DEPARTMENT OF COMPUTER SCIENCE
UNIVERSITY OF DELHI

Revised Scheme of Examination and Courses of Studies for the Master of Computer Applications (MCA) Programme

1. There shall be Master of Computer Applications (MCA) Programme in the Department of Computer Science under the Faculty of Mathematical Sciences.

2. The eligibility criterion, admission procedure, etc. for admission to the MCA programme would be as determined by the University from time to time.

3. The duration of the course shall be three academic years consisting of six semesters.

4. Medium of instruction and examination shall be English.

5. Scheme of examination and courses of studies:

(i) The students shall register for the courses as mentioned in 5 (viii). Performance of the students will be evaluated based on a comprehensive system of continuous evaluation. For each theory course, there shall be two minor tests, assignments and an end-semester examination: (Minor Test I, Minor Test II, Assignments - 40% weightage; End-semester examination - 60% weightage). The implementation of the evaluation process would be monitored by a Committee to be constituted by the Department at the beginning of each academic year.

(ii) The project in sixth semester shall carry 500 marks as follows:

(a)	Mid-term evaluation		25% weightage
(b)	End-semester evaluation		
	(i)	Dissertation	50% weightage
	(ii)	Presentation and Viva-voce	25% weightage

End semester evaluation will be carried out by internal and external examiners. Each student shall carry out the project in the Department/Organization/Institution as approved by the Department under the supervision of a teacher assigned by the Department. When a student is assigned to an Organization/Institution for project work, the Department may also appoint a supervisor in consultation with the Organization/Institution.

(iii) In order to pass a course and earn credits prescribed for it, a student must secure at least 40% marks in the end semester examination and 40% marks in the aggregate of internal assessment and end semester examination.

(iv) A student has to re-register for the course in which he/she fails to secure pass

marks and earn credits prescribed for it as mentioned in 5(iii).

(v) (a) For promotion from first year to second year a student must acquire at least 44 credits out of the courses prescribed for Semester I and Semester II taken together. A student who fails to get promoted to II year shall be required to seek fresh admission in I year as per the University rules for readmission of failed students.

(b) For promotion from second year to third year a student must acquire at least 89 credits out of the courses prescribed for semester I, II, III, IV taken together.

(vi) Eligibility for the Award of Degree

(a) In order to be eligible for the award of the degree of MCA programme, a student must earn at least 149 credits, including theory papers, and the project work.

(b) The candidates eligible for the award of MCA degree shall be classified on the basis of the marks obtained in the aggregate of best 149 credits acquired during Semester I, II, III, IV, V, VI taken together as follows:

(i)	First Division with Distinction	75% or more marks in the aggregate
(ii)	First Division	60% or more marks but less than 75% marks in the aggregate
(iii)	Second Division	50% or more marks but less than 60% marks in the aggregate
(iv)	Third Division	40% or more marks but less than 50% marks in the aggregate

(vii) A candidate must pass the MCA programme within five years of the initial admission to the first year of the course.

(viii) **Courses of Studies for MCA Programme**

(a) The students would be required to register for the courses in the first year as follows:

Semester I

Course No.	Title	L – T – P*	Credits	Total Marks
MCA 101	Object Oriented Programming	4 - 0 - 2	5	100
MCA 102	Systems Programming	4 - 0 - 2	5	100
MCA 103	Statistical Techniques	4 - 1 - 0	5	100
MCA 104	Computer Systems Architecture	4 - 1 - 0	5	100
MCA 105 (Optional Paper)	Options (a) Organizational Behaviour (b) Economics	4 - 1 - 0	5	100
MCA 106	Technical Communication	1 - 1 - 0	2	50

Semester II

Course No.	Title	L – T – P*	Credits	Total Marks
MCA 201	Data Structures and File Processing	4 - 0 - 2	5	100
MCA 202	Discrete Mathematics	4 - 1 - 0	5	100
MCA 203	Computer Graphics	4 - 0 - 2	5	100
MCA 204	Data Communication and Computer Networks	4 - 0 - 2	5	100
MCA 205	Fundamentals of Accounting and Finance	4 - 1 - 0	5	100
MCA 206	Digital and Microprocessor Laboratory	0 - 0 - 4	2	50

(b) The students would be required to register for the courses in the second year as follows:

Semester III

Course No.	Title	L – T – P*	Credits	Total Marks
MCA 301	Design and Analysis of Algorithms	4 - 1 - 0	5	100
MCA 302	Information Security	4 - 0 - 2	5	100
MCA 303	Database Systems	4 - 0 - 2	5	100
MCA 304	Automata Theory	4 - 1 - 0	5	100
MCA 305	Operating Systems	4 - 0 - 2	5	100

Semester IV

Course No.	Title	L – T – P*	Credits	Total Marks
MCA 401	Compiler Design	4 - 0 - 2	5	100
MCA 402	Software Engineering	4 - 0 - 2	5	100
MCA 403	Programming Paradigms	4 - 0 - 2	5	100
MCA 404	Network Programming	4 - 0 - 2	5	100
EL 4 XX !	Elective	4 - 0 - 2	5	100

! To be decided by the Department from the list of electives.

(c) The students would be required to register for the courses in the third year as follows:

Semester V

Students shall register for at least 25 credits amongst those out of the following list of electives as offered by the Department from time to time:

List of Electives

Course No.	Title	L – T – P*	Credits	Total Marks
EL X01	Modeling & Simulation	4 - 0 - 2	5	100
EL X02	Data Base Applications	4 - 0 - 2	5	100
EL X03	Operating Systems Case Studies	4 - 0 - 2	5	100
EL X04	Visual Programming	4 - 0 - 2	5	100
EL X05	Data Mining	4 - 0 - 2	5	100
EL X06	Computational Intelligence	4 - 0 - 2	5	100
EL X07	Artificial Intelligence	4 - 0 - 2	5	100
EL X08	Electronic Commerce	4 - 0 - 2	5	100
EL X09	Digital Image Processing & Multi-media	4 - 0 - 2	5	100
EL X10	Neural Networks	4 - 0 - 2	5	100
EL X11	Numerical Computing	4 - 0 - 2	5	100
EL X12	Combinatorial Optimization	4 - 0 - 2	5	100
EL X13	Computational Linguistics	4 - 0 - 2	5	100
EL X14	Software Quality Assurance & Testing	4 - 0 - 2	5	100
EL X15	Machine Learning	4 - 0 - 2	5	100
EL X16	Embedded Systems	4 - 0 - 2	5	100
EL X17	Cryptography	4 - 0 - 2	5	100
EL X18	Operating System Design and Practice	4 - 0 - 2	5	100
EL X19	Database Systems and Implementation	4 - 0 - 2	5	100

EL X20	Human Resource Management	4 - 0 - 2	5	100
EL X21	XML and Databases	4 - 0 - 2	5	100
EL X22	Satellite and Mobile Communication Networks	4 - 0 - 2	5	100

* L – T – P : Lectures - Tutorials - Practical
X – 4 if the elective is offered in 4th Semester.
X- 5 if the elective is offered in 5th Semester.

Semester VI

MCA 601 Project – 25 Credits

Semester I

MCA 101 OBJECT ORIENTED PROGRAMMING

Programming Concepts: Algorithm and its characteristics, pseudo code / flowchart, program, identifiers, variables, constants, primitive data types, expressions, structured data types, arrays, compilers & interpreters

Statements: Assignment statement, if then else statements, switch statement, looping statements- while, do while, for, break, continue, input/output statements, functions/procedures

Object Oriented Concepts: Abstraction, encapsulation, objects, classes, methods, constructors, inheritance, polymorphism, static and dynamic binding, overloading,

Program Development: Object oriented analysis, design, unit testing & debugging, system testing & integration, maintenance.

Programming Language: Java as a vehicle for teaching the concepts

References

1. Cay Horstmann, **Computing Concepts with Java Essentials** (5th ed.), John Wiley & Sons, 2006
2. Bruce Eckel, **Thinking in Java**, Pearson Education, 2006.
3. H. Schildt, **Java 2: The Complete Reference** (5th ed.), Tata McGraw Hill, 2002
4. Richard Johnson, **An Introduction to Java Programming and Object-Oriented Application Development,** Thomson Learning, 2006
5. Cay S. Horstmann & Gary Cornell, **Core Java Volume I** (7th ed.), Sun Microsystems Press Java Series, 2006
6. Deitel & Deitel, **Java-How to Program** (7th ed.), Prentice Hall, 2006

7. Daniel Liang, **Introduction to Java Programming** (5th ed.), Prentice Hall, 2005
8. J.A. Slack, **Programming and Problem Solving with Java**, Thomson Learning, 1999

MCA 102 SYSTEMS PROGRAMMING

Assembly Language Programming: Data representation, Instruction formats, addressing techniques, Flow control, Segments – Data Segment, Code Segment, Stack Segment, Procedures, Input/ Output, Interrupts and Program development in 8086.

Assembler: macro processor, macros, calls, parameters, expansion, design of two-pass assembler.

