and Tools

System Development Life Cycle: Critical Success Factors in customized software, traditional sequential method for system development, CASE tools and modern process of system development. Flexibility Integrity and Control issues in software.

Module 4: Future Trends

Emerging concepts and issues in information system: Intranet, Extranet and Enterprise Collaboration System, EERPs, Client Server Architecture, and other emerging concepts in information system design and application.

References:

1. Oka: Management Information Systems: a complete text book including solved cases, Everest
2. Sadagopan: Management Information Systems, PHI
3. Murdick, Ross, Clagget: Information System and Modern Management, PHI

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Information Retrieval					
Paper Code: CSEN6148					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I:
Models. taxonomy, Formal Characterization, Classic Boolean, Vector, Probablistic Models. Fuzzy Set Model. Gneralized Vector Space, Latent Semantic Indexing, Neural Network models. Bayesian, Inference and Belief Network models. Structured Text Retrieval Models.

Retrieval utilities. Relevance Feedback, Clustering, Passage-based Retrieval, N-grams, Regression Analysis, Thesauri, Semantic Networks, Parsing.

Retrieval Evaluation. Recall and Precision. Alternative Measures. Reference Collections, TREC.

Module II:
Query Languages. Keyword-based querying, single-word queries. Context, Bollean, Natural Language Queries. Pattern matching, Structural queries. Cross-language information retrieval: Strategies and Utilities.

Computational Efficiency. Inverted index, Query processing, Signature files, Duplicate document detection.

Query Operations. User relevance feedback, Automatic Local Analysis, Automatic Global Analysis.

Module III:
Text and multimedia languages and properties. Text: formats, information theory, modeling natural language, similarity models. Markup languages: SGL, HTML, XML. Multimedia: formats, textual images, Graphics and Virtual Reality.

Text Operations. Document preprocessing. Lexical analysis, Stopword elimination, Stemming, Index term selection, Document clustering, Text compression.

Module IV:

Indexing and Searching. Inverted Files. Suffix Trees and Suffix Arrays. Boolean Queries. Sequential seraching, Knuth-Morris-Pratt algorithm, Boyer-Moore algorithm, Shift-Or, Suffix automation. Pattern matching, String matching allowing errors, Regular expressions and extended patterns, Pattern matching using indices.

Web information retrieval. Charcterizing the web. Search Engines: Architecture, Ranking, Crawling. Browsing, web directories. Metasearchers. Web query languages.

References:

1. Modern Information Retrieval by Ricardo Baeza-Yates and Berthier Ribeiro-Neto. (Pearson Education).
2. Information Retrieval: Algorithms and Heuristics by David A. Grossman and Ophir Frieder. (Springer).

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Big Data Analysis					
Paper Code: CSEN6149					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Introduction to Hadoop [9L]
Starting Hadoop. Components of Hadoop. HDFS. Working with files in HDFS. Introduction to MapReduce. Streaming in Hadoop. Advanced MapReduce: Chaining MapReduce jobs, Joining data from different sources. Developing MapReduce programs in local mode and pseudo-distributed mode. Moving data into and out of Hadoop. Data input and output in MapReduce. Applying MapReduce patterns to Big Data. Streamlining HDFS for big data.

Module II: Algorithms Using MapReduce [13L]
Matrix-Vector Multiplication by MapReduce. Relational-Algebra Operations. Computing Selections by MapReduce. Computing Projections by MapReduce. Union, Intersection, and Difference by MapReduce. Computing Natural Join by MapReduce. Grouping and Aggregation by MapReduce. Matrix Multiplication.

Graph Algorithms using MapReduce: Shortest Paths, Friends-of-Friends. PageRank computation in MapReduce.

Module III: Hadoop Extensions, Libraries and Related Technologies [13L]
Pig, Hive, HBase, Sqoop, Zookeeper, Flume, Oozie, Avro. Introduction to R. Integrating R with Hadoop. Predictive Analytics using Apache Mahout: Recommendation, Classification, Clustering.

Module IV: Data Mining for Very large Datasets. [13L]
Near Neighbor Search in High Dimensional Data, Locality Sensitive Hashing (LSH), Dimensionality reduction: SVD and CUR. Large scale machine learning: k-nearest neighbor, Classification and Regression, Support Vector Machines. Mining data streams. Mining Social Network Graphs.

Text Books :
1. Hadoop in Action by Chuck Lam. Manning Publishers. 2011.
2. Hadoop in Practice by Alex Holmes. Manning Publishers. 2012.
3. Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeff Ullman. Cambridge University Press. 2011.

