- T Cormen, C Leisersson, R Rivest, C Stein, Introduction to Algorithms, PHI, 2003.
- V. Aho, J. Hopcraft, J. Ulmann, The Design and Analysis of Computer Algorithms, Addison Wesley, 1974.
- E Horowitz, S Sahni, S Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, 2008.
- S. Basse, A. V. Gelder, Computer Algorithms: Introduction to Design and Analysis, Pearson Education Asia Pvt. Ltd., 2009.

Database Management Systems

Database Approach - System Concepts and Architecture, Database Users; Database Design - Entity-Relationship (E-R) Model, Relational Model, Mapping E-R to Relational Model; Languages - Relational Algebra, Tuple and Domain Relational Calculus , SQL; Normalization - Functional and Multivalued Dependency, 1NF to 5NF; Security; Transaction Management - Transaction, ACID properties, Concurrency, Recovery ; Query Optimization - Cost based and Heuristics based. Practical: Design E-R model for a real world, map to relational model, implement using available RDBMS and execute SQL queries.

Text/ Reference Books:

- R. Elmasri, S. Navathe, Fundamentals of Database Systems, Pearson, Sixth Edition, 2006.
- Silberschatz H, Korth, S. Sudarshan, Database System Concepts , McGraw-Hill, Sixth Edition, 2010.
- C. Desai, An Introdcution to Database System, Galgotia Publications Pvt Ltd, 2012.
- H G Molina, J. D. Ullman, J Widom, Database Systems: The Complete Book, Pearson, 2008.

Operating Systems

Introduction to Operating Systems; layered architecture, basic concepts: interrupt architecture, system calls,, Processes and Threads, CPU scheduling; Deadlocks; Main memory management including paging and segmentation schemes; Virtual memory management including page replacement algorithms; Storage management including file systems; Case studies.

Text/ Reference Books:

- Silberschatz, P. Galvin and G. Gagne, Operating System Concepts, Wiley, 2008.
- W. Stallings, Operating Systems: Internals and Design Principles, Pearson, 2014.
- S. Das, UNIX Concepts and Applications, McGraw Hill Education, 2006.

Machine Learning

An overview of Machine learning, Inductive learning: ID3, C4.5,C5; Learning Concepts and rules from Examples; Learning by analogy; Learning from observation and discovery;

Learning by experimentation; Learning by training Neural Networks; Genetic Algorithm; Analysis learning; Reinforcement learning ;Applications to KDD.

Text/ Reference Books:

- T.M. Mitchell, Machine Learning McGraw-Hill, 1997.
- S. Marsland, Machine learning: an algorithmic perspective, CRC Press, Taylor and Francis Group, 2015.
- E Alpaydin, Introduction to Machine Learning, MIT Press, 2010.
- C M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer, 2010.

Theory of Computation

Regular language Models: Finite state machines (deterministic, non-deterministic), regular languages and regular grammars, properties; Context-free language models: Context-free languages, properties of CFL, Pushdown automata; Turing Machines, limits of algorithmic computation; Grammars, hierarchy of formal languages, properties of models of computation, Computational complexity, complexity class P and NP.

Text/ Reference Books:

- L, Peter, An introduction to Formal Languages and Automata, Narosa Publishing House, 2007
- H. R. Lewis, C. H. Papadimitriou, Elements of Theory of Computation, Pearson Education, 2002
- J. E. Hofcroft, J. D. Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing house, 2008.
- J. C. Martin, Introduction to Languages and Theory of Computation, Tata McGraw-Hill Publication, 2007

Computer Networks

Overview of Computer Network, OSI and TCP/IP Reference Models, Guided and Unguided Transmission Media, Analog and Digital communication, Encoding and Modulation, Nyquist theorem, Shannon's capacity, Switching techniques, multiplexing techniques-TDM, FDM, Framing, Error detection and Error correction – VRC, LRC, CRC, Stop and Wait Protocol, Sliding Window Protocol, Go-back-n ARQ, Selective-Reject ARQ, HDLC, Channel Allocation, ALOHA Systems, CSMA Protocols, Collision Free Protocols, Local Area Networks, Bridges, ATM, Routing: Flooding, Spanning tree, Distance Vector routing, Link state routing, Bellman-Ford and Dijkstra routing algorithms, Congestion control - Leaky Bucket and Token Bucket algorithms , IP Protocol, IP Addressing, ARP, RARP, OSFP, BGP, TCP, UDP, Application Protocols-DHCP, DNS, Telnet, SMPT, Network Security-RSA

Text/ Reference Books:

- A. S. Tanenbaum, Computer Networks, Pearson Education India, 2013.
- B. A. Ferouzan, Data Communications and Networking, McGraw Hill Education, 2006.

