SECOND YEAR
THIRD SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				Credit
			L	T	P	Theory	Sess.	Pract.	Total	
*1.	MA 231	ENGINEERING MATHEMATICSñIII	3	1	0	70	30	-	100	3.5
2.	MA 232	DISCRETE MATHEMATICS	3	1	0	70	30	-	100	3.5
*3.	HU 231	ECONOMICS FOR ENGINEERS	2	0	0	35	15	-	50	2
*4.	ME 231	ENGINEERING MECHANICS	3	1	0	70	30	-	100	3.5
*5.	CS 231	PROGRAMMING AND DATA STRUCTURES	3	0	0	70	30	-	100	3
6.	CS 232	DIGITAL LOGIC DESIGN	3	0	0	70	30	-	100	3
		SUB-TOTAL							550	18.5
		PRACTICAL/DESIGN								
7.	ME 231 P	ENGINEERING GRAPHICS	1	0	3	-	30	70	100	2.5
8.	CS 231 P	PROGRAMMING AND DATA STRUCTURES LAB	0	0	3	-	30	70	100	1.5
9.	CS 232 P	DIGITAL LOGIC DESIGN LAB	0	0	3		15	35	50	1.5
		SUB-TOTAL							250	5.5
		TOTAL	**18**	**3**	**9**				**800**	**24.0**
10.	***NC 231***	***TECHNICAL ENGLISH***	***2***	***0***	***1***	***-***	***35*****	***15*****	***-***	***0.0***
11.	***NC 232***	***PHYSICAL TRAINING***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***

MA 231 ENGINEERING MATHEMATICS - III

L T P C
3 1 0 3.5 Full Marks: 100 (30+70)

Fourier Series:

Derichlet's condition-General Fourier series- odd and even functions, Half range-sine and cosine series-complex form of Fourier series, Practical Harmonic analysis.

Fourier Transforms:

Statement of Fourier integral theorem, Fourier transforms pairs, Fourier sine and cosine transforms, properties, transform of simple functions, convolution theorems, Parsevel's identity.

Boundary Value Problems:

Classification of second order quasi linear partial differential equations-solution of one dimensional wave equation, one dimensional heat equation-

steady state solution of two dimensional heat equation (insulated edges exclude) Solution by separation of variables.

Solution in Series:
Series solution of second order differential equations, Bessel's and Legendre's equations- their series solutions, elementary of properties of Bessel functions and Legendre polynomials-recurrence relations-generating functions-orthogonality conditions

Complex Variables:
Analytic functions-properties, Cauchy-Rieman equations, construction of analytic function, determination of conjugate harmonic, application to two dimensional potential problems; Conformal transformations- $w = z + a$, $w = az$, $w = 1/z$ and Bilinear Transformation. Cauchy's Integral theorem and Cauchy's integral formula (statement only), Taylor's and Laurent's expansions, isolated singularities, residues-Cauchy's residues theorem (statement only), contour integration-over unit circle and semi-circle(excluding poles on real axis).

Suggested Text Books & References:

1. R.V. Churchill, "Fourier Series and Boundary Value Problems", McGraw Hill,
2. I.N. Sneddon, "Fourier Transforms" McGraw Hill, 1951.
3. Churchill, Brown and Verhy, "Complex Variables and Applications", McGraw Hill
4. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 41st Edition, New Delhi.

MA 232 DISCRETE MATHEMATICS

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

Logic:
Statements – Truth Tables – connectives-Normal forms-Predicate Calculus-Inference theory for statement calculus and Predicate Calculus.

Combinatories:
Review of Permutation and combination-Mathematical Induction-Pigeon hole principle – Principle of inclusion and exclusion-Generating function-Recurrence relations

Groups:
Semi groups – Monoids – groups – permutation group – Concepts – Language's theorem – Group homomorphism-Kemel, Rings and Fields (definitions and simple examples only)

Lattices:
Partial ordering-Posets-Hass Lattices-Properties of Lattices-Sub Lattices-Special Lattices-Boolean Algebra.

Graphs:
Introduction to Graphs-Graph terminology – Representation of Graphs – Graph Isomorphism-Connectivity-Euler and Hamilton Paths.

Suggested Text Books & References:

1. "Discrete Mathematical Structure with Applications to Computer Science" by Tremlay J.P. and Manohar R. McGraw Hill Book Company
2. "Discrete and Combinatorial mathematics", Ralph P. Grimaldi Áddision Wesley, Publishing Company: Reprinted in 1985 Section : 1:1
3. "Discrete Mathematics and Its Application", Kenneth H. Rosen McGraw Hill Book Company

***HU 231 ECONOMICS FOR ENGINEERS**

L	T	P	C	
2	0	0	2	**Full Marks: 50 (35 + 15)**

Economics:
Meaning, Definition, Scope: Micro and Macro, Assumptions and Methods. Usefulness

Market demand and cost concepts:
Economic reasoning, Circular Flow in an economy, Law of supply and demand, Economic efficiency, Element of costs, Marginal cost, Marginal

Revenue, Sunk cost, Private and Social cost, Opportunity cost, Functions of Money and commercial Banking.

Inflation and deflation:
Concepts and regulatory measures, Economic Policy Reforms in India since 1991: Industrial policy, Foreign Trade policy, Monetary and fiscal policy, Impact on industry.

Accounting:
Book keeping single and double entry system, Journal and ledger, Preparation of Trial Balance, Trading account, Profit and loss account, Balance sheet(with simple adjustments).

Suggested Text Books & References:

1. Modern Economic Theory, K.K. Dewett.
2. Introduction to Accountancy, T.S. Grewal.
3. Panneer Selvam, R, Engineering economics, Prentice Hall of India, New Delhi.
4. Wheeler R (Ed) Engineering economic analysis, Oxford University Press.
5. A Text Book of Economic Theory : Stonier and Hauge.
6. Engineering Economics : Degramo.
7. International Economics : Bo Sodersten
8. Principles of Macroeconomics : Rangarajan and Dholakia.
9. Monetary Economics : Suraj B. Gupta
10. Cost Accounting : Jawahar Lal
11. Project Planning Analysis, Selection Implementation and Review: Prasanna Chandra

ME 231 ENGINEERING MECHANICS

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70 + 30)**

System of Forces:
Introduction to mechanics, laws of mechanics, concept of a force, system of forces, resultant and equilibrium of system of coplanar concurrent forces , resultant and equilibrium of system of coplanar non- concurrent forces.

Friction:
Frictional force, types of friction, laws of friction, coefficient of friction, angle of friction, angle of repose, cone friction, impending motion of connected bodies, wedge, screw jack and rope friction.

Centroid & Area Moment of Inertia:
Centroid, Centre of gravity, Centroid of simple figures and composite sections. Area moment of inertia, polar moment of inertia, radius of gyration, theorems of moment of inertia, moment of inertia of standard figures and moment of inertia of composite sections.

Centre of Gravity & Mass Moment of Inertia:
Centre of gravity from first principles, centre of gravity of composite bodies and theorem of Pappus- Guldinus. Definitions, Mass moment of inertia from first principles, transfer formula and mass moment of inertia of composite bodies.

Kinematics:
Introduction to Dynamics, Linear motion- motion with uniform velocity and uniform acceleration, Acceleration due to gravity, motion with varying acceleration. Curvilinear motion- motion of body associated with horizontal projection and inclined projection.

Kinetics:
Introduction, laws of motion, rectilinear motion of a particle, D'Alembert's Principle, Work- Energy Principle- work energy equation for translation, motion of connected bodies.

Suggested Text Books & References:

1. Engineering Mechanics, S. S. Bhavikattis, New Age International Pvt. Ltd.
2. Engineering Mechanics, K.L. Kumar, Harper & Row Publishers, New Delhi.
3. Engineering Mechanics, R. K. Rajput, Dhanpat Rai Publications, New Delhi.
4. Engineering Mechanics, A. Nelson, Tata McGraw Hill Education Pvt. Ltd.
5. Engineering Mechanics, R. K. Bansal and Sanjay Bansal.
6. Engineering Mechanics, Ferdin and L. Singer
7. Engineering Mechanics, A.K. Tayal
8. Engineering Mechanics, Irving H. Shames, Printice Hall of India Pvt. Ltd.
9. Engineering Mechanics, S. Timoshenko, D.H. Young & J. V. Rao-Tata McGraw Hill

CS 231 PROGRAMMING AND DATA STRUCTURES

L	T	P	C	
3	0	0	3	**Full Marks: 100 (70 + 30)**

Introduction to Algorithm:
Algorithm Development, Complexity analysis, Asymptotic Notations-Big-O, big-Theta, Big-Omega, little-o etc- Recursion and examples

Linear Data Structures:
Stacks-Operations and Applications, Queues-Operations and Applications, Circular Queues-Operations and Applications, Links Lists-Operation – Creations, insertion, Deletion, Circular Lists, Doubly Linked List, stacks, queues-implementations and applications- Sorting- Bubble sort- Insertion sort-Gnome sort-Selection sort-Stooge sort-Merge sort-Heapsort-Quicksort-Radix sort

Tree Structures:
Tree – tree traversals –Binary Tree – expression trees – applications of trees – binary search tree – AVL trees – binary heaps

Hashing and Sets:
Hashing – hashing functions- Separate chaining – open addressing-rehashing – extendible hashing – Sets-Representation -Operations -Union and Find.

Graphs:
Definitions – Representations- breadth-first traversal – shortest-path algorithms – minimum spanning tree – Prim's and Kruskal's algorithms – Depth-first traversal – applications of graphs

Suggested Text Book & References:

1. Seymour Lipschutz, Data Structures (Schaum Series.) McGraw Hill.
2. Seymour Lipschutz, Data Structures with C (Schaum Series.) 1st Edition 2010, McGraw Hill Education (India) Private Limited.
3. Horowitz, Sahni, Anderson-Freed, Fundamentals Of Data Structures In C,2nd Edition 2008, Orient Longman.

CS 232 DIGITAL LOGIC DESIGN

L	T	P	C	
3	0	0	3	**Full Marks: 100 (70 + 30)**

Binary Systems:
Digital Systems, Binary Numbers, Number base conversions, Octal and Hexadecimal Numbers, complements, Signed binary numbers, Binary codes, Binary Storage and Registers, Binary logic.

Boolean Algebra and LOGIC GATES:
Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and properties of Boolean algebra, Boolean functions canonical and standard forms, other logic operations, Digital logic gages, integrated circuits.

GATE – Level Minimization:
The map method, Four-variable map, Five-Variable map, product of sums simplification Don't-care conditions, NAND and NOR implementation other Two-level implementations, Exclusive – OR function

Combinational LOGIC :
Combinational Circuits, Analysis procedure Design procedure, Binary Adder-Subtractor Decimal Adder, Binary multiplier, magnitude comparator, Decoders, Encoders, Multiplexers

Synchronous Sequential LOGIC:
Sequential circuits, latches, Flip-Flops Analysis of clocked sequential circuits, State Reduction and Assignment, Design Procedure.

Registers and Counters:
Registers, shift Registers, Ripple counters, Synchronous counters, other counters.

Memory and Programmable LOGIC:
Introduction, Random-Access Memory, Memory Decoding, Error Detection and correction Read-only memory, Programmable logic Array programmable Array logic, Sequential Programmable Devices.

Asynchronous Sequential LOGIC:
Introduction, Analysis Procedure, Circuits with Latches, Design Procedure, Reduction of state and Flow Tables, Race-Free state Assignment Hazards, Design Example.

Suggested Text Book & References:

1. M. Moris Mano, Charles R. Kime, Logic and Computer Design Fundamentals, 2nd Edition, PEARSON EDUCATION Asia
2. M. Moris Mano, Michael D. Ciletti, Digital Design, Prentice HALL.
3. Stephen Brown Zvonko Vranesic, Fundamentals of Digital Logic with VHDL design, McGraw Hill
4. Enocho Hwang, Digital Logic and Microprocessor Design with VHDL, Thomson,
5. John F. Wakerly, Digital design Principles & Practices, 3rd EDITION, Prentice HALL.
6. H.T. Nagle, Introduction to Computer Logic, Prentice Hall.

PRACTICAL / DESIGN

***ME 231P ENGINEERING GRAPHICS**

L	T	P	C	
1	0	3	2.5	**Full Marks: 100 (70 + 30)**

Fundamentals, Engineering Curves and Scale:

A) Fundamentals of Engineering Graphics: Introduction to Drawing instruments and their uses. Layout of drawing sheets, different types of lines used in drawing practice, dimensioning system as per BIS.
B) Engineering curves: Construction of regular polygons (up to hexagon). Construction of ellipse, parabola and hyperbola.
C) Scales: Scale and representative fraction, construction and reading of plain and diagonal scales.

Projections of lines & Planes:
Introduction to first angle and third angle methods of projection.

A) Projections of straight lines: perpendicular to one plane and parallel to the other, parallel to both the planes, parallel to one plane and inclined to the other, inclined to both the planes.
B) Projections of planes: perpendicular to one plane and parallel to the other, perpendicular to both the planes, one plane and inclined to the other, inclined to both the planes.

Orthographic Projections of solids:
Projections of Prisms, Pyramids, Cylinder and Cones in simple position, axis perpendicular to one plane and parallel to the other, axis parallel to both planes, parallel to the to one plane & inclined to one plane (Excluding frustum and sphere).

Sections of solids & Development of surfaces:
A) Sections of solids: Prisms, Pyramids, Cylinders and Cones (Simple positions and inclined to one plane and parallel to other).
B) Development of plane and curved surfaces: Prisms, Pyramids, Cylinders and Cones along with cutting planes.

Isometric projections:
Isometric projections: Introduction to isometric, Isometric scale, Isometric projections and Isometric views of planes and solids – prisms, cones, pyramids and spheres.

Note: The above syllabus is to be covered in first angle method of projection.

Suggested Text Books & References:
1. Engineering Drawing and Graphics, K. Venugopal, New Age Publication.
2. Engineering Drawing, N. D. Bhatt, Charotor Publication House, Mumbai.
3. Fundamentals of Engineering, W. J. Luzadder, Drawing, Prentice Hall of India.
4. Graphic Science, French and Vierck, McGraw Hill International.
5. A text book of Engineering Drawing, R. K. Dhawan, S. Chand and Co.
6. Engineering Drawing, N. B. Shaha and B. C. Rana, Pearson Education.
7. Engineering Drawing and Graphics Using AutoCAD, T. Jeyapoovan, Vikas Publ.
8. Engineering Drawing, K.L. Narayana, P. Kannaya& K. Venkata Reddy.

CS 231P PROGRAMMING AND DATA STRUCTURES LAB.

L	P	T	C	
0	0	3	1.5	**Full Marks: 100 (30 + 70)**

Laboratory practical based on CS 231.

CS 232P DIGITAL LOGIC DESIGN LAB.

