UNIVERSITY OF HYDERABAD

COURSE CURRICULUM
FOR
MASTER OF COMPUTER APPLICATIONS AND
MASTER OF TECHNOLOGY
PROGRAMMES
(2007-)

DEPARTMENT OF COMPUTER
AND
INFORMATION SCIENCES

CURRICULUM DOCUMENT

INTRODUCTION

Department of Computer and Information Sciences constituted a committee with Prof. B. L. Deekshatulu as Chairman. The members are: Prof. K. Viswanath, Prof. H. Mohanty, Dr. C. Bhagvati, Dr. S. Bapi Raju (Convenor), Dr. R. Wankar, Dr. V. N. Sastry (IDRBT) and Dr. A. Saxena (IDRBT). The committee met several times between June 2005 and January 2006. The committee was asked to look into the MCA and MTech course curricula and propose any changes required for addressing the current trends.

The points addressed by the committee are:

- Minimising redundancy in courses offered across departments/schools
- Modifying the course offerings to be in tune with the current trends
- Encouraging inter-disciplinary studies

Salient Features**:**

Credit-to-Contact hour Mapping:

One class room lecture hour = 1 credit and 1.5 lab hours = 1 credit. Thus a 3-Credit course requires 3 class room contact hours and 2 Lab credits correspond to 3 contact hours in the lab. 4-credit courses usually have lab/tutorial hours explicitly scheduled in the timetable for the course.

MCA:

MCA programme will have a minimum of 100 credits comprising 25 courses, 4 labs and a final semester project. Of the 25 courses, 15 are core courses — 10 of CS core, 3 of Mathematics core, and 2 of Management core. Of the remaining 10 elective courses, at least 8 must be from CS/AI/IT advanced courses and at most 2 approved courses from outside the department. Students are strongly encouraged to take an interdisciplinary course for Elective I in the third semester.

MTech:

It is assumed that students possess knowledge of computer science topics such as Digital Electronics, Computer Organization, Architecture, Data Structures and Algorithms, DBMS, Computer Networks, Theory of Computation and Programming Methodology and Languages (C/C^{++}). These topics form the syllabus for the written test as well as GATE (CS) exam. Consequently, CS 700 – Foundations of Computer Science – is not included in the regular curriculum. All the MTech programmes now have a uniform scheme of minimum 56 credits comprising 10 theory, 3 Lab courses and a final year project.

> MTech (CS) programme: Of the 10 courses, 4 are core courses and the remaining 6 are elective courses. The core courses are Operating Systems, Algorithms, Computer Architecture and Software Engineering.

MTech (AI) students are required to take one CS core course, i.e., Algorithms. They have 5 AI core courses and 4 electives. The second semester lab emphasizes AI programming and use of AI tools.

MTech (IT) has 8 core topics and 2 electives. Of the core subjects, 4 are CS related core and the rest are BT&IS related core subjects.

MTech Electives: The elective courses can be selected from the common list of CS/AI/IT electives shown in this document.

MTech final year project is worth 18 credits, of which the first semester evaluation is for 6 credits. It is recommended that the Final Mark Sheet for MTech programme should list the Course work GPA and Project GPA separately.

Communication Skills

This course has been formally introduced in the MCA and MTech curricula now as a 2-credit lab course.

MTech Project Evaluation:

The committee felt that grades for MTech course work and Project work should be shown separately on the Final Mark sheet. Further, the grading process is to be spread over two semesters, the first semester accounting for 6 credits and the final semester for 12 credits. The first semester grade is given based on semester-end presentation/demo. The final-semester grade is based on evaluations by the internal supervisor and an external examiner.

Interdisciplinary / Joint Programmes:

DCIS is participating currently in three programmes, namely, MTech (Computational Techniques in Physics) with the School of Physics; MTech (Bioinformatics) jointly with Schools of Life Sciences and Chemistry and CDFD; and, the Integrated Masters programme. The courses and curricula for these programmes are made compatible with the existing programmes and assigned course numbers as per the proposed scheme.