Loaders and Linkers: Loading schemes, design of absolute and direct linking loaders.

References

1. Yu-Cheng Gibson and Glenn A. Liu, **Microcomputer Systems : The 8086-8088 Family, Architecture, Programming, and Design**, Prentice-Hall Inc., NJ, 2000
2. Barry B. Brey, **The Intel Microprocessors: 8086/8088, 80186, 80286, 80386, 80486, Pentium, Pentium Pro, and Pentium II, Pentium III, Pentium 4** (7th ed.), Prentice-Hall, 2005
3. Peter Abel, **IBM PC Assembly Language and Programming** (5th ed.), Pearson Education, 2001
4. J.R. Levine, **Linkers and Loaders**, The Morgan Kaufmann Series in Software Engineering and Programming, 1999
5. S. Chattopadhyay, **System Software**, Prentice-Hall of India, 2007

MCA 103 STATISTICAL TECHNIQUES

Probability: Basic concepts & definitions (Classical & Axiomatic definition), random variable, probability density function, probability mass function, distribution function and their properties, mathematical expectation, conditional expectation, moment generating function, Characteristic Function, Chebyshev's inequality.

Various discrete and continuous probability distributions: Uniform (continuous and discrete), Binomial, Negative Binomial, Poisson, Exponential, Erlang, Gamma, Normal, χ^2, t-distribution and F-distribution, Bivariate normal distribution (Marginal and Conditional distributions), weak Law of Large Numbers, Central Limit Theorem. Simple random sampling with and without replacement, Random number generation using inverse transformation technique (exponential distribution, gamma distribution)

Statistical Testing and Estimation Techniques: Properties of good estimator-

unbiasedness, consistency, sufficiency, completeness, efficiency; Minimum variance unbiased estimators, Cramer Rao Inequality, Method of Maximum likelihood, method of Moments, Confidence Intervals for mean, variance and proportions. Large sample tests for mean and proportion, χ^2 test for goodness of fit, Tests based on t and F-distributions.

Correlation and Regression: Partial and multiple Correlation (for three variables only), Least square method for curve fitting, multiple regression (three variables only).

References

1. V.K Rohtagi and A.K. Saleh, **An Introduction to Probability and Statistics** (2nd ed.), John Wiley & Sons, 2005
2. A.M. Goon, M.K. Gupta and T.S. Dasgupta, **Fundamentals of Statistics** (7th ed.), Vol. I, The World Press Pvt. Ltd., 2000
3. R.V. Hogg and A.T. Craig, **Introduction to Mathematical Statistics**, Macmillan Publishing Co. Inc., 1978
4. Neil A. Weiss, **Introductory Statistics** (7th ed.), Pearson Education, 2007
5. A.M. Goon, M.K. Gupta and T.S. Dasgupta, **An Outline of Statistical Theory** (2nd ed.), Vol. II, The World Press Pvt. Ltd., 2000

MCA 104 COMPUTER SYSTEMS ARCHITECTURE

Basic Building Blocks: Boolean logic and Boolean algebra, tri-state logic; flip-flops, counters, shift registers, adders, substractor, encoders, decoders, multiplexors, demultiplexors

Register Transfer and Micro Operations: Bus and memory transfers, arithmetic, logic shift micro operations; basic computer organization: common bus system, instructions, instruction cycle, input/output configuration, CPU organization, micro programmed control unit, register organization, stack organization, instruction formats; RISC architecture; microprocessor architecture.

Memory Unit: Primary memory, secondary memory, associative memory, sequential access, direct access storage devices.

Input-Output Architecture: Input/Output devices; data transfer schemes - programmed I/O and DMA transfer; data transfer schemes for microprocessors.

References

1. M. Morris Mano, **Computer System Architecture** (3rd ed.), Prentice –Hall of India, 2007.
2. W. Stallings, **Computer Organization and Architecture: Designing for Performance** (7th ed.), Pearson Education, 2006

3. A.S. Tanenbaum, **Structured Computer Organization** (4th ed.), Prentice–Hall of India, 1999.
4. J.P. Hayes, **Computer Architecture and Organization** (2nd ed.), McGraw-Hill Book Company, 1988.

MCA 105 (a) ORGANIZATIONAL BEHAVIOUR

Organization Behavior: Introduction to Organization Behavior: Historical roots of Organizational Behavior, Fundamental concepts, Nature, Emerging trends in the organizational behavior, Limitation of Organization Behavior, Challenges & Opportunities for Organization Behavior

Individual processes in Organizations: The nature of individual –differences, personality and work, attitudes and attitude formation, job-related attitude.

Motivation: Importance of motivation at work, approaches to motivation, content theories, process theories, motivation and its effects, McGreoger theory X and Y, Maslow's need hierarchy, Herzberg's two factor theory, Vroom expectancy theory, OB modification.

Group dynamics: What is group dynamics?, Reasons for formation of group, Types of groups , Problems associated with group, Stages in development of groups, Theories of group formation, Cohesiveness, Conditions effecting group cohesiveness, Role dynamics in organizations, Social loafing, How to overcome social loafing, How to develop successful group.

Teams: Types of teams, model of team effectiveness, factors influencing team effectiveness, how to develop successful teams.

Power and Politics: Definition and nature of Power, Types of Power, Contingencies of Power, Organizational Politics, Where does it occur, Types of political activity, Political strategies for power acquisition in modern organization, Coping with organizational politics. Empowerment. Organizational politics and its effects, Organizational politics and ethics

Conflicts and negotiation: What is conflict? Historical perspective behind conflict or approaches to conflict, Nature and type of conflict, Conflict Processes, Interpersonal Conflict Management Styles, Levels of conflict, Perceptual Errors Responsible For conflict, Consequences of conflict, coping strategies, Negotiation, strategies, processes, issues on negotiation.

Stress: Nature of stress, causes, and consequences, Individual differences in resistance to stress, techniques of managing stress.

Communication and feedback: Transactional analysis, Johari window, job analysis and job design: issues, techniques and methodology.

Leadership: Concept and style, Fiedler's contingency mode, path-goal theory, leadership effectiveness.

Performance Appraisal: Need, methods and applications; organizational processes: organizational effectiveness and change.

References

1. Narender. K. Chadha, **Perspectives in Organizational Behavior**, Galgotia Publications Pvt. Ltd., New Delhi, 2007
2. F. Luthans, **Organizatonal Behavior** (9th ed.), McGraw-Hill companies Inc., 2002
3. J. Greenberg, R.A. Baron, **Behavior in Organizations** (8th ed.), Pearson Education Inc., 2005
4. Steven L. McShane, Mary Ann VanGlinow, **Organizational Behavior**, Tata McGraw Hill Company Ltd., 2001

MCA 105 (b) ECONOMICS

Market and Market Forces, Demand and its Determination: Market and Industry, concept of demand, market and individual demand functions, Determinants of demand. Demand elasticity – price, income and cross elasticity. Supply: determinant of supply, elasticity of supply.

Production and Cost: Production function, concept of productivity, isoquants, ridge lines, production range, isocost lines, least-cost combination of inputs, producers equilibrium. Classification of costs- short run and long run costs. Cost function, law of variable proportion, return to scale, scope economies.

Price and Output Relationship under Different Market Structure: Pure and perfect competition, monopoly, oligopoly and barrier to entry.

Elements of Factor Pricing: Demand and supply of factors of production, concept of rent, profits and interest, measurement of profit.

National Income and Employment Determination: Classical theory, keynesian theory, neo-classical theory, consumption function, investment function, investment multiplier and its determinants, foreign trade and budget multipliers.

References

1. Case, Karl. E. and Fair, **Principles of Economics** (6th ed.), Pearson Education, 2002.
2. Lipsey and Chrystal, **Economics** (10th ed.), Oxford University Press, Delhi, 2004.
3. Pindyck, Rubinfeld and Mehta, **Microeconomics** (1st Indian reprint), Pearson Education, 2005.

MCA 106 Business and Technical Communication

Language and communication: speech and writing, functions and features of linguistic communication

Interpersonal and business communication: message structure and message rewriting, effective textual strategies - clarity, conciseness, consistency and coherence.

Format and content: style and persuasion; argumentation; document summarization.

Technical writing: scientific and technical writing; formal and informal writing; report, handbook, manual, letter, memorandum, notice, agenda, and minutes.

Report writing: topic, assumptions, hypothesis, overview, analysis and discussion, conclusion, appendices, references.

References

1. Victoria Fromkin, Robert Rodman and Nina Hyams, **An Introduction to Language** (7th ed.), Thomson Learning, 2002
2. Leech Thomas, **How to prepare, stage, and deliver winning presentations** (3rd ed.), American Management Association, 2004
3. Carol M. Lehman, Deborah Daniel Dufrene and Debbie D. Dufrene, **Business Communication** (14th ed.), South-Western Educational Pub, 2004
4. H.A. Murphy, H.W. Hildebrandt and J.P. Thomas, **Effective Business Communication** (7th ed.), McGraw-Hill, New York, 1997
5. J. Anderson and M.E. Poole, **Assignment and Thesis Writing** (4th ed.), John Wiley and Sons, 2001

Semester II

MCA 201 DATA STRUCTURES AND FILE PROCESSING

Basic Data Structures: Abstract data structures- stacks, queues, linked lists and binary trees.

