# Detailed syllabi of Bachelor of Computer Science & Engineering Course

# Jadavpur University

**Ph /CSE/T/ 112A** **Physics**

1. Assumption for the kinetic theory of gases, Expression for pressure, Significance of temperature, Deduction of gas laws, Qualitative idea of (i) Maxwell's velocity distribution. (ii) degrees of freedom and equipartition of energy, Specific heat of gases at constant volume and constant pressure.

**[6L]**

2. Equation of state of a gas, Andrew's experiment, Qualitative discussion on van der Waal's equation of state, Critical constants, Law of corresponding states.

**[6L]**

3. Macroscopic and microscopic description, Thermal equilibrium, Zeroth law of thermodynamics, Concept of international practical temperature scale, Heat and Work, First law of thermodymamics and some applications, Reversible and irreversible processes, Carnot cycle, Second law of thermodymamics, Concept of entropy, Thermodynamic relations.

**[12L]**

4. Energy levels of the hydrogen atom and the Bohr atom model, X-ray spectra, X-ray diffraction, Bragg's law, Compton effect.

**[8L]**

5. Introduction to Quantum Mechanics. Schrodinger Equation, Angular Momentum, Spin, De-Broglie waves, Particle diffraction, Heisenberg’s Uncertainty principle and its application.

**[8L]**

**Math /CSE/ T/ 113A** **Mathematics – I**

Set Theory: Review of set theory basics, Partially ordered sets, Lattice, Equivalence relations and induced partitions, Countable and uncountable sets and their properties. Reordered sets. Least upper bound property. Statement of real number system as an ordered field with least upper

bound property. Rational numbers. Algebraic and transcendental numbers. Infinite decimal expansion of real numbers. Cantor's diagonalisation method for uncountability of real numbers.

**[10L]**

Introduction to Mathematical Logic. **[10L]**

Permutations, their parity and cycle structure.

**[8L]**

Geometry of three dimension and vector algebra: Cartesian Co-ordinates in three dimension, Position vectors, Addition of vectors, Multiplication of a vector by a scalar, Division of a line segment in a given ratio, Rectangular resolution of vectors, Direction cosines, Scalar and vector product of two vectors, Equations of planes and straight lines, Shortest distance between two skew lines, Product of three vectors, Volume of a tetrahedron, Equation of sphere, cylinder and cone, Application of mechanics.

**[12L]**

**Math /CSE/ T/ 114A** **Mathematics – II**

Sequence and infinite series, their convergence and divergence, Cauchy's general principle of convergence (statement only), Comparison test, D'Alembert's ratio test and Cauchy's root test, Rearrangement of terms of a series, Power series, Radius of convergence.

**[10L]**

Successive differentiation, Rolle's theorem, Mean value theorem, Taylor's theorem and Maclaurian's series, Expansion of elementary function: e, log(1+x), (1+x)m, Sin(x), Cos(x),etc., Indeterminate forms, Maxima and Minima, Riemann integration, Definition and properties, Fundamental theorem of integral calculus, Improper integrals, Gamma and Beta functions, Partial differentiation.

**[12L]**

Applications: Curvature and asymptotes, Rectification, Quadrature, Volume and surface areas of solids of revolution

**[6L]**

Functions of several variables: Limit and continuity, Partial derivatives, Differentials, Partial derivatives of a composite function, Euler's theorem on homogeneous functions, Implicit function, Jacobian function, Taylor's theorem, Maxima & minima and Lagrange's method.

**[12L]**

**CSE/T/ 115A**

# Digital Logic

**Introduction :**

Digital Systems and their evolution. Number system(s) for digital operation- Decimal, Binary, Octal, Hexadecimal. Number base conversion, Binary codes for decimal digits and code conversion. Error detecting codes- Parity and Hamming codes. Other coding systems - Seven segment code, Alpha Numeric codes like ASCII, EBCDIC, ISCII and Unicode.

**[6L]**

**Digital Arithmetic:**

Addition and subtraction of unsigned binary numbers. Complement arithmetic; n's complement and (n-1)'s complement. Representation of signed binary numbers ; sign-magnitude, sign-1's complement and sign-2's complement, Addition and subtraction of signed binary numbers. Other binary arithmetic- BCD, NBCD, Excess-3 BCD.

**[8L]**

Fixed and Floating point representation of numbers - Decimal, Binary. Floating point arithmetic for signed and unsigned numbers.

**[4L]**

**Boolean Algebra:**

Truth table, logic operations- AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR. De Morgan's theorem. Minimization of Boolean functions - Karnaugh Veitch map method and Quine-McCluskey's method. Digital Logic Gates.

**[4L]**

**Combinational logic circuit design:**

Half-adder, Full-adder, Encoder, Decoder, Multiplexer, de-multiplexer, parity generator, parity checker, priority encoder, magnitude comparator. **[8L]**

**Sequential logic circuit design:**

Flip-flops - SR, JK, Master slave JK, D and T. Registers- serial-in-serial-out, serial-in-parallel-out, parallel-in-serial-out, shift registers, circulating shift registers and their applications. Counters - Synchronous, asynchronous, up, down and modulo-n.
Finite state machines (FSM) - state table, state diagram, Mealy and Moore machines, state minimization, implementation with flip-flops.

**[10L]**

**Suggested Readings:**


1. M. Moris Mano, " Digital System Design", Prentice Hall, New Delhi.
2. R.F.Tinder, "Engineering Digital Design, Academic Press, Harcourt India Pvt. Ltd.
3. A.B.Marcovitz, " Introduction to Logic design", Tata –McGraw-Hill Edition.
4. B. Vranesic, " Fundamentals of Digital Logic with VHDL Design", Tata-Mc-Graw-Hill Edition.
5. Basu, Nasipuri and Kundu, "Computer Systems and Data Analysis", Narosa, New Delhi.
6. A. P. Malvino "Digital Principles and Applications", McGraw Hill International Editions(Fourth Edition).


## Math/CSE / T / 121A Mathematics – III

Abstract algebra: Definition of Groups, Subgroups and Cyclic groups, Lagrange's theorem, Homomorphism, Theorem of group, Permutation group.

**[6L]**

Rings and subrings, Ideals, Prime ideals, Maximal ideals, Fields, Polynomial rings, Algebraic exension of field, Existance and construction of finite fields, Galois fields.

**[12L]**

Linear algebra: Vector space, Linear dependence and independence of vectors, Basis and dimension.

**[10L]**

Definition of matrix, Algebra of matrices, Row and column operations, Row and column space, Rank of a matrix, Inverse of a matrix, Solution of a system of linear equations by matrix method, Eigen values and eigen vector of a matrix, Caley Hamilton theorem, Jordan canonical form.

**[10L]**

## EM/ME/T/1A Engineering Mechanics

### Statics:

Introduction, Idealizations of Mechanics, Fundamentals of Vector Algebra, Application of Vectors in Mechanics, Equiv System, Equilibrium, FBD Concept, Fundamentals of Friction, Properties of surface, Centroid, Moment of Inertia

### Dynamics:

Intro to vector calculus, Definition of vectors in Dynamics, Rectilinear Motion, Curvilinear motion of particle and description of different coordinate systems, Kinetics, Newton's Law and D' Alembert's principle and application to rectilinear and curvilinear motion, constrained motion, Energy and Momentum methods.

**CSE /ET / T/ 123A** **Basic Electronics**

Review of P-N junction diodes and bi-polar transistors **[2L]**

Introduction to MOS and CMOS FETs, Equivalent circuits of diode, bipolar transistor and FETs **[6L]**

Switching characteristics of diodes and transistors **[6L]**

Elementary physics and characteristics of Schottky diodes, P-N-P-N structures and their applications **[4L]**

Application of diodes in rectification, clipping, clamping etc. **[2L]**

Basic concepts of voltage and current amplifiers **[4L]**

Feedback in amplifiers, R-C oscillators **[4L]**

Design of regulated D.C. power supplies **[4L]**

Elementary physics of cold cathode displays, LEDs, LCDs, TFTs, OLEDs **[4L]**

Opto-isolators, photo-electric and photo-voltaic devices **[4L]**

**Suggested Readings:**


1. Microelectronics by J.Millman and A.Grabel, Tata McGraw Hill.
2. Integrated Electronics by Millman and Halkias, TMH.
3. Foundation of Electronics by D. Chattopadhyay and P.C.Rakshit, Willey India.
4. Semiconductor Devices: Physics and Technology by S.M. Sze, Willey India.


**CSE/ET/T/124A** **Circuit and Network Theory**

Passive circuit parameters and their equilibrium conditions – Kirchoff's law **[1L]**

Differential equation representation of passive circuits **[1L]**

Solution of circuit differential equations for simple circuits, concept of impedance and reactance **[2L]**

Steady state response, Frequency domain analysis of RLC circuits, Amplitude and phase, Vector representation, resonance, circle diagram **[6L]**

Network equations,Y-DELTA transforms **[2L]**

Network theorems – superposition, reciprocity, Thevenin, Norton, Maximum power transfer theorems **[6L]**

Fourier series and Fourier transform **[3L]**

Laplace transform, Solution of circuit differential equations using Laplace transform, transient and steady state responses **[6L]**

Transfer function – concept of poles and zeros – frequency response **[4L]**
Filters – low-pass, High-pass, band-pass and band elimination **[4L]**

Basic ideas of characteristic impedance, matching, attenuation and phase distortion in transmission lines **[5L]**

**Suggested Readings:**


1. Network Analysis by M.E.Van Valkenburg, Prentice Hall India,
2. Schaum's outline of Electric Circuits by Mahmood Nahvi & Joseph Edminister
3. Network Lines and Fields by John D. Ryder, PHI.
4. Network Theory by D. Chattopadhyay and P.C.Rakshit, S.Chand & Co. Ltd.


## CSE/T/125A Introduction to Computer Programming

**Introduction:** History of Computing, Evolution of Programming Languages, Compilers, Interpreters **[2L]**

**Problem Solving Method:** Algorithms and Flowcharts **[2L]**

**Overview of C:** Brief History of C, C Standards, Structure of a C Program, C Libraries and Linking, Compiling a C Program **[2L]**

**Expressions:** Basic Data Types, Variables, Type Qualifiers, Storage Class Specifiers, Variable Scopes, Constants, Operators, Operator Precedence, Expression Evaluation, Type Conversion in Expressions, Type Casting **[6L]**

**Statements:** Selection Statements (if, switch-case), Iteration Statements (for loop, while loop, do-while loop), Jump Statements (return, goto, break, exit, continue) **[6L]**

**Console I/O:** Reading and Writing Characters, Reading and Writing Strings, Formatted Console I/O **[2L]**

**Arrays and Strings:** Single Dimension Arrays, Double Dimension Arrays, Strings, Arrays of Strings, String Library Functions

**[4L]**

**Functions:** General Form, Function Prototypes, Parameter Passing Mechanisms, Command Line Arguments, Recursion **[4L]**

**Pointers:** Pointer Variables, Pointer Operators, Pointer Expressions, Pointers and Arrays, Functions and Pointers, Pointers to Functions, Dynamic Memory Allocation **[4L]**

**Structures, Unions, Enumerations and Typedef:** Structures, Arrays of Structures, Structure Pointers, Unions, Bit Fields, Enumerations, Typedef **[4L]**

**File I/O:** Data Organization, File Operations, Text Files and Binary Files, Random Access

**[2L]**

**The Preprocessor:** Preprocessor Directives, Macros, Macro vs. Function, File Inclusion, Conditional Compilation **[2L]**

**Suggested Readings:**


1. **C: The Complete Reference**, by Herbert Schildt, 4th Edition, Tata McGraw Hill, 2000
2. **C Primer Plus** by Stephen Prata, 5th Edition, SAMS Publishing, 2005
3. **C Programming Language**, by Brian W. Kernighan and Dennis M. Ritchi, 2nd Edition, Pearson Education, 2006
4. **C: A Reference Manual** by Samuel P. Harbison and Guy L. Steele, 5th Edition, Prentice Hall, 2003
5. **Let Us C** by Yashwant Kanetkar, BPB Publications, 9th Edition, 2008
6. **C Programming**: A Modern Approach by K. N. King, 2nd Edition, W. W. Norton and Company, 2008
7. **C Traps and Pitfalls** by Andrew Koenig, Addison Wesley Professional, 1989


## Math/CSE /T/ 211A **Mathematics – IV**

Power series: uniform convergence, validity of term by term operation and product operation.

**[8L]**

Fourier series, Euler formulae, Dirichlet's conditions, even and odd functions, half-range sine and cosine series

**[8L]**

Ordinary differential equations – 2nd and higher order, Euler – Cauchy equations, variation of parameters, ordinary point and regular singular solution of 2nd order linear equations – series solution, Legendre and Chebycheff's polynomials

**[10L]**

Complex analysis: differentiation of complex functions, analytic functions, Cauchy – Reimann equations, line – integral, Cauchy's integral formulae, Laurant's series, singularity, Residue theorem, contour integration.