- In MTech (CT): The following MCA courses are designated as CS core for this programme: Computer Organization and Architecture (CA520), Programming Methodology (CA521) in the first semester; and, Data and File Structures (CA522), and Algorithmics (CA529) in the second semester. In addition, an elective from the approved list (see Appendix A) is also offered in the second semester.
- MTech (BI): The following courses are offered in this programme: Computational Methods (CS701) in the first semester and Databases course (CS727) in the second semester. In the third semester, Advanced Bioinformatics (AI751) and an elective from the approved list is offered to these students.
- Integrated Masters Programme: 2 courses (course numbers to be assigned) in the first two semesters along with labs are offered to this programme.

Attendance and Assessment:

- Attendance Requirements: To be eligible to write the end-semester examination in a particular subject, a student must have at least 75% attendance in that subject.
- Continuous Assessment: Each course is for 100 marks. Of these, the end-semester examination will account for 60 marks. The other 40 marks are awarded based on continuous internal assessment. At the end of the major examination, grade points on a 10-point scale will be awarded as shown in the following table. The University has a set procedure to deal with backlog of courses and improvement/supplementary examinations and are applicable to all the programmes offered by DCIS. Registration for each programme has a fixed duration. Additional information is available in the Section on Teaching and Evaluation of the prospectus for information on backlog/ improvement/registration of courses.

Letter Grade	**Points**	**Marks range MCA**	**Marks range M.Tech.**
A+	10	85 to 100	85 to 100
A	9	75 to 84	75 to 84
B+	8	65 to74	65 to74
B	7	55 to 64	60 to 64
C	6	50 to 54	55 to 59
D	5	40 to 49	50 to 54
F	0	<40	<50

MCA PROGRAMME(2007-)

Course Structure:
MCA programme comprises 15 Core (10 CS Core, 3 Mathematics Core, 2 Management Core), 4 CS Advanced courses, 6 Electives, 3 Lab Courses, a Communication Skills Course, and a final semester project.

Course Numbering Scheme: 500-509: Mathematics and Management; 510-519: Lab and Projects; 520-544: CA Core (Required); 545-569: CA Advanced (Required); 570-599: CA Electives

Computer Science Core Courses (Required):	Credits
CA520 Computer Organization and Architecture	4
CA521 Programming Methodology	3
CA522 Data and File Structures	3
CA523 Operating Systems	4
CA524 Object Oriented Programming	3
CA525 Software Engineering	3
CA526 Data Base Management Systems	3
CA527 Computer Networks	3
CA528 Theory of Computation	4
CA529 Algorithmics	4

Computer Science Advanced Courses (Required):	Credits
CA545 Internet Technologies	3
CA546 Data Warehousing	3
CA547 Computer Graphics and Visualization	4
CA548 Introduction to AI	3

Mathematics Core Courses (Required):	Credits
CA500 Mathematical Foundations of Computer Science	3
CA501 Computer Based Numerical and Statistical Techs.	3
CA502 Computer Based Optimization Techniques	3

Management Core Courses (Required):	Credits
CA505 Accounting and Financial Management	3
CA506 Information Systems Management	3

Lab Courses (Required)	Credits
CA510 Software Lab -I (Intro to UNIX & C, H/W Install.)	2
CA511 Software Lab - II (ALP, C++ & Java)	2
CA512 DBMS Lab	2
CA513 Communication Skills (Lab)	2

Project	Credits
CA519 Project	12

Other Suggested Electives for MCA III, IV and V Semesters:
Current Trends in Programming, Network Programming, Language Processors, Multimedia Technologies, Graph Theory, Number Theory, Enterprise Resource Planning, E-Commerce and Payment Systems, Banking Technology, Datamining, Softcomputing, Other relevant CS/AI/IT courses, Logic and other approved courses offered by other departments.