Sets: Dictionary implementation, use of priority queues, hashing, binary trees, balanced trees, sets with merge-find operations.

Searching: Internal and external searching, use of hashing and balancing techniques.

Memory Management: Garbage collection algorithms for equal sized blocks, storage allocation for objects with mixed size, buddy systems.

Physical Devices: Characteristics of storage devices such as disks and tapes, I/O

buffering.

Basic File System Operations: Create, open, close, extend, delete, read-block, write-block, protection mechanisms.

File Organizations: Sequential, indexed sequential, direct, inverted, multi-list, directory systems, Indexing using B-tree, B+tree and their variants, hashing – hash function, collision handling methods, extendible hashing.

References

1. M.T. Goodrich, R. Tamassia and D. Mount, **Data Structures and Algorithms in C++**, John Wiley & Sons, Inc., 2004
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, **Introduction to Algorithms** (2nd ed.), Prentice-Hall of India, 2006
3. M.J. Folk, B. Zoellick and G. Riccardi, **File Structures: An Object Oriented Approach With C++** (3rd ed.), Addison- Wesley, 1997.
4. Robert L. Kruse and A.J. Ryba, **Data structures and program design in C++**, Prentice-Hall, Inc., NJ, 1998

MCA 202 DISCRETE MATHEMATICS

Overview: Counting, generating functions, recurrence relations, linear recurrence relations with constant coefficients, homogenous solutions, particular solutions, total solutions, solution by the method of generating functions.

Growth of Functions: Asymptotic notations, monotonicity, comparison of standard functions - floors and ceilings, polynomials, exponentials, logarithms and factorials, summations: summation formulas and properties, bounding summations, approximation by integrals.

Graph Theory: Basic terminology, multigraphs and weighted graphs, paths and circuits, searching techniques: BFS, DFS and their applications, shortest paths in weighted graphs, Eulerian paths and circuits, Hamiltonian paths and circuits, Traveling Salesperson problem, planar graphs, trees and rooted trees, prefix codes, minimal spanning trees, cut sets, directed graphs.

Mathematical Logic: Propositions, connectives, conditionals and biconditionals, well formed formulas, tautologies, equivalence of formulas, duality law, normal forms, inference theory for propositional calculus; predicate calculus: predicates, free and bound variables, inference theory of predicate calculus.

Introduction to algebraic structures groups, lattices and boolean algebra.

References

1. C.L. Liu, **Elements of Discrete Mathematics**, McGraw-Hill Pub. Co., 1977
2. D.E. Knuth, **The Art of Computer Programming** (3rd ed.), Vol. 1, Addison Wesley, 1997
3. K.D. Joshi, **Foundations of Discrete Mathematics**, New Age International Publishers, 2003
4. D.S. Malik and M.K. Sen, **Discrete Mathematical Structures: Theory and Applications**, Thomson Learning, 2004
5. R.L. Graham, D.E. Knuth, O. Patashnik, **Concrete Mathematics** (2nd ed.), Addison-Wesley, 1994.

MCA 203 COMPUTER GRAPHICS

Development of computer Graphics: Raster Scan and Random Scan graphics storages, displays processors and character generators, colour display techniques, interactive input/output devices.

Points, lines and curves: Scan conversion, line-drawing algorithms, circle and ellipse generation,conic-section generation, polygon filling anti aliasing.

Two-dimensional viewing: Co-ordinate systems, linear transformations, line and polygon clipping algorithms.

Fractals: Generation, Classification and Dimension. Some basic fractal images- Koch curve, Spearpinski triangle, Mandelbort and Julia sets. Applications.

Three-dimensional concepts: 3-D representations, transformations, perspective and parallel projections, spline curves and surfaces, Quadtree and Octree data structures. Hidden Surface and hidden - line removal algorithms, Shading modelsand colour models for solid objects.

References

1. D. Hearn and M.P. Baker, **Computer Graphics** (2nd ed.), Prentice–Hall of India, 2004
2. J.D. Foley, A van Dam, S.K. Feiner and J.F.Hughes, **Computer Graphics: Principals and Practices** (2nd ed.), Addison-Wesley, MA, 1990
3. D.F. Rogers, **Procedural Elements in Computer Graphics** (2nd ed.), McGraw Hill Book Company, 2001
4. D.F. Rogers and A.J. Admas, **Mathematical Elements in Computer Graphics** (2nd ed.), McGraw Hill Book Company, 1990

MCA 204 DATA COMMUNICATION AND COMPUTER NETWORKS

Data Communication: Theoretical basis of data communication; analog and digital signals; asynchronous and synchronous transmission; data encoding and modulation, techniques, broadband and base band transmission; pulse code modulation, bandwidth, channel, baud rate of transmission; multiplexing; transmission medium; transmission errors - error detection and correction.

Network Classification and Data Communication Services: Local area networks, metropolitan area network, wide area network, wireless network, internetworking; switched multi-megabit data services, X.25, frame relay, narrow band and broad band ISDN, asynchronous transfer modes.

Network Reference Models: Layered architectures, protocol hierarchies, interface and services : ISO-OSI reference model, TCP/IP reference model; internet protocol stacks.

Datalink Layer Functions and Protocols: Framing, error-control, flow -control; sliding window protocol; HDLC; Data link layer of internet and ATM.

Medium Access Sublayer: CSMA/CD protocol, switched and fast ethernet, token ring, FDDI, IEEE standards for LAN and MAN; satellite networks.

Network functions and protocols: Switching mechanism: Circuit switching, message switching, packet switching, cell switching, routing and congestion control, TCP/IP protocol architecture.

Network Applications: File transfer protocol, electronic mail, World Wide Web.

References

1. A.S. Tanenbaum, **Computer Networks** (4th ed.), Prentice-Hall of India , 2003
2. W. Tomasi, **Introduction to Data Communications and Networking**, Pearson Education, 2007.
3. S. Haykin, **Digital Communications**, John Wiley & Sons, Inc., 2005
4. P.C. Gupta, **Data Communications and Computer Networks**, Prentice-Hall of India, 2006
5. Behrouz Forouzan and S.C. Fegan, **Data Communications and Networking**, McGraw Hill, 2006
6. L. L. Peterson and B. S. Davie, **Computer Networks: A Systems Approach** (3rd ed.), Morgan Kaufmann, 2003
7. William Stallings, **Data and Computer Communications** (8th ed.), Pearson Education, 2007

MCA 205 FUNDAMENTALS OF ACCOUNTING AND FINANCE

Accounting: Overview of Accounting using Computers.

Basics of Financial Accounting: Theory base- GAAP; practical base, account process, drafting of financial statement.

Corporate Accounting: Accounting for equity shares / debentures and drafting of financial statement as per company act – 1956

Financial Statement Analysis: Ratios, common size statements and comparative financial statements

Basics of Cost Accounting: Material, labour, overheads, absorption, activity based costing, marginal Costing, including C-V-P Analysis.

Financial Management: Value maximization objective, strategic financial decisions, present value concept, concept of return, risk and value, Long term Investment decision.

References

1. Bhabatosh Banerjee, **Cost Accounting: Theory and Practice** (12th ed.), Prentice-Hall of India, 2006.
2. Ashish K. Bhattacharya, **Principles and Practice of Cost Accounting** (3rd ed), Prentice-Hall of India.
3. P.C. Tulsian, **Financial Accounting**, Pearson Education, 2006
4. D.C Bose, **Fundamentals of Financial Management**, Prentice-Hall of India, 2006
5. R.J. Bodhanwala, **Understanding and Analyzing Balance Sheets using Excel Worksheet**, Prentice-Hall of India, 2005

MCA 206 DIGITAL AND MICROPROCESSOR LABORATORY

Lab work based on the course MCA104

Digital Experiments: To verify universal nature of NAND gate, to make half adder and full adder, to make an adder – subtractor, to make JK flip flop, to make 4-bit shift register, 4-bit synchronous/asynchronous counter designing, multiplexer and decoder designing, RAM designing, non-sequential counter designing in synchronous mode

Microprocessor Experiments: Addition/subtraction of two binary numbers for 8/16 /32 bit numbers, multiplication/division of two binary numbers, to find maximum/minimum of two binary numbers. To generate Fibonacci series, to find HCF of two 8 bit numbers using routine for division, to sort an array of numbers using bubble sort/insertion sort/merge sort, 8085 and 8086 interfacing with 8253 timer, 8255 PPI, 8251 USART.