L	P	T	C	
0	0	3	1.5	**Full Marks: 50 (15 + 35)**

Laboratory practical based on CS 232.

NC 231 TECHNICAL ENGLISH

L	T	P	C	
2	0	1	0	**Full Marks: 50 (Non Credit)**

Style and organization in technical communication:
Listening, speaking, reading and writing as skills; Objectivity, clarity, precision as defining features of technical communication; Various types of business writing: Letters, reports, notes, memos; Language and format of various types of business letters; Language and style of reports; Report writing strategies; Analysis of a sample report.

Oral Presentation and professional speaking:
Basics of English pronunciation; Elements of effective presentation; Body Language and use of voice during presentation; Connecting with the audience during presentation; Projecting a positive image while speaking; Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Basics of public speaking; Preparing for a speech.

Career Oriental Communication:
Covering, Resume and bio-data: Design & style; Applying for a job: Language and format of job application. Job Interviews: purpose and process; How to prepare for interviews; Language and style to be used in interview; Types of interview questions and how to answer them; Group Discussion: structure and dynamics; Techniques of effective participation in group discussion; Preparing for group discussion;

Language Practice:
Emphasizing Listening and comprehension skills; Reading Skills; Sound Structure of English and intonation patterns; training in speaking skills covering oral presentations.

Suggested Text Books & References:

1. Fred Luthans, Organizational Behaviour, McGraw Hill
2. Lesikar and petit, Report writing for Business
3. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill
4. Wallace and masters, Personal Development for Life and Work, Thomson Learning
5. Hartman Lemay, Presentation Success, Thomson Learning
6. Malcolm Goodale, Professional Presentations
7. Farhathullah, T. M. Communication skills for Technical Students
8. Michael Muckian, John Woods, The Business letters Handbook
9. Herta A. Murphy, Effective Business Communication

SECOND YEAR
FOURTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				Credit
			L	T	P	Theory	Sess.	Pract.	Total	
*1.	MA 241	NUMERICAL METHODS AND COMPUTATION	3	1	0	70	30		100	3.5
2.	CS 241	COMPUTER ORGANIZATION AND ARCHITECTURE	3	1	0	70	30	-	100	3.5
3.	CS 242	OBJECT ORIENTED PROGRAMMING	3	1	0	70	30		100	3.5
4.	CS 243	FORMAL LANGUAGES AND AUTOMATA THEORY	3	1	0	70	30		100	3.5
5.	CS 244	DESIGN AND ANALYSIS OF ALGORITHMS	3	1	0	70	30		100	3.5
		SUB-TOTAL							500	17.5
		PRACTICAL/DESIGN								
6.	CS 241P	COMPUTERORGANIZATION AND ARCHITECTURE LAB.	0	0	3	-	30	70	100	1.5.
7.	CS 242P	OBJECT ORIENTED PROGRAMMING LAB.	0	0	3	-	30	70	100	1.5
8.	CS 244P	DESIGN AND ANALYSIS OF ALGORITHMS LAB.	0	0	4	-	30	70	100	2
		SUB-TOTAL							300	5
		TOTAL	**15**	**5**	**10**				**800**	**22.5**
9.	***NC 241***	***SOFT SKILL-I***	***3***	***0***	***0***	***-***	***50*****	***-***	***-***	***0.0***
10.	***NC 242***	***PHYSICAL TRAINING***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***

MA 241 NUMERICAL METHODS AND COMPUTATION

L T P C

3 1 0 3.5 Full Marks: 100(30+70)

Computer Arithmetic and Errors:

Floating point representation, Concept of zero in floating point, Four fundamental arithmetic operations, consequences such as non-associativity of arithmetic, Pitfalls in computing , Pitfalls in computing, Errors representation-Inherent and truncation, Absolute, relative, general errors formulae.

Solution of Algebraic and Transcendental Equations:
Bisection, Regular-Falsi, Newton-Raphson and iterative methods, their convergence conditions, Generalisations of Newton-Raphson and iterative methods to simultaneous non-linear equations.

Solutions of Linear System of Equations:
Gaussian elimination method with partial pivoting, Factorization method, Matrix Inverse method, Gauss-Gacobi and Gaus-Siedel iterative methods, Method of Least square fit.

Solution of Differential Equations:
Picard's Taylor series, Euler's Modified Euler's, Runge-Kutta and Milne's methods, solution of two-point boundary value problems; Explicit and implicit schemes for one-dimensional parabolic equations, Finite difference method for elliptic and hyperbolic equations.

Eigen-Values and Eigen-Vectors:
Gershgorin's Theorem, Power method for dominant, sub-dominant and the smallest Eigen-values, Determination of Eigen-values and Eigen-vectors of symmetric and non-symmetric matrices with special reference to the methods of Jacobi and Givens algorithms.

Suggested Text Books & References:

1. Grewal B.S., "Numerical Methods", Khanna Pub., New Delhi
2. Shartry S.S., "Numerical Methods", Prentice Hall Inc., India
3. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis", Addison Wesley
4. J.H. Wilkinson, "Algebraic Eigen – Value Problems", Oxford Univ. Press,
5. G.D. Smith, "Numerical Solution of Partial Differential Equations", Oxford Univ. Press

CS 241 COMPUTER ORGANIZATION AND ARCHITECTURE

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70 + 30)**

Introduction:
Introduction to Computer Systems-Number System and Representation-Brief History of Computer Systems-Generations of Computers.

Arithmetic and Logical Unit:
Arithmetic & Logical Operation and Hardware Implementation – Implementation Issues of some Operation.

Memory:
Concept of Memory-Cache Memory-Memory Management-Virtual Memory

Instruction Set & Addressing:
Various Addressing Modes-Machine Instruction-Instruction Format

CPU Design:
Introduction to CPU-Processor Organization-Execution of Complete Instruction Design of Control Unit, Microprogrammed Control – I, Microprogrammed Control – II

Input/Output:
Introduction to I/O-Programmed Control I/O-Interrupt Driven I/O-Direct Memory Access

Connecting I/O Devices:
I/O Buses -External Storage Devices-Disk Performance

Reduced Instruction Set Computing:
Introduction to RISC -Design issues of RISC

Pipeline:
Introduction to Pipeline Processor-Performance Issue-Branching

Multi-Processor/Parallel Processing:
Introduction to Parallel Processing-Introduction to Network -Cache Coherence

Suggested Text Book & References:

1. M. Moris Mano, Computer System Architecture, PHI
2. M. Moris Mano, Michael D. Ciletti, Digital Design, Prentice HALL.
3. John, Hayes, Computer Architecture & Organization, McGraw Hill
4. Enocho Hwang, Digital Logic and Microprocessor Design with VHDL, Thomson,
5. John F. Wakerly, Digital design Principles & Practices, 3rd EDITION, Prentice HALL.
6. H.T. Nagle, Introduction to Computer Logic, Prentice Hall

CS 242 OBJECT ORIENTED PROGRAMMING

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70 + 30)**

UNIT-1:

Introduction: Overview of C++, Sample C++ program, Different data types, operators, expressions, and statements, arrays and strings, pointers & user defined types Function Components, argument passing, inline functions, function overloading, recursive functions.

UNIT-2:

Classes & Objects – I: Class Specification, Class Objects, Scope resolution operator, Access members, Defining member functions, Data hiding, Constructors, Destructors, Parameterized constructors, Static data members, Functions- Friend functions, Passing objects as arguments, Returning objects, Arrays of objects, Dynamic objects, Pointers to objects, Copy constructors, Generic functions and classes, Applications Operator overloading using friend functions such as +, - , pre-increment, post-increment, [ ] etc., overloading <>.

UNIT-3:

Inheritance – Base Class, Inheritance and protected members, Protected base class inheritance, Inheriting multiple base classes - Constructors, Destructors and Inheritance, Passing parameters to base class constructors, Granting access, Virtual base classes

UNIT-4:

Virtual functions, Polymorphism: Virtual function, Calling a Virtual function through a base class reference, Virtual attribute is inherited, Virtual functions are hierarchical, Pure virtual functions, Abstract classes, Using virtual functions, Early and late binding.

UNIT-5:

I/O System Basics, File I/0: C++ stream classes, Formatted I/O, I/O manipulators, fstream and the File classes, File operations

Suggested Text Book & References:

1. Sourav Sahay, Object Oriented Programming with C++, Oxford University Press.
2. Balagurusamy , Object Oriented Programming with C++, TMH
3. Robert Lafore, Object-Oriented Programming in C++, Third Edition, Macmillan Computer Publishing
4. Rajesh Shukla, Object Oriented Programming With C++ Wiley India.
5. Rohit Khurana, Object Oriented Programming With C++ , Vikas Publishing House

CS 243 FORMAL LANGUAGES AND AUTOMATA THEORY

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

Fundamentals :
Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non deterministic finite automaton, transition diagrams and Language recognizers.

Finite Automata :
NFA with Î transitions - Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without Î transitions, NFA to DFA conversion, minimisation of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Melay machines.

Regular Languages :
Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets (proofs not required).

Grammar Formalism :
Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, sentential forms. Right most and leftmost derivation of strings.

Context Free Grammars :
Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted).

Push Down Automata :
Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, inter conversion. Introduction to DCFL and DPDA.

Turing Machine :
Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines.

Suggested Text Book & References:

1. Vivek Kulkarni, Theory of Computation, Oxford University Press
2. Mishra, Chandrashekhran, Theory of Computer Science, PHI
3. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Addison-Wesley

CS 244 DESIGN AND ANALYSIS OF ALGORITHMS

L	P	T	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

Introduction:
Euclid's algorithm Problem, Instance, RAM model, Asymptotic complexity of Algorithms

Divide and conquer:
Introduction, Binary Sort, quick sort, strassen multiplication, Median Finding

Dynamic Programming:
Shortest Path in graph, Knapsack, Longest common subsequence, Matrix chain multiplication or Optimal search trees, TSP, A machine scheduling problem

Greedy Algorithms:
Introduction, Set of Intervals, Fractional Knapsack, Minimum cost spanning tree, Huffman Coding, single source shortest path

Back Tracking:
8-queen problem, knapsack problem

Branch and bound:
TSP

Suggested Text Book & References:

1. S. K. Basu, Design Methods and Analysis of Algorithms, PHI
2. Parag Himanshu Dave, Design and Analysis of Algorithms, Pearson Education India
3. Chandra Mohan, Design and Analysis of Algorithms, Prentice-Hall India Pvt. Limited.
4. Cormen, Thomas, Introduction to Algorithms, PHI, New Delhi

PRACTICAL / DESIGN

CS 241P COMPUTER ORGANIZATION AND ARCHITECTURE LAB.

L	T	P	C	
0	0	3	1.5	**Full Marks: 100(30+70)**

Laboratory practical based on CS 241.

CS 242P OBJECT ORIENTED PROGRAMMING LAB.

L	T	P	C	
0	0	3	1.5	**Full Marks: 100(30+70)**

Laboratory practical based on CS242.

CS 244P DESIGN AND ANALYSIS OF ALGORITHMS LAB.

L	T	P	C	
0	0	4	2	**Full Marks: 100(30+70)**

Laboratory practical based on CS 244.

NC 241 SOFT SKILL - I

L	T	P	C	
3	0	0	0	**Full Marks: 50 (Non Credit)**

Self Analysis:
SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem

Attitude:
Factors influencing Attitude, Challenges and lessons from Attitude.

Change Management:
Exploring Challenges, Risking Comfort Zone, Managing Change

Motivation:
Factors of motivation, self-talk, Intrinsic & Extrinsic Motivators.

Goal Setting:
Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals.

Time Management:
Value of time, Diagnosing Time Management, Weekly Planner, to do list, Prioritizing work.

Creativity:
Out of box thinking, Lateral Thinking

Suggested Text Book & References:

1. INSIGHT, 2012, Career Development Centre, SRM Publications.
2. Covey Sean, Seven Habits of Highly Effective Teens , New York, Fireside Publishers, 1998.
3. Carnegie Dale, How to win Friends and Influence People , New York: Simon & Schuster, 1998.
4. Thomas A Harris, I am ok, You are ok , New York - Harper and Row, 1972
5. Daniel Coleman, Emotional Intelligence , Bantam Book, 2006

THIRD YEAR
FIFTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				Credit
			L	T	P	Theory	Sess.	Pract.	Total	
1.	CS 351	MICROPROCESSOR AND APPLICATION	3	1	0	70	30	-	100	3.5
2.	CS 352	OPERATING SYSTEM	3	0	0	70	30	-	100	3.0
3.	CS 353	COMPUTER NETWORKS	3	0	0	70	30	-	100	3.0
4.	CS 354	INTRODUCTION TO COMPLEXITY THEORY	3	0	0	70	30	-	100	3.0
5.	CS 355/X	ELECTIVE ñ I	3	0	0	70	30	-	100	3.0
6.	CS 356/X	ELECTIVE-II	3	0	0	70	30	-	100	3.0
		SUB-TOTAL							600	18.5
		PRACTICAL/DESIGN								
7.	CS 351P	MICROPROCESSOR AND APPLICATION LAB.	0	0	3	-	30	70	100	1.5
8.	CS 353P	COMPUTER NETWORKS LAB.	0	0	4	-	30	70	100	2
9.	CS 356/XP	ELECTIVE-II LAB	0	0	4	-	30	70	100	2
		SUB-TOTAL							300	5.5
		TOTAL	**18**	**1**	**11**				**900**	**24.0**
10.	***NC 351***	***NCC / N.S.S.***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***
11.	***NC 352***	***PHYSICAL TRAINING***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***

CS 351 MICROPROCESSOR AND APPLICATION

L T P C
3 1 0 3.5 Full Marks: 100 (70+30)

UNIT-I:
MS-DOS:-Constituents of MS-DOS, booting and its sequences.

UNIT-II:
8086 Architecture - 8086 Architecture-Internal Block Diagram-Register Organization, Memory Segmentation- Programming Model- Memory addresses, Physical memory organization.

UNIT-II:
Instruction Set and Assembly Language Programming of 8086-1: Instruction formats, addressing mode and its types, instruction sets, assembler directives, writing simple programs.

UNIT-III:
Instruction Set and Assembly Language Programming of 8086-2: Arithmetic and Logic Instructions, String instructions, shift and rotate, comparisons, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations, macros, and subroutines.

UNIT-IV:
Interrupt: Basic Interrupt processing, hardware interrupt, expanding the interrupt structure, Interrupt structure of 8086, Vector interrupt table, Interrupt service routine.

UNIT-V:
Arithmetic coprocessor: The 80x87 architecture, data types, instruction set, simple 80x87 programs

UNIT-VI:
Interfacing with devices: Memory interfacing to 8086, Interfacing Interrupt Controller 8259, DMA Controller 8257 to 8086 etc.