**[14L]**

## CSE /T/ 212A Digital Circuits

Different logic families- Diode Logic, DCTL, RTL, IIL, DTL, HTL, TTL, ECL, MOS & CMOS – their operations, Characteristics and specifications. Open collector & Tristate gates, wired-AND and bus operations. **[20L]**

Timing circuits- 555 timer & its use as monostable and astable multivibrators, VCO and PLL-their operational principles and applications. **[4L]**

Memory devices: semiconductor main memory RAM, ROM, EPROM, EAPROM etc. Secondary storage device principles. **[8L]**

Analog digital interfacing: Different D/A and A/D conversion techniques, sample-hold units and analog multiplexers in multichannel data acquisition. **[8L]**

**Suggested Readings:**

1. Millman & Halkias- Integrated Electronics
2. Taub & Schilling- Digital Integrated Electronics

## CSE/T/ 213A Data Structures and Algorithms

1. Introduction – Data and Information - Program Structures – Abstract Data Type – Data Structure - Static and Dynamic Data Structures [**2L]**

2. Array as a Data Structure – Representation of Polynomials and Sparse Matrix - Linear List – Implementation using array **[4L]**

3. Review of Pointers and Functions **[1L]**

4. Linked List – Single and Double Linked List – Applications **[3L]**

5. Concepts of Algorithm Design Techniques – Divide and Conquer – Greedy – Dynamic Programming – Backtracking – Branch and Bound – Examples **[3L]**

6. Concepts of Algorithm Analysis – Performance Measurement and Analysis – Time Complexity and Space Complexity – Introduction to Order functions – Examples of Analysis **[3L]**

7. Searching and Sorting Algorithms – Linear and Binary Search – Sorting – Insertion, Selection, Merge, Quick, Heap, Bucket – Stable sorting **[3L]**

8. Stack and Queue – Implementations using Arrays and Linked List – Applications – Expression Evaluation and Conversions **[3L]**

9. Recursion – Types of Recursion – Examples – Implementation using stack **[3L]**

10. Trees – Binary Trees – Binary Search Tree – Balanced Trees – 2-3 Tree – B-Tree – B+-Tree

**[10L]**

11. Graphs – Adjacency Matrix and List – Graph Search Algorithms – Spanning Tree Algorithms – Shortest Path Algorithms – Transitive Closure Matrix **[3L]**

12. Hashing – Terminologies – Hash functions – Collision Resolution Strategies – Types of Hashing **[2L]**

**Suggested Readings:**


1. Fundamentals of Data Structures in C by Horowitz, Sahni & Anderson-Freed, 2e Universal Press
2. Data Structures and Algorithm Analysis in C by Mark Alan Weiss, 2nd ed., Pearson Education
3. Data Structues and Algorithms by Aho, Hopcroft & Ullman
4. Data Structures and Program Design by Kruse et. al., PHI
5. Data Structures using C and C++ by Tanenbaum et. al., PHI
6. Fundamentals of Data Structures in C++ by Horowitz, Sahni & Mehta
7. Data Structures in Java by Sahni

8. Algorithms + Data Structures = Programs by N. Wirth, PHI
9. How to solve it by Computers by Dromey

**CSE/T/ 214A** **Numerical Methods**

Approximations and Errors associated with numerical methods. **[1L]**

**Solution of non-linear equations:**
Iterative method using repeated substitutions, Bisection method, method of false position, Newton-Raphson method, Secant method, Chebyshev method.
Analysis and comparison of these methods. **[6L]**

**Finding complex roots of a polynomial equation**: Lin's method, Bairstow's method. **[2L]**

**Solution of linear simultaneous equations:**
*Direct methods:*
Gaussian elimination, Gauss-Jordan elimination, matrix inversion using Gauss-Jordan elimination. **[3L]**
*Iterative methods:*
Jacobi's method, Gauss-Seidel method and their analysis. **[2L]**

**Solution of non-linear simultaneous equations:**
Iterative method and newton-Raphson method. **[2L]**

**Finding the eigenvalues and corresponding eigenvectors of a suare matrix:**
Definitions of eigenvalues and eigenvectors, Power method for finding the eigenvalues and corresponding eigenvectors of a square matrix. **[3L]**
*Transform methods* : Jacobi's method, Hessenberg's method. **[3L]**

**Methods for interpolation:**
Newton's forward difference formula, Newton's backward difference formula, Gauss central difference formula. **[3L]**
Divided difference formula, Lagrange's formula, iterative interpolation method. **[2L]**
*Curve fitting:* method of least squared error, cubic splines. **[2L]**

**Methods for differentiation:**
Computation of derivatives using Newton's forward/backward difference formulae**. [1L]**

**Methods for integration:**
Trapezoidal method, Simpson's method, Boole's method, analysis and comparison of these methods, Romberg's method, Gauss quadrature formula. **[4L]**

**Solution of differential equations:**
Euler's method, modified Euler's method, Runge-Kutta 2nd order formula, Runge-Kutta 4th order formula, predictor-corrector methods. **[4L]**

**Solution of partial differential equations** **[2L]**

**Suggested Readings:**


1. Numerical Algorithms by Krishnamoorthy and Sen
2. Numerical Methods by J.H.Mathews, PHI
3. Numerical Analysis and Algorithms by P. Niyogi, TMH
4. Numerical Methods for scientific and engineering computations by Jain, Iyengar and Jain, New Age International publisher
5. Computer Systems and Data Analysis by D.K.Basu, M.Nasipuri and M.Kundu, Narosa
6. Introductory Methods of Numerical Analysis by S.S.Sastry , P.H.I.


## CSE/T/ 215A Computer Organization

**Fundamentals of Computers** **[1L]**

Introduction to Digital Computers
Hardware and Software & their dual nature
Von-Neumann Concept
Role of Operating System and Compiler

**Instruction Set** **[4L]**

Opcode and operand
Instruction formats
Addressing modes and effective address calculation
Instruction decoding and Instruction execution cycle

**Arithmetic Unit** **[8L]**

ANSI representation of data
Signed addition and subtraction
Fast addition, carry-look-ahead adders and carry save adders
Different multiplication techniques for signed numbers, Booth's Technique including Bit-pair technique
Binary division techniques. Restoring type and Non-restoring type

Floating point arithmetic and different rounding techniques

**Memory Organization** **[8L]**

Memory Hierarchy and different access techniques
Main memory and Secondary memory concepts
Memory Interleaving, S-access and C-access organization
Cache Memory, Different mapping techniques and Replacement Algorithms
Virtual memory and implementation using Page map table

**Control Unit Design** **[8L]**

Instruction interpretation and execution
Hardwired control design
Micro-programmed control design
Instruction format design and nano-programming

**Input Output Organization** **[7L]**

I/O interface and drivers
Programmed I/O
Synchronous and Asynchronous I/O transfer
Interrupt driven I/O transfer
Direct Memory Access (DMA)
I/O processor

**Pipeline Processing** **[4L]**

**Suggested Readings:**


1. Computer Organization , Hamacher et.al.
2. Computer Architecture & Organization , J.P. Hayes
3. Computer System Architecture, Morris Mano
4. Computer Organization & Design, P.Pal Chaudhuri


**ETech/EE/CSE/T/216A** **Electrical Technology**

DC Circuits: Kirchhoff's Laws. Maxwell's Loop Current Methods of Analysis. Star-Delta Conversion. Superposition Theorem. Thevenin's Theorem. Maximum Power Transfer.

Magnetic Circuit: MMF, Flux ,Reluctance. B-H Loop. Hysteresis and Eddy current loss. Magnetic circuit analysis with air gap. AC 1 -phase: Periodic Waves and Sinusoids. Average and RMS Values, Form Factor, Peak. Factor. Phasor concept of Sinusoids. Impedance and Admittance. Power, Power Factor, V A, V AR. Series R-L-C Circuit ,Parallel R-L-C circuit. Resonance. Balanced 3-phase: 3-phase AC balanced circuits. Phase-sequence. Star and Delta connections. Power, V A, V AR, Power Factor _or balanced 3-phase circuits. Power Measurement: Wattmeter circuit connection. Power Measurement by two wattmeter methods in 3phase system. DC Machines: Construction and general principle of operation. Generator EMF Equation. Field connection ,shunt series and compound. Generator characteristics.

Motor-equation and general operation. starting and speed control, torque -speed curve. 1-PhaseTransformer: Construction. EMF equation. Phasor diagram. Equivalent circuits. Losses and Efficiency. Open circuit and Short circuit test. 3-Phase Induction Machine: Types of induction machines. Rotating magnetic field, slip ,torque equation, torque speed curve.DOL starting and reduced voltage starting. 3-Phase Synchronous Machines: Alternator, constructional features, EMF equation, synchronous reactance, power -angle characteristics. Concept of synchronous motor. Meters: DC and AC Ammeters and Voltmeters. Megger. Multiplier.

**Math/CSE/ T / 221A** **Mathematics-V**

Mathematical Theory of Probability: Basic concepts, Classical and axiomatic approaches, Sample space and events, Properties of probability functions.

**[5L]**

Conditional probability and independent events, Concept of random variable, Discrete and continuous probability density, mass and distribution functions

**[7L]**

Expectations and moments, Moment generating and characteristic functions, Uniform, binomial, poisson, exponential and normal distributions, Multi – dimensional random variables and random

vectors, Joint, marginal and conditional probability distributions

**[10L]**

Functions of random variable and random vector, Linear transformation of random variable and random vector, Independent random variables, Mean square estimation, Correlation and regression, Central limit theorem.

**[8L]**

Introduction to stochastic processes: Markov, stationary and ergodic processes, Correlation function and power spectral density. Introduction to Queuing Theory: Kendall's Notations, M/M/1, M/M/m Queue, effect of bulk arrival.

**[10L]**

## CSE / T/ 222A Object Oriented Programming

**Introduction to object oriented programming concept** **[1L]**

**C++:**

**Overview of Procedural Feature:** Concept of Reference variable, Default Parameters to Function, Function overloading **[1L]**

**Fundamental Object Oriented Features:**

Class and Object, Abstraction/ Encapsulation, Access Specifier **[1L]**

Static Members, Friend Function **[2L]**

Constructor and Destructor **[2L]**

Operator Overloading **[2L]**

Inheritance **[2L]**

Abstract Class, Run time polymorphism, Virtual Base Class **[2L]**

**File Handling** **[3L]**

**Exception Handling** **[1L]**

**Class Template and Function Template** **[2L]**

**JAVA:**

**Introduction:** Features of Java, JVM, Concepts of Java Application and Applet **[1L]**

**Fundamental Object Oriented Features:**
Class and Object, Access Specifier, Static Members, Constructor, Garbage Collector **[2L]**

Function overloading, Inheritance, Runtime Polymorphism, Abstract class **[2L]**

**Package and Interface** **[2L]**

**Exception Handling** **[1L]**

**Wrapper Classes** **[1L]**

**I/O handling** **[3L]**

**Threads, Communication and Synchronization of threads** **[4L]**

**Event Driven Programming**: AWT/Swing GUI Components, AWT/Swing Events **[2L]**

**Design Pattern** **[3L]**

**Suggested Readings:**


1. The Complete reference C++ by H. Schildt, McGrawHill
2. Learning C++: A Hands on Approach by Nagler, Jayco Publishing House
3. The C++ Programming Language by Stroustrup, Adisson Wesley
4. Object Oriented Programming in C++ by R. Lafore, SAMS
5. Java 2.0 Complete Reference by H. Schildt, McGrawHill
6. JAVA How to Program by Deitel and Deitel, Prentice Hall


## CSE / T/ 223A Microprocessors and Assembly Language Programming

**Introduction to microprocessor**
Basic features of 8085 microprocessors and its addressing modes, 8085 microprocessor architecture [**2L**]

**Memory and I/O interfacing**
Address decoding, Address aliasing, Memory read and write operations, Timing diagrams, Memory mapped I/O and I/O mapped I/O [**4L**]

**Programming of 8085**
Instruction Set, Assembly Language Programming and Illustrative examples [**6L**]

**8085 Interrupt Structure** **[2L**]

**Data Transfer Techniques**
Synchronous and Asynchronous modes of data transfer, Interrupt driven I/O, DMA [**2L**]

**Peripheral Devices**
8255 programmable peripheral interface, 8254 programmable counter, 8251 UART programmable communication interface, 8257 DMA Controller. 8259 Interrupt controller, 8279 Keyboard & display interface. Signal converter and their interfacing techniques- ADC 0809, DAC 0808.

[**10L**]

**Introduction to micro-controller**
8051 as an example. Micro-controller architecture, bi-directional data ports, internal ROM and RAM, counters/timer s, oscillator and clock, serial communication.
8051-register set, memory organization – internal & external, program memory & data memory, bit addressable memory, and special function registers
Introduction to instruction set of 8051 and assembly language programming

[**8L**]

**Introduction to advanced microprocessors**
8086 as an example, 8086Architecture and Internal Resister Set, Brief discussion on Instruction Set, Min-Max mode, Concept of Co-processor and its interfacing, Brief studies on Important features of higher processor in the Intel 80X86 family.