References

1. Ramesh S. Gaonkar, **Microprocessor Architecture, Programming, and Applications with the 8085** (5th ed.), Prentice Hall, 2002.
2. W.A. Triebel, Autar Singh, **The 8088 & 8086 Microprocessor: Programming, Interfacing, Software, Hardware & Applications** (4th ed.), Prentice-Hall of India Private Ltd, 2003
3. M. Morris Mano, **Digital Design** (3rd ed.), Prentice-Hall Inc., 2002

Semester III

MCA 301 DESIGN AND ANALYSIS OF ALGORITHMS

Introduction: Review of data structures, basic algorithm design and analysis techniques, probabilistic analysis of algorithms.

Algorithm Design Techniques: Iterative techniques, Divide and conquer, dynamic programming, greedy algorithms, backtracking, amortized algorithms, online algorithms.

Sorting: Review of elementary sorting techniques- selection sort, bubble sort, insertion sort; advanced sorting techniques - quick sort, heap sort, merge sort, shell sort; external sorting.

Lower bounding techniques: Decision Trees, Adversaries.

String Processing: KMP, Boyre-Moore, Robin Karp algorithms.

Introduction to randomized algorithms: random numbers, randomized Qsort, randomly Built BST

Number Theoretic Algorithms: GCD, addition of two large numbers, polynomial arithmetic, fast-fourier transforms

Complexity Theory: NP completeness, approximation methods.

References

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, **Introduction to Algorithms**, Prentice-Hall of India, 2006
2. Sara Baase, **Computer Algorithms: Introduction to Design and Analysis**, Addison Wesley, 1999
3. A.V. Levitin, **Introduction to the Design and Analysis of Algorithms**, Pearson Education, 2006
4. Jon Kleinberg and Éva Tardos, **Algorithm Design**, Pearson Education, 2006

5. S. Dasgupta, C. Papadimitriou and U. Vazirani, **Algorithms**, Tata McGraw-Hill, 2007

MCA 302 INFORMATION SECURITY

Overview of Security: Protection versus security; aspects of security–data integrity, data availability, privacy; security problems, user authentication, Orange Book.

Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer overflow; system threats- intruders; communication threats- tapping and piracy.

Cryptography: Substitution, transposition ciphers, symmetric-key algorithms-Data Encryption Standard, advanced encryption standards, public key encryption - RSA; Diffie-Hellman key exchange, ECC cryptography, Message Authentication- MAC, hash functions.

Digital signatures: Symmetric key signatures, public key signatures, message digests, public key infrastructures.

Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring;

References

1. W. Stalling, **Cryptography and Network Security Principles and Practices** (4th ed.), Prentice-Hall of India, 2006
2. C. Pfleeger and SL Pfleeger, **Security in Computing** (3rd ed.), Prentice-Hall of India, 2007
3. D. Gollmann, **Computer Security**, John Wiley and Sons, NY, 2002
4. J. Piwprzyk, T. Hardjono and J. Seberry, **Fundamentals of Computer Security**, Springer-Verlag Berlin, 2003
5. J.M. Kizza, **Computer Network Security**, Springer, 2007
6. M. Merkow and J. Breithaupt, **Information Security: Principles and Practices**, Pearson Education, 2006.

MCA 303 DATABASE SYSTEMS

Basic Concepts: Data modeling for a database, abstraction and data integration, three level architecture of a DBMS, overview of relational, network, hierarchical data models.

Database Design: Entity Relationship model, Extended Entity Relationship model

Relational Model & Relational Data Manipulations: Relation, conversion of ER diagrams to relations, integrity constraints, relational algebra, relational domain & tuple calculus

Structured Query Language: DDL, DML, Views, Embedded SQL,

Relational Database Design Concepts: Functional dependencies, determining keys, normalization-1st, 2nd, 3rd, 4th and 5th, BCNF, lossless join and dependency preserving decomposition

Advanced Database Concepts: Security and recovery, Concurrency Control in databases

References

1. A. Silberschatz, H. Korth and S. Sudarshan, **Database System Concepts** (5th ed.), McGraw Hill, 2006
2. Elmasri and Navathe, **Fundamentals of Database Systems** (4th ed.), Addison Wesley, 2006
3. R. Ramakrishnan and J. Gehrke, **Database Management Systems** (3rd ed.), McGraw Hill, 2005
4. Philip Lewis, Arthur Berstein and Michael Kifer, **Databases and Transaction Processing-An application oriented approach**, Addison Wesley, 2002
5. P. Rob and C. Coronel, **Database Systems: Design, Implementation, and Management** (7th ed.), Thomson Learning, 2006.
6. S.K. Singh, **Database Systems Concepts, Design and Applications**, Pearson Education 2006.

MCA 304 AUTOMATA THEORY

Introduction: Alphabets, strings, and languages.

Finite Automata and Regular Languages: Deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems about CFGs.

References

1. J. E. Hopcroft, R. Motwani, and J. D. Ullman, **Introduction to Automata Theory, languages, and computation** (2nd ed.), Addison-Wesley, 2001
2. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, **Elements of the Theory of Computation** (2nd ed.), Prentice-Hall, NJ, 1997
3. J.A. Anderson, **Automata Theory with Modern Applications**, Cambridge University Press, 2006.

MCA 305 OPERATING SYSTEMS

Introduction: Operating System as a resource manager, operating system classification, system calls, traps, architectures for operating systems.

Device Management: Goals of I/O software, Design of device drivers.

Processor Management: Process overview, process states and state transition, multi-programming, multi-tasking, levels of schedulers and scheduling algorithms. Process Synchronization - Critical section and mutual exclusion problem, classical synchronization problems, deadlock prevention. Multithreading

Memory Management: Classical memory management techniques, paging, segmentation, virtual memory.

File Management: Overview of file management system, disk space management, directory structures. Protection domains, access control lists, protection models.

References

1. A. Silberschatz, P.B.Galvin and G. Gagne, **Operating System Concepts** (6th ed.), John Wiley & Sons, Inc., 2001
2. A.S. Tanenbaum, **Modern Operating Systems** (2nd ed.), Prentice-Hall of India, 2001.
3. William Stallings, **Operating Systems: Internals and Design Principles** (5th ed.), Prentice-Hall of India, 2006.
4. Gary Nutt, **Operating Systems: A Modern Approach** (3rd ed.), Addison Wesley, 2004
5. D.M. Dhamdhere, **Operating Systems: A Concept Based Approach** (2nd ed.), Tata McGraw-Hill, 2007

Semester IV

MCA 401 COMPILER DESIGN

Lexical and Syntactic Analysis: Review of regular languages, design of a lexical analyzer generator, context free grammars, syntactic analysis - design of top down and bottom up parsers.

Syntax directed translation: Top down and bottom up approaches, data types, mixed mode expression; subscripted variables, sequencing statement, subroutines and functions: parameters called by address, by name and by value, subroutines with side effects.

Code generation, machine dependent and machine independent optimization techniques.

References

1. A..V. Aho, R. Sethi and J. D. Ullman, **Compilers: Principles, Techniques, and Tools** (US edition), Addison Wesley, 1986.
2. A. Holub, **Compiler Design in C**, Prentice-Hall of India, 2006
3. R. Mak, **Writing Compilers and Interpreters** (2nd ed.), John Wiley & Sons, 1996.
4. D. Galles, **Modern Compiler Design**, Pearson Education, 2007
5. S. Chattopadhyay, **Compiler Design**, Prentice-Hall of India, 2005

MCA 402 SOFTWARE ENGINEERING

Software Engineering: The software crisis, principles of software engineering, programming-in-the-small vs. programming-in-the-large

Software process: The software lifecycle, the waterfall model and variations, risk-driven approaches, introduction to evolutionary and prototyping approaches, agile process models, system classifications

Project management: Relationship to lifecycle, project planning, project control, project organization, risk management, cost models, configuration management, version control, quality assurance, metrics

Software requirements: Requirements analysis, functional and non-functional requirements elicitation, analysis tools, requirements definition, requirements specification, static and dynamic specifications, requirements review.

Software design: Design for reuse, design for change, design notations, design evaluation and validation

Implementation and Maintenance: Programming standards and procedures, modularity, data abstraction, static analysis, unit testing, integration testing, regression testing, verification and validation, tools for testing, fault tolerance, The maintenance problem, the nature of maintenance, planning for maintenance

References

1. R.S. Pressman, **Software Engineering: A Practitioner's Approach** (6th ed.), McGraw-Hill, 2006
2. P. Jalote, **An Integrated Approach to Software Engineering** (3rd ed.), Narosa Publishing House, 2005
3. K.K. Aggarwal and Y. Singh, **Software Engineering** (revised 2nd ed.), New Age International Publishers, 2006
4. I. Sommerville, **Software Engineering** (6th ed.), Pearson Education, 2004
5. Douglas Bell, **Software Engineering for Students** (4th ed.), Addison-Wesley, 2005.
6. R. Mall, **Fundamentals of Software Engineering** (2nd ed.), Prentice-Hall of India, 2006

MCA 403 PROGRAMMING PARADIGMS

Overview: Overview of programming languages, programming paradigms and models.