Suggested Text Book & References:

1. Barry B. Brey, The Intel Microprocessors: 8086/8088, 80186/80188, 80286,80386,80468, ….., Pentium 4 and Core 2,Prentice Hall, 2009.
2. Yu-Cheng Liu,Glenn A. Gibson , Microcomputer systems: the 8086/8088 family,PHI,2003.
3. Douglas V. Hall,Microprocessors and Interfacing,TMH,1991.

CS 352 OPERATING SYSTEM

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

Basics:
Operating System Functionalities, Types of Operating Systems, Evolution of Operating Systems, Components of Operating Systems.

Process Management:
Process Scheduling – Uniprocessor scheduling algorithms, Multiprocessor and Real-time scheduling algorithms, Process Synchronization - Peterson's Solution, Bakery Algorithm, Hardware Support to Process Synchronization, Semaphores, Critical Regions, Monitors - Deadlock prevention, deadlock avoidance and Deadlock Detection and Recovery - Bankers Algorithm

CPU Scheduling:
Basic Concepts - Scheduling Criteria - Scheduling Algorithms - Thread Scheduling – Multiple - Processor Scheduling.

Memory Management:
Swapping - Contiguous Memory Allocation - Paging - Structure of the Page Table- Demand Paging –TLB-Copy-on-Write - Page Replacement - Page replacement algorithms-Allocation of Frames - Translation Lookaside Buffer (TLB)-TLB Searching- Thrashing -Memory-Mapped Files - Allocating Kernel Memory.

File Systems:
Contiguous, Sequential and Indexed Allocation, File system interface, File System implementation, Case study of Unix File system - Buffer Cache, Inodes, The system calls - ialloc, ifree, namei, alloc and free, Mounting and Unmounting files systems, Network File systems.

I/O System:
Disk Scheduling Algorithms, Device drivers - block and character devices, streams, Character and Block device switch tables.

Suggested Text Book & References:

1. Silberschatz, Galvin and Gagne, “Operating Systems Concepts”, 2008, Wiley India.
2. Harvey M Dietel, “ An Introduction to Operating System”, Pearson Education.
3. William Stallings, “Operating Systems: Internals and Design Principles”, 6th Edition, Pearson Education.
4. D M Dhamdhere, “Operating Systems : A Concept based Approach”, 2nd Edition, TMH

CS 353 COMPUTER NETWORKS

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

UNIT-1:
Network architecture – layers – Physical links – Channel access on links – Hybrid multiple access techniques - Issues in the data link layer - Framing – Error correction and detection – Link-level Flow Control

UNIT-2:
Medium access – CSMA – Ethernet – Token ring – FDDI - Wireless LAN – Bridges and Switches

UNIT-3:
Circuit switching vs. packet switching / Packet switched networks – IP – ARP – RARP – DHCP – ICMP – Queueing discipline – Routing algorithms – RIP – OSPF – Subnetting– CIDR – Interdomain routing – BGP – Ipv6 – Multicasting – Congestion avoidance in network layer

UNIT-4:
UDP – TCP – Adaptive Flow Control – Adaptive Retransmission - Congestion control – Congestion avoidance – QoS.

UNIT-5:
Email (SMTP, MIME, IMAP, POP3) – HTTP – DNS- SNMP – Telnet – FTP – Security–PGP–SSH.

Suggested Text Book & References:

1. A.S. Tanenbaum, Computer Networks, Pearson Education.
2. W. Stallings, Data and Computer Communication, Pearson Education.
3. Forouzen, "Data Communication and Networking", TMH.
4. G. Shanmugarathinam, ”Essential of TCP/ IP”, Firewall Media

CS 354 INTRODUCTION TO COMPLEXITY THEORY

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

Turing Machines, Turing Machine Construction, The Halting Problem, Undecidability, Recursive functions, Church-Turing thesis ,Machines and languages, Reducibility between languages, Complexity classes: The class P, The robustness of the class P, Polynomial-time reducibility, The class NP, NP-complete languages, Computing and verifying a function, Optimization problems, Reducibility and optimization problems, Beyond NP, The class co-NP, The Boolean hierarchy, The polynomial hierarchy, Exponential-time complexity classes, Space-complexity classes, Space-complexity classes, relations between time and space, determinism and space, Non-determinism, complement and space, Logarithmic space, Polynomial space, Probabilistic algorithms and complexity classes, Some probabilistic algorithms, Probabilistic Turing machines, Probabilistic complexity classes.

Suggested Text Book & References:

1. Sanjeev Arora, Boaz Barak, Computational Complexity: A Modern Approach Hardcover, Cambridge University Press; 1 edition, 2009.
2. Oded Goldreich, Computational Complexity: A Conceptual Perspective, Cambridge University Press; 1 edition, 2008.

CS 355/X ELECTIVE-I

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

CS 355/X ELECTIVE -1 LIST (Open Elective; Any One of the following)

1. **PROBABILITY THEORY AND RANDOM PROCESSES**
2. **DATA ANALYSIS AND PROCESS INTERPRETATION**
3. **LOGIC FOR COMPUTER SCIENCE**
4. **DATA COMMUNICATION**

1. CS 355/1 : Probability Theory and Random Processes

Sets and set operations, Probability space, Conditional probability and Bayes theorem, Combinatorial probability and sampling models; Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions; Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments, Characteristic functions, Markov, Chebyshev and Chernoff bounds, Detection and Estimation. Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square), Limit theorems, Strong and weak laws of large numbers, central limit theorem. Random processes, Stationary processes, Mean and covariance functions, Ergodicity, Linear filtering of random processes, Power spectral density.

Suggested Text Book & References:

1. T Veerarajan, Probability, Statistics and Random Processes ,McGraw Hill Education, 2008.
2. Palaniammal S., Probability and Random Processes,PHI,2011.
3. Himanshu Chaurasiya, Dr. K.M. Soni, Probability, Random Variables and Stochastic Methods, S.K. Kataria & Sons; 2014 edition.
4. Aitsahlia, Chung , Elementary Probability Theory: With Stochastic Processes And An Introduction To Mathematical Finance, Springer 2004.

2. CS 355/2 : Data Analysis and Process Interpretation

The role of statistics, Graphical and numerical methods for describing and summarising data. Probability, population distributions. Sampling variability and sampling distributions. Estimation using a single sample. Hypothesis testing a single sample. Comparison two population or treatments. Simple linear regression and correlation. Case studies.

Suggested Text Book & References:

1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Elsevier, New Delhi.
2. Papoulis, Probability, Random Variables, and Stochastic Processes, 4th Edition, McGraw Hill.
3. William Feller, An Introduction to Probability Theory and Its Applications, 3rd Edition, Wiley India.

3. CS 355/3 Logic for Computer Science

Communication and Concurrency:
Processes as transition systems, operations on these processes (composition, hiding etc.). Bisimulation and observational equivalences. Calculus of mobile systems: pi-calculus. Some theory related to pi calculus. Logics to reason about transition systems, LTL, CTL* and modal mu calculus.

Reasoning about Knowledge:
Knowledge as modality, axioms of knowledge. Common knowledge, distributed agents exchanging messages, agreeing to disagree. Logical omniscience.

Finite Model Theory:
Expressiveness of FO and its extensions on finite structures. Games for lower bounds. Connections with complexity classes, role of order on the domain.

Feasible Proofs:
Propositional proof systems for tautologies. Simulation and lower bounds on length of proofs for specific systems (e.g. PHP requires super polynomial length using resolution). Theories of weak arithmetic, provably total functions and relations to complexity theory.

Full Abstraction problem for PCF:
PCF as an extension of lambda calculus. Operational and denotational semantics and the full abstraction problem. Solutions to the full abstraction problem. Games semantics.

Suggested Text Book & References:

1. R. Milner, Communicating and Mobile Systems: the pi calculus, Cambridge University press, 1999.
2. R. Fagin, J. Y. Halpern, Y. Moses, M. Y. Vardi, Reasoning about Knowledge, MIT press, 1995.
3. H. D. Ebbinghaus, J. Flum, Finite Model Theory, Springer, 1995.
4. N. Immerman, Descriptive Complexity, Springer, 1999.
5. J. Krajicek, Bounded Arithmetic, Propositional Logic and Complexity Theory, Cambridge university press, 1995.

4. CSS 355/4: Data Communication

UNIT-1:
Introduction to data communication: Components, data representation, data flow and basic model, data representation, Serial & Parallel transmission, Modes of data transmission, Encoding: Unipolar, Polar, Bipolar line & block codes, Data compression Frequency dependant codes, Run length encoding, Relative encoding, LZ Compression Image and multimedia compression. Review of analog & digital transmission methods, Nyquist Theorem.

UNIT-2:
Multiplexing: FDM, TDM, WDM, Synchronous & Statistical TDM, North American digital multiplexing hierarchy, European TDM, Spread spectrum: Frequency Hopping & Direct Sequence spread spectrum. Terminal handling & polling. Switched Communication Networks: Circuit, Message, Packet & Hybrid Switching, Softswitch Architecture with their comparative study, X.25, ISDN.

UNIT-3:
Physical Layer: Introduction, Interface, Standards, EIA-232-D, RJ-45, RJ-11, BNC connector & EIA-449 digital Interface: Connection, specifications & configuration, X.21 Modem: Types, features, signal constellation, block schematic, limited distance, dial up, baseband, line driver, Group Band and Null modems etc., ITU-T V-series modem standards Connecting Devices: Active and Passive Hubs, Repeaters, Bridges, Two & Three layer switches & Gateway. Study of various types of topology and their comparative study and introduction to queuing theory.

UNIT-4:
Transmission Media: Transmission line characteristics, distortions, Crosstalk, Guided Media: Twisted Pair, Baseband & Broadband Coaxial. Optical Fibre : Physics and velocity of propagation of light, Advantages & Disadvantages Block diagram, Nodes And classification, Comparison, losses, light source and detectors, Construction, Unguided media : Electromagnetic polarization, Rays and waves front, electromagnetic spectrum and radiation, spherical wave front and inverse square law, wave attenuation and absorption, optical properties of Radio waves, Terrestrial Propagation of electromagnetic waves, skip distance, free - space path loss, Radio waves, Microwave, Infrared & Satellite Communication system. Telephone Network: Components, LATAs,

Signaling and Services, Digital Subscriber Line: ADSL, HDSL, SDSL, VDSL, Cable TV network for data transfer.

UNIT-5:
Transmission Errors : Content Error, flow integrity error, methods of error control, Error detection, Error correction, Bit error rate, Error detection methods: Parity checking, Checksum Error Detection, Cyclic Redundancy Check, Hamming code, Interleaved codes, Block Parity, Convolution code, Hardware Implementation, Checksum.

Suggested Text Book & References:

1. I.A. Dhotre, V.S. Bagad, Data Communication, Technical Publications Pune
2. A.S. Tanenbaum, Computer Networks, Pearson Education.
3. W. Stallings, Data and Computer Communication, Pearson Education.
4. Forouzen, "Data Communication and Networking", TMH.
5. G. Shanmugarathinam, ”Essential of TCP/ IP”, Firewall Media

CS 356/XP ELECTIVE-II

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

CS 356/X ELECTIVE -II LIST (Any One of the following)

1. **PROGRAMMING IN PYTHON**
2. **UNIX/LINUX SHELL PROGRAMMING**
3. **PROGRAMMING IN MATLAB**
4. **ADVANCED C-PROGRAMMING**

1. PROGRAMMING IN PYTHON

Introduction:
History –Features-Setting up path-Working with Python-Basic Syntax - Variable and Data Types Operator

Conditional Statements:
If, If- else, Nested if-else

Looping:
For, While, Nested loops

Control Statements:
Break, Continue, Pass

String Manipulation:
Accessing Strings, Basic Operations, String slices, Function and Methods

Lists:
Introduction, Accessing list, operations, Working with lists, Function and Methods

Tuple:
Introduction, Accessing tuples, Operations, Working, Functions and Methods

Dictionaries:
Introduction, Accessing values in dictionaries, Working with dictionaries, Properties, Functions

Functions:
Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables

Modules:
Importing module, Math module, Random module, Packages

Input-Output:
Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions

Exception Handling:
Exception, Exception Handling, Except clause ,Try- finally clause User Defined Exceptions

Advance Python:
OOPs concept-Class and object–Attributes-Inheritance-Overloading - Overriding - Data hiding

Regular expressions:
Match function, Search function, Matching VS Searching ,Modifiers, Patterns

2. UNIX/LINUX SHELL PROGRAMMING

Shell Basics:
Types of shells, Shell functionality, Environment

Writing first script:
Writing script & executing basic script, Debugging script, Making interactive scripts, Variables (default variables), Mathematical expressions

Conditional statements:
If – else - elif, Test command, Logical operators-AND,OR,NOT, case – esac

Loops:
While, For, Until, Break & continue

Command line arguments:
Positional parameters, Set & shift, IFS, Break & continue

Functions & file manipulations:
Processing file line by line, Functions

Regular Expression & Filters:
What is regular expression, Grep, cut, sort commands, Grep patterns

AWK:
AWK pattern scanning, BEGIN and END patterns, AWK arithmetic and variables and operators, functions

Suggested Text Book & References:

1. Unix: The Complete Reference by Kenneth Rosen (Author), Douglas Host (Author), Rachel Klee (Author), Richard Rosinski (Author)
2. Programming the UNIX/LINUX Guide by Claude Cantin.
3. The Unix Shell Guide- Norman J. Buchanan, Douglas M. Gingrich

3. PROGRAMMING IN MATLAB

Introduction to MATLAB:
Matlab Interactive Sessions- Menus and the toolbar- Computing with Matlab-Script files and the Editor Debugger- Matlab Help System

Arrays:
Arrays- Multidimensional Arrays- Element by Element Operations-Polynomial Operations Using Arrays- Cell Arrays-Structure Arrays

Functions & Files:
Elementary Mathematical Functions-User Defined Functions-Advanced Function Programming-Working with Data Files

Programming Techniques:
Program Design and Development-Relational Operators and Logical Variables-Logical Operators and Functions-Conditional Statements-Loops-The Switch Structure-Debugging Mat Lab Programs

Plotting:
XY- plotting functions-Subplots and Overlay plots-Special Plot types-Interactive plotting-Function Discovery-Regression- 3-D plots

Linear Algebraic Equations:
Elementary Solution Methods-Matrix Methods for (LE) - Cramer's Method

Probability and Statistics:
Interpolation -Statistics, Histogram and probability- The Normal Distribution-Random number Generation-Interpolation

Symbolic Processing with Matlab:
Symbolic Expressions and Algebra-Algebraic and Transcendental Equations-Calculus-Symbolic Linear Algebra

Image Processing:
Vector Graphics-Morphological Image Processing-Filtering

Suggested Text Book & References:

1. Hanselman, D. and B. Littlefield, "Mastering MATLAB 7," PEARSON/Prentice Hall.
2. Etter, D.M. and D.C. Kuncicky, "Introduction to MATLAB", E-Source, Prentice Hall.
3. Palm III, W.J., "Introduction to MATLAB for Engineers," B.E.S.T Series, McGraw-Hill.