[**6L**]

**Suggested Readings**


1. R. Gaonkar, “Microprocessor Architecture, Programming and Applications”, 5th Ed., Pearson International, 2001.
2. K. Ayala, “The 8051 Microcontroller – Architecture, Programming and Applications”, 2nd Ed., Pearson International,1996.
3. Liu and Gibson, “Microcomputer Systems: The 8086/8088 Family”, 2nd Ed., Prentice-Hall India (EEE), 1986.
4. J. Uffenberk, “Microcomputers and microprocessors”, 3rd Ed., Pearson Education, Asia (LPE), 2002.
5. C. Gilmore, “Microprocessors Principles and Applications”, 2nd Ed., McGraw-Hill International, 1995.
6. D. Hall, “Microprocessors and Interfacing”, 2nd Ed., Tata-McGraw-Hill, 1999.
7. Treibel and Singh, “The 8088 and 8086 Microprocessors”, 4th Ed., Prentice-Hall India (EEE), 1991.
8. Mazidi, “The 8051 Microcontrollers & Embedded Systems”, Pearson Education Asia (LPE).

9. M. Predco, “Programming and Customizing the 8051 Microcontroller”, Tata McGraw-Hill EA., 1999.

## CSE / T/ 224A Graph Theory and Combinatorics

**Introduction to Graph Theory [4L]**
Definitions and Examples, Subgraphs, Complement of a graph, Graph Isomorphism, Degree, Directed and undirected graphs, weighted and unweighted graphs, dual graph.

**Path, Cycles, Coloring [8L]**
Walk, Trail, Path, Cycle, Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles, Vertex coloring, Edge coloring, Chromatic Polynomials.

**Trees [4L]**
Definitions, Properties and Examples, Rooted Trees, Trees and Sorting, Binary Trees, Weighted Trees and Prefix Codes

**Graph Algorithms [7L]**
Graph Traversals, Shortest Path Algorithms, Minimal Spanning Trees – the algorithms of Kruskal and Prim, Max-flow Min-cut Theorem, Matching.

**Principle of Inclusion and Exclusion [6L]**
The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.

**Generating Functions [6L]**
Definition and Examples – Calculational Techniques, Partitions of Integers, The Exponential Generating Function, The Summation Operator.

**Recurrence Relations [5L]**
First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients, The Non-homogeneous Recurrence Relation, Solving Recurrences by Generating Functions, Fibonacci Numbers and Golden Ratio.

**References:**
1. F. Harary: Graph Theory
2. N. Deo: Graph Theory with Applications to Engineering and Computer Science
3. A. Tucker: Applied Combinatorics

**CSE / T/ 225A**

# Computer Architecture

**1. Introduction:** Design objectives of a computer architect; cost and performance measures; benchmark & metrics; instruction set architecture classification; instruction format and semantics; memory addressing modes; instruction encoding principles; role of compilers; formal description of architecture; VHDL; AADL. **[2L]**

**2. Instruction level parallelism:**
Basic principles of pipelines; structural, control and data hazards; instruction pipelines; branch prediction; pipeline scheduling and collision avoidance; optimizing pipeline performance; RISC & CISC pipeline examples. VLIW architecture; overview of proposed and commercial VLIW Systems.

**[2L]**

Superscalar architecture; basic objectives of superscalar processing; superscalar instruction issues; issue policies; instruction pairing rules; shelving; register renaming; load/ store reordering; the reorder buffer; instruction pipeline – D1, D2 execution and write-back stages; branch handling – delayed branch, multiway branch; case study – Power PC620, Pentium Pro.

**[4L]**

Code scheduling for ILP processor; basic block scheduling; loop scheduling; global scheduling.

**[2L]**

**3. Data parallel architecture:** Basic idea of data parallelism; connectivity – nearest neighbour, tree, pyramid, mesh, hypercube and reconfigurable networks; different classes of data parallel architecture – SIMD, associative, neural, data parallel pipeline, systolic and vector architectures.

**[3L]**

SIMD architecture; features – granularity, connectivity, processor complexity & local autonomy; fine grained SIMD overview; an example – the Massively Parallel Processor; coarse grained SIMD overview; an example – the CM5; SIMD algorithm examples – matrix multiplication/ inversion, sorting/ searching.

**[3L]**

Systolic architecture; introduction; systolic design space; comparison with multidimensional pipeline; spatial convolutions; case study – the WARP processor. **[2L]**

Vector architecture; principles of vectorization; pipelined & parallel stream implementation of vector machine; case study – the CRAY-1, C-90 and the Convex C4/X4 system. **[2L]**

**4. Thread/ Process level parallelism:** Basic architectural concepts; scalable parallel architecture; design issues for scalable MIMD computers. **[1L]**

Multi-thread implementation on sequential control flow model; case study – the Dencolor HEP machine, the MIT 'Sparcle' machine. **[3L]**

Dataflow architecture; the classical static dataflow machine proposed by J Dennis; tagged token dataflow machine; explicit token-store architecture; dataflow model verification using simple/ coloured Petri Net. **[3L]**

Shared memory MIMD architecture; systems using single & multiple shared buses; blocking & non-blocking interconnection networks such as cross-bar and other MINs. **[2L]**

Cache coherence problem; hardware & software coherence policies – write-invalidate, write-update, write-through and write-back policies; snoopy protocol. **[2L]**

Synchronization; spin-lock; event ordering in coherent systems. **[1L]**

Uniform memory access (UMA) machine example; non-uniform memory access (NUMA) machine example; cache coherent NUMA (CCNUMA) machine example; case study – the SUN Enterprise 6000. **[2L]**

**5. RISC Architecture:** comparison between CISC & RISC concepts; RISC machine features; hardwired control; horizontal machine code format; register file; jumps & delay slots. **[2L]**

**6. Special Architecture:** Architectural considerations for low power hand held mobile devices, embedded systems. **[1L]**

**7. Parallelization:** Parallel program development environment and software tools; mapping application onto multi-computers. **[1L]**

**8. Performance Evaluation:** Role of performance; performance metrics; Amdahl's law; benchmarks; the SPEC benchmarks; SPEC95 for Pentium & Pentium Pro; SPEC 2000 benchmarks; MIPS as performance metric; native, peak & relative MIPS & FLOPs as performance measure; synthetic benchmarks; price-performance metric. **[2L]**

**Suggested Readings:**


1. Computer Architecture: A Quantitative Approach by J. L. Hennessy and D. A. Patterson, 3rd & 4th ed, Elsevier.
2. Advanced Computer Architecture: Parallelism, Scalability, Programmability by Kai Hwang, TMH.
3. Computer Organization and Design: The Hardware/ Software Interface, by D. A. Patterson and J. L. Hennessy, 4th ed, Morgan Kaufmann.
4. Advanced Computer Architecture: A Design Space Approach, by D. Sima, T. Fountain and P. Kacsuk, Pearson Education.
5. Advanced Microprocessors by D. Tabak, McGraw-Hill.
6. The Pentium Microprocessor by J. L. Antonakos, Prentice Hall.

**CSE / T / 311A** # Computer Graphics

**Introduction:**
Brief discussion on historical perspective; graphics primitives such as points, lines, polygons, etc.; representation of pictures using primitives; storage & retrieval of pictures; introduction to graphics display devices; calligraphic/ vector graphics versus raster graphics; bit plane; colour look-up table; introduction to graphic input devices – track ball, mouse, digitizing tablet, light pen etc. **[2L]**

**Rasterization techniques:** **[2L]**
Line – DDA; Bresenham's generalized integer version; Mid-point rasterization.
Circle – Bresenham's algorithm; Mid-Point algorithm - 1st order difference & 2nd order difference methods. **[3L]**

Ellipse – Mid-Point algorithm - 1st order difference method, brief discussion on 2nd order difference method **[1L]**

**2D Scan conversion & polygon filling:**
Active-Edge-List (y-bucket) scan conversion of lines & polygons; **[1L]**

Edge –fill , Fence –fill, & Edge –flag polygon filling algorithms; simple Seed –fill & Scan –line seed –fill algorithms. **[2L]**

**2D Geometric transformations**:
Introduction to position vector; representation of 2D objects as matrices; transformation matrices for scaling, shear, rotation, reflection **[2L]**

homogeneous coordinates; representing translation as a transformation matrix; composite transformation matrix for arbitrary transformation; invariance of origin under transformation; **[2L]**
invariance of parallelism under transformation; transformation of intersecting lines; area of transformed polygons; 2D view-port & viewing window. **[2L]**

**2D Clipping:**
Clipping against regular window – Explicit line clipping; **[1L]**
Sutherland & Cohen line clipping, **[1L]**
Mid-point subdivision line clipping; **[1L]**
Clipping against arbitrary convex window – Cyrus Beck clipping algorithm, **[1L]**

Liang Barsky clipping algorithm; **[1L]**
Sutherland & Hodgemann polygon clipping. **[1L]**

**3D Graphics:**
Indroduction to right handed coordinate system for 3D representation; matrix representation of 3D object; scaling, shear & translation transformation; **[1L]**

rotation about principal coordinate axes & about arbitrary line; composite transformation for arbitrary 3D transformation. **[2L]**

**Projection:**
Introducing the idea of projecting 3D object on to 2D plane; broad classification – parallel & perspective projection; different types of parallel projection & examples of each; **[ 1L]**
formal definition of 3D to 2D projection and derivation of projection matrix; 1-point, 2-point & 3-point perspective projection; formal derivation of vanishing point(s) and physical implication of the same. **[2L]**

**Curves:**
Introduction to curve fitting; piece-wise approximation using known curves; approximation using different functions – polynomial, exponential, trigonometric etc.; **[1L]**

Introduction to blending function; detailed illustration by creating a hypothetical polynomial blending function;
**[1L]**

general spline; cubic spline; B- spline; Hermite curve; boundary & continuity conditions for these curves; **[2L]**

Bezier curve; $1^{st}$ & $2^{nd}$ order continuity conditions for joining Bezier curves; splitting Bezier curve; **[2L]**

**Hidden line removal**:
Introduction; simple z-buffer algorithm; scan line z-buffer algorithm; floating horizon algorithm.
**[2L]**

**Basic interaction handling**:
Different classes of devices – locator, pick, valuator etc.; input & output handling in a window system. **[1L]**

**Illumination & shading**:
Introduction; basic illumination models; ambient, diffused and specular reflection light models; simple flat/ faceted shading; Gourad shading; Phong shading; simple ray tracing algorithm.
**[2L]**

**Suggested Readings:**

1. Procedural Elements for Computer Graphics by David F.Rogers, TMH publication.

2. Mathematical Elements for Computer Graphics by David F. Rogers and J. A. Adams, TMH publication.
3. Computer Graphics, principles & practices by J.D. Foley, A. van Dam, S.K. Feiner and J.F. Huges, Addison Wesley.
4. Computer Graphics, C version, by D. Hearn and M.P. Baker, Pearson Education.
5. Computer Graphics, a programming approach, by S. Harrington, TMH publication.
6. Computer Graphics by A.N. Sinha and A.D. Udai, TMH publication

## CSE / T / 312A System Programming

Introduction to Systems Programming [**1L**]
Assembler - Functions of an assembler, features (with respect to machine dependence) of an assembler, design of assembler – two pass, one pass, concept of overlay [**6L**]
Assembler Design: A case study – Overview of 16 / 32 bit architecture and assembly language programming features, Functionalities and design of assembler for such specifications [**6L**]
Macro processor – Functions of macro processor, features of macro processor, design of macro processor [**3L**]
Loaders and Linkers – functions of loader, absolute loader, bootstrap loader, Machine dependent and machine independent features of loader, Relocation, Linking, concept and design of relative/relocating loader, linking loader, linkage editor, dynamic linking and dynamic loading [**6L**]
Text editor – types of editors, types of files, features, examples [**2L**]
Cross assembler – requirements, features, example [**2L**]
Debug – functions of a debugger, hardware support for debugging, example debuggers [**2L**]
Device drivers – concepts, design and developing [**8L**]
Window manager – Features and facilities, types, examples of X Windows manager, widget toolkit [**4L**]

**Suggested Readings:**

1. System Software: An Introduction to Systems Programming – L. Beck
2. System Software – M. Joseph, Laxmi Publications
3. Systems Programming and Operating Systems – D. M. Dhamdhere, TMH
4. Linux Device Drivers – J. Corbet, A. Rubini, G. Kroah-Hartman, O' Reilly Media