Course Plan for MCA (2007-)

Semester I

Course Number and Course Name	Credits
CA500 Mathematical Foundations of Computer Science	3
CA520 Computer Organization and Architecture	4
CA505 Accounting and Financial Management	3
CA521 Programming Methodology	3
CA501 Computer Based Numerical and Statistical Techniques	3
CA510 Software Lab -I (Intro to UNIX & C, H/W Installation)	2
	18

Semester II

CA522 Data and File Structures	3
CA523 Operating Systems	4
CA524 Object Oriented Programming	3
CA502 Computer Based Optimization Techniques	3
CA525 Software Engineering	3
CA511 Software Lab - II (ALP, C^{++} & Java)	2
	18

Semester III

CA526 Data Base Management Systems	3
CA545 Internet Technologies	3
CA527 Computer Networks	3
CA528 Theory of Computation	4
Elective – I (Interdisciplinary subject)	3/4
CA512 DBMS Lab	2
	18/19

Semester IV

CA546 Data Warehousing	3
CA529 Algorithmics	4
CA547 Computer Graphics and Visualization	4
CA548 Introduction to AI	3
Elective – II	3/4
CA513 Communication Skills (Lab)	2
	19/20

Semester V

CA506 Information Systems Management	3
Elective – III	3/4
Elective – IV	3/4
Elective – V	3/4
Elective – VI	3/4
	15/19

Semester VI

CA519 Project **12**

Grand Total **100 (min)**

MTECH PROGRAMMES (2007 -)

Course Structure for MTech Programmes:
MTech (CS) programme comprises: 4 Core (4 CS Core), 6 Electives, 2 Lab Courses, a Communication Skills Course and a final year project. At least 5 of the six electives must be from the list of advanced CS/AI/IT courses. The other elective may be taken from courses offered by other departments.

MTech (AI) programme consists of 6 Core (5 AI Core and 1 CS Core), 4 Electives, 2 Lab Courses, a Communication Skills Course and a final year project. At least 3 of the 4 electives must be from the list of advanced CS/AI/IT courses. The other elective may be taken from courses offered by other departments.

MTech (IT) programme comprises 8 Core (5 BT Core and 3 CS Core), 2 Electives, 2 Lab Courses, a Communication Skills Course and a final year project. At least one of the 2 electives must be from the list of advanced IT courses while the other may be selected from one of the advanced CS/AI/IT courses.

Course Numbering Scheme: 700-709: Basic Courses; 710-719: Lab and Projects; 720-744: CS/AI/IT Core (Required); 745-799: CS/AI/IT Electives

MTech (CS)

Computer Science Core Courses (Required):	Credits
CS720 Operating Systems	4
CS721 Algorithms	4
CS722 Computer Architecture	3
CS723 Software Engineering	3

Elective Courses: See List of CS/AI/IT Electives

Lab Courses	Credits
CS710 Research Methods in CS (Lab)	2
CS711 Communication Skills (Lab)	2
CS712 Software Engineering Practices (Lab)	2
CS718 Project & Seminar-I	6
CS719 Project & Seminar-II	12

MTech (AI)

Artificial Intelligence Core Courses (Required):	Credits
AI720 Problem Solving Methods	3
AI721 Knowledge Representation and Reasoning	3
AI722 Machine Learning	4
AI723 Human Computer Interaction	3
AI724 Computational Intelligence	3

Computer Science Core Courses (Required):	Credits
CS721 Algorithms	3

Elective Courses: See List of CS/AI/IT Electives

Lab Courses	Credits
CS710 Research Methods in CS (Lab)	2
CS711 Communication Skills (Lab)	2
AI711 AI Programming and Tools Lab Course	2
AI718 Project & Seminar-I	6

AI719 Project & Seminar-II	12

MTech (IT)