4. ADVANCED C-PROGRAMMING

Module-1:

C Program Compilation, Execution Process, Tokens of C Program, C Instructions, Constants, Variables, Identifiers and Keywords, Primitive Data Types, Structures - The Definition, Structures – Declaration & Type, Accessing Elements of Structure, Range of Signed/Unsigned Data-types, Efficient way of Printing Pointer, Compiler Memory Allocation for Data-types, Compiler Memory Allocation for Structures, Data-type Alignments, Compiler Memory Allocation for Unions, Practical Usage of Unions, Practical Usage of Bit fields, Bit fields Overflow, Printing every byte of an Integer, Enumeration, Type def Statements, Practical example of Type def Usage, type defing a Function Pointer, Bit-Fields in Structure, Practical examples of Bit field Usage, Structure Padding & Pitfalls, Programming Model & Memory Sizes, Why Sizeofint and Long is 4 or 8?,Use of long in 32-bit Architecture, Array – Representation, Array – Memory Allocation, Array – Declaration & Initialization, Two Dimensional Arrays

Module-2:

Accessing a Variable Through Pointer, Pointer – Memory Allocation, Pointer – Declaration & Initialization, Pointer – Dereferencing Pointers & Arrays, Character Arrays using Pointers, Array of Character Pointers, Memory Diagram – Array of Char Pointers Arrays as Pointers, Constant Pointers, Pointer Arithmetic, String Handling Functions, String Conversion Functions, Efficient usage of sscanf()/sprintf()

Module-3:

Binary & Octal Systems, Decimal & Hexadecimal Systems, Signed Representations in Memory, Binary Shifts – Right & Left, Sign Bits and Bit-Shift Operations, Right Shift – Logical Vs Arithmetic Shift, Bit-Shift Overflow, ASCII Representations, Endianness – Little VsBig, Endian-ness – Portability Issues, mixing 80x86 code with c inline code, separate assembly code subroutines, TASM, MASM

Module-4:

Bitwise Operations, Logical Operators – Short Circuit, Bitwise Vs Logical Operations, sizeof() operator, Pitfalls/Issues with sizeof() usage, Pointer Increment & Scaling, Operator Precedence, Operator Associativity, True meaning of Associativity, Examples of Precedence & Associativity, Ternary Operator Associativity Rule, Data-type Conversion Rules, float to Int to

Float Conversions, Variadic functions & default promotion rules, PrintfIdiosynchracies, Pointer Format Specifiers, Signed Vs Unsigned – Pitfalls, Evaluation of i = ++i + ++I, Evaluation of i = ++i + ++i + ++i

Module-5:
Storage Classes, Storage Class Specifiers, Scope of a Variable, Register, Auto, Static, Extern, Why Register Class and Practical Examples, Automatic Variables and Stack, Static Variables and Functions, True meaning of Extern, How to Use extern across Multiple Files with Examples, Best Practices for Extern Usage, Local/Block/Global Scope, Nesting of Scope, Lifetime of a Variable, Linkage of a Variable, W hat is Const?, Practical Examples of Const Qualifier, Practical Examples of Volatile Qualifier, Register Vs Volatile Performance, Practical Examples of Const Volatile ,Pointer Aliasing, Restrict Qualifier,: Dynamic Memory Allocations, malloc, calloc, realloc, freemalloc Vscalloc, Heap Memory, Stack Memory – Pitfalls, Dangling Pointers, DMA – Errors, Best Practices for malloc() & free(),DMA – Unspecified Behaviour

Module-6:
Functions & Pointers, Invoking Functions, Passing Arguments to Functions, Call by Value & Reference, Is C call by Value?, Is C call by Reference?, Array as Function Argument, Rules for Array Argument Passing, Multi-dimensional Array Argument Passing, Structure as Function Argument, Static Vs Dynamic Runtime Environment, Function Call and Runtime Stack, Rules for Evaluation of Function Arguments.

Module-7:
Memory Organization, Code Segment, Data Segment, Heap Segment, Stack Segment, free space, register space, Stack Frames, Calling Sequence, View of Runtime Stack with Example, Access to Local Variable in Stack, Local Temporaries, Function Pointers, Declaration and Usage of Function Pointers, Function Pointers as Function Parameters, Practical Example of Function Pointers, Pointer to an Integer Array C ,complex pointer declarations, int **p, int (*p)(), int (*p)[], int *p(), int *(*p[])(), int *(**p)[]

Module-8:
Preprocessor, #include statements, Multiple Inclusion of a Header File?, Preprocessor – #define statements, Conditional Compilation, Preprocessor – Nested Macros, Preprocessor – Multiline Macros, Preprocessor –

Stringizer, Preprocessor – Token Concatenation, Preprocessor – Useful Directives, Conditional Directives for Debugging, Where Macros are Heavily Used, Practical Examples of Macros, Macros Pitfalls, Macros Vs Enums, Inline Functions, Macros Vs Inline, Inline Recursive Functions, Command Line Argument, Environment Variables in C Programs, Recursion Example, Recursion Vs Iteration, Code/Space/Time Complexity.

Module-9:

Standard I/O Library, Files & Streams, Streams Buffers, IO Buffers – Line Vs Full Vs No-Buffers, Setting & Flushing Buffers, File Access, File Access Modes, Sequential Vs Random Access, Concept of File Offsets, File Operation Errors, End-of-File Condition?, Return Values and Error Values, Character Based File I/O, Line Based File I/O, Formatted File I/O, Block File I/O,Dangerous – gets() Vsfgets(),File Random Access Methods.

PRACTICAL / DESIGN

CS 351P MICROPROCESSOR AND APPLICATION LAB.

L	T	P	C	
0	0	3	1.3	**Full Marks: 100 (30+70)**

Laboratory practical based on CS 351.

CS 353P COMPUTER NETWORKS LAB.

L	T	P	C	
0	0	4	2	**Full Marks: 100 (30+70)**

Laboratory practical based on CS 353.

CS 356/XP ELECTIVE-II LAB.

L	T	P	C	
0	0	4	2	**Full Marks: 100 (30+70)**

Laboratory practical based on CS 356/XP.

THIRD YEAR
SIXTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				Credit
			L	T	P	Theory	Sess.	Pract.	Total	
1.	CS 361	DATABASE MANAGEMENT SYSTEM	3	0	0	70	30	-	100	3.0
2.	CS 362	COMPILER	3	0	0	70	30	-	100	3.0
3.	CS 363	SOFTWARE ENGINEERING	3	0	0	70	30	-	100	3.0
4.	CS 364	COMPUTER GRAPHICS	3	0	0	70	30	-	100	3.0
5.	CS 365	GRAPH THEORY	3	1	0	70	30	-	100	3.5
6.	CS 366/X	ELECTIVE ñ III	3	1	0	70	30	-	100	3.5
		SUB-TOTAL							600	19.0
		PRACTICAL/DESIGN								
7.	CS 361P	DATABASE MANAGEMENT SYSTEM LAB	0	0	3	-	15	35	50	1.5
8.	CS 362P	COMPILER LAB.	0	0	3	-	15	35	50	1.5
9.	CS 363P	SOFTWARE ENGG. LAB.	0	0	4		30	70	100	2.0
		SUB-TOTAL							200	5.0
		TOTAL	**18**	**2**	**10**				**800**	**24.0**
10.	**NC 361**	**NCC / N.S.S.**	**0**	**0**	**3**	**-**	**-**	**50****	**-**	***0.0***
11.	***NC 362***	***PHYSICAL TRAINING***	***0***	***0***	***3***	**-**	**-**	***50*****	**-**	***0.0***

CS 361 DATABASE MANAGEMENT SYSTEM

L T P C

3 0 0 3 Full Marks: 100 (70+30)

Introduction :

General introduction to database systems, Database-DBMS distinction, Approaches to building a database, Data models, Database management system, Three-schema architecture of a database, Challenges in building a DBMS, Various components of a DBMS.

E/R Model:

Conceptual data modeling - motivation, Entities, Entity types, Various types of attributes, Relationships, Relationship types, E/R diagram notation, Examples.

Relational Data Model :
Concept of relations, Schema-instance distinction, Keys, referential integrity and foreign keys, Relational algebra operators- Selection, Projection, Cross product, Various types of joins, Division, Example queries- Tuple relation calculus, Domain relational calculus, Converting the database specification in E/R notation to the relational schema.

SQL :
Introduction, Data definition in SQL, Table, key and foreign key definitions, Update behaviors, Querying in SQL -Basic select- from- where block and its semantics, Nested queries - correlated and uncorrelated, Notion of aggregation, Aggregation functions group by and having clauses, Embedded SQL.

Dependencies and Normal forms :
Importance of a good schema design, Problems encountered with bad schema designs, Motivation for normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, Minimal covers, Definitions of 1NF, 2NF, 3NF and BCNF, Decompositions and desirable properties of them, Algorithms for 3NF and BCNF normalization, Multi-valued dependencies and 4NF, Join dependencies and definition of 5NF.

Data Storage and Indexes :
File organizations, Primary, Secondary index structures, Various index structures - hash-based, Dynamic hashing techniques, Multi-level indexes, B+ trees.

Transaction processing and Error recovery :
Concepts of transaction processing, ACID properties, Concurrency control, Locking based protocols for CC, Error recovery and logging, Undo, Redo, Undo-redo logging and recovery methods

Suggested Text Book & References:
1. Ramez Elmasri, Fundamentals of Database Systems, Pearson Education India,2008.
2. Ramakrishna, Gehrke," Database Management Systems", McGraw Hill
3. G. K. Gupta, Database Management System, Tata McGraw-Hill Education, 2011.
4. Gerald Tel, "Distributed Algorithms", Cambridge University Press

CS 362 COMPILER

L	T	P	C	
3	0	0	3	**Full Marks: 100 (70+30)**

Compiler structure:
Analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction.

Lexical analysis:
Interface with input, parser and symbol table, token, lexeme and patterns. Difficulties in lexical analysis. Error reporting. Implementation. Regular definition, Transition diagrams.

Syntax analysis:
CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, LR parsers (SLR, LALR, LR).

Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions.

Type checking:
Type system, type expressions, structural and name equivalence of types, type conversion, overloaded functions and operators, polymorphic functions.

Run time system:
Storage organization, activation tree, activation record, stack allocation of activation records, parameter passing mechanisms.

Intermediate code generation:
Intermediate representations, translation of declarations, assignments, control flow, boolean expressions and procedure calls, Implementation issues.

Code generation and instruction selection:
Issues, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peep hole optimization, code generator generators, specifications of machine.

Suggested Text Book & References:

1. Alfred V Aho, Principles Of Compiler Design Paperback, Narosa Publishing House
2. Alfred Aho and Jeffrey Ullman, Principles of Compiler Design, Addison-Wesley.
3. D. Chithra, Principles of Compiler Design,CBS
4. Adesh K. Pandey, Fundamentals of Compiler Design, S.K. Kataria & Sons;
5. A.A. Puntambeka, Compiler Construction, Technical Publication Pune

CS 363 SOFTWARE ENGINEERING

L	T	P	C	
3	0	0	3	**Full Marks: 100 (70+30)**

Introduction:
What is Software Engineering-Importance of software - the software evolution - software characteristics – software components-software crisis and its solutions

Software Development Life-cycle:
Requirements analysis, software design, coding, testing, maintenance, etc.

Software Requirements Specification:
Waterfall model, prototyping, interactive enhancement, spiral model- Role of Management in software development- Role of metrics and measurement- Problem analysis, requirement specification, validation, metrics, monitoring and control.

System Design:
Problem partitioning, abstraction, top-down and bottom-up design, Structured approach. Functional versus object-oriented approach, design specification and verification metrics, monitoring and control, cohesion, coupling

Coding :
Top-down and bottom-up, structured programming, information hiding, programming style, and internal documentation. Verification, Metrics, monitoring and control.

Testing:
Levels of testing, functional testing, structural testing, test plane, test cases specification, reliability assessment.

Software Project Management:
Cost estimation, Project scheduling, Staffing, Software configuration management, Quality assurance, Project Monitoring, Risk management, etc.

Suggested Text Book & References:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill
2. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
3. Pankaj Jalote, Software Engineering, Wiley
4. Carlo Ghezzi, M. Jarayeri, D. Manodrioli, Fundamentals of Software Engineering, PHI.
5. Ian Sommerville, Software Engineering, Addison Wesley.
6. Pfleeger, Software Engineering, Pearson Education.

CS 364 COMPUTER GRAPHICS

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Graphics display devices, Input devices, Rendering pipeline, Raster Graphics: Line and Circle drawing algorithms, Windowing, Clipping: Cohen and Sutherland line clipping, Cyrus-beck clipping method, 2D and 3D Geometrical Transformations, Viewing Transformations: parallel and perspective projection, Curves and Surfaces: Cubic splines, Bezier curves, B-splines, Tensor product surfaces, Surface of revolution Sweep surfaces, Fractal curves and surfaces, Hidden line/surface removal methods, Illumination model, Polygon Shading: Gouraud, Phong, Introduction to Ray-tracing, Animation.

Suggested Text Book & References:

1. Zhigang Xiang, Schaum's Outline of Computer Graphics,2nd Edition, TMH.
2. Donald Hearn and M Pauline Baker, “Computer Graphics C Version”, Pearson Education.
3. Rogers, “Procedural Elements of Computer Graphics”, McGraw Hill
4. Amrendra N Sinha and Arun D Udai,” Computer Graphics”, TMH
5. Steven Harrington, “Computer Graphics: A Programming Approach” , TMH

CS 365 GRAPH THEORY

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

Unit –I:
Graphs, Sub graphs, some basic properties, various example of graphs & their sub graphs, walks, path & circuits, connected graphs, disconnected graphs and component, euler graphs, various operation on graphs, Hamiltonian paths and circuits, the traveling sales man problem.

Unit- II:
Trees and fundamental circuits, distance diameters, radius and pendent vertices, rooted and binary trees, on counting trees, spanning trees, fundamental circuits, finding all spanning trees of a graph and a weighted graph, algorithms of primes, Kruskal and Dijkstra Algorithms.

Unit –III:
Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets , connectivity and separability, network flows Planer graphs, combinatorial and geometric dual: Kuratowski graphs, detection of planarity, geometric dual, Discussion on criterion of planarity, thickness and crossings.