List of Electives

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Elective IV:

1. **Fault tolerant Computing**
2. **Business Process Modeling**
3. **Compilers**
4. **Computational Complexity**
5. **Information & Coding Theory**
6. **Approximation algorithms**
7. **Spatial Informatics & GIS**
8. **Computer Graphics & MultiMedia**
9. **Social Network Analysis**

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Fault tolerant Computing					
Paper Code: CSEN6151					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Principles of Fault Tolerance; Reliability Requirements; Hardware F-T Techniques; System Abstractions; Software Structuring Schemes;

Module II: Techniques for Different Stages of Fault Tolerance; Techniques for Different Types of Faults;

Module III: Fault Tolerance in Distributed Systems; Fundamental Problems in Coordination; Communication and Remote Operation over Unreliable Channels; Fault Tolerant Control and Coordination Algorithms Design;

Module IV: F-T System Abstractions/Functions; System Mechanisms for F-T; Fault Tolerant Programming Paradigms; Modeling and Analyzing F-T Distributed Systems.

References:

1. "Reliability of computer systems and networks" by Martin L. Shooman, John Wiley & Sons Inc., 2002, ISBN 0-471-29342-3.
2. Anderson, T., and P.A. Lee, Fault-Tolerant Principles and Practices, Prentice-Hall Int'l., London, 1981.
3. Hwang, K., and F.A. Briggs, Computer Architecture and Parallel Processing, McGraw-Hill, 1984.
4. Jalote, P. Fault-Tolerance in Distributed Systems, ISBN 0-13-301367-7, Prentice-Hall, 1994.
5. Johnson, B.W., Design and Analysis of Fault-Tolerant Systems, Addison Wesely, 1989.
6. Leveson, Nancy G., Safeware, system safety and computers, Addison Wesely, 1995.
7. Pradhan, D.K., Fault-Tolerant Computing -- Theory and Techniques, (2 Volumes), Prentice-Hall, 1986.
8. Pradhan, Dhiraj K., Fault-Tolerant Computer System Design, ISBN 0-13-057887-8, Prentice-Hall PTR , 1996.
9. Sahner, R.A., K.S. Trivedi and A. Puliafito, Performance and Reliability Analysis of Computer Systems, Kluwer Academic Publishers, 1996.
10. Sieworek, and R.S. Schwarz, The Theory and Practice of Reliable System Design, Digital Press, 1982.
11. Storey, Neil, Safety-Critical Computer Systems, Addison Wesely, 1995.
12. Martin L. Shooman, Reliability of computer systems and networks, John Wiley & Sons Inc., 2002, ISBN 0-471-29342-3. Trivedi, K.S., Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Prentice-Hall, 1982.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name Business Process Modeling					
Paper Code: CSEN6152					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1: Introduction

- A methodology for analyzing, modeling, and designing business processes, including the use of simulation for measuring and comparing performance of various models.
- Knowledge of the current and emerging information technologies and architectures as enablers of business process improvement, integration and automation.
- Relationships between business processes, strategy and performance

Module 2: Business Process Flow and Performance

- Process flow measurement, including key process measures, their interrelationships, and managerial levers for controlling them
- Effects of variability on process performance and associated managerial levers to manage for variability
- Techniques for modeling, analyzing, and redesigning a process to achieve specific performance goals, including business process simulation.

Module 3: Business Process automation

- Challenges and opportunities associated with IT-enabled business process automation
- Overview of various management methods in use for achieving process improvement
- Business process automation through modeling with Business Process Management

Module 4: Business Process Tools

- Notation (BPMN 2.0) and service composition and orchestration using BPEL (Business Process Execution Language)

Text Books:

- Managing Business Process Flows, Principles of Operations Management, **Second Edition**, Anupindi, Ravi, Sunil Chopra, Sudhakar D. Deshmukh, Jan A. Van Mieghem, and Eitan Zemel, Pearson Prentice Hall, 2006, ISBN: 0-13-067546-6.
- Getting Started with Oracle BPM Suite 11gR1, Buelow, Heidi, Prasen Palvankar, Manoj Das, Meera Srinivasan, Manas Dob, PACKT Publishing, 2010.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Compilers					
Paper Code: CSEN6153					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I:

Introduction: Concept of Language processing system, Phases of compilation and overview.

Lexical Analysis (scanner): Regular language, regular expression, finite automata, Regular expression to NFA,NFA to DFA conversion, from regular expression to deterministic finite automata, scanner generator (lex,flex).

Symbol Table: Its structure, symbol attributes and management.

Module II:

Syntax Analysis (Parser): Context-free language and grammar, push-down automata, LL(1) grammar and top-down parsing, bottom-up parsing, Operator precedence parsing, LR Parsers(LR,Canonical LR,LALR), ambiguity and LR parsing, LALR(1) parser generator (yacc,bison) .