## CSE / T / 313A Operating Systems

1. Introduction to Operating Systems **[1L]**
2. Concept of batch-processing, multi-programming, time sharing, real time operations **[2L]**
3. Process Management: Concept of process, state diagram, process control block; scheduling of processes – criteria, types of scheduling, non-preemptive and preemptive scheduling algorithms like: FCFS, Shortest Job First/Next (SJF/N), Shortest Remaining Time Next (SRTN), Round Robin (RR), Highest Response ratio Next (HRN), Priority based scheduling, different Multilevel queue scheduling etc.; **[5L]**
4. Threads – concept, process vs thread, kernel and user threads, multithreading models **[2L]**
5. Inter-process Communication (IPC) – Shared memory, message, FIFO, concept of semaphore, critical region, monitor **[2L]**
6. Process Synchronization: concepts, race condition, critical section problem and its solutions; synchronization tools- semaphore, monitor etc., discussion of synchronization problems like producer-consumer, readers-writers, dining philosophers, sleeping-barber etc.
   Deadlock – conditions, resource allocation graph, prevention techniques, avoidance technique – Banker's algorithm and related algorithms **[6L]**
7. Memory management: Address space and address translation;
   static partitioning, dynamic partitioning, different types of fragmentation, paging, segmentation, swapping, virtual memory, demand paging, page size, page table, page replacement algorithms – FIFO, LRU, Optimal page replacement, Variants of LRU, etc; thrashing, working set strategy **[6L]**
8. File Management: File and operations on it, file organization and access; file allocation; directory structures, file sharing, file protection **[4L]**
9. Device management: Magnetic disks,
   disk scheduling- criteria, algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, etc, disk management – formatting, boot block, disk free space management techniques, concept of RAID etc **[3L]**
10. Protection and Security: Concepts of domain, Access matrix and its implementation, access control, Security of systems- concepts, threats- Trojan horse, virus, worms etc, introduction to cryptography as security tool, user authentication **[5L]**
11. Case Studies **[4L]**

## Suggested Readings:

1. Operating Systems Concepts – A. Silberschatz, P. Galvin and G. Gagne. Wiley India

2. Operating Systems Concepts - Gary Nutt, N. Chaki and S. Neogy, Pearson Education
3. Operating Systems – W. Stallings, Pearson Education
4. Operating Systems: A Concept-based Approach – D. M. Dhamdhere, Tata McGraw-Hill

**CSE / T / 314A**

# Formal Language and Automata Theory

**Finite Automata** **[7L]**
DFA, NFA, Recognition of a language by an automaton, Equivalence of DFA and NFA, Minimization of FA, Equivalence of FAs

**Regular Languages** **[9L]**
Regular Sets and Languages, Pumping Lemma for Regular Languages, Closure Properties of Regular Sets, Kleen's Theorem

**Context-free Languages and Push-Down Automata** **[10L]**
Non-regular languages, CFLs, Closure properties of CFLs, Grammars, Ambiguity, Push-Down Automata, Normal Forms, Pumping Lemma for CFL.

**Turing Machines** **[8L]**
Introduction to Context Sensitive Languages and Grammars, Turing Machines and its variants, Universal TMs, Halting Problem, Recursive Functions and Sets, Recursively Enumerable Sets, Arithmetization of TMs.

**Complexity Classes** **[6L]**
Space and Time Complexity, RAM programs and TMs, PTIME, NP, PSPACE etc., Polynomial reducibility.

**Suggested Readings:**

1. Introduction to Automata Theory, Languages and Computation - J. E. Hopcroft and J. D. Ullman
2. Elements of the Theory of Computation - H. R. Lewis and C. H. Papadimitriou
3. An Introduction to Formal Languages and Automata – Peter Linz, Narosa
4. Introduction to the Theory of Computation – Michael Sipser, Thomson Press
5. Automata and Computability – Dexter C. Kozen, Springer

**CSE / T / 315A** # Digital Communication Systems

**Introduction:** Data and signal fundamentals, Analog and digital signals

**[1L]**

**Signals and Signal Analysis:** Periodic and nonperiodic signals, Composite signals, Signal analysis, Time and frequency domain representation, Bandwidth, Wave symmetry, Linear and non-linear mixing of signals.

**[2L]**

**Transmission Impairments:** Attenuation, Distortion, Noise - correlated and uncorrelated noises and their categories, Thermal noise, Noise factor and noise figure, Harmonic distortion and intermodulation distortion, Data rate limits for noisy and noiseless channels, Performance

**[3L]**

**Digital Transmission:** Problems with digital transmission, Different line coding schemes, Block coding schemes, Scrambling techniques; Analog to digital conversion – Sampling techniques, Sampling theorem, Pulse amplitude modulation, Pulse code modulation, Differential pulse code modulation, Delta modulation (along with advantages and disadvantages of each technique), Transmission modes (serial and parallel).

**[4L]**

**Analog Transmission:** Concepts of carrier signal, modulating signal and modulated signal; Amplitude modulation – double sideband suppressed carrier, double sideband transmitted carrier, single sideband; Frequency modulation – Narrowband FM and wideband FM; Digital to analog conversion – Amplitude shift keying, Frequency shift keying, Phase shift keying, Quadrature amplitude modulation, Performance.

**[4L]**

**Transmission Media:** Guided (wired) media – Twisted pair cable, Coaxial cable and Fibre optic cable, Construction, categories and connectors of each type, Performance, Advantages and disadvantages and applications of each type of media, Different propagation modes through fibre optic cable, Unguided (wireless) media – Different propagation modes, Radio waves, Terrestrial microwaves, Infrared, Applications and performances, Satellite communication.

**[4L]**

**Multiplexing and Spreading:** Concept of multiplexing, Frequency division multiplexing, Time division multiplexing – Synchronous and Statistical time division multiplexing, Handling variable length data, Pulse stuffing, Concept of spreading spectrum, Frequency hopping spread spectrum and Direct sequence spread spectrum.

**[6L]**

**Modems and Interfaces:** Dial-up modems, modem speed, standards; other modems; Interface standards.

**[4L]**

**Error Detection and Correction:** Types of errors, Basic concepts of error detection and correction, Redundancy, Hamming distance, Error detection – Simple parity check codes, Two-dimensional parity check, Cyclic redundancy check, Polynomials and cyclic code analysis, Checksum, Error correction – Hamming code.

**[6L]**

**Protocols for Data Communication:** Flow control and Error control, Stop and Wait protocol and its efficiency, Sliding window protocols - Go-back-N and Selective repeat, Piggybacking, HDLC, Point-to-point protocol.

**[6L]**

**Suggested Readings:**


1. Data & Computer Communications, William Stallings, Pearson Education
2. Data Communications and Networking, Behrouz A Forouzan, McGraw Hill
3. Electronic Communications Systems, Tomasi, Pearson Education
4. Digital Communications, Haykin, Wiley


## CSE / T / 321A Database Management Systems

**Introduction:** Advantages of DBMS, Various levels of Data Definition and abstraction, Data Independence **[2L]**

Concepts of Different Database Models, Functional Components of DBMS and Overall Structure of DBMS **[2L]**

**Relational Model:** Relation, Attribute, Key, Foreign Key and other Relational Constraints **[2L]**

**Database Design:** ER Diagram, Mapping and Participation Constraints, Weak Entity Set, Aggregation, Extended ER diagram, Design of Database Tables from ER/EER Diagram **[4L]**

**Languages:** Relation Algebra, Relational Calculus **[3L]**

Structured Query Language **[3L]**

**Functional Dependency:** Concepts of Functional Dependency, Normalization, Multivalued Dependency **[5L]**

**Database Storage:** Fixed/Variable Length Record, Ordered/Unordered file and Operations on them **[1L]**

**Indexing:** Primary/Clustering/Secondary/Multilevel Index, B/B+ Tree based Indexing, Hashing **[3L]**

**Query Optimization:** Search Strategies, Expression level Optimization, Join strategies **[2L]**

**Database Security** **[1L]**

**Case Study:** Introduction to Oracle Architecture, PL/SQL, Trigger **[3L]**

**Transaction and Recovery:** Concept of Transaction and its States, Log based Recovery, Checkpoint **[3L]**

**Concurrency Control:** Lock based Protocol, Time Stamp based Protocol, Recoverable Schedule etc. **[3L]**

**Advanced Concepts:** Object-oriented database concepts and other query languages **[3L]**

**Suggested Readings:**


1. Fundamentals of Database Systems by E. Navathe, Pearson
2. Database System Concepts by Korth and Silberschatz, McGrawHill
3. Commercial Application Development Using Oracle Developer - 2000 by I. Bayross, BPB


## CSE / T / 322A Principles of Programming Languages

**Introduction:** programming language definition, brief history of programming languages, overview of programming paradigms. [**1L]**

**Language design principles:** design criteria, efficiency, regularity. [**1L]**

**Syntax:** lexical structure, Context free grammar, BNF, syntax tree, parse tree, S-expression syntax. **[4L]**

**Semantics:** declaration, allocation, evaluation, symbol table, runtime environment, data types, type checking, weak typing, strong typing, static typing, parameter passing methods such as pass by value, pass by name, pass by result, pass by value-result, pass by reference, exceptions and exceptions handling. [**5L]**

**Garbage collection:** advantages, explicit garbage collection, automatic garbage collection, compacting. [**1L]**

**Imperative programming:** impact of Von Neumann architectures on programming languages, assignments, names, locations, L- value, R-value, memory allocation, scope rules, control flow, control abstraction, functions, exception handling, primitive and constructed data types, data abstraction. [**4L]**

**Object oriented paradigm:** objects, classes, methods, dynamic binding, inheritance, polymorphism, design and implementation issues in object-oriented languages, case study. [**3L]**

**Declarative programming:** distinctive features of declarative programming, first order logic, Horn clauses, resolution unification, sequencing of control, negation, implementation issues, the language Prolog. [**8L]**

**Functional programming:** distinctive features of functional programming languages, functional programming in imperative language, recursion, tail recursion, higher order functions, lazy evaluation, types in functional programming, mathematics of functional programming: lambda calculus. Introduction to functional programming using Scheme/Haskell/ML. [**9L]**

Brief introduction to multi-paradigm languages (Python/Leda/Ada/C#). [**4L]**

**Suggested Readings:**


1. Kenneth C. Louden, Programming Languages: Principles and Practice, 2003
2. D. A. Watt, Programming Languages and Paradigms, *Prentice*-Hall, 1990.
3. J. Lloyd, Foundations of Logic Programming, Springer Verlag, 1984.
4. M. Hennessey, The Semantics of Programming Languages, John Wiley, 1990.
5. Luca Cardelli and P. Wegner, On Understanding Types, Data Abstraction and Polymorphism, Computing Surveys, 17(4), pp 471, 1985.
6. C. Reade, Elements of Functional Programming, Addison Wesley, 1989.
7. Benjamin C. Pierce, ed., Advanced Topics in Types and Programming Languages, MIT Press, 2005.

**CSE / T / 323A**

# Compiler Design

**Introduction:** Programs, interpreters, and translators; Analysis-Synthesis model of translation; Examples of translators; Structure of a compiler; Issues in compiler design. [**2L**]

**Programming Language Basics:** Syntax, Semantics and Pragmatics; [**1L**]
The static/dynamic distinction, Environments and states, Static scope and block structures, Explicit access control, Dynamic scope, Parameter passing mechanisms, Aliasing. [**2L**]

**Lexical Analysis:** Role of a lexical analyzer; Input buffering, Specification of tokens, Recognition of tokens; Languages, Regular expressions, Regular definitions; Finite automata, Nondeterministic and deterministic finite automata, Transitions tables, Acceptance of input strings by automata, Conversion of an NFA to DFA; State-machine-driven lexical analyzers and their implementations. [**7L**]

**Syntax Analysis:** Role of a parser, Representative grammars, Context-free grammars, Parse trees, derivations and sentential forms, Ambiguity; [**2L**]

Top down parsing, Predictive and Recursive descent parsing, Elimination of left recursions, Left factoring, FIRST and FOLLOW sets and their computations, LL(1) grammars, Error recovery techniques; [**4L**]

Bottom up parsing, Reductions, Handle pruning, Shift reduce parsing; LR parsing, Implementing the parser as a state machine, viable prefixes, Items and the LR(0) automaton; Constructing SLR parsing tables: LR(0) grammars, SLR(1) grammars; Canonical LR(1) items and constructing canonical LR(1) parsing tables; Constructing LALR parsing tables. [**5L**]

Using Yacc and Lex. [**1L**]
**Semantics and Semantic Analysis:** Syntax-directed translation, Attribute grammars, Inherited and synthesized attributes, Dependency graphs, Evaluation orders of attributes, S-Attributed definitions, L-attributed definitions, Syntax-directed translation schemes. [**2L**]

Symbol tables and their relationship to semantic objects; Symbol table implementation: binary trees vs. hashing. [**2L**]

**Intermediate Code Generation:** Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back patching – Procedure calls. [**2L**]

**Runtime Environment:** Static versus dynamic storage allocation, Names, scopes and bindings; Object lifetimes; Stack allocation; Access to non-local data on the stack; Heap management; Garbage collection. [**4L**]

**Code Optimization:** Overview of optimization; Data Flow Analysis; Peephole Optimizations; Constant Folding, Common Subexpression Elimination, Copy Propagation, Strength Reduction. Global Optimization: Loop optimizations; Induction Variable elimination, Optimizing procedure calls – inline and closed procedures. Machine-Dependent Optimization: Pipelining and Scheduling. [**4L**]

**Code Generation:** Issues in the design of code generator – The target machine, Construction of executable code and libraries. [**2L**]

**Suggested Readings:**


1. "Compilers – Principles, Techniques, and Tools"; Alfred V. Aho, Monica S. Lam, Ravi Sethi,
2. Jeffrey D. Ullman; Pearson Education.
3. "Compiler Design in C", Allen I. Holub, Prentice Hall.
4. "Crafting a compiler with C", C. N. Fischer and R. J. LeBlanc, Pearson Education.
5. "Compiler Construction: Principles and Practice", Kenneth C. Louden, , Thomson Learning.