Unit –IV:
Vector space of a graph and vectors, basis vector, cut set vector, circuit vector, circuit and cut set subspaces, Matrix representation of graph – Basic concepts; Incidence matrix, Circuit matrix, Path matrix, Cut-set matrix and Adjacency matrix. Coloring, covering and partitioning of a graph, chromatic number, chromatic partitioning, chromatic polynomials, matching, covering, four color problem.

Suggested Text Book & References:

1. Deo, N, Graph theory with applications to Engineering and Computer Science, PHI.
2. Gary Chartrand and Ping Zhang, Introduction to Graph Theory, TMH.
3. Robin J. Wilson, Introduction to Graph Theory, Pearson Education.
4. Harary, F, Graph Theory, Narosa
5. Bondy and Murthy: Graph theory and application. Addison Wesley.
6. V. Balakrishnan, Schaum's Outline of Graph Theory, TMH

CS 366/X ELECTIVE –III

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

CS 366/X ELECTIVE –III ELECTIVE LIST(Any One)

1. **SOFT COMPUTING**
2. **ARTIFICIAL INTELLIGENCE**
3. **INFORMATION THEORY& CODING**
4. **LINUX INTERNAL**

1. CS 366/1 SOFT COMPUTING

Introduction to Soft Computing and Neural Networks:
Evolution of Computing - Soft Computing Constituents -From Conventional AI to Computational Intelligence - Machine Learning Basics

Genetic Algorithms:
Introduction to Genetic Algorithms (GA) – Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition.

Neural Networks:
Machine Learning Using Neural Network, Adaptive Networks – Feed forward Networks – Supervised Learning Neural Networks – Radial Basis Function Networks – Reinforcement Learning – unsupervised Learning Neural Networks – Adaptive Resonance architectures – Advances in Neural networks.

Fuzzy Logic:
Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership FunctionsFuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.

Neuro – Fuzzy Modelling:
Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rulebase Structure Identification – Neuro-Fuzzy Control – Case studies.

Suggested Text Book & References:

1. Samir Roy, Udit Chakraborty , Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms, 1st Edition, Pearson Education, India.
2. Hung T. Nguyen, Elbert A. Walker, A First Course in Fuzzy Logic, Third Edition, CRC Press.
3. Timothy J. Rose, Fuzzy Logic with Engineering Applications, Wiley India.
4. S. Rajasekaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications, Phi, 2011.

2. CS 366/2 Artificial Intelligence

Chapter 1:

Intro to AI: What is AI ? Examples of AI systems. Approaches to AI. Brief history of AI Intelligent Agent : stimulus-response agents. components of intelligence

Chapter 2:

Introduction to State Space Search Statement of Search problems: state space graphs. Searching explicit state spaces. Feature based state spaces. Problem types, examples (puzzle problem, n-queen, the road map, traveling salesman, etc.) Uninformed Search: Formulating the state space. Greedy search, breadth-first, depth- first, iterative deepening, bidirectional search Informed Search Strategies I - Using evaluation functions. A general graph-searching algorithm. Uniform cost search, A*, admissibility of A* Informed Search Strategies II - Iterative deepening A*, recursive best first search.

Chapter 3:

Problem Solving using Search -Two agent search Adversarial search- Two agent games. Minimax Two agent games- alpha beta pruning

Chapter 4:

Constraint satisfaction problems- Definitions, examples, constraint-graph, backtracking, forward checking, constraint propagation (arc-consistency, path-consistency) dynamic ordering, incremental repair (min-conflicts heuristic), CSP and SAT, GSAT

Chapter 5:
Knowledge Representation and Logic - Propositional Logic Propositional logic, syntax, semantics, semantic rules, terminology - validity, satisfiability, interpretation, entailment, proof systems Propositional Logic inference rules, natural deduction, propositional resolution.

Chapter 6:
Knowledge Representation and Logic - First Order Logic, First Order Logic - I Motivation, Syntax, Interpretations, semantics of quantifiers First Order Logic - II Entailment in FOL, interpretation Inference in FOL - I First Order resolution. Conversion to clausal form. Inference in FO

Chapter 7:
Knowledge Representation and Logic - Rule based Systems Rule Based Systems - I Forward chaining. Backward chaining. Conflict resolution Rule Based Systems – II

Suggested Text Book & References:

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill.
2. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education.
3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education.
4. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India.

3. CS 366/3 INFORMATION THEORY & CODING

Communication processes. Channel matrix. Probability relation in a channel. The measure of information. Entropy function – Properties of entropy function. Channel capacity. Special types of channels. Binary symmetric channel. Encoding. Block code. Binary code. Binary Huffman code. Shannon–Fano Encoding procedure. Noiseless coding theorem. Shannon’s first theorem. Error – correcting codes. Examples of codes. Hadamard matrices and codes. Binary Colay code. Matrix description of linear codes. Equivalence of linear codes. The Hamming codes. The standard array. Syndrome decoding.

Suggested Text Book & References:

1. Monica Borda, Fundamentals in Information Theory and Coding, 2011, Springer.
2. Wells Richa Wells Richard B., Applied Coding and Information Theory for Engineers, Pearson Edition, 2009.
3. Ranjan Bose, Information Theory, Coding and Cryptography, McGraw Hill, 2008.
4. Steven Roman, Coding and Information Theory, Springer.
5. Hsu & Mitra, Analog and Digital Communication, Schaums Series,2008.

4. CS 366/4 LINUX INTERNAL

General Overview of the System:

History – System structure – User perspective – Operating system services – Assumptions about hardware – Introduction to the kernel – Architecture of the LINUX operating system – Introduction to system concepts – Kernel data structures – System administration – Summary and preview.

Buffer Cache:

Buffer headers – Structure of the buffer pool – Advantages and disadvantages of the buffer cache – Internal representation of files – Inodes – Structure of a regular file – Directories – Conversion of a path name to an inode – Super block – Other file types.

System Calls for File System:

Open – Read – Write – File and record locking – Adjusting the position of file I/O – LSEEK – Close – File creation – Creation of special files – Pipes – Dup – Mounting and unmounting file systems.

The Structure of Processes:

Process states and transitions – Layout of system memory – The context of a process – Saving the context of a process – Process control – Process creation – Signals – Process termination – Awaiting process termination – Invoking other programs – The shell – System boot and the INIT process.

Process Scheduling and Memory Management Policies:

Process scheduling – Memory management policies – Swapping – A hybrid system with swapping and demand paging – The I/O subsystem – Driver interfaces – Disk Drivers – Terminal drivers.

Suggested Text Book & References:

1. Bach Maurice, The Design of the Unix Operating System Paperback, PHI.
2. Robert Love, Linux Kernel Development, Pearson, 2010
3. Richard Petersen, Linux: The Complete Reference, TMH, Sixth Edition, 2007

PRACTICAL / DESIGN

CS 361P DATABASE MANAGEMENT SYSTEM LAB.

L	T	P	C	
0	0	3	1.5	**Full Marks: 50(15+35)**

Laboratory practical based on CS 361

CS 362P COMPILER LAB.

L	T	P	C	
0	0	3	1.5	**Full Marks: 50(15+35)**

Laboratory practical based on CS 362

CS 363P SOFTWARE ENGINEERING LAB.

L	T	P	C	
0	0	4	2	**Full Marks: 100(30+70)**

Laboratory practical based on CS 363

FOUR YEAR
SEVENTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				Credit
			L	T	P	Theory	Sess.	Pract.	Total	
***1.	HU 471	PRINCIPLE OF MANAGEMENT	3	0	0	70	30	-	100	3.0
2.	CS 471	DISTRIBUTED SYSTEMS	3	0	0	70	30	-	100	3.0
3.	CS 472/X	ELECTIVE ñ IV	3	1	0	70	30	-	100	3.5
4.	CS 473/X	ELECTIVE ñV	3	1	0	70	30	-	100	3.5
5.	CS 474/X	ELECTIVE ñ VI	3	1	0	70	30	-	100	3.5
		SUB-TOTAL							500	16.5
		PRACTICAL/DESIGN								
6.	CS 475P	PROJECT PRELIMINARY	0	0	6	-	100	-	100	3.0
7.	CS 476P	SOFTWARE SYSTEMS LAB.- II	0	1	3	-	15	35	50	2.0
8.	CS 477P	SEMINAR ñ I	0	0	2		15	35	50	1.0
		SUB-TOTAL							200	6.0
		TOTAL	**15**	**4**	**11**				**700**	**22.5**
9.	***NC 471***	***NCC / N.S.S.***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***
10.	***NC 472***	***PHYSICAL TRAINING***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***

HU 471 PRINCIPLE OF MANAGEMENT

L T P C

3 0 0 3 Full Marks: 100 (70+30)

Overview of Management:

Definition -Management -Role of managers-Evolution of Management thought -Organization and the environmental factors –Trends and Challenges of Management in Global Scenario.

Planning:

Nature and purpose of planning-Planning process -Types of plans – Objectives - Managing by objective (MBO) Strategies -Types of strategies - Policies -Decision Making -Types of decision -Decision Making Process - Rational Decision Making.

Organizing:

Nature and purpose of organizing -Organization structure - Formal and informal groups organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority -Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal.

Directing:
Creativity and Innovation - Motivation and Satisfaction -Motivation Theories- Leadership Styles -Leadership theories - Communication - Barriers to effective communication - Organization Culture -Elements and types of culture - Managing cultural diversity.

Controlling:
Process of controlling -Types of control -Budgetary and non-budgetary control Q techniques -Managing Productivity - Cost Control -Purchase Control – Maintenance Control - Quality Control - Planning operations

Suggested Text Book & References:
1. Tripathi, Principles Of Management, TMH
2. P. K. Saxena, Principles of Management: A Modern Approach, Global India Publ.
3. D. Chandra Bose, Principles of Management and Administration, PHI
4. L.M. Prasad, Principles and Practices of Management, S. Chand & Sons
5. J.C. Vanhom, Fundamentals of Financial Management, PHI.

CS 471 DISTRIBUTED SYSTEMS

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Basics concepts -Computer architecture : CICS, RISC, Multi-core-Computer networking : ISO/OSI Model-Evolution of operating systems-Introduction to distributed computing systems (DCS) DCS design goals, Transparencies, Fundamental issues-Distributed Coordination -Temporal ordering of events-Lamport's logical clocks-Vector clocks; Ordering of messages-Physical clocks-Global state detection Process synchronization -Distributed mutual exclusion algorithms-Performance matrix Inter-process communication -Message passing communication-Remote procedure call-Transaction communication-Group communication; Broadcast atomic protocols-Deadlocks in distributed systems Load scheduling and balancing techniques -Distributed database system : A Case study.

Suggested Text Book & References:
1. Coulouris, Distributed Systems: Concepts and Design, 4/e, Pearson
2. Shehal Kamalapur Mrs.Neeta Deshpande, Distributed Systems, Technicals Publications
3. Jie Wu, Distributed System Design, CRC Press
4. Sukumar Ghosh, Distributed Systems: An Algorithmic Approach, CRC Press.
5. Sape J. Mullender, Distributed Systems, ACM Press.

CS 472/X ELECTIVE-IV

L	T	P	C	
3	1	0	3.5	Full Marks: 100(70+30)

CS 473/X ELECTIVE-V

L	T	P	C	
3	1	0	3.5	Full Marks: 100(70+30)

CS 474/X ELECTIVE-VI

L	T	P	C	
3	1	0	3.5	Full Marks: 100(70+30)

LECTIVE-IV, ELECTIVE-V & ELECTIVE-VI LIST
(Any Three of the following)

1. SOFTWARE TESTING
2. ADVANCE COMPUTER ARCHITECTURE
3. MACHINE LEARNING
4. DATA MINING
5. DISTRIBUTED DATABASE SYSTEM
6. PRINCIPLE OF ROBOTICS
7. DIGITAL SIGNAL PROCESSING
8. DIGITAL IMAGE PROCESSING
9. FUZZY LOGIC
10. XML
11. WEB TECHNOLOGY
12. PRINCIPLE OF PROGRAMMING LANGUAGE
13. CRYPTOGRAPHY
14. SIMULATION AND MODELING
15. WIRELESS SENSOR NETWORK
16. COMPUTATIONAL GEOMETRY
17. APPROXIMATION ALGORITHMS
18. VLSI DESIGN, TEST AND VERIFICATION

1. SOFTWARE TESTING

Introduction:

Faults, Errors, and Failures, Basics of software testing, Testing objectives, Principles of testing, Requirements, behavior and correctness, Testing and debugging, Test metrics and measurements, Verification, Validation and Testing, Types of testing, Software Quality and Reliability, Software defect tracking.

White Box and Black Box Testing:

White box testing, static testing, static analysis tools, Structural testing: Unit/Code functional testing, Code coverage testing, Code complexity testing, Black Box testing, Requirements based testing, Boundary value analysis, Equivalence partitioning, state/graph based testing, Model based testing and model checking, Differences between white box and Black box testing.

Integration, System, and Acceptance Testing:

Top down and Bottom up integration, Bi-directional integration, System integration, Scenario Testing, Defect Bash, Functional versus Non-functional testing, Design/Architecture verification, Deployment testing, Beta testing, Scalability testing, Reliability testing, Stress testing, Acceptance testing: Acceptance criteria, test cases selection and execute.

Test Selection & Minimization for Regression Testing:

Regression testing, Regression test process, Initial Smoke or Sanity test, Selection of regression tests, Execution Trace, Dynamic Slicing, Test Minimization, Tools for regression testing, Ad hoc Testing: Pair testing, Exploratory testing, Iterative testing, Defect seeding.

Test Management and Automation:

Test Planning, Management, Execution and Reporting, Software Test Automation: Scope of automation, Design & Architecture for automation, Generic requirements for test tool framework, Test tool selection, Testing in Object Oriented Systems.

Suggested Text Book & References:

1. S. Desikan and G. Ramesh, “Software Testing: Principles and Practices”, Pearson Education.
2. Aditya P. Mathur, “Fundamentals of Software Testing”, Pearson Education
3. Naik and Tripathy, “Software Testing and Quality Assurance”, Wiley
4. K. K. Aggarwal and Yogesh Singh, “Software Engineering”, New Age International Publication.

2. ADVANCE COMPUTER ARCHITECTURE

Single-threaded execution, traditional microprocessors, DLP, ILP, TLP, memory wall, Parallel programming and performance issues, Shared memory multiprocessors, Synchronization, small-scale symmetric multiprocessors on a snoopy bus, cache coherence on snoopy buses, Scalable multiprocessors, Directory-based cache coherence, Interconnection network, Memory consistency models, Software distributed shared memory, multithreading in hardware, Chip multiprocessing, Current research and future trends.