Semantic Analysis(Syntax-Directed definitions): inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions**.**

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

Run-time environment: storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation**.**

Module III:

Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

Code Improvement (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 IV:

Code generations

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

Advanced topics

Compilation of object oriented programming languages. (introduction**)**

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Text Books: 1. A. V. Aho, R. Sethi, and J. D. Ullman.Compilers: Principles, Techniques and Tools, Addison-Wesley, 1988.
2. C. Fischer and R. LeBlanc.Crafting a Compiler, Benjamin Cummings, 1991.
3. C. Fischer and R. LeBlanc.Crafting a Compiler in C, Benjamin Cummings.
4. A. C. Holub.Compiler Design in C, Prentice-Hall Inc., 1993.
5. Appel.Modern Compiler Implementation in C: Basic Design, Cambridge Press.
6. Appel.Modern Compiler Implementation in Java: Basic Design, Cambridge Press.

References:
1. Fraser and Hanson.A Retargetable C Compiler: Design and Implementation, Addison-Wesley
2 Dhamdhere.Compiler Construction, McMillan India.
3. Holmes.Object Oriented Compiler Construction, Prentice Hall.
4. Holmes.Building your own Compiler with C++, Prentice Hall.
5.Wirth.Compiler Construction, Addison-Wesley.
6.Wilhelm and Maurer.Compiler Design, Addison-Wesley.
13. Lex and Yacc ,Willey publications
7. Michael L. Scott, Programming Language Pragmatics, Elsevier.
8. Andrew W. Appel, Modern Compiler Implementation in C/Java, Cambridge University Press.
9.Keith D. Cooper and Linda Torczon, Engineering a Compiler, Elsevier.
10.Steven S. Muchnik, Advanced Compiler Design and Implementation, Elsevier.
11. Randy Allen and Ken Kennedy, Optimizing Compilers for Modern Architectures, Elsevier.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Computational Complexity					
Paper Code: CSEN6154					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Basic Complexity Classes
The computational model. NP and NP completeness. Diagonalization. Space complexity. The polynomial hierarchy. Boolean circuits.

Module II: Randomized Computation. Interactive proofs, Cryptography, Quantum computation. PCP Theorem and Hardness of Approximation.

Module III: Lower bounds for concrete computational models. Decision trees, Communication complexity. Circuit lower bounds Proof Complexity Algebraic computation models.

Module IV: Advanced topics
Complexity of counting Average case complexity: Levin's theory Hardness amplification and error correcting codes. Derandomization. Pseudorandom constructions: expanders and extractors. Proofs of PCP theorems and the Fourier transform technique.

Text Books:
1. Computational Complexity: A Modern Approach
by Sanjeev Arora and Boaz Barak.
Cambridge University Press, 2009.
2. Computational Complexity
by Christos Papadimitrou.
Addison Wesley, 1994.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Information and Coding Theory					
Paper Code: CSEN6155					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I:
Concept of information, complexity. Formal derivation of information, Law of Weber and Fechner.

Module II:
Concept of entropy – Laws of thermodynamics, Maroscopic, Statistical and dynamic entropy, Renyi's entropy. Extension of Shannon's Information, Generalized entropy measures, Information functions and Gaussian distributions, Shannon's Information of discrete probability distribution, information function; Bounds of variance, ambiguity functions Akaike's information criterion, Channel information, deterministic and stochastic information, Maximum entropy estimation.

Module III:
Information, entropy and self-organization, complexity theory, data reduction, cryptology.

Module IV:
Packing and Covering radii of codes, Golay Code, Reed-Mueller Code, BCH Code, Reed Solomon Code, Quadratic Residue Code, Alternant Code, Goppa Code, Justesen Code, MDS Codes, Invariant theory and self-dual codes, Concatenated codes, Bounds of Singleton, Johnson, Plotkin and Elias.

Referencess:

1. C. Arndt: Information Measures – Information and its description in Science & Engineering, Springer Verlag.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Approximation Algorithms					
Paper Code: CSEN6156					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module 1

NP-Completeness: Polynomial time, NP-Hardness, NP-Completeness and reducibility, NP-Completeness proofs.

Approximation Algorithms: Fundamentals and Concepts. Performance Ratio. Polynomial approximation scheme (PTAS), Fully polynomial time approximation scheme (FPTAS).

Module 2

Approximation algorithms for scheduling. List scheduling. Job scheduling with deadlines. Identical aparallel machines. Unrelated parallel machines. Bin Packing. Next fit, first fit, online and offline algorithms. Average case analysis.

Module 3

Approximate covering and poacking, set cover, vertex cover, independent set.

Approximation algorithms for highly connected subgraphs. Weighted and unweighted vertex connectivity. Weighted and unweighted edge connectivity. Strong connectivity.