Banking Technology & IS Core Courses (Required):	Credits
IT700 Banking Technology	3
IT720 Cryptography	4
IT721 Quantitative Techniques in Finance	4
IT722 E-Commerce and Payment Systems	3

Computer Science Core Courses (Required):	Credits
CS723 Software Engineering	3
CS724 Data Base Management Systems	3
CS725 Computer Networks and Distributed Computing	3
CS726 Systems Security	3

Elective Courses: See List of CS/AI/IT Electives

Lab Courses	Credits
IT710 Lab – I (Java and Scripting Languages)	2
IT711 Communication Skills (Lab)	2
IT712 Lab – II (N/W Programming and Web Services)	2
IT718 Project & Seminar-I	6
IT719 Project & Seminar-II	12

Course Plan for MTech Courses (2007-)

Course Plan for MTech (CS) (2007-)

Semester I

Course Number and Course Name	Credits
CS720 Operating Systems	4
CS721 Algorithms	4
CS722 Computer Architecture	3
Elective – I	3/4
Elective – II	3/4
CS710 Research Methods in CS (Lab)	2
CS711 Communication Skills (Lab)	2
	21/23

Semester II

CS723 Software Engineering	3
Elective – III	3/4
Elective – IV	3/4
Elective – V	3/4
Elective – VI	3/4
CS712 Software Engineering Practices (Lab)	2
	17/21

Semester III

CS718 Project & Seminar-I **6**

Semester IV

CS719 Project & Seminar-II **12**

Grand Total **56 (min)**

Course Plan for MTech (AI) (2007-)

Semester I

Course Number and Course Name	Credits
AI720 Problem Solving Methods	3
AI721 Knowledge Representation and Reasoning	3
CS721 Algorithms	4
Elective – I	3/4
Elective – II	3/4
CS710 Research Methods in CS (Lab)	2
CS711 Communication Skills (Lab)	2
	20/22

Semester II

AI722 Machine Learning	4
AI723 Human Computer Interaction	3
AI724 Computational Intelligence	3
Elective –III	3/4
Elective – IV	3/4
AI711 AI Programming and Tools (Lab)	2
	18/20

Semester III

AI718 Project & Seminar-I **6**

Semester IV

AI719 Project & Seminar-II **12**

Grand Total **56 (min)**

Course Plan for MTech (IT) (2007-)

Semester I[1]

Course Number and Course Name	Credits
IT700 Banking Technology	3
IT720 Cryptography	4
CS725 Computer Networks and Distributed Computing	3
CS724 Data Base Management Systems	3
IT721 Quantitative Techniques in Finance	4
IT710 Lab – I (Java and Scripting Languages)	2
	19

Semester II

CS726 Systems Security	3
CS723 Software Engineering	3
IT722 E-Commerce and Payment Systems	3
Elective – I	3/4
Elective – II	3/4
IT711 Communication Skills (Lab)	2
IT712 Lab – II (Network Programming and Web Services)	2
	19/21

Semester III
IT718 Project & Seminar-I **6**

Semester IV
IT719 Project & Seminar-II **12**

Grand Total **56 (min)**

[1] At the beginning of the first semester, students are required to take an Orientation course on Banking and a Foundation course in Computer Science to be held at IDRBT.

Complete List of Courses

Numbering scheme: Following are guidelines for the numbering scheme as per the circular UH/Exams/2006 dated 27-March-2006.

- Courses for the MCA, MTech (CS), MTech (AI), and MTech (IT) are suffixed with the following 2-letter codes, respectively: CA, CS, AI, and IT.
- Course Numbering Scheme for MCA Programme: 500-509: Mathematics and Management; 510-519: Lab and Projects; 520-544: CA Core (Required); 545-569: CA Advanced (Required); 570-599: CA Electives
- Course Numbering Scheme for MTech Programmes: 700-709: Basic Courses; 710-719: Lab and Projects; 720-744: CS/AI/IT Core (Required); 745-799: CS/AI/IT Electives