Imperative Language: Principles, data, flow of control, program, composition, examples of imperative languages.

Object Oriented Paradigms: Principles, classes, inheritance, class hierarchies, polymorphism, dynamic binding reference semantics -and their implementation.

Functional Programming: Principles, functions, lists, types and polymorphisms, higher-order functions, lazy evaluation, equations and pattern matching, program development in LISP, implementation of -LISP.

Logic Programming: Principles, Horn clauses and their execution, logical variables, relation, data structures, controlling the search order.

Parallel Programming: Principles of Parallelism, co-routines, communication and synchronization, parallel procedural and logic programming concepts and their implementation

References

1. R.W. Sebesta, **Concepts of programming Languages** (4th ed.), Addison Wesley MA, 2000

2. T.W. Pratt, **Programming Languages: Design and Implementation** (2nd ed.) Printice Hall, NJ, 2000
3. A.B. Tucker, R.E. Noonan, **Programming Languages: Principles and Paradigms** (2nd ed.), Tata McGraw-Hill, 2007.
4. L.B. Wilson, R.G. Clark, **Comparative Programming languages** (3rd ed.), Pearson Education, 2001
5. P.H. Winston and B.K.P. Horn, **LISP** (3rd ed.), Pearson Education Asia, 2000

MCA 404 NETWORK PROGRAMMING

Overview of TCP/IP. Protocol: Distinction between Transmission Control Protocol and User Data gram Protocol, well-known and empirical Port, connection oriented and connectionless services.

Socket interface: Distinction between socket and connection, socket address structure, socket system calls.

Client Server Interaction: Connection-oriented client-server interaction, connection-less client server interaction, interactive and concurrent server, multiprocessor server and-multi-threaded server design concepts.

Application Development: Design of file transfer protocol, remote log-in protocol etc., using socket interface

References

1. W. Richard Stevens, **Unix Network Programming**, Prentice-Hall of India, 1990
2. Bill Rieken and Lyle Weiman, **Adventures in UNIX Network Applications Programming**, John Wiley & Sons, 1992.

EL X01 MODELING AND SIMULATION

Systems and environment: Concept of model and model building, model classification and representation, Use of simulation as a tool, steps in simulation study.

Continuous-time and Discrete-time systems: Laplace transform, transfer functions, state-space models, order of systems, z-transform, feedback systems, stability, observability, controllability. Statistical Models in Simulation: Common discrete and continuous distributions, Poisson process, empirical distributions

Random Numbers: Properties of random numbers, generation of pseudo random numbers, techniques of random number generation, tests for randomness, random variate generation using inverse transformation, direct transformation, convolution method, acceptance-rejection

Design and Analysis of simulation experiments: Data collection, identifying distributions with data, parameter estimation, goodness of fit tests, selecting input models without data, multivariate an time series input models, verification and validation of models, static and dynamic simulation output analysis, steady-state simulation, terminating simulation, confidence interval estimation, Output analysis for steady state simulation, variance reduction techniques

Queuing Models: Characteristics of queuing systems, notation, transient and steady-state behavior, performance, network of queues

Large Scale systems: Model reduction, hierarchical control, decentralized control, structural properties of large scale systems

References

1. Narsingh Deo, **System Simulation with Digital Computer**, Prentice Hall of India, 1999
2. Averill Law, **Simulation Modeling and Analysis** (3rd ed.), Tata McGraw-Hill, 2007
3. G. Gordan, **System Simulation** (2nd ed.), Pearson Education, 2007.
4. A.F. Seila, V. Ceric and P. Tadikamalla, **Applied Simulation Modeling** (International Student Edition), Thomson Learning, 2004
5. Jerry Banks, **Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practice**, Wiley Inter Science, 1998
6. J. Banks, J.S. Carson, B.L. Nelson, **Discrete Event System Simulation** (4th ed.), Prentice-Hall of India, , 2004
7. N.A. Kheir, **Systems Modeling and Computer Simulation**, Marcel Dekker, 1988.
8. B.P. Zeigler, T.G. Kim, and H. Praehofer, **Theory of Modeling and Simulation** (2nd ed.), Academic Press, 2000.

EL X02 DATABASE APPLICATIONS

Application Design and Development: User interfaces and tools, web interfaces to Databases

Web Fundamentals: HTML, static vs.dynamic web pages, client (Javascript/VB) and server side scripting (JSP/ASP/PHP/VB), web servers and sessions, two level & three level architecture,

Real Life Application Development using Popular DBMS: SQL, procedures & functions, exception handling, triggers, large objects, user defined datatypes, collection types, bulk loading of data

Query Optimization: Query Processing, query tree, query plans, measures of query cost, estimates of basic operations, equivalent relational algebra expressions, evaluation of expressions

Authorizations in SQL: System and user privileges, granting & revoking privileges, roles, authorization on views, functions and procedures, limitations of SQL authorizations, audit trails

Application Security: Encription techniques, digital signatures & digital certificates

References

1. A. Silberschatz, H. Korth and S. Sudarshan, **Database System Concepts** (5th ed.), McGraw Hill, 2006
2. J. Morrison, M. Morrison and R. Conrad, **Guide to Oracle 10g**, Thomson Learning, 2005
3. Loney and Koch, **Oracle 10g The Complete Reference**, Tata McGraw Hill, 2006
4. David Flanagan, **JavaScript: The Definitive Guide**, O'Reilly Media, 2006
5. Marty Hall, Larry Brown, and Yaakov Chaikin, **Core Servlets and Javaserver Pages: Core Technologies, Vol. 2 (2nd ed.)**, Sun Microsystems Press, 2006.
6. S.K.Singh, **Database Systems Concepts, Design and Applications**, Pearson Education 2006.

EL X03 OPERATING SYSTEM CASE STUDIES

Detailed study of contemporary popular operating systems such as UNIX, LINUX, Window 98, Window NT

Process and Processor Management: Scheduling schemes, Interprocess communication, threads

Design of the File system: Interface between file systems and IOCS,directory structures, allocation of disk space, file protection, file system reliability

I/O Management System: I/O system, I/O strategies, buffering.

Memory Management: Swapping, demand paging, segmentation

References

1. Daniel P. Bovet and Marco Cesati, **Understanding the Linux Kernel** (2nd ed.), O'Reilly Media, Inc., 2003.
2. Maurice J. Bach, **Design of the UNIX Operating System**, Prentice Hall, 1986
3. Gary Nutt, **Kernel Projects for Linux**, Addison Wesley, 2001

4. Gary Nutt, **Operating Systems Projects Using Windows NT**, Addison Wesley, 1999

EL X04 VISUAL PROGRAMMING

Introduction: Development in a visual programming environment to develop interactive programs using a graphical user interface, iconic systems and their specifications, messages and message passing/ events and event-handling in visual programming environment,

Programming: Programming with graphics devices, interaction with the user in event-based graphical environment, implementation of visual systems, different components and controls of visual system. Elementary data base usage.

Project: a programming project involving object-oriented design, user interface design and implementation, and coding to support the interface and database linkages. It can be an Internet application in a visual programming environment.

References

1. David I. Schneider, **An Introduction to Programming using Visual Basic 2005** (6th ed.), Pearson Educations Inc., 2007
2. R. Brown, **Visual Basic .NET – Your visual blueprint for building versatile programs on the .NET Framework**, Wiley Publishing, Inc., 2002
3. Anne Prince, **Murach's Beginning Visual Basic .NET**, Murach Publishing, 2003
4. T. Willis, J. Crossland and R. Blair, **Beginning VB.NET 2003**, Wrox Publication, 2004
5. Fred Barwell, et. al., **Professional VB.NET** (2nd ed.), Wrox Publication, 2002
6. Paul Kimmel, **Visual Basic .NET Unleashed**, Sams Publishing, 2002

EL X05 DATA MINING

Overview: The process of knowledge discovery in databases, predictive and descriptive data mining techniques, supervised and unsupervised learning techniques.

Techniques of Data Mining: Link analysis, predictive modeling, database segmentation, score functions for data mining algorithms, Bayesian techniques in data mining.

Issues in Data Mining: Scalability and data management issues in data mining algorithms, parallel and distributed data mining, privacy, social, ethical issues in KDD and data mining, pitfalls of KDD and data mining.