- A. L. Garcia, I. Widjaja, Communication Networks, McGraw-Hill Education, 2003.
- W. Stallings, Data and computer Communications, Pearson Education India, 2013.

Elective Courses for B. Tech Computer Science & Engineering:

Compiler Design

Lexical Analysis (Scanner): Regular language, finite automata, regular expression, regular expression to finite automata, scanner generator (lex/flex). Syntax Analysis (Parser): Context-free grammar, push-down automata, ambiguity, associativity, precedence, transformations on the grammars; top down parsing, recursive descent predictive parsing, LL(1) parsing; bottom up parsing, LR parsers (SLR, LALR, LR), LALR(1) parser generator (yacc/bison). Semantic Analysis: Attribute grammar, syntax directed definitions, inherited and synthesized attributes, dependency graph, evaluation order, S- and L-attributed definitions, type-checking. Run time system: storage organization, activation tree, activation record, stack allocation of activation records, parameter passing mechanisms, Symbol table. Intermediate Code Generation: intermediate representations, translation of declarations, assignments, control flow, Boolean expressions and procedure calls. Code Improvement: Analysis: control-flow, data-flow analysis, local optimization, global optimization, loop optimization, peep-hole optimization, instruction scheduling. Register allocation and target code generation.

Text/ Reference Books:

- A. V. Aho, M S. Lam, J. D. Ullman, R. Sethi, Compilers: Principles, Techniques, and Tools, Pearson, 2011.
- K. C. Louden, Compiler Construction: Principles and Practices, PWS Publishing, 1997.
- A W. Appel: Modern Compiler Implementation in C / Java, Cambridge Univ. Press, 2004.
- S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann, 1997.

Numerical Methods

Computing Arithmetic, Significant Digits and Numerical Instability, Root finding methods. Bisection, Newton Raphson, Secant and Regula Falsi, methods for multiple roots. System of Linear Algebraic Equations and Eigenvalue problems-Gauss Elimination, LU Decomposition. Jacobi-Gauss-Seidel and SOR methods, Interpolation and Approximation-spline approximation. Linear, quadratic and Cubic, Differentiation and Integration-Richardson's extrapolation, Gauss Quadrature methods, ordinary differential equations-Initial and Boundary Value Problems, introduction to numerical solutions of Partial Differential Equations.

Text/ Reference Books:

- M.K. Jain, SRK Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 2003.

- S.C. Chopra and R. P. Canale, Numerical Methods for Engineers, McGraw-Hill Higher Education, 2005.
- S.D. Conte h C. de Boor, Elementary Numerical Analysis: An Algorithmic Approach, McGraw-Hill Book Company, 1980.
- E.W. Cheney and D. R. Kincaid, Numerical Analysis, Brooks Cole, 1996.

Artificial Intelligence

Overview of AI: Foundations, history and sate of art; Problem Solving: Search, Game playing; Knowledge Representation and Reasoning: First Order Logic, building knowledge-bases, Logic based Reasoning Systems, Semantic Networks, Frames; Uncertainty and Reasoning: Bayesian networks, Demster-Shafer theory, Fuzzy Sets; Planning; Machine Learning: learning from observations, Artificial Neural Networks, Reinforcement learning; Intelligent Agents; Natural Language Processing; Robotics

Text/ Reference Books:

- Knight, Kevin, Rich, Elaine, Nair, B., artificial Intelligence, Tata McGraw-Hills, 2008
- Russell, Stuart, Artificial Intelligence: A Modern Approach, Pearson Edition 2013
- Winston, P.H. Artificial Intelligence, Pearson, 2002

Cloud Computing

Overview of Distributed Computing: Trends of computing, Introduction to Parallel/distributed computing, Grid Computing, Cloud computing, Introduction to Cloud Computing: What's cloud computing, Properties and Characteristics, Service models, Deployment models. Components of a computing cloud, Different types of clouds: public, private, hybrid, Delivering services from the cloud, Categorizing service types, Comparing vendor cloud products: Amazon, Google, Microsoft and others, Infrastructure as a Service (IaaS): Introduction to IaaS, Resource Virtualization, Server, Storage, Network, Case studies, Platform as a Service (PaaS): Introduction to PaaS, Cloud platforms and Management, Computation, Storage, Case studies, Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS, Case studies, Cloud Issues and Challenges: Cloud provider Lock-in, Security.