MCA

CA500 Mathematical Foundations of Computer Science
CA501 Computer Based Numerical and Statistical Techniques
CA502 Computer Based Optimization Techniques
CA503 Computer Oriented Statistical Methods

CA505 Accounting and Financial Management
CA506 Information Systems Management

CA520 Computer Organization and Architecture
CA521 Programming Methodology
CA522 Data and File Structures
CA523 Operating Systems
CA524 Object Oriented Programming
CA525 Software Engineering
CA526 Data Base Management Systems
CA527 Computer Networks
CA528 Theory of Computation
CA529 Algorithmics

CA545 Internet Technologies
CA546 Data Warehousing
CA547 Computer Graphics and Visualization
CA548 Introduction to AI

MCA Lab Courses

CA510 Software Lab -I (Intro to UNIX & C, H/W Installation)
CA511 Software Lab - II (ALP, C++ & Java)
CA512 DBMS Lab
CA513 Communication Skills (Lab)

MCA Project

CA519 Project

MTech (CS)
CS700 Foundations of Computer Science
CS701 Computational Methods (MTech BI course)
CS720 Operating Systems
CS721 Algorithms
CS722 Computer Networks
CS723 Software Engineering
CS724 Advanced Data Base Management Systems
CS725 Networks and Distributed Computing
CS726 Systems Security
CS727 Databases (MTech BI course)

Computer Science Electives:
CS745 Theory of Computation
CS746 Software Technology And Management
CS747 Formal Methods in Software Engineering
CS748 Mobile Computing
CS749 Embedded Systems
CS750 Simulation and Modelling
CS751 Parallel Computing
CS752 Grid Computing
CS757 Agent Technologies
CS758 Intelligent and Cooperative Information Systems
CS759 Cryptography

CS770 Network Programming
CS771 Language Processors
CS772 Mathematical Algorithmics
CS773 Decision Support Systems
CS774 Geographical Information System & Spatial Decision Support System
CS775 Graph Theory
CS776 Number Theory
CS777 Fractals And Chaos Theory
CS778 Enterprise Resource Planning (ERP)
CS779 Electronic Commerce
CS780 Multimedia Technologies
CS781 Human Computer Interaction
CS782 Current Trends In Databases
CS783 Current Trends In Programming
CS784 Current Trends In Information Technology
CS785 Advanced Computer Networks
CS786 Unix Network Programming

MTech (CS) Lab Courses
CS710 Research Methods in CS (Lab)
CS711 Communications Skills (Lab)
CS712 Software Engineering Practices (Lab)

MTech (CS) Project
CS718 Project & Seminar-I
CS719 Project & Seminar-II

MTech (AI)
AI720 Essentials of Artificial Intelligence
AI721 Knowledge Representation and Reasoning

AI722 Machine Learning
AI723 Human Computer Interaction
AI724 Computational Intelligence

Artificial Intelligence Electives:
AI745 Natural Language Processing
AI746 Pattern Recognition
AI747 Document Analysis and Recognition
AI748 Logic and Engineering
AI749 Neural Networks
AI750 Datamining
AI751 Bioinformatics
AI752 Information Retrieval & Web Search
AI753 Computer Vision
AI754 Text Processing
AI755 Speech Processing-I
AI756 Speech Processing-II
AI757 Image Processing (IP)
AI758 Colour Image Processing

MTech (AI) Lab Courses
CS710 Research Methods in CS (Lab)
CS711 Communications Skills (Lab)
AI711 AI Programming and Tools (Lab)

MTech (AI) Project
AI718 Project & Seminar-I
AI719 Project & Seminar-II

MTech (IT)
IT700 Banking Technology
IT720 Cryptography
IT721 Quantitative Techniques in Finance
IT722 E-Commerce and Payment Systems

Information Technology Electives:
IT745 Softcomputing in Finance
IT746 Data Warehousing and Data Mining
IT747 Middleware Technologies
IT748 Sensor Networks and Embedded Systems

MTech (IT) Lab Courses
IT710 Lab – I (Java and Scripting Languages)
IT711 Lab – II (N/W Programming and Web Services)

MTech (IT) Project
IT718 Project & Seminar-I
IT719 Project & Seminar-II

SYLLABUS OF CORE COURSES

MCA CORE COURSES

MATHEMATICS

CA500 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Prerequisite: Nil

Aim: To provide basic mathematical foundation required for various computer science courses.