References

1. Margaret H. Dunham, **Data Mining: Introductory and Advanced Topics**, 2002
2. Jiawei Han and Micheline Kamber, **Data Mining: Concepts and Techniques** (2nd ed.), Morgan Kaufmann, 2006.
3. Arun Pujari, **Data Mining Techniques**, University Press, 2001
4. D. Hand, H. Mannila and P. Smyth, **Principles of Data Mining**, Prentice-Hall of India, 2006
5. G.K. Gupta, **Introduction to Data Mining with Case Studies**, Prentice-Hall of India, 2006

EL X06 COMPUTATIONAL INTELLIGENCE

Fuzzy Logic Systems: Notion of fuzziness, fuzzy modeling, operations on fuzzy sets, T-norms and other aggregation operators, basics of approximate reasoning, compositional rule of inference, fuzzy rule based systems, (Takagi-Sugeno and Mamdani-Assilian models), schemes of fuzzification, inferencing, defuzzificatin, fuzzy clustering, fuzzy rule based classifier

Genetic Algorithms: Genetic operators, building block hypothesis, evolution of structure, genetic algorithms based on tree and linear graphs, applications in science and engineering

Artificial Neural Networks: The neuron as a simple computing element, the perceptron, multilayer neural networks, accelerated learning in multilayer neural networks

References

1. K.H. Lee, **First Course on Fuzzy Theory and Applications**, Springer, 2005
2. D. E.Goldberg, **Genetic Algorithms in Search, Optimization, and Machine Learning**, Addison-Wesley, Reading, 1989
3. E. Alpaydin, **Introduction to Machine Learning**, Prentice-Hall of India, 2004.

EL X07 ARTIFICIAL INTELLIGENCE

Introduction and Problem Solving: Various definitions of AI, Introduction to AI applications and AI techniques, Production systems, control strategies, reasoning - forward & backward chaining

Intelligent Agents: Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, the environment in which a particular agent operates

Search and Game Playing: Breadth first search, depth first search, iterative deepening,

uniform cost search, hill climbing, simulated annealing, genetic algorithm search, heuristic search, Best first search, A* algorithm, AO* algorithm, Minmax & game trees, refining minmax, Alpha – Beta pruning, constraint satisfaction

Knowledge Representation: First order predicate calculus, resolution, unification, natural deduction system, refutation, logic programming, PROLOG, semantic networks, frame system, value inheritance, conceptual dependency, Ontologies

Planning: basic representation for planning, symbolic-centralized vs. reactive-distributed, partial order planning algorithm

Uncertainty: different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes' rule, other approaches to modeling uncertainty such as Dempster-Shafer theory and fuzzy sets/logic

Natural language processing: component steps of communication, contrast between formal and natural languages in the context of grammar, parsing, and semantics

References

1. S. Russell and P. Norvig, **Artificial Intelligence: A Modern Approach** (2nd ed.), Pearson Education, 2005.
2. Elaine Rich and Kelvin Knight, **Artificial Intelligence**, Tata McGraw Hill, 2002.
3. Nils J Nilson, **Artificial Intelligence: A New Synthesis**, Morgan Kaufmann Publishers , Inc., San Francisco, California, 2000.
4. R. Akerkar, **Introduction to Artificial Intelligence**, Prentice-Hall of India, 2005
5. Dan W. Patterson, **Introduction to Artificial Intelligence and Expert Systems**, Prentice Hall of India, 2006.
6. Nils J. Nilson, **Principles of Artificial Intelligence**, Narosa Publishing House, 2001
7. Clocksin and C.S. Mellish, **Programming in PROLOG**, Narosa Publishing House, 2002.
8. Saroj Kaushik, **Logic and Prolog Programming**, New Age International Publisher, 2006

EL X08 ELECTRONIC COMMERCE

Building Blocks of Electronic Commerce: Introduction, internet and networking technologies, Internet and network protocols, web server scalability, software technologies for building E-commerce applications, distributed objects, object request brokers, component technology, web services, web application architectures, BizTalk framework Compliant Server

Security of E-commerce transactions: Review of cryptographic tools, authentication,

signatures, observers, anonymity, privacy, traceability, key certification, management and escrow

Payment protocols and standards: Smart card, e-cash, e-wallet technologies, electronic money and electronic payment systems, business models for electronic commerce, electronic marketplaces, auctions and other market mechanisms, design of auctions, optimization algorithms for marketplaces, multi-agent systems.

Global eCommerce and Law: Cyber law in India. Comparative evaluation of Cyber laws of certain countries.

References

1. E.M. Awad, **Electronic Commerce From Vision to Fulfillment** (3rd ed.), Prentice-Hall of India, 2006
2. P.T. Joseph, **E-Commerce An Indian Perspective**, Prentice-Hall of India, 2007
3. Scott Bonneau, Tammy Kohl, Jeni Tennison, Jon Duckett and Kevin Williams, **XML Design Handbook**, Wrox Press Ltd., 2003.
4. Michael Cheshar, Ricky Kaura, and Peter Linton, **Electronic Business and Commerce**, Springer, 2003.
5. W.J. Pardi, **XML in Action: Learn to quickly create dynamic, data-driven sites with the Web's hottest new technology**, Prentice Hall of India, 1999.
6. P. Weill and M.R. Vitale, **Place to Space: Migrating to eBusiness Models**, Harvard Business School Press, 2001.
7. Whiteley, **eCommerce: Strategy, Technologies and Applicaitons**, Tata McGraw-Hill Edition, 2001.
8. Fitzgerald, **Building B2B Applications with XML: A Resource Guide**, John Wiley and Sons, Inc., 2001

EL X09 DIGITAL IMAGE PROCESSING AND MULTI-MEDIA

Fundamental Steps in Image Processing: Element of visual perception, a simple image model, sampling and quantization, some basic relationships between pixel, image geometry in 2D, image enhancement in the spatial domain.

Introduction to spatial and frequency methods: Basic gray level transformations, histogram equalization, local enhancement, image subtraction, image averaging, basic spatial, filtering, smoothing spatial filters, sharpening spatial filters.

Introduction to the fourier transformation: Discrete fourier transformation, fast fourier transformation, filtering in the frequency domain, correspondence between filtering in the spatial and frequency domain smoothing frequency-domain filters, sharpening frequency-domain filters, homomorphic filtering, dilation and erosion, opening and closing, hit-or-miss transformation.

Some basic morphological algorithms: Line detection, edge detection, gradient operator, edge linking and boundary detection, thresholding, region-oriented segmentation, representation schemes like chain codes, polygonal approximations, boundary segments, skeleton of a region, recognition and interpretation patterns and pattern classes, decision-theoretic methods, introduction to neural network.

Introduction to Image Compression: JPEG, MPEG, Wavelets, operating system issues in multimedia, real time OS issues, interrupt latency etc., network management issues Like QOS guarantee, resource reservation, traffic specification etc., security issues like digital watermarking, partial encryption schemes for video stream encryption.

Latest developments in field of multimedia like VOIP, video on demand and video conferencing.

References

1. Rafael C. Gonzalez and Richard E.Woods, **Digital Image Processing**, Prentice–Hall of India, 2002
2. William K. Pratt, **Digital Image Processing: PIKS Inside** (3rd ed.), John Wiley & Sons, Inc., 2001
3. Bernd Jahne, **Digital Image Processing**, (5th revised and extended edition), Springer, 2002
4. S. Annadurai and R. Shanmugalakshmi, **Fundamentals of Digital Image Processing**, Pearson Education, 2007
5. M.A. Joshi, **Digital Image Processing: An Algorithmic Approach**, Prentice-Hall of India, 2006
6. B. Chanda and D.D. Majumder, **Digital Image Processing and Analysis**, Prentice-Hall of India, 2007

EL X10 NEURAL NETWORKS

Introduction: Neuron as basic unit of Neurobiology, McCulloch-Pitts model, Hebbian Hypothesis; limitations of single-layered neural networks.

Supervised Learning: Single-layered neural networks, Hopfield-Little model, perceptron rules, Gradient-descent algorithms; Multi-layered neural networks: first order methods, back propagation algorithm, second order methods, RBF networks; Constructive algorithms: single-hidden layer algorithms, upstart algorithm, cascade correlation algorithm; Unsupervised Learning: competitive learning, competition through lateral inhibition.

Kernel methods and support vector machines: binary classification, multiclass classification, allowing for training errors: soft margin techniques; neural networks and temporal sequences: sequence recognition, sequence generation; applications.

References

1. S. Haykin, **Neural Networks: A Comprehensive Foundation** (2nd ed.), Prentice Hall, 1999
2. R.Rojas and J. Feldman, **Neural Networks: A Systematic Introduction** (1st ed.), Springer, 1996.
3. C.M. Bishop, **Neural Networks for Pattern Recognition**, Oxford University Press, 1995.
4. S.N. Sivanandam, S. Sumathi and S.N. Deepa, **Introduction to Neural Networks using MATLAB 6.0**, Tata McGraw-Hill, 2006
5. B. Yegnanarayana, **Artificial Neural Networks**, Prentice-Hall of India, 2006

EL X11 NUMERICAL COMPUTING

Solution to Transcendental and Polynomial Equations: Iterative methods, bisection method, secant method, Newton-Raphson method, fixed point iteration, methods for finding complex roots.

Matrices and Linear System of Equations: LU decomposition method for solving systems of equations, Symmetric positive definite matrices and least square approximation, iterative algorithms for linear equations.

Interpolation: Polynomial interpolation, Newton-Gregory, Stirling's, Bessel's and Lagrange's interpolation formula, Newton's divided differences interpolation formulae.

Curve fitting: B-spline and Approximation: Fitting linear and non-linear curves, weighted least square approximation, method of least square for continuous functions.