Suggested Text Book & References:

1. K. Hwang and F. A. Briggs. Computer Architecture and Parallel Processing, McGraw Hill
2. H. Stone, Advanced Computer Architecture, Addison Wesley
3. H. J. Siegel, Interconnection Network for Large Scale Parallel Processing, McGraw Hill
4. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, 2nd Edition, Morgan Kaufmann

3. MACHINE LEARNING

Algorithmic models of learning. Learning classifiers, functions, relations, grammars, probabilistic models, value functions, behaviors and programs from experience. Bayesian, maximum a posteriori, and minimum description length frameworks. Parameter estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, probabilistic relational models, association rules, nearest neighbor classifiers, locally weighted regression, ensemble classifiers. Computational learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting. Dimensionality reduction, feature selection and visualization. Clustering, mixture models, k-means clustering, hierarchical clustering, distributional clustering. Reinforcement learning; Learning from heterogeneous, distributed, data and knowledge. Selected applications in data mining, automated knowledge acquisition, pattern recognition, program synthesis, text and language processing, internet-based information systems, human-computer interaction, semantic web, and bioinformatics and computational biology.

Suggested Text Book & References:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2nd Edition
2. Mitchell, Machine Learning. TMH
3. Jason Bell, Machine Learning for Big Data: Hands-on for Developers and Technical Professionals, Wiley India
4. Christopher Bishop, Pattern Recognition and Machine Learning 2010, Springer.

4. DATA MINING

Introduction :
Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective.

Data Mining Techniques :
A Statistical Perspective on Data Mining, Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms.

Classification :
Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques.

Clustering :
Similarity and Distance Measures, Hierarchical Algorithms, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes.

Association Rules :
Basic Algorithms, Parallel and Distributed Algorithms, Incremental Rules, Advanced Association Rule Techniques, Measuring the Quality of Rules.

Advanced Techniques :
Web Mining, Spatial Mining, Temporal Mining

Suggested Text Book & References:

1. J. Han & M. Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann
2. M. J. A. Berry and G. Linoff, Mastering Data Mining: The Art and Science of Customer Relationship Management, Wiley
3. P. Adriaans & D. Zantinge, Data Mining, Addison WesleyR. Mattison, Data Warehousing: Strategies, Tools and Techniques, McGraw Hill.
4. P. Ponniah, Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Wiley,

5. DISTRIBUTED DATABASE SYSTEM

UNIT-I:

Transaction and schedules, Concurrent Execution of transaction, Conflict and View Serializability, Testing for Serializability, Concepts in Recoverable and Cascadeless schedules.

UNIT –II:

Lock based protocols, time stamp based protocols, Multiple Granularity and Multiversion Techniques, Enforcing serializablity by Locks, Locking system with multiple lock modes, architecture for Locking scheduler.

UNIT-III:

Distributed Transactions Management, Data Distribution, Fragmentation and Replication Techniques, Distributed Commit, Distributed Locking schemes, Long duration transactions, Moss Concurrency protocol.

UNIT-IV:

Issues of Recovery and atomicity in Distributed Databases, Traditional recovery techniques, Logbased recovery, Recovery with Concurrent Transactions, Recovery in Message passing systems, Checkpoints, Algorithms for recovery line, Concepts in Orphan and Inconsistent Messages.

UNIT-V:

Distributed Query Processing, Multiway Joins, Semi joins, Cost based query optimization for distributed database, Updating replicated data, protocols for Distributed Deadlock Detection, Eager and Lazy Replication Techniques.

Suggested Text Book & References:

1. Ozsu M. Tamer, Principles of Distributed Database Systems, Pearson Education, 2006
2. Ramakrishna and Gehrke,' Database Management System, Mc Graw Hill
3. Garcia-Molina, Ullman, Widom,' Database System Implementation' Pearson Education
4. Ceei and Pelagatti, Distributed Database', TMH
5. Chhanda Ray, Distributed Database Systems, Pearson 2009.
6. Silberschatz, orth and Sudershan, Database System Concept', Mc Graw Hill

6. PRINCIPLE OF ROBOTICS

Basic Concepts:

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors – work cell – Programming languages.

Direct and Inverse Kinematics:

Mathematical representation of Robots – Position and orientation – Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics-PUMA560 & SCARA robots- Solvability – Solution methods-Closed form solution.

Manipulator Differential Motion and Statics:

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity – Static analysis – Force and moment Balance.

Path Planning:

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric descriptions-Straight line and circular paths-Position and orientation planning.

Dynamics and Control:

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model -Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

Suggested Text Book & References:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression
2. K. K. Appu Kuttan, Robotics, I K International
3. Edwin Wise, Applied Robotics, Cengage Learning
4. R.D. Klafter, T.A. Chimielewski and M. Negin, Robotic Engineering–An Integrated Approach Prentice Hall of India, New Delhi
5. B.K. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai
6. S. Ghoshal, "Embedded Systems & Robotics" Projects using the 8051 Microcontroller", Cengage Learning

7. DIGITAL SIGNAL PROCESSING

Discrete-Time Signals and Systems: Discrete Time Signals, Analysis of Discrete Time Linear Time Invariant Systems, Systems described by Difference Equation, Correlation of Discrete Time Signals. Design of Digital Filters: Digital Filters by placement of poles and zeros in the Z-plane. Low pass, High pass and band pass Filters, Notch Filter; Comb Filter & All pass Filter. Realization of FIR & IIR systems, Design of FIR Filter using windows, Design of IIR filter by the Bilinear Transformation method. Discrete Fourier Transform : DFT and its relationship to other Transform, properties of the DFT, Circular convolution in time and frequency domains, Linear convolution in time and frequency domain by overlap save and overlap add methods. Fast Fourier Transform: Adaptive Filter, Inverse system, Deconvolution and System Identification. Power Spectrum Estimation: Estimation of Auto correlation and power spectrum of random signals, use of DFT in Power Spectrum Estimation. Parametric method - The Burg Method for the AR Model Parameters, Least Square Method, ARMA Model for Power Spectrum Estimation. The Adaptive Linear Combiner, Wiener Filters, Adaptive Transversal Filter Using Gradient Vector Estimation, LMS algorithm and its convergence analysis.

Suggested Text Book & References:

1. J. G. Proakais and D. G. Manolakis, Digital Signal Processing: Principles Algorithms and Applications, Pearson Education
2. V. Oppeinheim and R. W. Schafer, Digital Signal Processing, Pearson Education
3. S. K. Mitra, Digital Signal Processing: A computer based approach, TMH
4. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Pearson Education,

8. DIGITAL IMAGE PROCESSING

Image digital representation. Elements of visual perception. Sampling and quantisation. Image processing system elements. Fourier transforms. Extension to 2-D, DCT, Walsh transform, Hadamard transforms. Enhancement and segmentation. Point and region dependent techniques. Image encoding: Fidelity criteria. Transform compression. KL, Fourier, DCT, Spatial compression, Run length coding. Huffman and contour coding. Restoration Models: Constrained & unconstrained, Inverse filtering, Least squares filtering, Recursive filtering.

Suggested Text Book & References:

1. Digital Image Processing & Analysis, Chanda & Majumder, PHI.
2. Fundamentals of Digital Image Processing, Jain, PHI
3. Image Processing, Analysis & Machine Vision, Sonka, VIKAS.

9. FUZZY LOGIC

Introduction to fuzzy sets. Fuzzy sets and basic definitions. Extensions. Fuzzy measures and measures of fuzziness. The extension principle and applications. Fuzzy relations and fuzzy graphs. Fuzzy Logic, Fuzzy Sets and System Modelling, Fuzzy Relations, Fuzzy Equations, Membership Function in Fuzzy Logic, Fuzzy Rules, Fuzzy analysis. Fuzzy set theory. Decision making in fuzzy environments. Fuzzy set models in operations research. Empirical examining in fuzzy set theory. Applications with Matlab Fuzzy Toolbox.

Suggested Text Book & References:

1. Timothy J. Rose, Fuzzy Logic with Engineering Applications, Wiley India.
2. Samir Hung T. Nguyen, Elbert A. Walker, A First Course in Fuzzy Logic, Third Edition, CRC Press.
3. Samir Roy, Udit Chakraborty, Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms, 1st Edition, Pearson Education, India.
4. S. Rajasekaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications, Phi, 2011.

10. XML

XML Introduction and Overview, XML Syntax, XML Namespaces and Infoset, Document Type Definitions (DTDs), XML Schemas, Data Modeling, XPATH, XSL, XSLT, XLink, and XPointer, Document Object Model (DOM), Simple Application Programmer Interface (API) for XML (SAX), XML and Databases, Simple Object Access Protocol (SOAP).

Suggested Text Book & References:

1. Williamson, Xml: The Complete Reference, TMH
2. Steven Holzne, Sams Teach Yourself XML in 21 Days, 3rd Edition, SAMS.
3. Devan Shepherd, Sams Teach Yourself XML in 21 Days, 2001, SAMS
4. Bill Evjen, Kent Sharkey, Thiru Thangarathinam, Michael Kay, Alessandro Vernet, Sam Ferguson, Professional XML, Wrox/Peer Information Inc.

11. WEB TECHNOLOGY

Introduction:

History of internet and World Wide Web, Web server like Apache, Multi-tier Application architecture, client side versus server scripting, accessing web servers, HTML, XHTML, CSS.

Java Script:

Introduction, Simple program, obtaining user input with prompt dialogs, memory concepts, arithmetic, decision making, assignment operators, control structures – IF, IF…ELSE, WHILE, , FOR repetition statement, SWITCH multiple-selection statement, DO…WHILE repetition statement, logical operators, Program modules in JavaScript, function definitions, scope rules, global functions, recursion, arrays, references and reference parameters, passing arrays to functions, sorting arrays, searching arrays, multidimensional arrays, math object, string object, date object, Boolean and number object, document object, window object, using cookies.

PHP:

PHP Essentials, Installation and Configuration files, Variables, constants, Operators, Control Structures, Strings, Array , Functions , Built-in PHP Function Libraries, Forms, Data Validation, File Handling (Including and Requiring Files, Reading and Writing Files, Allowing Users to Download Files) ,PHP ODBC, Sessions, Cookies, FTP, GET and POST data, HTTP Headers, HTTP Authentication

MYSQL:
Introduction about Database, Data Types, DML, DDL, Aggregate functions, Data Time functions.

Suggested Text Book & References:

1. James Jaworski, Mastering JavaScript and Jscript, BPB Publication.
2. Timothy, Elizabeth, Jason, Scouarnec (Author), Jeremy, Michael K. Glass, Beginning PHP6, Apache, MYSQL Web Development, Wiley/Wrox, 2009.
3. PHP 6 and MySQL 5 for Dynamic Web Sites: Visual Quick Pro Guide, Larry Ullman, Pearson Education.
4. Steven Holzner, PHP: The Complete Reference, TMH

12. PRINCIPLE OF PROGRAMMING LANGUAGE

Overview of programming languages; language design and implementation - Grammars (regular expressions, context-free grammars); parse trees; recursive descent parsing, interpretation, and compilation -Expressions; control structures; subroutines -Storage management; scoping rules; bindings for names - Principles of object-oriented languages (data abstraction, encapsulation, inheritance, polymorphism); implementation mechanisms - Functional programming principles; Scheme - Data types - Other topics.

Suggested Text Book & References:

1. Robert W. Sebesta, Principles of Programming Languages, Pearson Education, 2012
2. Seema Kedar, Principles of Programming Languages, Technical Publication, 2011
3. Dr. Sachin Kumar (Author), Kadambri Agarwal, Principles of Programming Languages, S.K. Kataria & Sons, 2013
4. Principles of Programming Languages, Professional Publications, 2014
5. Kenneth C. Louden, Programming Languages: Principles and Practice, Cengage Learning, 2002

13. CRYPTOGRAPHY

UNIT-I :
Security trends – Attacks and services – Classical crypto systems – Different types of ciphers – LFSR sequences – Basic Number theory – Congruences – Chinese Remainder theorem – Modular exponentiation – Fermat and Euler's theorem – Legendre and Jacobi symbols – Finite fields – continued fractions.

UNIT-II :
Simple DES – Differential cryptoanalysis – DES – Modes of operation – Triple DES –AES – RC4 – RSA – Attacks – Primality test – factoring.

UNIT-III :
Discrete Logarithms – Computing discrete logs – Diffie - Hellman key exchange –ElGamal Public key cryptosystems – Hash functions – Secure Hash – Birthday attacks -MD5 – Digital signatures – RSA – ElGamal – DSA.

UNIT-IV :
Authentication applications – Kerberos, X.509, PKI – Electronic Mail security – PGP, S/MIME – IP security – Web Security – SSL, TLS, SET.

UNIT-V :
System security – Intruders – Malicious software – viruses – Firewalls – Security Standards.

Suggested Text Book & References:

1. William Stallings, “Crpyptography and Network Security”, Pearson/PHI, 4th Edn. 2006.
2. Kahate , Cryptography And Network Security Paperback, 2007,TMH.
3. Forouzan, Cryptography And Network Security, TMH.

14. SIMULATION AND MODELLING

Introduction to Probability theory, Random variables, commonly used continuous and discrete distributions. Introduction to Stochastic Process, Poisson process, Markov chains, steady state and transient analysis. Psuedo random numbers: Methods of Generation and testing. Methods for generating continuous and discrete distributions. Methods for generating Poisson Process. Building blocks of Simulation, Data Structures and Algorithms. Introduction to Probabilistic modelling, Maximum Likelihood Variance reduction techniques: antithetic variates, control variates, common random numbers, importance sampling. Analysis of Simulation results: confidence intervals, design of experiments. Markov Chain Monte Carlo techniques.

Suggested Text Book & References:

1. Sheldon M. Ross: Introduction to Probability Models 7th Edition, Academic Press, 2002
2. Donald E. Knuth: The Art of Computer Programming - Volume 2: Semi Numerical Algorithms, 2nd Edition, Addison Wesley, Reading MA, USA 2000.
3. Sheldon M. Ross Simulation 3rd Edition, Academic Press, 2002
4. M. Law and W. D. Kelton: Simulation Modeling and Analysis, 3rd Edition, Mc GrawHill, New York, USA, 1998
5. Raj Jain The Art of Computer Systems Performance Analysis, John Wiley and Sons, New York, USA, 1991

15. WIRELESS SENSOR NETWORKS

Overview of Wireless Sensor Networks:
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.

Architectures:
Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Networking Sensors:
Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S - MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

Infrastructure Establishments:
Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Sensor Network Platforms and Tools:
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

Suggested Text Book & References:

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" John Wiley
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier
3. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley
4. Anna Hac, “Wireless Sensor Network Designs”, John Wiley

16. COMPUTATIONAL GEOMETRY

Algorithmic design paradigms (divide and conquer, incremental, sweep line, and prune and search) and basic data structures (segment and interval trees). Geometric searching: point locations (slab and chain methods) and range searching (kD and range trees); Convex hull: Graham's scan, gift wrapping, quick hull, divide-and-conquer; Voronoi diagram and Delaunay triangulation: properties and construction algorithms (sweep line and divide-and-conquer algorithms). Visibility and Art gallery problems, motion PLANNING and shortest paths. Arrangements and duality; Line segments intersection problem; closest pair computation.