Module 4

Approximation Algorithms for Geometric problems. Euclidean TSP, Steiner tree problems, Steiner ratio, Minimum weight triangulation with steiner points, Clustering, K-minimum spanning tree, polygon separation, point set separation.

Hardness of approximations. Inapproximability results. PCP theorem. PCP and inapproximability of MAX-3SAT.

Text Books:

1. Approximation Algorithms by Vijay Vazirani, (Springer, 2001)

2. Approximation Algorithms for NP-Hard Problems by Dorit S. Hochbaum (PWS

Publishing Company, 1997)

Subject Name: Spatial Informatics & GIS					
Paper Code: CSEN6157					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Introduction and overview of GIS. GIS: Definition, features, functions; why GIS is important; how GIS is applied, GIS as an Information System;
GIS and cartography; contributing and allied disciplines; historical development of GIS.

Module II: GIS and Maps, Map Projections and Coordinate Systems. Maps and their characteristics, selection, abstraction, scale. Automated cartography vs. GIS, Map projections, Coordinate Systems, Precision and Error. Making Maps. Parts of a Map; Map functions in GIS; Map design and map elements

Module III: Data Sources, Data Input, Data Quality, Database Concepts. Major Data Feeds and their characteristics: maps, GPS, images, databases, commercial data; locating and evaluating data; data formats; data quality; metadata. Database concepts and components; flat files, relation database concepts; data modeling; views of the database; normalization; databases and GIS.

Module IV: Spatial Analysis. Questions a GIS can answer; GIS analytical functions, vector analysis including topological overlay; raster analysis; statistics; integrated spatial analysis.

Spatial Informatics: Mathematical concepts (e.g. Euclidean space, topology of space, network space), Geo-information models (e.g. field-based, object-based), Representations (e.g. discretized, spaghetti, tessellation, voronoi diagram), Algorithms (e.g. metric and Euclidean, topological, set-based, triangulation, graph-based), Data Structures and access methods (e.g. space filling curves, quad-trees, R-tree), Analysis (e.g. spatial query languages, spatial statistics, spatial data mining). Location based services: Overview, Positioning Technologies, Mapping, Applications.
Spatial Networks: Representation, Access Methods.

TEXTBOOKS:

1. Concepts and Techniques of Geographic Information Systems by C.P. Lo and Albert K.W. Yeung, Prentice Hall, 2006.

2. Spatial Databases: A Tour by Shashi Shekhar and Sanjay Chawla, Prentice Hall, 2003.

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Computers Graphics & Multimedia					
Paper Code: CSEN6158					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I

Introduction to computer graphics & graphics systems and Scan conversion [10L]:
Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; 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

Basic 3D transformation & viewing [6L]:
Basic 2D transformations, 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.

Module III

Curves [3L]:
Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.

Hidden surfaces [3L]: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods , fractal - geometry.

Module IV

Introduction to Multimedia[4L]: Review-hypermedia; authoring and tools; data type and file formats; audio and video signals; digitization –audio and video; Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI

Compression[6L]: MPEG, JPEG; transformations; lossy and loseless algorithms, audio and video compression standards.

Multimedia data base [6L]: data structures – quad trees , R-trees ; image databox, image processing and retrieval; text and document database ; video database ; audio database; design and architecture of a MM database.
MM Servers[4L]: architecture; scheduling, storage and cache management. Mobile multimedia. Watermarking and stenography. MM over Internet and wireless network.

Text Books:

1. Hearn & Baker: Computer Graphics, PHI
2. Xiang, Plastock: Theory and Problems of Computer Graphics, TMH
3. Roggers & Adams: Mathematical Elements of Computer Graphics, TMH

References:
1. Shanar: Multimedia: a practical approach, Jaico,
2. Buford: Multimedia Systems, Pearson

COURSE STRUCTURE AND DETAILED SYLLABUS OF M. TECH 1st YEAR, COMPUTER SCIENCE & ENGINEERING, HIT

Subject Name: Social Network Analysis					
Paper Code: CSEN6159					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	**0**	**0**	**4**	**4**

Module I: Introduction to Network Science

Complex networks, Network graphic metrics, , Small-world networks, Scale-free networks, Network centrality measures.

Module II: Advanced concepts in Network Science

Random networks, Network mathematical models, Network structural constraints, Temporal networks, Spatial networks, Network visualization

Module III: Network Functions and Behavioral Patterns

"Rich gets richer" phenomenon, Link, neighborhood and community, Cascades and epidemics, Network structure balance.

Sentimental, temporal and spatial analysis of social media networks.

Module IV: Understanding Real World Communication Networks

Internet core structure – evolution and modeling, Structure of the Web – PageRank and document networks, Online social media networks - Twitter, Facebook, Amazon.

References:

Networks: An Introduction by Mark Newman. Oxford University Press.