Course Content: Discrete Maths: Theory of Sets; Mathematical Induction; Relations and Functions; Recurrence Relation; Calculus: Functions; Limits and Continuity; Differentiation and Integration; Differential Equations. Logic: Logic operators such as AND, OR etc., Truth tables; Theory of inference and Deductions; Mathematical Introduction; Predicate calculus Predicates and Quantifiers.
Linear equation & Matrices: Row/Column operations; Gaussian Elimination; Decomposition; Inverse; Determinants; Properties of determinants; Cramer's Rule; Decomposition; Inverse. Vector spaces Linear Independence, Bases, subspace and dimensionality, Length, angle, direction cosines; orthogonalizations. Theory of Graphs: Graphs, subgraphs, isomorphism; Classes of graphs; paths and cycles; Trees; Connectivity; Planar Graphs; Hamiltonian and Eulerian Graphs.

Books:
1. Korthage, R.R.: Discrete Computational Structures, Academic Press, 1974.
2. Preparata, F.P.: Introduction to Discrete structures, Addison-Wesley, 1973.
3. Trembley, J.P. and Manohar R.P.: Introduction to Discrete Mathematical structures with Applications to Computer Science, McGraw Hill, 1975.
4. Lew: Computer Science: Mathematical Introduction, Prentice Hall International.

CA501 COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES

Prerequisite: Nil

Aim: To familiarise students with statistical and numerical techniques needed in problem-solving and industrial applications.

Course content: CA503 and Numerical Techniques for finding roots, Bisection method, Newton-Raphson method, numerical integration using Simpson's rules, Gaussian quadrature method, solving differential equations, interpolation and extrapolation.

Books:
1. Numerical Recipes in C
2. The books suggested for CA503

CA502 COMPUTER BASED OPTIMIZATION TECHNIQUES

Prerequisite: None

Aim: To introduce various optimization techniques and their computer implementation.

Course Content: Optimization Problems; The Simplex Algorithm; Duality; Computational Considerations for the Simplex Algorithm Max-Flow and Shortest Path; Transportation Problem, Assignment Problem;

Integer Linear Programming; Cutting-Plane Algorithm for Integer Linear Programs; Branch-And-Bound and Dynamic Programming;

Book: Christos H. Papadimitriou and Kenneth Steiglitz: Combinatorial Optimization (Algorithms and Complexity).

CA503 COMPUTER ORIENTED STATISTICAL METHODS

Prerequisite: Nil

Aim: To familiarise students with basic statistical concepts and their application in different areas of computer science. Also to introduce students to efficient algorithms for computing different statistical measures.

Course Content: Basic statistical measures – mean, median, standard deviation, skew, kurtosis; rank, percentile, frequency distributions, standard distributions, regression analysis, least squares fit, polynomial and curve fitting, multiple regression; Introduction to time-series analysis, forecasting, moving averages, exponential smoothing, autoregressive models; Goodness of fit methods, ANOVA, F-test, applications to computer Science.

Books: Any book on statistics with additional books given below:
1. W.H. Press, et.al: Numerical recipes in C, Cambridge University Press.
2. Statsoft : Statsoft online Textbook, http://www.statsoft.com.
3. C. Chatfield: An Introduction to Time-Series Analysis, Oxford University Press.

Course Format: Class lectures and lab assignments. Typical break-up: Classroom lectures: 20 Classes, Lab sessions: 6 classes.