Numerical Differentiation and Integration: Numerical differentiation and errors in numerical differentiation, Newton-Cotes formulae, trapezoidal rule, Simpson's rule, Gaussian integration.

Numerical Solutions of Ordinary Differential Equations: Picard's and Taylor's series, Euler's and Runge-Kutta (RK) methods, Predictor-corrector's, Milne-Simpson's, Adams-Bashford, Adams-Moulton methods.

Finite Element Method: Boundary value problems, Rayleigh and Galerkin methods of approximation, applications.

References

1. K.E. Atkinson, W. Han, **Elementary Numerical Analysis**, 3rd Edition, Wiley, 2003
2. C. Xavier, S. S. Iyengar, **Introduction to Parallel Algorithms** (Wiley Series on Parallel and Distributed Computing, Wiley-Interscience, 1998
3. A. Kharab, R.B.Guenther, **An Introduction to Numerical Methods: A MATLAB**

Approach (1st ed.), Chapman & Hall/CRC, 2001.

4. B. Bradie, **A Friendly Introduction to Numerical Analysis**, Pearson Education, 2007
5. S.R. Otto and J.P. Denier, **An Introduction to Programming and Numerical Methods in MATLAB**, Springer, 2005
6. M.K. Jain, S.R.K. Iyengar and R.K. Jain, **Numerical Methods for Scientific and Engineering Computation** (7th ed.), New Age International Publishers, 2007

EL X12 COMBINATORIAL OPTIMIZATION

Introduction: Optimization problems, neighborhoods, local and global optima, convex sets and functions, simplex method, degeneracy; duality and dual simplex algorithm, computational considerations for the simplex and dual simplex algorithms-Dantzig-Wolfe algorithms.

Integer Linear Programming: Cutting plane algorithms, branch and bound technique and approximation algorithms for traveling salesman problem.

Graph Algorithms: Primal-Dual algorithm and its application to shortest path, Math-flow problems (Ford and Fulkerson labeling algorithms, Dijkstra's algorithm, Ford-Warshall algorithms), networking labeling and digraph search, Max-flow problem, matching problem, bipartite matching algorithm, non-bipartite matching algorithms, weighted matching-hungarian method for the assignment problem, non-bipartite weighted matching problem, efficient spanning tree algorithms, algorithm for matroid intersection problem.

References

1. C.H. Papadimitriou and K. Steiglitz, **Combinatorial Optimization: Algorithms and Complexity**, Prentice-Hall of India, 2006
2. K. Lange, **Optimization**, Springer, 2004
3. Mokhtar S.Bazaraa, John J. Jarvis and Hanif D. Sherali, **Linear Programming and Network Flows**, John Wiley & Sons, 2004
4. H.A. Taha, **Operations Research: An Introduction** (8th ed.), Prentice Hall, 2006

EL X13 COMPUTATIONAL LINGUISTICS

Man-Machine Interface: Concept of Artificial Intelligence (AI), information system and information processing, concept of formal language, Natural Language (NL) and real language, natural language as man-machine interface.

Natural Language Processing: Basic characteristic of NL, knowledge representation, level of representation in NL, function of natural language.

Computational Linguistics: Relationship between linguistics and NLP, computational models for phonology, unphology, lexicography, syntax, semantics and discourse.

Processes and Methods: Pursuing applications – machine translation, information retrieval, information extraction, natural language in multimodal and multimedia systems, computer assisted language learning, multilingnal on-line natural language processing.

References

1. Andrew, A.M. **Artificial Intelligence**. Kent: Abacus Press, 1983.
2. Grishman, R., **Computational Linguistics**, Cambridge: Cambridge University Press, 1986.
3. Keith, G and Glover, M., **Primary Language Learning with Microcomputers.** London: Croom Helm, 1987.
4. Nirenburg, S.(ed) **Machine Translation: I Theoretical and Methodological Issues**. Cambridge, Cambridge University Press, 1987.
5. Sedlow, W.A. and Sedlow, S.Y. (eds.) **Computer in Language Research,** Hillsdale: N.S. Lawrence Erlbawn, 1979

EL X14 SOFTWARE QUALITY ASSURANCE AND TESTING

Introduction: Concept of Software quality, product and process quality, software quality metrics, quality control and total quality management, quality tools and techniques, quality standards.

Designing software quality assurance system: Statistical methods in quality assurance, fundamentals of statistical process control, process capability, Six-sigma quality.

Testing: Test strategies, test planning, functional testing, stability testing and debugging techniques

Reliability: Basic concepts, reliability measurements, predictions and management.

References

1. N.S. Godbole, Software Quality Assurance: Principles and Practice, Narosa Publishing House, 2006
2. G.G. Schulmeyer and J. McManus (eds.), **Handbook of Software Quality Assurance** (3rd ed.), Prentice Hall, 1999
3. G. O'Regan, **A Practical Approach to Software Quality**, Springer Verlag, 2002
4. Daniel Galin, **Quality Assurance: From theory to implementation**, Pearson Education Ltd., 2004
5. S.H. Kan, **Metrics and Models in Software Quality Engineering** (2nd ed.), Pearson

Education Inc., 2003

6. J.D. McGregor and D.A. Sykes, **A Practical Guide to Testing**, Addison-Wesley, 2001
7. Glenford J. Myers, **The Art of Software Testing** (2nd ed.), John Wiley, 2004
8. D. Graham, E.V. Veenendaal, I. Evans and R. Black, **Foundations of Software Testing**, Thomson Learning, 2007

EL X15 MACHINE LEARNING

Overview and Introduction to Bayes Decision Theory: Machine intelligence and applications, pattern recognition concepts classification, regression, feature selection, supervised learning
class conditional probability distributions,Examples of classifiers bayes optimal classifier and error, learning classification approaches.

Linear machines: General and linear discriminants, decision regions, single layer neural network, linear separability, general gradient descent, perceptron learning algorithm, mean square criterion and widrow-Hoff learning algorithm; multi-Layer perceptrons: two-layers universal approximators, backpropagation learning, on-line, off-line error surface, important parameters.

Learning decision trees: Inference model, general domains, symbolic decision trees, consistency, learning trees from training examples entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm continuous test nodes, confidence, pruning, learning with incomplete data

Instance-based Learning: Nearest neighbor classification, k-nearest neighbor, nearest neighbor error probability,

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

Machine learning assessment and Improvement: Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting.

Support Vector Machines: Margin of a classifier, dual perceptron algorithm, learning non-linear hypotheses with perceptron kernel functions, implicit non-linear feature space, theory, zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, maximal margin classifier.

References

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

EL X16 EMBEDDED SYSTEMS

Introduction to Embedded Systems: Overview of embedded systems, features, requirements and applications of embedded systems, recent trends in the embedded system design, common architectures for the ES design, embedded software design issues, communication software, introduction to development and testing tools.

Embedded System Architecture: Basics of 8 – bit RISC microcontroller (PIC), block diagram, addressing modes, instruction set, timers, counters, stack operation, programming using PIC controller, basics of 32 – bit microprocessor (ARM), processor and memory organization, data operations, flow of control, pipelining in ARM, ARM bus (AMBA).

Embedded Software: Programming in embedded environment, Programming for microcontrollers such as Intel 8051 and PIC. Overview of Java 2 micro edition (J2ME), concept of a MIDLET, applications of J2ME in mobile communication.

Interfacing and Communication Links: Serial interfacing, real time clock, SPI / micro wire bus, I2C bus, CAN bus, PC parallel port, IRDA data link, PCI bus architecture.

Operating Systems for Embedded Systems: OS Fundamentals, processes and threads, context switching, scheduling issues, inter task communication, introduction to memory management, evaluating OS performance, real time operating systems, popular RTOS and their applications.

Applications of Embedded Systems: Industrial and control applications, networking and telecom applications, DSP and multimedia applications, applications in the area of consumer appliances, concept of smart home.

References

1. Daniel W. Lewis, **Fundamentals of Embedded Software, where C and assembly meet,** Pearson Education 2001.

2. John B. Peatman, **Design with PIC Microcontrollers,** Pearson Education, 1997.
3. Robert B. Reese, **Microprocessors: From assembly language to C using PIC18Fxx2**, Shroff Publishers and Distributors Pvt Ltd. 2005.
4. Wayne Wolf, **Computers as Components: Principles of Embedded Computing System Design**, Elsevier Publication 2000.
5. Michael Juntao Yuan Enterprise, J2ME **– Developing Mobile Java Applications,** Pearson Education, 2003.
6. Andrew N. Sloss, Dominic Symes, Chris Wright, **ARM System Developer's Guide – Designing and Optimizing System Software,** Elsevier Publications, 2007.
7. A. Silberschatz, P.B.Galvin and G. Gagne, **Operating System Concepts** (6^{th} ed.), John Wiley & Sons, Inc., 2001
8. K.V.K.K.Prasad**, Embedded/Real Time Systems: Concepts, Design and Programming** , Dreamtech Press, New Delhi, India, 2003.