## CSE / T / 324A Computer Networks

**Introduction:** Uses of Computer Networks, Types of Computer Networks, OSI Reference Model, TCP/IP model

**[4L]**

**Review of Physical Layer**

**[4L]**

**Data Link Control and Protocols:** Link Layer Services, Error detection and Correction Techniques, Multi Access Protocols, Link Layer Addressing, Ethernet, Hubs, Switches and Switches, Point to Point Protocol, Asynchronous Transfer Mode, Multiprotocol Label Switching

**[6L]**

**Network Layer:** Introduction, Virtual Circuit and Datagram Networks, IP Addressing, Subnetting, Routing Algorithms (Link State, Distance Vector, Hierarchical), Routing in the Internet (RIP, OSPF, BGP), Broadcast and Multicast Routing Algorithms, Routers, ICMP, IPv6

**[8L]**

**Transport Layer:** Introduction to Transport Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection Oriented

Transport: TCP, Principles of Congestion Control, TCP Congestion Control, Sockets and Socket Programming, Quality of services (QOS)

**[8L]**

**Application Layer:** Web and HTTP, Domain Name Space (DNS), Electronic Mail (SMTP, MIME, IMAP, POP3), File Transfer Protocol, Cryptography

**[6L]**

**Introduction to Wireless and Mobile Networks**

**[4L]**

**Suggested Readings:**


1. Computer Networking: A Top-Down Approach Featuring the Internet, by James F. Kurose and Keith W. Ross, 5th Edition, Pearson Education, 2010
2. Data communication and Networking, by Behrouz A. Forouzan, 4th Edition, Tata McGraw-Hill, 2007
3. Computer Networks, by Andrew S. Tanenbaum, 4th Edition, Prentice Hall India, 2003
4. Computer Networks: A Systems Approach, by Larry L. Peterson and Peter S. Davie,4th Edition, Morgan Kauffman Publishers, 2007
5. Data and Computer Communication, by William Stallings, 9th Edition, Pearson Education, 2011
6. Unix Network Programming: Networking APIs: Sockets and XTI, (Volume 1) by W. Richard Stevens, 2nd Edition, Prentice Hall India, 1999


## CSE / T / 325A Design and Analysis of Algorithms

**Definition and Characteristics of Algorithms** – Role of Algorithms in Computing.

**[2L]**

**Notion of Optimality and Satisfiability** – Practical Considerations, Deterministic and Heuristic Algorithms. **[2L]**

**Performance Analysis** – Space Complexity, Time Complexity, Asymptotic Notations, Recursive functions. **[4L]**

**Solving Recurrences** – Induction, Substitution and Master Theorem **[4L]**

**Probabilistic and Randomised Algorithms.** **[2L]**

**Methodologies for Design of Algorithms** – Divide and Conquer, Dynamic Programming, Greedy Approach, Back-tracking, Branch and Bound – Domains of Applicability and relative advantages and disadvantages of these methodologies. Extensive emphasis to be given on design and analysis of representative algorithms – e.g. Sorting Algorithms (Insertion Sort, Merge Sort, Heap Sort, Quick Sort ), Horner's

Method for Evaluation of Polynomials, Matrix Multiplication Problem (Strassen' Algorithm), Matrix Chain Multiplication Problem, Longest Subsequence Problem, Cutting Rod Problem, Knapsack Problem, Huffman Code Problem, etc. **[16L]**

**Graph Algorithms** – Representation of Graphs, Breadth-First Search, Depth-First Search, Topological Sort, Minimal Spanning Trees (Prim's Algorithm, Kruskal's Algorithm), Travelling Salesman Problem, Single-Source Shortest Paths, All-Pairs Shortest Paths, Maximum Flow. **[4L]**

**Amortized Analysis** **[2L]**

**NP-Hard and NP-Complete Problems** – Non-deterministic Algorithms, Cook's Theorem, Introduction to Approximation Algorithms **[4L]**

**Suggested Readings**:


1. Introduction to Algorithms – T.H. Corman, C.E. Leiserson., R.L. Rivest, C. Stein.
2. Fundamentals to Computer Algorithms – E. Horowitz, S. Sahni, S. Rajasekaran.
3. Combinatorial Optimization Algorithms and Complexity – C.H. Papadimitriou, E. Steiglitz.


## CSE / T / 411A Software Engineering

Software as an engineering product, Software vs. Program, Software engineering vs. conventional engineering, Goals of software engineering, Issues and challenges **[2L]**

Software development process models, Waterfall, Prototyping, Spiral, Incremental, RAD and Component based development model. Comparative analysis of models **[2L]**

Requirement Engineering, Tools for requirement elicitation and analysis, Analysis issues, System Requirement Specification, Formal techniques– Z, Spec, Analysis Models for Structured approach & Object Oriented approach, Requirement Traceability. **[2L]**

Software Design & Modeling - Problem partitioning, Structured charts, coupling, cohesion, Modular Design and Structured Programming. Data design, User Interface design. **[2L]**

Overview of models in software development – UML, DFD, ERD, Modeling concurrent & distributed systems - PetriNets, High Level Petri Nets **[4L]**

Introduction to Design Patterns, Role of Design Patterns in Object Oriented design, Goals of Design Patterns, Selection of Design Patterns in Object Oriented systems, Using a

Design Pattern, Describing Design Patterns, Design Patterns classification. Case study. [**2L**]

Introduction to Aspect Oriented Paradigm. Case Study.

[**2L**]

Introduction to Software Architecture, Architecture models - 4+1 views, Architecture Definition Language, Evolution – Model Driven Architecture, Component Based architecture, Service Oriented Architecture, Event Driven Architecture, Architecture models [**2L**]

Coding Standards and Guidelines, Code reviews & Walkthroughs, Coding Principles, Code reuse [**2L**]

Program analysis – slicing and merging, Correctness proof, Symbolic execution, Formal Verification

Software testing objectives and principles, Verification vs. Validation, Types of testing, Cyclomatic complexity, Test Case Generation, Test tools & Models, Object-oriented Testing, Model Based testing, Test automation. [**6L**]

Software Quality Assurance and Quality control, Software Process Control, Quality factors, Quality standards – TQM, ISO, SEI CMM, PCMM, Six sigma, Reliability, Hazard, Availability, Steady State Availability, Estimation of Residual Errors, Reliability Models

[**4L**]

Software Project Management concepts, Software Project Management Plan, Tools for project plan – WBS, PERT, GANTT, Project Scheduling & Monitoring, Risk Management, Software Project Complexity, Estimation Metrics –Size Oriented and Function Point Oriented; Cost Estimation - Algorithmic Cost Modeling, COCOMO Model (including COCOMO II and advanced COCOMO), Personnel Productivity & team structure [**6L**]

Software Metrics, Significance, Project, process and product metrics, Halstead's metrics, OO metrics –Performance Metrics, Defect Metrics

[**2L**]

Software maintenance and types, Software reengineering process model; Computer Aided Software Engineering,, building blocks for CASE, Taxonomy of CASE tools

[**2L**]

**Suggested Readings:**


1. Fundamentals of Software Engineering – C. Ghezzi, M. Jazayeri, D. Mandrioli
2. Software Engineering – Sommerville, Pearson
3. Software Engineering – Martin L. Shooman, TMH
4. Software Engineering , A practitioner's approach – Roger Pressman
5. Software Engineering – Rajib Mall

**CSE / T / 412A** **Artificial Intelligence**

**Introduction**

**[2L]**

**Intelligent Agents**

**[2L]**

**Solving problems by Searching** – Uninformed (BFS, DFS, DLS, ID, IB, Bi-directional Search, Island-Driven Search), Informed/Heuristic (Greedy, A*, IDA*)

**[5L]**

**Advanced intelligent search techniques –** Uniform Cost Search, Hill Climbing, Simulated Annealing, Genetic Algorithm, Tabu Search

**[8L]**

**Adversarial search** - Game Playing

**[2L]**

**Knowledge and Reasoning** - Predicate calculus in Artificial intelligence, Resolution Refutation Systems, Structured Knowledge Representation Techniques

**[6L]**

**Reasoning under Uncertainty** – Non Monotonic Reasoning Systems, Assumption based Truth Maintenance System, Probabilistic Reasoning, Fuzzy Reasoning

**[4L]**

**Machine Learning** - Decision Trees, Artificial Neural Networks

**[5L]**

**Planning** – Classical, Algorithm for Planning as State-space Search, Planning Graph

**[2L]**

Some Applications of Artificial Intelligence

**[4L]**

**Suggested Readings:**


1. N. J. Nilsson. Artificial Intelligence : A New Synthesis, Elsevier India, 2010
2. N. J. Nilsson. Principles of Artificial Intelligence, Narosa Publishing House, 2002

3. N. J. Nilsson. Problem-Solving Methods in Artificial Intelligence, New York: McGraw-Hill, 1971.
4. S. Russel, P. Norvig. Artificial Intelligence and Modern Approach, Pearson Education, 2003
5. G. F. Lugar, Artificial Intelligence, Pearson Education, 2001
6. M. Ginsberg, Essentials of Artificial Intelligence, Morgan Kaufman Publishers, 1993
7. Elaine Rich, Kevin Knight. Artificial Intelligence

**CSE / T / 413A** **Internet Technologies**

**Introduction:** History of Internet and WWW, Internet Infrastructure, Internet Standards and Authorities

**[2L]**

**Review of Network Technologies:** IP, IP Subnetting and Addressing, DHCP, IPv6, Internet Routing Protocols (RIP, OSPF, BGP), TCP, UDP

**[5L]**

**Client Server Concepts:** Client-Server Programming In Java, DNS, Telnet, SSH, FTP

**[4L]**

**Electronic Mail:** SMTP, POP, IMAP, MIME

**[2L]**

**World Wide Web:** WWW Architecture, Web 2.0, Web 3.0, HTML, DHTML, XML (DTD, DOM, XSL, SOAP),

**[5L]**

**Web Services:** Design and Implementation, Web Caching and Content Distribution, CGI Scripts, Cookies, Javascript, Java Applets, Servelets

**[10L]**

**Internet Security:** Basic Cryptographic Concepts, Firewall, Virus and Worms, IPSec, SSL, PGP, S/MIME, Web Security, Web Application Vulnerabilities (SQL Injection, XSS, XSRF etc.)

**[7L]**

**Other Internet Based Applications:** Electronic Commerce, Streaming Multimedia, Internet Telephony, Search Engine and Web Crawlers

**[5L]**

**Suggested Readings:**

1. Internet and World Wide Web How to Program by Harvey M. Deitel, Paul J. Deitel, and T. R. Nieto, 4th Edition, Prentice Hall PTR Upper Saddle River, NJ, USA, 2008
2. TCP/IP Protocol Suite, 4/e by Behrouz Forouzan, Mc Graw Hill,
3. Core Web Programming, 2nd ed, 2001, by Marty Hall and Larry Brown
4. CGI Programming with Perl, 2nd ed, by Scott Guelich, O'Reilly
5. Core Servlets and JSPs, by Marty Hall, 2nd Edition, Prentice Hall
6. Cryptography and Network Security, by William Stallings, Fifth Edition, , Prentice Hall, 2010

**CSE / T / 421A**

# VLSI SYSTEMS

**Introduction:**
Categorization of Integrated Circuits; SSI, MSI, LSI, VLSI etc.
Technologies for VLSI and their features : TTL, ECL, NMOS, CMOS, Bi-CMOS, GaAs MOSFET. Comparison between different technologies for VLSI implementation.

[**2L**]

**Fabrication processes:**
Diffusion, doping, oxidation, Epitaxial layer formation, photo, ion-beam and x-ray lithographies. Silicon, Aluminium, Copper and polysilicon etching. Local oxidation and dielectric isolation, ion implantation. Outlines of Bipolar, MOS, CMOS and GaAs VLSI fabrication.

[**4L**]

**Advanced MOS and CMOS technology :**
Silicon gate technology, SOI technology, supper buffers, pre-charge nMOS and CMOS, Dynamic CMOS, Bi-CMOS. [**4L**]

**Design of MOS and CMOS:**
Standard MOS inverters, MOS inverters driven by pass transistors, MOS and CMOS inverter pair delay, Driving large capacitive load by MOS and CMOS inverters, stick and mask diagrams for MOS and CMOS, λ-based design rules, scaling. [**8L**]

**Structured design of VLSI:**
ROM, Multiplexer, PLA, PAL, CPLD and FPGA based implementation of VLSI, VHDL Programming.

[**10L**]

**CAD tools for VLSI design:**
Design entry, functional and timing simulation, logic synthesis and optimization, layout synthesis. Different placement and routing algorithm algorithms of standard cells.