Suggested Text Book & References:

1. F. P. Preparata and M. I. Shamos, Computational Geometry: An Introduction, Springer-Verlag,
2. J. O'rourke, Computational Geometry In C, 2nd Ed, Cambridge University Press, 1998.
3. M. Laszlo, Computational Geometry and Computer Graphics In C++, Prentice-Hall, 1996
4. M. De Berg, M. Van Kreveld, M. Overmars, O. Schwarzkopf, Computational Geometry: Algorithms And Applications, Springer -Verlag, 1997

17 . APPROXIMATION ALGORITHMS

Review of basic concepts:

LP duality, complementary slackness, convex optimization via separation oracles, NP-completeness

Greedy algorithms:

Vertex/Set Cover, Sub-modular Function Maximization Application: Maximizing the spread of influence through a social network

Tree based approximations:
Undirected Traveling Salesman Problem and the Held-Karp bounds Undirected Minimum Steiner Tree-Embedding metric spaces into trees-Application: Buy-At-Bulk Network Design-Application: Group Steiner Trees

Simultaneous Optimization:
Fairness in load balancing and resource allocation-Data aggregation in sensor networks-Shallow Light Trees

Dynamic programming techniques:
Zero-One Knapsack and Bin Packing-Application: Constrained Shortest Paths-Directed Steiner Trees or Geometric PTASs (polynomial time approximation schemes)

Geometric Embeddings:
Bourgain's embeddings of metric spaces into normed spaces-The Sparsest Cut Problem, with applications-Semi-Definite Programming and Max-Cut-The l1-l2 gap, with algorithmic applications, Open problem: embedding minor-closed graphs

Scheduling Problems and Resource Augmentation :
Flow-time with and without augmentation Non-clairvoyant scheduling

Primal-Dual algorithms:
Facility Location and the k-Median Problem, Steiner Network Design.

Suggested Text Book & References:

1. Vijay V.Vazirani, Approximation Algorithms, Springer 2003
2. Ding-Zhu Du, Ker-I Ko, Xiaodong Hu, Design and Analysis of Approximation Algorithms, Springer.
3. David P. Williamson, David B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press.

18. VLSI DESIGN, TEST AND VERIFICATION

VLSI Design: Combinational logic; Synchronous sequential logic; Asynchronous sequential logic; Topics in SoC Interconnect; Topics in Network on Chip. VLSI TESTING: Introduction; Fault models: Stuck-at faults, Advanced Fault Models; Fault Simulation: Serial, Parallel, Deductive, Concurrent; Test generation for combinational circuits; D algorithm; Test generation algorithms for sequential circuits; Scan and partial scan design;

Built in self-test (BIST); Memory testing. Verification Techniques: Introduction to Hardware Verification and methodologies; Binary Decision Diagrams (BDDs) and algorithms over BDDs; Combinational equivalence CHECKING; Temporal Logics; modeling sequential systems and model checking; Symbolic model checking.

Suggested Text Book & References:

1. J. Nurmi, H. Tenhunen, J. Isoaho and A. Jantsch, Interconnect-centric design for advanced SoC and NoC, Springer, 2004.
2. C. J. Myers, Asynchronous circuit design, John Wiley & Sons, July 2001.
3. M. Mano, Digital Design, 3rd EDITION, 2001
4. M. Huth and M. Ryan, Logic in COMPUTER SCIENCE modeling and reasoning about systems, Cambridge University Press, 2nd EDITION, 2004.
5. Bushnell and Agrawal, Essentials of Electronic Testing for Digital, Memory & Mixed-Signal Circuits, Kluwer Academic Publishers, 2000.
6. P. Lala, Fault Tolerant and Fault Testable Hardware Design, Prentice-Hall, 1984.
7. N. H. E. Weste, K. Eshraghian, Principles of CMOS VLSI Design, Addison Wesley, 2nd edition, 1994.
8. G. De Micheli and L. Benini, Networks on Chips: Technology and Tools (Systems on Silicon), Morgan Kaufmann, 2006.

PRACTICAL / DESIGN

CS 475P PROJECT PRELIMINARY

L	T	P	C	
0	0	6	3	**Full Marks: 100**

Details of the Project Preliminary is to be decided by the Department.

CS 476P SOFTWARE SYSTEM LAB. – II

L	T	P	C	
0	1	3	2	**Full Marks: 50 (15 + 35)**

CS 477P SEMINAR – 1

L	T	P	C	
0	0	2	1	**Full Marks: 50 (15 + 35)**

FOUR YEAR
EIGTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				Credit
			L	T	P	Theory	Sess.	Pract.	Total	
1.	CS 481/X	ELECTIVE ñ VII	3	0	0	70	30	-	100	3.0
2.	CS 482/X	ELECTIVE ñ VIII	3	0	0	70	30	-	100	3.0
3.	CS 483/X	ELECTIVE-IX	3	0	0	70	30	-	100	3.0
		SUB-TOTAL							300	9.0
		PRACTICAL/DESIGN								
4.	CS 484P	PROJECT	0	0	18	-	200	200	400	9.0
5.	CS 485P	SEMINAR-II	0	0	3		15	35	50	1.5
		SUB-TOTAL							450	10.5
		TOTAL	**9**	**0**	**21**				**750**	**19.5**
6.	***NC 481***	***SOFT SKILL-II***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***
7.	***NC 482***	***PLACEMENT/ PHYSICAL TRAINING***	***3***	***0***	***0***	***-***	***50*****	***-***	***-***	***0.0***

CS 481/X ELECTIVE-VII

L T P C
3 0 0 3 Full Marks: 100 (70 + 30)

CS 482/X ELECTIVE-VIII

L T P C
3 0 0 3 Full Marks: 100 (70 + 30)

CS 483/X ELECTIVE-IX

L T P C
3 0 0 3 Full Marks: 100 (70 + 30)

ELECTIVE-VII, ELECTIVE-VIII & ELECTIVE-IX(Any Three)

1. **EMBEDDED SYSTEM**
2. **FORMAL METHODS FOR SYSTEM VERIFICATION**
3. **COMPUTER VISION**
4. **NATURAL LANGUAGE PROCESSING**
5. **INFORMATION RETRIEVAL**
6. **CLOUD COMPUTING**
7. **NETWORK PROTOCOLS**
8. **RESEARCH METHODOLOGY**
9. **SOFTWARE RELIABILITY**
10. **SOFTWARE PROJECT MANAGEMENT**
11. **RANDOMIZED ALGORITHMS**
12. **PARALLEL ALGORITHM**
13. **REINFORCEMENT LEARNING**
14. **DISTRIBUTED ALGORITHMS**
15. **HIERARCHICAL MEMORY ALGORITHM**
16. **MOBILE ROBOTICS**
17. **HUMAN COMPUTER INTERACTI**ON
18. **MULTIMEDIA SYSTEMS**

1. EMBEDDED SYSTEMS

Embedded Computing:
Challenges of Embedded Systems – Embedded system design process. Embedded processors – 8051 Microcontroller, ARM processor – Architecture, Instruction sets and programming.

Memory and Input/Output Management:
Programming Input and Output – Memory system mechanisms – Memory and I/O devices and interfacing – Interrupts handling.

Processes and Operating Systems:
Multiple tasks and processes – Context switching – Scheduling policies – Interprocess communication mechanisms – Performance issues.

Embedded Software:
Programming embedded systems in assembly and C – Meeting real time constraints – Multi-state systems and function sequences. Embedded software development tools –Emulators and debuggers.

Embedded System Development:
Design issues and techniques – Case studies – Complete design of example embedded systems.

Suggested Text Book & References:
1. Lyla, Embedded Systems, Pearson, 2013
2. Frank Vahid, Tony Givargis, Embedded System Design - John Wiley.
3. David E. Simon, An Embedded Software Primer - Pearson Education.
4. Raj Kamal, Embedded Systems - TMH.

2. FORMAL METHODS FOR SYSTEM VERIFICATION

Introduction to formal methods and hardware verification. Review of logics: Propositional Calculus and Predicate Calculus. Axioms and rules of Floyd-Hoare Logic. APPLICATION of Floyd-Hoare logic to verify hardware circuits. Describing hardware directly in higher ORDER logic. Combinational and sequential behaviour of circuits. Specification of hardware systems. Introduction to Binary Decision Diagram (BDD) and modelling hardware with BDDs. Algorithms for BDD operations. Concept of OBDDs and ROBDDs and operation on ROBDDs. Introduction to Temporal Logic. Linear and Branching time temporal logic. Expressing properties in CTL and CTL*. CTL model CHECKING algorithm. State space explosion problem: Symbolic data structure and symbolic model checking algorithms. Concept of on-the-fly model checking and automata-theoretic model checking. Study of verification tools: SMV and PVS.

Suggested Text Book & References:
1. M. Huth and M. Ryan, Logic in COMPUTER SCIENCE: Modelling and Reasoning about Systems, 2nd Ed, Cambridge University PRESS, 2004.
2. T. F. Melham, Higher Order Logic and Hardware Verification, Cambridge University Press, 1993.
3. E. M. Clarke, O. Grumberg and D. Peled, Model Checking, MIT Press, 1999
4. K. L. McMillan, Symbolic Model Checking, Kluwer Academic Publisher, 1993
5. Z. Manna and A. Pnueli, The Temporal Logic of Reactive and Concurrent System Specification, Springer-Verlag, 1992

3. COMPUTER VISION

Digital Image Formation and low-level processing:
Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth estimation and Multi-camera views:
Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

Feature Extraction:
Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation:
Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

Pattern Analysis:
Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Motion Analysis:
Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X:
Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

Miscellaneous:
Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS.

Suggested Text Book & References:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. K. Fukunaga, Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
5. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992

4. NATURAL LANGUAGE PROCESSING

Unit-I:
Introduction to Natural Language Understanding: The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

Unit-II:
Introduction to semantics and knowledge representation, Some applications like machine translation, database interface.

Unit-III:
Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

Unit-IV:
Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

Unit-V:

Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Suggested Text Book & References:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009
2. James A.. Natural language Understanding 2e, Pearson Education, 1994.
3. Bharati A., Sangal R., Chaitanya V. Natural language processing: a Paninian Perspective, PHI, 2000.
4. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008.

5. INFORMATION RETRIEVAL

Introduction to Information Retrieval: Motivation-Information Retrieval vs Data Retrieval-Flashback Models of Information Retrieval: Boolean Model-Vector Space Model-Probabilistic Model-Alternative Models Retrieval Evaluation: Recall and Precision-Alternative Measures-Reference Collections and Evaluation of IR systems Query Languages for IR: Keywords-Boolean Queries-Context Queries-Natural Language Queries-Structural Queries Advanced Query Operations: Relevance Feedback-Query Expansion-Automatic Local Analysis-Automatic Global Analysis Text Indexing, Preprocessing and File Organization: Stopwards, stemming, thesauri-File (Text) organization (invert suff)-Text statistics (properties)-Text compression Text Searching: Knuth-Morris-Pratt-Boyer-Moore family-Suffix automaton-Phrases and Proximity Document Clustering & Multimedia Information Retrieval: Similarity Queries-Feature-based Indexing and Searching-Spatial Access Methods-Searching in Multidimensional Spaces Parallel and Distributed IR: Architectures MIMD and SIMD-Collection Partitioning-Source Selection-Query Processing--2-Peer Architectures and Systems Meta-Ranking: Integrated vs Isolated Methods-Interleaving-Voting Web Search: History of Web-Indexing Spidering Crawling-Link Analysis (HITS, Page Rank)User Interfaces and Visualization

Suggested Text Book & References:

1. Baeza-Yates, Berthier- Neto, Modern Information Retrieval, Pearson, 2009.
2. Gerald J. Kowalski, Information Retrieval Systems: Theory and Implementation, Springer

3. Frakes, Information retrieval: data structures & algorithms, 2009,PHI.
4. Gerald J. Kowalski, Mark T. Maybur, Information Storage and Retrieval Systems: Theory and Implementation, Springer

6. CLOUD COMPUTING

Cloud Architecture and Model:
Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture. Cloud Models:- Characteristics – Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

Virtualization:
Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data-center Automation.

Cloud Infrastructure:
Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

Programming Model:
Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping APPLICATIONS - Programming Support - Google App Engine,
Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim

Security in the Cloud:
Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

Suggested Text Book & References:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
4. Rajkumar Buyya, Christian Vecchiola, S.Tamarai Selvi, ‘Mastering Cloud Computing”, TMGH, 2013.
5. Gautam Shroff, Enterprise Cloud Computing, Cambridge University Press, 2011
6. Michael Miller, Cloud Computing, Que Publishing, 2008.
7. Ronald L. Krutz, Russell Dean Vines, “Cloud Security – A comprehensive Guide to Secure Cloud Computing”, Wiley – India, 2010.
8. Katarina Stanoevska-Slabeva, Thomas Wozniak, Santi Ristol, “Grid and Cloud Computing – A Business Perspective on Technology and Applications”, Springer.
9. George Reese, “Cloud Application Architectures: Building APPLICATIONS and Infrastructure in the Cloud” O'Reilly.
10. Kumar Saurabh, “ Cloud Computing – insights into New-Era Infrastructure”, Wiley India, 2011

7. NETWORK PROTOCOLS

Overview of IPv4, TCP, IPv6, ICMP, ARP, DHCP; Routing Protocols: OSPF, RIP, BGP, Ad hoc network routing (AODV, DSR); IP Security: NAT, IPSEC, Socks, SSL; Quality of Service related protocols: Intserv, diffserv, Queuing techniques (WFQ, RED, etc.); Multi-Protocol Label Switching (MPLS) and GMPLS; Virtual Private Network (VPN) Protocols: L2TP, PPTP; Overview of Application Layer Protocols: DNS, LDAP, SMTP, POP3, IMAP4, SNMP; Voice over IP Protocols (VOIP) and videoconferencing: SIP, H323. Server Load BALANCING Techniques.

Suggested Text Book & References:

1. Charles. M.Kozierek, TCP/IP GUIDE, Shroff Publishers, Mumbai, 2005.
2. Uyless Black, MPLS and Label Switching Networks, Pearson Education (LPE), 2002
3. Forouzan, TCP/IP Protocol Suite, 3/E, TMH, 2008.
4. Karanjit Siyan, Tim Parker, TCP/IP Unleashed, 2002, Sams.
5. Request for Comments (RFC) from www.ietf.org.

8. RESEARCH METHODOLOGY

1. RESEARCH METHODS:

Unit-I:
Introduction to research; Definitions and characteristics of research; Types of research; Main components of any research work.

Unit-II:
Topic Selection: Learning Objectives; Problem identification; Criteria for prioritizing problems for research.