Text/ Reference Books:

- K Hwang, G Fox, J Dongarra, Distributed and Cloud Computing, Elsevier, 2012.
- R Buyya, C Vecchiola, T Selvi, Mastering Cloud Computing, TMH, 2013.
- D C. Marinescu, Cloud Computing: Theory and Practice, Elsevier, 2013.
- B Sosinsky, Cloud Computing Bible, Wiley, 2011.

Computer Graphics

Input devices, Video display devices, Area filling algorithms with irregular boundaries, Cohen-Sutherland and Cyrus-Beck line clipping algorithms, Basic 2-dimensional and 3-dimensional geometric transformations, Homogeneous coordinate system, Parallel projection,

Isometric projection and its construction, Perspective projection, Hidden surface elimination algorithms, Basic illumination models, Gouraud and Phong surface rendering models, Representation of curves and surfaces.

Text/ Reference Books:

- J.D. Foley, A. V Dam, J.F. Hughes and S.K. Feiner, Computer Graphics: Principles and Practice, Addison Wesley, 2013
- D. Hearn and P. M. Baker, Computer Graphics, Prentice Hall of India, 1996
- D. F. Rogers, Procedural Elements for Computer Graphics, McGraw-Hill Inc. 1997
- D. F. Rogers, J. A. Adams, Mathematical elements for computer graphics, McGraw-Hill, Inc. New York, NY, 1990

Digital Image Processing

Digital Image fundamentals; Image sensing and acquisition; Image sampling and Quantization; Image Enhancement in Spatial Domain; Grey level transformation; Histogram Processing; Image Transforms; Spatial filters; Fourier Transforms and their properties; Fast Fourier Transforms; Image Enhancement in Frequency Domain; Image Segmentation: edge detection, Hough Transform, Region based segmentation; Image Compression.

Text/ Reference Books:

- R. E. Woods, R C. Gonzalez, Digital Image Processing, Pearson, 2007.
- A K. Jain, Fundamentals of Digital Image Processing, PHI, 1989.

Modeling& Simulation

Advantages and disadvantages of simulation systems, Components of system, Discrete and continuous systems, Examples – Simulation of queuing and network protocols, concepts in discrete-event simulation; Statistical models in simulation; Analysis of simulation data, Verification and validation of simulation models, Output analysis for single model, Simulation of computer systems, Queuing models – long run measures of performance, steady-state behavior, M/M/1, M/M/C/∞/∞, M/M/C/N/∞, M/M/C/K/K; Pseudo random numbers, random variate generation, Inverse transform technique. Deterministic v/s probabilistic systems, Elements of Stochastic process, Markov chains, Markov process, Poisson process, Brownian motion process. Principles of Monte Carlo, Geomatric Brownian motion and generation of sample paths, Black-Scholes model

Text/ Reference Books:

- R Jain, Art of Computer Systems Performance Analysis, John Wiley and Sons, Inc, 1991.
- A M. Law and W. D. Kelton, Simulation Modeling and Analysis, 3rd Ed. Tata McGraw-Hill, 2003
- W.J.Stewart, Probability, Markov Chains, Queues and Simulation, Princeton University, 2009.
- P. Glasserman, Monte Carlo Methods in Financial Engineering, Springer, 2004

Object Oriented Programming

Concept of Object-Oriented Programming paradigm: Abstraction, Encapsulation, Inheritance, Polymorphism, Classes, Objects, member function, static member function, Data types, Arrays, Memory Allocation for Objects, Storage Management, constructors, destructor, Inheritance: single and multiple inheritances, operator overloading, function overloading, Polymorphism, abstract class, overriding, memory layout of objects; Exception Handling, Template class and function, Packages and Interfaces, Multithreaded programming, Input/Output

Text/ Reference Books:

- B. Stroustrup, The C++ Programming Language, Addison Wesley, 2013.Lipman, S. B. C++ Primer, 3rd ed. Pearson Education.
- H.M. Deitel, P.J.Deitel, Java : how to program, Fifth edition, Prentice Hall Publication.
- H. Schildt, The Java 2: Complete Reference, Fourth edition, TMH.