[**7L**]

**Testing and testability:**
Different fault models; stuck-at, short circuit and open circuit faults. Automatic test pattern generator (ATPG), Design for testability; ad-hoc, scan-based and built in self test(BIST) techniques.

[**5L**]

**Suggested Readings:**

1. K.Eshraghian. D.A. Pucknell and S. Eshraghian, " Essential of VLSI Circuits and Systems", Prentice Hall of India Pvt. Ltd.

2. D.A.Pucknell and K.Eshraghian, “Basic VLSI Design”, Prentice-Hall of India Pvt. Ltd.
3. J.P.Uyemura, “ Chip design for Submicron VLSI: CMOS layout and Simulation”, Thomson India Edition.
4. W.Wolf, “ Modern VLSI design System- On chip Design”, Pearson Education.
N. Sherwani, “ Algorithms for VLSI
5. Bhaskar, “VHDL Programming”, Pearson.

## CSE / T / 422A Optimization Techniques and Operations Research

**Introduction** **[4L]**

Historical development, Engineering application of optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems.

**Linear Programming I** **[10L]**

Graphical method, Simplex method, Revised simplex method, Duality in linear programming, Sensitivity analysis, other algorithms for solving LP problems.

**Linear Programming II** **[6L]**

Transportation Problem, Assignment Problem and other applications, Integer Programming.

**Non Linear Programming** **[8L]**

Unconstrained optimization techniques, Direct search methods, Descent methods, Constrained optimization, Direct and indirect methods, Optimization with calculus, Khun-Tucker conditions.

**Dynamic Programming** **[6L]**

Introduction, Sequential optimization, computational procedure, curse of dimensionality.

**Queuing Theory** **[6L]**

Kendall’s notation, M/M/1 queue, M/G/1 queue, bulk arrival

**Suggested Readings:**

1. H. A. Taha: Operations research
2. S. Fang et al: Linear optimizations and Extensions
3. G. Hadley: Linear programming, Narosa Publishing House, New Delhi, 1990.
4. K. Deb: Optimization for Engineering Design – Algorithms and Examples.

**CSE / T / 414A** **Pattern Recognition**

Basic concepts of Pattern Recognition **[2L]**

Pattern Preprocessing and Feature Selection **[3L]**

Decision Functions **[2L]**

Bayesian decision theory **[2L]**

Parametric Estimation: Maximum likelihood estimation and Bayesian estimation **[5L]**

Non- parametric Estimation: Parzen windows, Nearest Neighbor estimation **[4L]**

Pattern Classification:

Linear classifier: Perceptron, SVM [**3L]**

Non-linear classifiers: MLP, Non-linear SVM [**5L]**

Unsupervised learning and Clustering: Partitioning method, Density-based method, MST-based method, Self organizing map, Hierarchical Clustering, Cluster validity **[10L]**

Syntactic Pattern Recognition (Basic concepts) **[2L]**

Some real-life applications **[2L]**

**Suggested Readings:**


1. Pattern Recognition Principles, Tou and Gonzalez, Addison-Wesley
2. Pattern Classification, Duda, Hart and Stork, Second Edition, Wiley
3. Pattern Recognition and Machine Learning, Christopher Bishop, Springer
4. Introduction to Statistical Pattern Recognition, Fukunaga, Second Edition, Academic Press

**CSE / T / 414B** **Mobile Computing**

1. Introduction to wireless networking and characteristics of mobile computing **[4L]**
2. Fundamentals of wireless transmission - Medium Access Control Protocols FDMA, TDMA, CDMA **[3L]**
3. Overview of Wireless LAN (IEEE 802.11) **[3L]**
4. Overview of Bluetooth architecture **[2L]**
5. Introduction to Mobile Adhoc Network and routing protocols- DSDV, WRP, CGSR, FSR, AODV, DSR, ABR, TORA etc. **[5L]**
6. Mobile Networking protocol (Mobile IP) **[3L]**
7. Mobile transport layer - Effects of mobility on Reliable Transport Protocols, Mechanisms for improving TCP performances on wireless links **[4L]**
8. Energy / Power Management **[3L]**
9. Wireless application Environments Wireless Application Protocol, WML, Push Architecture, Push/Pull Services **[8L]**
10. Overview of Security in mobile environments **[3L]**
11. Overview of fault tolerance in mobile computing systems **[2L]**

**Suggested Readings:**


1. *Ad Hoc Wireless Networks: Architectures and Protocols*, C. Siva Ram Murthy and B. S. Manoj.
2. Adhoc Networking, Charles Perkins, Pearson Education
3. Wireless Communication, W. Stallings


**CSE / T / 414C** **Distributed Systems**

**Characterization of Distributed Systems**:

Introduction, advantages and examples of distributed systems Models of distributed systems. **[4L]**

**Communication Issues:**

External data representation and marshaling, client-server communication, peer-to-peer communication, remote procedure calls. **[4L]**

**Fundamental Issues in Distributed Systems:**

Event ordering and logical clocks, global state collection, physical clock synchronization, mutual exclusion, leader election, termination detection, spanning tree construction, routing **[4L]**

**Fault Tolerance:**

Fault models, types of tolerance, Agreement protocols, Reliable broadcast and multicast, Checkpointing and recovery **[4L]**

**Distrbuted File Systems**:

File service architecture, case studies: Sun network file systems and Andrew file system.

**[4L]**

**Name Services:**

Name services and the Domain Name System, Directory and Discovery Services. **[4L]**

**Distributed Transaction**:

Flat and Nested distributed Transaction, Atomic commit protocols, Concurrency control in distributed transactions, Distributed Deadlocks, Transaction recovery. **[4L]**

**Replication:**

System model and group communication, Fault-tolerant services, highly available services, transactions with replicated data. **[4L]**

**Distributed Shared Memory**:

Design and Implementation Issues, Sequential consistency and Ivy, Release consistency and Munin, Other consistency models.

**[4L]**

**Security in Distributed Systems:**

Models, Authentication protocols – Kerberos [**4L]**

**Suggested Readings:**


1. Distributed Systems: Concepts & Design by George Coulouris, Addison Wesley Pvt. Ltd.
2. Distributed Systems by Tanenbaum, Prentice Hall of India.
3. Distributed Operating Systems by Pradeep K. Sinha,Prentice Hall of India.
4. Distributed Systems & Networks by William Buchanan,Tata McGrawHill
5. Distributed Systems: An algorithmic approach by Sukumar Ghosh
6. Distributed Algorithms by Nancy Lynch


**CSE / T / 414D** **Machine Learning**

**Introduction:** **[3L]**
Machine learning applications, concepts learning

**Introduction to Bayesian learning theory:** **[5L]**
regression, feature selection, supervised learning, class conditional probability distributions, Examples of classifiers Bayes optimal classifier and error, learning classification approaches, handling continuous attributes.

**Decision tree learning algorithms:** **[6L]**
Inference model, general domains, symbolic decision trees, consistency, learning trees from training examples, entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm, handling continuous and missing attributes, confidence, overfitting, pruning, learning with incomplete data

**Artificial Neural Network:** **[4L]**
Single layer neural network, linear reparability, general gradient descent, perceptron learning algorithm, multi-Layer perceptron: two-layers universal approximators, backpropagation learning, important parameters, Margin of a classifier, dual perceptron algorithm, learning non-linear hypotheses with perceptron.

**Instance-based Learning:** **[2L]**
Nearest neighbor classification, k-nearest neighbor, nearest neighbor error probability,

**Machine learning concepts and limitations:** **[10L]**
Learning theory, formal model of the learnable, sample complexity, learning in zero-bayes and realizable case, VC-dimension, fundamental algorithm independent concepts, hypothesis class, target class, inductive bias, occam's razor, empirical risk, limitations of inference machines, approximation and estimation errors, Tradeoff.

**Support Vector Machine (SVM):** **[3L]**
Kernel functions, implicit non-linear feature space, theory, zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, maximal margin classifier.

**Machine learning assessment and Improvement:** **[3L]**
Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting.

**Unsupervised learning**: **[2L]**
Introduction, K- means clustering, Hierarchical Clustering
**Semi-supervised learning:** **[2L]**
introduction, self-training, co-training

**Suggested Readings**


1. T. M. Mitchell, Machine Learning, McGraw-Hill, 1997.
2. E. Alpaydin, Introduction to Machine Learning, Prentice Hall of India, 2006.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
4. R. O. Duda, P. E. Hart, and D.G. Stork, Pattern Classification, John Wiley and Sons, 2001.
5. Vladimir N. Vapnik, Statistical Learning Theory, John Wiley and Sons, 1998.
6. Shawe-Taylor J. and Cristianini N., Cambridge, Introduction to Support Vector
7. Machines, University Press, 2000.


## CSE / T / 414E Computer and Network Security

**Introduction:** Security Goals, Threat, Vulnerabilities and Attacks, Types of Attacks, Security Services and Mechanisms **[1L]**

**Cryptographic Tools:** Symmetric Key Cryptography, Asymmetric Key Cryptography, Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signatures **[2L]**

**User Authentication:** Password Based Authentication, Token Based Authentication, Biometric Authentication, Remote User Authentication **[2L]**

**Access Control:** Access Control Principles, Subjects, Objects, and Access Rights, Discretionary Access Control, Role-Based Access Control **[2L]**

**Database Security:** Database Access Control, Inference, Statistical Database, Database Encryption **[2L]**

**Internet Security Protocols and Standards:** IPSec, SSL and TLS, PGP and S/MIME **[6L]**

**Internet Authentication Applications:** Kerberos, X.509, Public Key Infrastructure **[4L]**

**Security Appliances:** Intrusion Detection Systems, Firewalls and Intrusion Prevention Systems **[3L]**

**Malicious Software:** Types of Malicious Software, Viruses, Virus Countermeasures, Worms, Bots, Rootkits **[2L]**

**Software Security:** Buffer Overflow Attacks, Defence against Buffer Overflows, Handling Program Inputs, Writing Safe Program Codes, Interaction with Operating System and Other Software **[4L]**

**Operating System Security:** Linux Security, Windows Security **[4L]**

**IT Security Management Issues:** IT Security Management, IT Security Standards, Organizational Context and Security Policy, Security Risk Assessment, IT Security Controls, Plans and Procedures, IT Security Audit, Cybercrime and Computer Crime, Intellectual Property, Privacy, Ethical Issues **[4L]**

**Wireless Network Security:** Authentication and Authorization in Wireless LANs, Data Protection in Wireless LANs **[4L]**

### Suggested Readings:


1. Computer Security: Principles and Practices, by William Stallings and Larry Brown, First Edition, 2008, Pearson Education
2. Network Security: Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Second Edition, 2003, Prentice Hall India
3. Cryptography and Network Security, by William Stallings, Fifth Edition, , Prentice Hall, 2010
4. Network Security Essentials: Applications and Standards, by William Stallings, Edition, Pearson Education
5. Cryptography and Network Security by Behrouz A. Forouzan and Debdeep Mukhopadhyay, Second Edition, 2010, Tata McGraw Hill
6. Security in Computing, by Charles P. Pfleeger, Shari Lawrence Pfleeger, 4th Edition, 2007, Prentice Hall


## CSE / T / 414F Information and Coding Theory

### Information Theory

Introduction to Information Theory **[1L]**

| | |
|---|---|
| Information and Entropy | **[1L]** |
| Joint Entropy | **[2L]** |
| Mutual Information | **[1L]** |
| Extension of a zero Memory Source | **[1L]** |
| Source Encoding, Kraft's Inequality, Huffman Coding | **[3L]** |
| Shannon's 1$^{st}$ Fundamental Theorem | **[1L]** |
| Idea of Markov Source | **[1L]** |
| BSC, BEC and Channel Capacity | **[3L]** |
| **Coding Theory** | |
| Introduction to Coding Theory | **[1L]** |
| **Block Codes**: | |
| Introduction | **[1L]** |
| Parity Check Code, Product code, Repetition Code | **[2L]** |
| Hamming Code, Minimum Distance of Block Codes | **[2L]** |
| **Review of Linear Algebra and Galois Field** | |
| Finite Field, Vector Spaces, Matrices | **[2L]** |
| Roots of Equation, GF($2^p$), Primitive Field Element, Irreducible and Primitive Polynomial, Minimal Polynomial | **[3L]** |
| **Linear Codes**: | |
| Definition, Systematic Format, Generator and Parity Check Matrices | **[2L]** |
| Syndrome and Error Detection | **[2L]** |
| Standard Array and Syndrome Decoding | **[2L]** |
| Hamming Code | **[1L]** |
| **Cyclic Codes**: | |
| Definition, Generator Polynomial and Its Properties, | |
| Parity Check Polynomial | **[2L]** |
| Encoding and Decoding | **[2L]** |
| Cyclic Hamming Code | **[1L]** |
| **Introduction to BCH Codes and Advanced topics** | **[3L]** |