Unit-III:
Analysis and Statement of the problem: Learning Objectives; Analyzing the problem; Formulating the problem statement.

Unit-IV:
Literature review: Uses of literature review; Source of information; Organization of Information on index cards.

Unit-V:
Objectives: Learning Objectives; Definitions; Formulation of the research objectives.

Unit-VI:
Research methodologies: Study population; Variables; Sampling; Sample size determination; Plan for data collection; Methods of data collection; Plan for data processing and analysis; Ethical considerations.

Unit-VII:
Work Plan; Major components and outline of the different phases in a research process; Summary of the major components of a research proposal; Fieldwork; Writing a research report.

2. QUANTITATIVE METHODS:

Unit-I:
Statistics: Probability & Sampling distribution; Estimation, Hypothesis testing & application; Correlation & regression analysis.

Unit-II:
Types of study designs/ Experiment design – Orthogonal array, ANOVA, interaction, Signal-to Noise ratio, replication.

3. COMPUTER APPLICATIONS:

Unit-I:
Spreadsheet tool: Introduction to spread-sheet applications, features & functions, using formulae & functions, data storing, features for statistical data analysis, generating charts/graphs & other features. [Tools: Microsoft Excel, Open office and similar or other advanced tools]

Unit-II:
Presentation tool: Introduction to presentation tool, feartures & functions, creating presentations, customising presentation. [Tools used: Microsoft Powerpoint, Open Office or any other tool]

Unit-III:
Web Search: introduction to internet, Use of Internet & www, using search engines using advanced search tools.

Unit-IV:
Thesis writing & Scientific editing tools.

Suggested Text Book & References:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press
3. Research Methodology – C.R. Kothari

9. SOFTWARE RELIABILITY

Introduction to Reliability Engineering:
Reliability — Repairable and Non Repairable systems — Maintainability and Availability-Designing for higher reliability — Redundancy — MTBF — MTTF – MTTR.

Software Reliability:
Software reliability - Software reliability Vs Hardware reliability – Failures and Faults - Classification of Failures – Counting – System Configuration – Components and Operational Models – Concurrent Systems – Sequential Systems – Stand by Redundant systems.

Software Reliability Approaches:
Fault Avoidance — Passive Fault detection — Active Fault Detection — Fault Tolerance - Fault Recovery - Fault Treatment.

Software Reliability Modeling:
Introduction to Software Reliability Modeling – Parameter Determination and Estimation - Model Selection – Markovian Models – Finite and Infinite failure category Models – Comparison of Models – Calendar Time Modeling.

Suggested Text Book & References:
1. John Musa, “Software Reliability Engineering”, McGraw-Hill
2. Fenton, and Pfleeger, “Software Metrics: A Rigorous and Practical Approach”, International Thomson Computer Press
3. Jeff Tian, Software Quality Engineering (SQE), Wiley
4. Stephen H. Kan, Metrics and Models in Software Quality Engineering, Addison-Wesley
5. Glenford J. Myers, “Software Reliability “, Wiley Interscience Publication, 1976.

10. SOFTWARE PROJECT MANAGEMENT

Introduction and Software Project Planning:
Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.

Project Organization and Scheduling:
Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts.

Project Monitoring and Control:
Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.

Project Management and Project Management Tools:
Software Configuration Management: Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project.

Suggested Text Book & References:
1. Shashikant A. Kelkar, Software Project Management: A Concise Study 2nd Edition, PHI.
2. Bob Hughes, Mike Cotterell, Software Project Management, 2010, TMH
3. Pankaj Jalote, Software Project Management in Practice, Pearson Education.

11. RANDOMISED ALGORITHMS

Review of discrete probability; Notion of randomized algorithms, motivating examples; Markov, Chebyshev inequalities, Chernoff bounds; Probabilistic method; Hashing, fingerprinting; Random walks and Markov chains. Program checkers; Polynomial identities; Randomized complexity classes, probabilistically checkable proofs; some number theoretic problems; approximate counting.

Suggested Text Book & References:
1. Rajeev Motwani, Prabhakar Raghavan, Randomized Algorithms Paperback, Cambridge University Press, 2008.
2. Michael Mitzenmacher, Eli Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis, 2005.
3. Russ Bubley, Randomized Algorithms: Approximation, Generation, and Counting, Springer.
4. Ketan Mulmuley, Computational Geometry: An Introduction Through Randomized Algorithms, Prentice-Hall.

12. PARALLEL ALGORITHM

Introduction:
Paradigms of parallel computing: Synchronous - vector/array, SIMD, Systolic; Asynchronous - MIMD, reduction paradigm. Hardware taxonomy: Flynn's classifications, Handler's classifications. Software taxonomy: Kung's taxonomy, SPMD.

Abstract parallel computational models:
Combinational circuits, Sorting network, PRAM models, Interconnection RAMs. Parallelism approaches - data parallelism, control parallelism Performance Matrices: Laws governing performance measurements. Matrices - speedups, efficiency, utilization, communication overheads, single/multiple program performances, bench marks.

Parallel Processors:
Taxonomy and topology - shared memory multiprocessors, distributed memory networks. Processor organization - Static and dynamic interconnections. Embeddings and simulations.

Parallel Programming:
Shared memory programming, distributed memory programming, object oriented programming, data parallel programming, functional and dataflow programming.

Scheduling and Parallelization:
Scheduling parallel programs. Loop scheduling. Parallelization of sequential programs. Parallel programming support environments.

Suggested Text Book & References:
1. Henri Casanova, Arnaud Legrand, Yves Robert, Parallel Algorithms, CRC Press, 2008.
2. M.J. Quinn, “Designing Efficient Algorithms for Parallel Computer” by Mc Graw Hill.
3. S.G. Akl, Design and Analysis of Parallel Algorithms, Prentice Hall
4. S.G. Akl, Parallel Sorting Algorithm, Academic Press

13. REINFORCEMENT LEARNING

The Reinforcement Learning problem:
Evaluative feedback, non-associative learning, Rewards and RETURNS, Markov Decision Processes, Value functions, optimality and approximation

Dynamic programming:
Value iteration, policy iteration, asynchronous DP, generalized policy iteration.

Monte-Carlo methods:
Policy evaluation, roll outs, on policy and off policy learning, importance sampling.

Temporal Difference learning:
TD prediction, Optimality of TD(0), SARSA, Q-learning, R-learning, Games and after states.

Eligibility traces:
n-step TD prediction, TD(lambda), forward and backward views, Q(lambda), SARSA(lambda), replacing traces and accumulating traces.

Function Approximation:
Value prediction, gradient descent methods, linear function approximation, ANN based function approximation, lazy learning, instability issues.

Policy Gradient methods:
Non-associative learning - REINFORCE algorithm, exact gradient methods, estimating gradients, approximate policy gradient algorithms, actor-critic methods.

Planning and Learning:
Model based learning and planning, prioritized sweeping, Dyna, heuristic search, trajectory sampling, E^3 algorithm.

Hierarchical RL:
MAXQ framework, Options framework, HAM framework, airport algorithm, hierarchical policy gradient.

CASE studies:
Elevator dispatching, Samuel's checker player, TD-gammon, Acrobot, Helicopter piloting.

Suggested Text Book & References:

1. R. S. Sutton and A. G. Barto: "Reinforcement Learning: An Introduction", Cambridge, MA: MIT Press, 1998.
2. "Neuro-dynamic programming". Dimitri P. Bertsikas and John N. Tsitsiklis
3. "Learning Automata - An Introduction". Kumpati S. Narendra and M. A.L. Thathachar

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14. DISTRIBUTED ALGORITHMS

Models of distributed computing, Synchrony, COMMUNICATION and failure concerns, Synchronous message-passing distributed systems, Algorithms in systems with no failures - Leader Election and Breadth-First SEARCH algorithms, The atomic commit PROBLEM , consensus problems - the Byzantine Generals Problem , Asynchronous message-passing distributed systems , Failure detectors, Logical time and vector clocks, Routing algorithms.

Suggested Text Book & References:

1. Nancy A. Lynch, Distributed Algorithms, Morgan Kaufmann, 1996.
2. Nancy A. Lynch, Distributed Algorithms, , Elsevier India; 1st Edition, 2005.
3. Professor Ajay D. Kshemkalyani, Professor Mukesh Singhal,Distributed Computing South Asian Edition: Principles, Algorithms, and Systems, Cambridge University Press, 2010.
4. Wan Fokkink , Distributed Algorithms: An Intuitive Approach, MIT Press, 2013.

15. HIERARCHICAL MEMORY ALGORITHMS

Hierarchical memory levels; performance characteristics; Parallel disk model. Fundamental I/O operations. Design and analysis of efficient external memory algorithms for some representative problems. Sorting, permutation, searching. Depth first search, breadth first search, Minimum spanning forest, connected components, single source shortest path, transitive closure hashing, string matching. External Memory Data Structures. Cache efficient algorithms. APPLICATIONS in various areas, for example, Computational geometry.

Suggested Text Book & References:

1. J. S. Vitter. Algorithms and Data Structures for External Memory, Now Publishers, 2008.
2. N. Zeh. I/O-efficient graph algorithms, Lecture notes from EEF Summer School on Massive Data Sets, 2002.
3. L. Arge. The Buffer Tree: A New Technique for Optimal I/O Algorithms, Proceedings of the fourth International Workshop on Algorithms and Data Structures (WADS), 1995.
4. M. H. Nodine and J. S. Vitter. Greed Sort: Optimal Deterministic Sorting on Parallel Disks, Journal of the ACM (JACM), 42 (4), 1995.
5. R. D. Barve, E. F. Grove and J. S. Vitter. Simple Randomized Mergesort on Parallel Disks, Proceedings of the eighth ACM symposium on Parallel algorithms and architectures (SPAA), 1996.
6. A. Beckmann, U. Meyer, P. Sanders and J. Singler. Energy-efficient Sorting using Solid State Disks, Proceedings of the first International Green Computing Conference (IGCC), 2010.

16. MOBILE ROBOTICS

Introduction to Mobile robot architectures, Control Paradigms, Sensors and actuators. Learning Approaches for robots. Navigation Strategies, Detecting and handling Novelty. Behavior-based robotics, AIE and their APPLICATION to robots. Case studies of learning robots, Laboratory sessions will include study and implementations of the above methodologies using real robots.

Suggested Text Book & References:

1. U. Nehmzow, Mobile Robotics - A Practical Introduction, 2nd Ed, Springer, 2003.
2. L. N. de Castro and J. Timmis, Artificial Immune SYSTEMS: A New Computational Intelligence Approach, Springer, 2002.
3. D. Dasgupta, Artificial Immune Systems and Their APPLICATIONS, Springer, 1999.
4. R. C. Arkin, Behaviour Based Robotics, MIT PRESS, 1998.

17. HUMAN COMPUTER INTERACTION

HCI foundation: HISTORY, human abilities, state of the art in computing technology, interaction styles and paradigms; Design process: interaction design basics, HCI in software process, design rules and guidelines, implementation support (UI software), universal design; Interaction styles: direct manipulation, WIMP, web interface, natural language interaction; Evaluation techniques; Models in HCI: formal models, linguistic models, cognitive models (KLM/GOMS), cognitive architectures, hybrid models; Task analysis; Dialogue design; Advanced topics (overview) pervasive computing, CSCW, virtual reality, tangible USER interface, multimedia.

Suggested Text Book & References:

1. A. Dix, J. Finlay, G. D. Abowd and R. Beale, Human Computer Interaction, 3rd Edn, PEARSON EDUCATION, 2005.
2. J. Preece, Y. Rogers, H. Sharp, D. Baniyon, S. Holland and T. Carey, Human Computer Interaction, Addison-Wesley, 1994.
3. C. Stephanidis (ed.), User Interface for All: Concepts, Methods and Tools. Lawrence Erlbaum Associates, 2001.
4. J. M. Caroll (ed.), HCI Models, Theories and Frameworks: TOWARDS a Multidisciplinary Science (Interactive Technologies), Morgan Kauffman, 2003.
5. W. O Galitz, The Essential Guide to User Interface Design, John Wiley & Sons, Inc, 2002 (Indian Edition).
6. B. Shneiderman, Designing the User Interface, Addison Wesley, 2000 (Indian Reprint).

18. MULTIMEDIA SYSTEMS

Introduction to Multimedia, DSP Preliminaries: Fundamentals of Signal and Systems, Transformations, IMAGE Representations and Transformations, Elements of Image Compression and CODING: Lossy and Lossless Image Compressions, Fixed-length and Variable-length Coding, Discrete Cosine Transforms and Coding, Wavelet Transform and Coding, Multimedia Standards: Still Image Compression Standards: JPEG and JPEG 2000, Elements of Video Compression System: DPCM, Motion Estimation, Video Compression Standards: Overview, H.261, H.263, H.264, MPEG-1: Specification, continuity and synchronization, MPEG-2: Overview, scalability, Audio Compression: Overview, MPEG Audio Coder

Suggested Text Book & References:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Multimedia Communication Systems: Techniques, Standards, and Networks, Prentice Hall PTR, 2000.
2. Yun Q Shi, Huifang Sun, Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, second Edn., CRC Press, 2008.
3. John G. Proakis and Dimitris K Manolakis, Digital Signal Processing (4th Edition), Prentice Hall, 2006.
4. Iain Richardson, Iain E. G. Richardson, " H.264 and MPEG-4 Video Compression: Video Coding for NEXT Generation Multimedia, "John Willey 2004.
5. Oge Marques, Practical Image and Video Processing Using MATLAB, Wiley-IEEE Press, 2009.
6. Andreas Spanias, Ted Painter, Venkatraman Atti, Audio Signal Processing and Coding, John Willey, 2007.

PRACTICAL/DESIGN

CS 484P PROJECT

L	T	P	C	
0	0	18	9	**Full Marks: 400 (200 + 200)**

In continuation and fulfillment of the CS 475P.

CS 485P SEMINAR-II

L	T	P	C	
0	0	3	1.5	**Full Marks: 50(15+35)**

NC 481 SOFT SKILL – II

L	T	P	C	
3	0	0	0	**Full Marks: 50 (Sessional – Non Credit)**

Numbers:
Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

Arithmetic – I :
Percentages, Profit & Loss, Simple Interest & Compound Interest, Clocks & Calendars

Algebra – I :
Logarithms, Problems on ages

Modern Mathematics – I:
Permutations, Combinations, Probability

Reasoning:
Logical Reasoning, Analytical Reasoning

Assessment:
Objective type – Paper based / Online – Time based test

Suggested Text Books & References:

1. Agarwal. R.S – Quantitative Aptitude for Competitive Examinations, S. Chand Limited 2011
1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 3rd Edition, 2011
2. Edgar Thrope, Test Of Reasoning for Competitive Examinations, Tata McGraw Hill, 4th Edition, 2012