Parallel and Distributed Systems

Introduction to Parallel and Distributed Systems, Classification, Various Speedup Laws, Interconnection Network Architecture, Algorithms On Parallel/Distributed Machine, PRAM Model, EREW, ERCW, CREW, CRCW Algorithms, Sorting Networks 0-1 Principle, Bitonic Sorter, Merger, Sorter, Distributed Systems, Interprocess Communication, Message Passing Communication, Distributed Coordination, Physical And Logical Clocks.

Text/ Reference Books:

- K Hwang, Advanced Computer Architecture, TMH, 2011
- M.J. Quinn, Parallel Computing, Mc-Graw Hill, 1994
- T. H. Cormen, Algorithms, PHI, 2009
- A. S. Tanenbaum, Distributed System, Pearson Education, 2002

Software Engineering

Introduction, Software Product and Process, Software Process Models, Requirements Engineering, Requirements Analysis–Data Flow Diagram, Requirement Specification, Requirement Validation; Design- Concepts, Coupling, Cohesion, Mapping Requirements to Design, User Interface Design, Structure Charts, Coding Principles, Coding Standards and Guidelines, Software Testing Techniques and Strategies, Software Debugging, Software Project Metrics and Estimation Techniques – Empirical, Heuristic and Analytical Techniques, Software Quality Assurance, CASE Tools.

Text/ Reference Books:

- R. Pressman, Software Engineering – A Practitioner's approach, Sixth Edition, McGraw-Hill International Edition, 2014.
- I. Sommerville, Software Engineering, Sixth Edition, Pearson Education, 2010.
- R. Mall, Fundamentals of Software Engineering, Prentice|Hall India, 2014.

- P. Jalote, An Integrated Approach to Software Engineering, Second Edition, Narosa Publishing House, 2005.

Courses for M. Tech in Computer Science & Engineering:

Advanced Algorithms

Probabilistic Recurrence, Basic Power and Efficiency of Randomization and Approximation, Computation Model and Complexity Classes, Reducibility, Classification of randomized algorithms: Las Vegas and Monte Carlo, Minimum cut algorithm, Bin-Balls Problem, Birthday-Paradox, Coupon-Collector, Stable Marriage Problem, Game Theory, Random variables and Basic inequalities (Markov, Chebyshev), Chernoff Bounds, Martingale Bound, Max-cut, Random Graphs, Markov chains and random walks, Random graph models for real-world networks, social networks, etc. Algorithms for 2-SAT and 3-SAT, Particle Swarm optimization (PSO), Multi-swarm optimization, Ant Colony optimization, Intelligent Water Drops algorithm, Genetic algorithm, Hill-Climbing optimization algorithm

Text/ Reference Books:

- V Vazirani, Approximation Algorithms, Springer-Verlag, 2001
- D. Williamson, D. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, 2011.
- T Cormen, C Leisersson, R Rivest, C Stein, Introduction to Algorithms, PHI, 2003.
- R. Motwani, P Raghavan, Randomized Algorithms, Cambridge University Press, 1995

Optimization Techniques

Mathematical preliminary, Linear programming, Simplex method, Duality in linear programming, Convex optimization and quadratic programming, Least squares optimization, Unconstrained optimization problems, Nonlinear constrained optimization, Problems with equality constraints, Problems with inequality constraints, Application of mathematical programming in machine learning.

Text/ Reference Books:

- S. Chandra, Jayadeva, A. Mehra, Numerical Optimization with Applications, Alpha Science International Ltd, 2008.
- I Griva, S. G. Nash, A Sofer, Linear and Nonlinear Optimization, Society for Industrial Mathematics, 2008.
- W Forst, D Hoffmann, Optimization—Theory and Practice, Springer-Verlag New York, 2010.