**Suggested Readings:**

1. Principles of Digital Communication – Das, Mukherjee, Chatterjee

2. Introduction to Error Control Codes – S. Gravano
3. Error Control Coding: Fundamentals and Applications – Shu Lin, Danilel J. Costello, Jr.
4. The Theory of Error-Correcting Codes, Vol 1 & 2, by F.J. MacWilliams and N.J.A. Sloane
5. Coding and Information Theory by Richard W. Hamming
6. Handbook of Coding Theory, Vol 1 & 2, by V. S. Pless and W. C. Huffman
7. Algebraic Codes for Data Transmission by Richard E. Blahut
8. Introduction to Coding Theory by Jacobus Hendricus van Lint
9. Coding and Information Theory by Steven Roman
10. Error Control Coding by Shu Lin and Daniel J. Costello
11. Error Correction Coding: Mathematical Methods and Algorithms by Todd K. Moon

**CSE / T / 414G**

# Data Mining

**Introduction to Data Mining:** **[2L]**
Process of Knowledge Discovery; Migration from Database to Data Warehouses ; Types of Data ; Data Mining Functionalities

**Data Preprocessing:** **[6L]**
Data Summarization; Data Cleaning; Data Integration; Data Transformation; Data Reduction; Data Discretization & Concept Hierarchy Generation

**Data Warehousing Techniques:** **[4L]**
OLAP vs. OLTP; Data cubes; Multidimensional Data Models and Schemas with their definitions; OLAP operations; Data Warehouse Architectures and Design Strategies

**Frequent Pattern Mining, Association Rule Generation, Correlation Analysis: [6L]**
Concepts; Frequent Itemset Mining Algorithms - Apriori, FP-Tree Growth; Association Rules & their types; Association to Correlation

**Classification Algorithms:** **[8L]**
Eager Learning Techniques – Decision trees, Neural Networks, Bayesian Methods, Support Vectors Machines & Lazy Learning Techniques - K Nearest Neighbours, Case-Based Reasoning; Prediction Techniques

**Cluster Analysis:** **[7L]**
Various Data types involved and Data Structures; Categories of Clustering Methods : Partitioning, Hierarchical, Density-based, Grid-based, Model-based, Constraint-based ; Industry Standard Techniques ; Outlier Detection Methods

**Mining Specific Data:** **[5L]**
Text Mining; Multimedia Mining; Web Mining

**Applications and Trends in Data Mining:** **[2L]**
Outlier Analysis and Fraud Detection.

**Suggested Readings**:

1. J. Han & M. Kamber, Data Mining: Concepts and Techniques, Elsevier

2. Margaret H. Dunham & S. Sridhar : Data Mining Introductory and Advanced Topics, Pearson Education

3. E-books - http://www.kdnuggets.com/publications/books.html

**CSE / T / 423A** **Bioinformatics**

Introduction to Bioinformatics, Central dogma of Molecular Biology
**[2L]**

Biological Databases- Concepts and Understanding
**[4L]**

Sequence alignment: Global and local alignment, scoring, dynamic programming, tree alignment, Hidden Markov Models
**[6L]**

Gene finding algorithms
**[3L]**

Protein Sequences and Substitution matrices: Suffix tree construction and applications
**[2L]**

Introduction to Gene Expression: Microarrays, their uses, idea about normalization
**[2L]**

Single Nucleotide Polymorphisms (SNPs): The Haplotype problem
**[1L]**

Phylogenetic Tree and Analysis
**[2L]**

Introduction to Gene Regulation: Gene regulation, binding sites, transcriptional networks, gene's circuitry

**[6L]**

Network of Interactions: Regulatory networks

**[2L]**

Signals in Sequences: Weight matrices, higher order MC dependencies, transcription factor binding sites

**[2L]**

Introduction to Proteomics: Protein structure, interactions

**[2L]**

Protein Structure Prediction: Attempts to predict secondary and tertiary structure of amino acid sequences

**[4L]**

Drug docking

**[2L]**

**Suggested Readings:**

1. Dan Gusfield. Algorithms on Strings, Trees, and Sequences, Cambridge University Press, 1997
2. Richard Durbin, Sean R Eddy, Anders Krogh, Graeme Mitchison. Biological Sequence Analysis, Cambridge, 1998
3. Roderic D M Page, Edward C Holmes. Molecular Evolution: A phylogenetic Approach, Blackwell Sciences Inc 1999
4. David W Mount. Bioinformatics: Sequence and Genome Analysis, CBS Publishers and Distributors (Pvt.) Ltd., 2005
5. Pierre Baldi, Soren Brunak. Bioinformatics: The Machine Learning Approach, MIT Press, 2001

## CSE / T / 423B Natural Language Processing

**Regular Expressions and Automata**: [**2L**]
Introduction to NLP, Regular Expression, Finite State Automata

**Tokenization** [**6L**]
Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance

**Morphology** [**4L**]

Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer

**Language Modeling** [**4L**]

Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models.

**Hidden Markov Models and POS Tagging** [**4L**]

Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation

**Text Classification** [**4L]**

Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques

**Context Free Grammar** [**6L**]

Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing

**Computational Lexical Semantics** [**4L**]

Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity

**Information Retrieval** [**6L**]

Boolean Retrieval, Term-document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback

**Suggested Readings:**


1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press


## CSE / T / 423C Distributed Computing

**Introduction to distributed environment:** [**4L]**
Goals, hardware & software concepts, P2P, Cluster, Grid, Cloud, the client-server model, Strengths and weakness of distributed computing, forms of computing

**Communication:** [**4L]**
Layered protocols, RPC, remote object invocation, message-oriented communication

**Distributed computing paradigms:** **[5L]**
Message passing, client server, P2P, remote procedure call model, distributed objects, object space, collaborative application (groupware)

**Socket:** [**2L]**
Socket metaphor, datagram socket API, stream mode socket API, sockets with non blocking I/O, secure socket API

**Java RMI:** [**6L]**
Client side, Server Side, object registry, Remote Interface, Server side software, client side software, RMI vs Socket

**Advanced RMI:** [**3L]**
Client callback, stub downloading, RMI security manager

**Group Communication:** **[2L]**
Unicasting, multicasting, connection oriented & connectionless, reliable and unreliable multicast, Java basic multicast API

**Internet Applications:** [**5L]**
HTML, XML, HTTP, Applets, Servlets, Web services, SOAP

**Mobile Agents:** **[2L]**
Basic architecture, advantages, mobile agent framework systems, design, implementation using Java RMI

**Distributed coordination-based systems** JINI: [**5L]**
Runtime environment, architecture, discovery protocol, join protocol, lookup service, distributed event, distributed leasing, transactions, surrogate architecture

**New paradigms of distributed computing environment** **[2L]**

**Suggested Readings:**


1. Distributed Computing: Principles and Applications, M. L. Liu, Pearson/Addison-Wesley.
2. A Programmer's Guide to Jini Technology, Jan Newmarch, Apress.

3. A. Taunenbaum, Distributed Systems: Principles and Paradigms, PHI
4. G. Coulouris, J. Dollimore, and T. Kindberg, Distributed Systems: Concepts and Design, Pearson Education
5. Core Jini, W. Kieth Edwards, Apress.

**CSE / T / 423D** **Embedded Systems**

Introduction, Definitions, Constituents of embedded systems, application areas, various categories of embedded systems. **[4L]**

Architecture of embedded systems: hardware, software, memory, Communication interfaces. **[6L]**

Overview of 8051 Microcontroller, Digital Signal Processors and FPGA. **[6L]**

Overview of Embedded/real-time operating systems **[4L]**

Simulation with VHDL. **[4L]**

Implementation with FPGA. [**3L]**

Hardware-software co-design. **[3L]**

Partitioning Hardware-Software. **[4L]**

Functional Partitioning and Optimization. **[2L]**

Low Power Embedded System Design. **[4L]**

**Suggested Readings:**

1. Embedded/Real-time Systems:Concepts Design and Programming by Dr. K.V.K.K. Prasad, Dreamtech Press.
2. Programming for Embedded Systems, Dreamtech Software team, Wiley-Dreamtech India Pvt.
3. Embedded System Design by S. Chattopadhyay, PHI
4. Embedded System Design - A unified Hardware/ Software Introduction by F. Vahid, T. Givargis, Willey India Edition

5. Embedded System Design with Platform FPGAs – Principles and Practices by R.Sass A.G.Schmidt, Morgan_kaufman Publisher

## CSE / T / 423E Programming Environment and User Interface Design

**Introduction :** **[4L]**

Importance of User Interfaces (UI) in Computer Applications.
UI Design as an Engineering problem.
Ergonomic aspects of UI, Cognitive and Cultural aspects of UI,
Principles of UID
Ease of Learning. Ease of Use – Consistency - Terseness.

**Design of Programming Environment** **[2L]**

**Human Computer Interaction:** **[4L]**

Hick-Hyman Law
Fitt's Law

**Formal methods for specification of UIs:** **[6L]**

Grammar
Petri Nets
Menu Trees etc.

UI Development and Evaluation Case study **[4L]**

Interaction Elements **[1L]**

Methodology for Design of Command Names **[2L]**

Error Messages and Exception Handling **[1L]**

Direct Manipulation - Graphic Design **[3L]**

**Multilingual UI:** **[4L]**

Internationalization
Handling locale-sensitive UI components like screen layouts, colors, date, time etc.

**Web Design:** **[3L]**

Designing navigation
Increasing accessibility- interface for differently-abled users

**Advanced UI's :** **[6L]**

Groupware
3D UIs
Multimedia UI's

**Suggested Readings:**


1. D. A Norman, *The Design of Everyday Things*. New York, NY: Doubleday, 1990.
2. B. Schneiderman, Designing the User Interface, Addison Wesley,fifth edition.
3. Alan Cooper, *About Face: (3rd edition) The Essentials of Interaction Design*, Wiley.


**CSE / T / 423F** **Image Processing**

**Introduction:**

Overview of Image Processing System **[1L]**

Image Digitization (Sampling and Quantization), Digital Image **[2L]**

Fundamentals of Colour image and Colour Models, Image File Format **[3L]**

**Mathematical Transformation:**

Fourier Transform (1-D and 2-D), Discrete Cosine Transform **[2L]**

**Image Enhancement:**

Contrast Intensification (linear and non-linear stretching) **[2L]**

Histogram Equalization **[1L]**

Spatial Domain Smoothing Filters **[3L]**

Image Sharpening **[1L]**

Frequency Domain Lowpass and Highpass filters **[2L]**

Colour Image Smoothing and Sharpening **[3L]**

**Image Segmentation:**

Point Detection, Line Detection **[1L]**

Edge Detection (Robert, Prewitt, Sobel and Canny Edge Detector) **[2L]**

Edge Linking and Edge Following by Local Processing, Hough Transform **[2L]**

Region Extraction by Pixel based Approach (Thresholding, Choice of Feature, Optimum Threshold etc.) **[3L]**

Region Extraction by Region based Approach ( Intoduction to Region Growing, Splitting, Merging, Split and Merge) **[1L]**

**Description and Representation:**

Boundary Representation by Chain Codes, Polygonal Approximation, Skeletons **[2L]**

Component Labelling and Counting **[1L]**

Geometrical Attributes (Perimeter, Area, Diameter of Enclosing Circle), Geometric Moments **[1L]**

Texture Descriptor (Graylevel Co-Occurrence Matrix etc.), Colour Descriptors **[1L]**

**Image Compression:**

Loss-less Compression by Run Length Coding, Huffman Coding, Predictive Coding **[2L]**

Lossy Compression by Block Truncation Coding, Vector Quantization **[2L]**

JPEG Compression **[2L]**

**Suggested Readings:**


1. Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods
2. Digital Image Processing and Analysis by B. Chanda and D. Dutta Majumder
3. Fundamentals of Digital Image Processing by Anil K. Jain


**CSE / T / 423G** **Biometric Systems**

**Introduction to Biometric Systems:** History, Definition, Characteristics, Systems model, Identification, Verification/Authentication, Applications.

**[2L]**

**Image processing and Pattern recognition Fundamentals:** Introduction to biometric samples, Representation, Biometrics as pattern recognition systems, Preprocessing, Segmentation, Noise removal techniques, etc.

**[4L]**

**Biometric Traits:** Fundamentals of acquisition sensors and techniques, Characteristics of Biometric traits- Face, Gait, Iris, Fingerprint, Signature, etc.

**[2L]**

**Biometric Systems Performance Terminology:** Performance assessment terminology – Estimation of errors, FAR, FRR, ROC, Ranking; Testing methods used in biometrics, Graphical analysis of system performance.

**[2L]**

**Biometric Feature Extraction: Subspace-based approaches:** Principal Component Analysis (PCA), Fisher's Linear Discriminant Analysis (FLDA), 2DPCA, 2DFLDA, Generalized 2DPCA, Generalized 2DFLDA, Kernel version of subspace-based approaches; Geometric-feature-based approaches; Hybrid approaches. Invariant features, etc.

**[10L]**

**Biometric Classification & Recognition:** Design of classifiers: Neural networks-based classifiers, Probabilistic classifiers, Neuro-Fuzzy classifiers; Template matching, etc.