EL X17 CRYPTOGRAPHY

Elementary number theory: Prime numbers, Fermat's and Euler's theorems, Testing for primality, Chinese remainder theorem, discrete logarithms

Finite fields: Review of groups, rings and fields; Modular Arithmetic, Euclidean Algorithms, Finite fields of the form GF(p), Polynomial Arithmetic, Finite fields of the form GF(2")

Data Encryption Techniques: block and stream ciphers, private key encryption – DES, AES, RC4; public key encryption – RSA, DH Key exchange, elliptic curve cryptosystems

Message authentication and hash functions, Digital Signatures and authentication protocols, Cryptanalysis (to be done in conjunction with above topics)

References

1. W. Stallings, **Cryptography and Network Security Principles and Practices** (4^{th} ed.), Prentice-Hall of India, 2006
2. C. Pfleeger and S.L. Pfleeger, **Security in Computing** (3^{rd} ed.), Prentice-Hall of India, 2007
3. MY Rhee, **Network Security**, John Wiley and Sons, NY, 2002.

EL X18 OPERATING SYSTEM DESIGN AND PRACTICE

Operating Systems Overview: Overview of processor management, memory management, device management, file management of LINUX or UNIX system V operating systems.

Operating Systems Architecture: Monolithic architecture, virtual machine architecture, micro-kernel architecture, client-server architecture.

Operating Systems Key Design Issues: Operating systems portability, machine dependent code, machine independent code, lower half of kernel design issues, upper half of kernel design issues.

Design Issues in Different Operating Systems: Core design issues of time sharing, real-time, network and distributed operating systems – kernel, memory, device, file-management design issues.

Operating System Design and Implementation: Design and implementation of a small operating system kernel/device driver/file systems

References

1. D.M. Dhamedhere, **Operating Systems: A Concept Based Approach** (2^{nd} ed.), Tata-McGraw-Hill, 2006.
2. William Stalling, **Operating System: Internals and Design Principles**, (5^{th} ed.), Pearson Education, 2005.
3. Maurice J. Bach, **Design of the UNIX Operating System**, Prentice Hall, 1986.

EL X19 DATABASE SYSTEMS AND IMPLEMENTATION

Overview of Database Management Concepts and models: Data Definition Language, Data Control Language, Storage management, Query Processing, Transaction Processing, Relational Model, Object Oriented Model and Object-Relational model.

Storage Management and Data Representation: Storage and access of data in secondary storage, Disk failures, Recovery from disk crashes-RAID levels 1 to 6. Representation of various data types, Fixed length/variable length data/record formats, Logical/physical addressing schemes, Pointer Swizzling, pinning/unpinning of records.

Index Structures for Single Dimension searches: Primary and secondary indexes, dense and sparse indexes, B+tree indexes, Hash indexes-linear and extensible hash indexes.

Index Structures for Multidimensional searches: Grid files, KD-trees, Quad trees, R-trees

Query Processing and Optimization: Query parsing, Algorithms and cost estimation for various operation - select, project, cross product, join, union, intersection, difference, and aggregate operations. Equivalent relational algebra expressions, generation of query plans and choice of query plan for query execution. Cost based and Heuristic based query optimization.

Transaction Processing and Concurrency Control: Concept of transaction, ACID properties, Serial and concurrent schedules, Serializability, testing for serializablity, Lock-based protocols, Timestamp based protocols, deadlock handling

Recovery: Classification of failures, Log based recovery, shadow paging, buffer management

References

1. Hector Garcia-Molina, Jeffrey D.Ullman and Jennifer Widom, **Database System Implementation**, Prentice Hall of India, 2005
2. Abraham Silberschatz, Henry Korth and S.Sudarshan, **Database System Concepts** (5th ed.), McGraw Hill, 2006
3. Elmasri and Navathe, **Fundamentals of Database Systems** (4th ed.), Addison Wesley, 2006
4. Raghu Ramakrishnan and Johannes Gehrke, **Database Management Systems** (3rd ed.), McGraw Hill 2005.
5. Philip Lewis, Arthur Berstein and Michael Kifer, **Databases and Transaction Processing-An Application Oriented Approach**, Addison Wesley 2002.
6. Peter Rob and Carlos Coronel, **Database Systems: Design, Implementation, and Management** (7th ed.), Thomson Learning 2006.

EL X20 HUMAN RESOURCE MANAGEMENT

Human Resource Planning: How HRP Relates to Organizational Planning or Strategic Planning, The need for Human Resource Planning, The Steps in Human Resource Planning Process, Situation Analysis, Environmental Scanning and Strategic Planning, Forecasting Human Resource Demands.

Job Analysis and Job Design: Purpose and uses of Job Analysis, Job Analysis Technique, Job Analysis – Methods of Data Collection, Job Design Approaches, Job Characteristic Approach to Job Design.

The Recruitment Process: Environmental Factors Affecting Recruitment Process, Recruitment Methods, Evaluating the Recruitment Process.

The Selection Process: Step in Selection Process (Techniques of Selection Process), Ethical Standards of Testing, Types of Interviews, Evaluation of the Selection Program.

Training and Development: The Functions of Training, Assessing Training Needs, Types of Training, Evaluation of Training and Development.

Career Planning and Development: Career Development, Career Management.

Industrial Relations: Characteristics of Industrial Relations, Significance of Harmonious

Industrial Relations, Approaches to Industrial Relations, Factors Affecting Industrial Relations Strategy, Causes of Poor Industrial Relations, Effects of Poor Industrial Relations.

Strategic Human Resource Management: Strategic Human Resource Management, Strategic Planning, Need for Strategic Management, Benefits of Strategic Management, Dysfunctions of Strategic Management.

References

1. David A. Dedecenezo, Stephen P. Robbins, **Personnel/ Human Resource Management** (3rd ed.) , Prentice-Hall of India, 1990.
2. Adwin B. Flippo, **Personnel Management**, (Mcgraw Hill Series in Management).
3. David, F.R., **Concept of Strategic Management**. New York:Macmillan., 1993.
4. Narender. K. Chadha, **Human Resource Management: Issues, Challenges and Case Studies** (2nd revised ed.), Shri Sai Printographers, New Delhi, 2002.
5. Nirmal Singh. **Human Resource Management**, Galgotia Publications Pvt. Ltd., New Delhi, 2004.
6. B. Pattanayak, **Human Resource Management** (3rd ed.), Prentice-Hall of India, 2006.

EL X21 XML and DATABASES

Introduction to XML: Representing data in XML, Element Content Model, Document Type Definition, XML schemas

Presentation of XML documents on the web: HTML, XHTML, CSS, XSLT, XSL-FO, XLinks, XPointers, XForms, Xpath

Database Concepts: Review of Relational, Object Relational and Object Oriented Database concepts

Type of Documents: Data-Centric Documents and Document Centric Documents

Mappings between traditional Databases and XML documents: Mapping Document Schemas to Database Schemas -Table-Based Mapping and Object-Relational Mapping, use of DOM, SAX and web enabled databases

Query Languages: Template Based Query languages and SQL Based Query Languages, XQuery

Native XML databases: Native XML Database Architectures, Storing Data in a Native XML Database, Retrieving Data from Native databases, Security, Transactions, Locking and Concurrency, Round-tripping

Applications of XML & Databases: Case Studies

References

1. Mark Greaves, **Designing XML Databases,** Prentice Hall, 2002.
2. Serge Abiteboul, Peter Buneman , Dan Suciu, **Data on the Web: From Relations to Semistructured Data and XML,** Morgan Kaufmann, 1999.
3. Akmal B. Chaudhri, Awais Rashid, Roberto Zicari , **XML Data Management: Native XML and XML-Enabled Database Systems,** Addison Wesley, 2005.
4. Kevin Williams, **Professional XML databases**, Wrox Publications, 2000.
5. Bhavani Thuraisingham, **XML Databases and the Semantic Web,** CRC Press 2002

EL X22 SATELLITE AND MOBILE COMMUNICATION NETWORKS

Satellite Communication and Networks: Geosynchronous satellite, low orbit satellite networks, polling, ALOA, FDMA TDMA, CDMA, low orbit satellite for mobile communication, VSAT networks.

Mobile Voice Communication and Networks, Global Systems for Mobile communication (GSM), Code Division Multiple Access (CDMA).

Mobile Voice Communication and Networks: High speed circuits switch data (HSCSD), GSM General Pocket Radio Service (GPRS), Third Generation Mobile Systems.

References

1. C.N. Thurwachter, **Wireless Networking**, Prentice-Hall of India, 2002.
2. A.S. Tanenbaum, **Computer Networks** (4^{th} ed.), Prentice-Hall of India, 2003
3. M. Richharia, **Mobile Satellite Communications: Principles & Trends**, Pearson Education, 2001
4. Jochen Schiller, **Mobile Communications**, Pearson Education, 2000
5. S.D. IIcev, **Global Mobile Satellite Communications**, Springer, 2005