**[5L]**

**Multi-biometric Systems:** Introduction to multi-biometric systems, Types of multi-biometric systems, levels of fusion in multi-biometric systems: Image fusion, Feature level fusion, Dimension reduction, Decision level fusion, Demster Shafer (DS) Theory, Multi-level fusion.

**[5L]**

**Video-based Person Identification:** Acquisition, Generic systems model, Face detection and recognition from video, Tracking.

**[4L]**

**3D face recognition systems:** 3D face model – Reconstruction, feature extraction and recognition; Expression and Action recognition; Multi-view 3D reconstruction.

**[4L]**

**Biometric Standards & Privacy:** Introduction to biometric standards, importance of biometric standards, privacy, Biometric attacks, interoperability of data, systems and applications.

**[2L]**

**Suggested Readings:**


1. Biometrics: Theory, Methods & Applications, N. V. Boulgouris, K. N. Plataniotis, E. Micheli-Tzanakou, IEEE Press, 2009.
2. A. Ross, K. Nandakumar and A. K. Jain, "Handbook of Multibiometrics", Springer Publishers.
3. Guide to Biometrics, Ruud Bolle, J. Connell, S Pankanti, N Ratha, A Senior, Springer.
4. Biometric Technologies and Verification Systems, J R Vacca, Elsevier.
5. Biometric Systems: Technology, Design & Performance Evaluation, J. Wayman, A. K. Jain, D. Maltoni, D. Maio, Springer Verlag, 2004.
6. Handbook of Biometrics, Springer Verlag, 2008, A. K. Jain, P. Flynn and A. A. Ross.


**CSE / T / 424A**

# Cryptography

**Introduction to Cryptography** **[6L]**

Cryptosystem. Encryption and Decryption. Cryptographic Attacks. Notions of Security. Perfect Secrecy. Symmetric and Asymmetric Key Cryptosystems. Block and Stream Ciphers.

**DES and AES** **[8L]**

Data Encryption Standard. Advanced Encryption Standard. Variants of DES and AES.

**Stream Ciphers** **[4L]**

LFSR based stream ciphers, software stream ciphers

**Cryptanalysis** **[6L]**

Differential Cryptanalysis. Linear Cryptanalysis. Correlation Attacks. Algebraic Attacks.

**Public Key and Related Concepts** **[6L]**

RSA and other public key systems. Hash Functions. Identification and Authentication. Digital Signatures.

**Key Management** **[4L]**

Key Distribution. Key Agreement. Public key infrastructure.

**Advanced Topics** **[6L]**

Elliptic Curve Cryptosystems, Secret Sharing. Multiparty Computation. Zero-knowledge Protocols.

**Suggested Readings:**


1. "Fundamentals of Computer Security", by Josef Pieprzyk, Thomas Hardjono and Jennifer Seberry (Springer), 2008.
2. "Cryptography: Theory and Practice", by Douglas Stinson, CRC Press, 2006.
3. "Applied Cryptography: Protocols, Algorithms, and Source Code in C", by Bruce Schneier, Wiley, 1996.
4. "Handbook of Applied Cryptography", by Alfred Menezes, Paul van Oorschot and Scott Vanstone, CRC Press, 1996.


**CSE / T / 424B** **Computational Geometry**

**Geometric Objects** – Points, Lines, Planes, Polygons, 3D Objects – Geometric Algorithms – Degeneracies and Robustness – Application Domains **[3L]**

**Convex Hull in 2D** – Incremental Algorithm **[2L]**
**Line Segment Intersection Algorithms** – Doubly Connected Edge List – Map Overlays – Boolean operations **[6L]**

**Polygon Triangulation** – Partitioning Polygons into Monotone Pieces – Triangulation of Monotone Polygons – Art Gallery Problem **[6L]**

**Half Plane Intersections** – Use of Linear Programming Techniques – Manufacturing with Moulds **[6L]**

**Orthogonal Range Searching** – Kd Trees – Range Trees – Higher Dimensional Range Trees – Database Searching – Point Location **[6L]**

**Voronoi Diagrams** – VD of Line Segments – Farthest Point VDs – Post Office Problem **[6L]**

**Convex Hulls in 3-space** **[3L]**

**Robot Motion Planning** – Work Space and Configuration Space – Translational Motion Planning **[2L]**

**Suggested Readings:**


1. Computational Geometry – Algorithms and Applications by Berg, Cheong, Kreveld and Overmars 3e, Springer
2. Computational Geometry – An Introduction by Preparata and Shamos, Springer
3. Computational Geometry in C – Joseph O'Rourke, 2e, Cambridge Univ Press


## CSE / T / 424C Big Data Analytics

## CSE / T / 424D Multimedia Technology

**Introduction**

Multimedia and its Application, Different Media, Hypertext and Hypermedia, Issues in Multimedia System, Component of a Multimedia System **[2L]**

**Overview of Text and Graphics:**

Types of Text Data (Plain/Formatted/Hypertext), Unicode Scheme, Concept of Font, File Formats (txt, doc, rtf, ps, pdf etc.), Vector and Raster Graphics **[2L]**

**Image:**

Image Digitization, Digital Image, Binary/GrayScale/ Colour Image, Colour Models, File Formats, Overview of Contrast Intensification, noise removal, edge detection and segmentation **[5L]**

Image Descriptors (Shape, Texture and Colour Features) **[3L]**

Loss-less and Lossy Image Compression including JPEG **[3L]**

An overview of Content Based Image Retrieval System **[3L]**

**Audio:**

Audio Digitization (Sampling and Quantization, Representation based on PCM/DPCM/DM/ADM), File Formats **[2L]**

Time Domain Descriptors (ZCR, STE etc.), Frequency Domain Descriptors (Spectral Centroid, Spectral Flux, Spectral Roll Off etc.), and Perception based Descriptors (Mel Scale, MFCC) **[3L]**

Psycho Acoustics and Audio Compression **[2L]**

An Overview of Audio Classification/Retrieval System **[2L]**

**Video:**

Structure of Video Data, File Formats **[1L]**

Video Compression **[2L]**

Motion Estimation **[1L]**

Structural Segmentation of Video Data **[3L]**

Overview of Video Summarization, Browsing and Retrieval System **[2L]**

**Animation:**

Keyframes & tweening, cel & path animation, principles and techniques of animation, Web animation, 3D animation principles, camera, special effects, transformations and editing, rendering algorithms, features of animation software, file formats.

**[4L]**

**Suggested Readings:**


1. Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods
2. Digital Image Processing and Analysis by B. Chanda and D. Dutta Majumder
3. Principles of Multimedia by Ranjan Parekh

4. Multimedia –A Practical Approach by Sanhker, Jaico.
5. Multimedia Systems by Buford J. K., Pearson Education.
6. Multimedia and Imaging Databases by S. Khoshafian, A. Brad Baker, Morgan Kaufmann.
7. Multimedia Systems Design, Prabhat k. Andleigh & Kiran Thakkar, Prentice Hall PTR.
8. Digital Multimedia by Nigel Chapman & Jenny Chapman, John-Wiley.
9. Fundamentals of Computer Graphics and Multimedia by D.P. Mukherjee, PHI

## CSE / T / 424E Information Storage and Retrieval Systems

**Introduction** **[2L]**
Objectives, Functional Overview, Relationship to DBMS, Digital libraries and Data Warehouses, Information Retrieval System Capabilities.

**Information storage** **[4L]**
Storage of structured, semi-structured and unstructured data, introduction to VLDB (Very large databases)

**Natural Language Interface to Databases:** **[2L]**
Natural language query processing, intermediate representation, SQL command generation.

**Cataloging and Indexing:** **[7L]**

Indexing Processes, Information Extraction.
Data Structures: Stemming Algorithms, Inverted file structures, N-gram data structure, PAT data structure

Automatic Indexing: Classes of automatic indexing, Statistical indexing, Concept indexing, Document and Term Clustering (Thesaurus generation, Item clustering, Hierarchy of clusters)

**Information retrieval models** **[5L]**
Boolean model, Vector Space Model, Probabilistic information retrieval models

**User Search Techniques** **[4L]**

Similarity measures and ranking, Query expansion, Relevance feedback, Pseudo relevance feedback.

**Text Search Algorithms** **[6L]**

Pattern matching Algorithms: Rabin-Karp, Knuth-Morris-Pratt, Boyer-Moore, Finite Automata based methods.
Searching the web: PageRank algorithm, HITS algorithm

**Introduction to Multimedia Information Retrieval [5L]**

Attribute-based image retrieval, Text-based image retrieval, Query by Image Content (Using content descriptors; color and texture, Identifying shapes - image objects), Streamed Image Retrieval - basic concepts, Improving Result Quality

**Information retrieval from Digital Libraries: [3L]**
Digital Libraries: history, definition, characteristics, architectures, collection management, Metadata. Representation of different media, Interoperability between different information resources, collections, and systems

**Evaluation of information retrieval systems [2L]**

Measures used in system evaluation, Measurement example – TREC results.

**Suggested Readings:**


1. Information Storage and Retrieval Systems: Theory and Implementation By Kowalski, Gerald, Mark T Maybury, Kluwer Academic Press, 2000.

2. Modern Information Retrival By Ricardo Baeza-Yates, Pearson Education, 2007.

3. Information Retrieval: Algorithms and Heuristics By David A Grossman and Ophir Frieder, 2nd Edition, Springer International Edition, 2004.

4. Information Retrieval Data Structures and Algorithms By William B Frakes, Ricardo Baeza-Yates, Pearson Education, 1992.

5. Information Storage & Retieval By Robert Korfhage – John Wiley & Sons.

6. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press, 2008.


## CSE / T / 424F Service Oriented Architecture (SOA)

- **SOA Fundamentals:** **[7L]**

Introduction & Evolution of Service Computing / Orientation, Defining SOA, Business Value of SOA, Evolution of SOA, SOA characteristics, concept of a service in SOA, Basic SOA architecture, infrastructure services, Enterprise Service Bus (ESB), SOA Enterprise Software models

- **Service Definition:** **[3L]**

Autonomy, ABC- addressing, Binding, Contract, Proxy, Web Service as an example of Service implementation

- **SOA Planning and Analysis :** **[7L]**

Stages of the SOA lifecycle, SOA Delivery Strategies, service-oriented analysis, Service modeling, Basic modeling building blocks, service models for legacy application integration and enterprise integration, Enterprise solution assets (ESA).

- **SOA Design and implementation:** **[7L]**

Service-oriented design process, design activities, determine services and tasks based on business process model, choosing appropriate standards, articulate architecture, mapping business processes to technology, designing service integration environment (e.g., ESB, registry)

- **Standards:** **[4L]**

WS Policy, WS Metadata, WSDL as WS- Metadata

- **Communication and SOA :** **[5L]**

SOAP, XML Serialization, Formatter- binary formatter, SOAP formatter, WS addressing, WS event, WS security, WS authorization, WS secure conversation

- **Managing SOA Environment:** **[7L]**

Distributing service management and monitoring concepts, operational management challenges, Service-level agreement considerations, SOA governance (SLA, roles and responsibilities, policies, critical success factors, and metrics), QoS compliance in SOA governance

**Suggested Readings:**

1. Thomas Erl, “Service-Oriented Architecture: Concepts, Technology, and Design”, Prentice Hall Publication, 2005.

2. Norbert Bieberstein, Sanjay Bose, Marc Fiammante, Keith Jones, Rawn Shah, “Service-Oriented Architecture Compass: Business Value, Planning, and Enterprise Roadmap”, IBM Press Publication, 2005.

3. Sandy Carter, “The New Language of Business: SOA & Web 2.0”, IBM Press, 2007.

4. Thomas Erl, “Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services”, Prentice Hall Publication, 2004.

5. Dave Chappell, “Enterprise Service Bus”,O'Reilly Publications, 2004.

6. Sanjiva Weerawarana, Francisco Curbera, Frank Leymann, Tony Storey, Donald F.Ferguson, “Web Services Platform Architecture: SOAP, WSDL, WS-Policy, WS- Addressing, WS-BPEL, WS-Reliable Messaging, and More”, Prentice Hall Publication, 2005.

7. Eric Newcomer, Greg Lomow, “Understanding SOA with Web Services”, Addison Wesley Publication, 2004.

**CSE / T / 424G**

# Soft Computing

1. Introduction to Soft Computing, Components of Soft Computing, Importance of Soft Computing, Applications. **[2L]**

2. Fuzzy Set Theory - Definition, Different types of fuzzy set membership functions. Fuzzy set theoretic operations, Fuzzy rules and fuzzy reasoning, Fuzzy inference systems. **[8L]**

3. Rough set theory. **[2L]**

4. Probabilistic Reasoning. **[4L]**

5. Genetic Algorithms, Simulated Annealing, applications. **[6L]**

6. Neural Networks- Artificial neural networks models, Supervised Learning, Unsupervised Learning, Applications. **[10L]**

7. Hybrid Systems and applications **[8L]**

**Suggested Readings:**

1. Neuro Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence - Jang, Sun and Mizutani, Printice Hall.
2. Soft Computing: Integrating Evolutionary, Neural, and Fuzzy Systems, by Tettamanzi, Andrea, Tomassini, and Marco. (2001), Springer.