MANAGEMENT

CA505 ACCOUNTING & FINANCIAL MANAGEMENT

Prerequisite: None

Aim: To introduce basic concepts of accounting and financial management to entry-level computer science students and work toward basics of computerized accounting & financial management systems.

Course Content: Accounting: Principles, Concepts and Conventions, Double entry system of Accounting, Introduction of basic books of Accounts of sole proprietary concern, Control Accounts for Debtors and Creditors, Closing of books of Accounts and preparation of Trial balance. Final Accounts: Trading, Profit and Loss accounts and Balance sheet of sole proprietary concern with normal closing entries. Introduction to Manufacturing account, finally accounts of partnership firms, limited Co.. Financial Management: Meaning and role. Ratio Analysis: Meaning, Advantages, Limitation, Types of ratios and their usefulness. Fund flow statement: Meaning of the terms - fund, flow and fund, working capital cycle, preparation and interpretation of the fund flow statement. Costing : Nature, importance and basic principles. Budget and budgetary control: Nature, scope and importance. Break-even analysis, it's uses and limitations, construction of break even chart, practical applications of marginal costing. Standard costing: Nature and scope, Computation and analysis of variances with reference to material cost, labour cost and overhead cost, interpretation of the variances. Introduction to computerized accounting system: Coding logic and codes required, master files, transaction files, Introduction to documents used for data collection, Processing of different files and output obtained.

Books:

1. Kellock, J.: Elements of Accounting, Heinemann, 1978.
2. Rockley, L.E.: Finance for the Non-Accountant, 2nd Edn. Basic Books, 1976.
1. Levy and Sarnet: Principles of Financial Management Prentice-Hall International.
3. Arnold. : Financial Accounting, Prentice-Hall International.
4. Horngren, and Sundem,: Introduction to Financial Accounting, Prentice-Hall International.
5. Murthy , U.S. : Management Finance, 2nd Edn., Vakils Fefers & Simons Ltd., 1978.
6. Van Home, James, C.: Financial Management & Policy, Prentice Inc.
7. Pandey, I.M.: Financial Management, Vikas Publications 1978.

CA506 INFORMATION SYSTEM MANAGEMENT

Prerequisite: Nil

Aim: To introduce the concepts and practices of Management Information Systems

Course Content: Introduction to data processing concepts, MIS, data collection, preparation, verification, editing and checking, storage, retrieval, records, files. Business files - Master and Transaction file, file generations, back-ups and file recovery procedures, Disk and Tape based files; Storage Organizations and accessing methods. COBOL programming - language constructs and structured programming features, examples for files accessing. File sorting, searching, merging, matching, Table handling, Report Writer, DBMS Concepts.

Books:

1. R J Verzello, John Reutter III: Data Processing: Systems and Concepts, Mc Graw Hill Book Co.- 1982.
2. Roy, M.K. and Dastidar Ghosh, D: COBOL Programming, Tata McGraw Hill Pub. Comp. Ltd. 1982.
3. Philippakis and Kazmier: Information system Through COBOL 2nd Ed. McGraw Hill Int. Ed.
4. Philippakis and Kazmier: Advanced COBOL Programming - McGraw Hill.
5. Popkin, G.S.: Advanced structured COBOL 2nd Edn. Kent Publ. Comp. 1987.
6. Pierson & Horn: Structured COBOL Programming, Scott Freshman and Co. 1986.
7. Rajaraman, V. & Sahasrabuddhe, H.V.: Computer Programming in COBOL, Prentice-Hall India.
8. Grover, P.S: Programming with Structured COBOL, Macmillan, 1989.
9. A Stern & Stern: Structured COBOL Programming - Addison Wesley.

CA520 COMPUTER ORGANIZATION AND ARCHITECTURE

Pre-requisite: Basic knowledge of Computer Programming in a high level language

Aims and Objectives: This is a first level course, suitable for both hardware and software oriented students. It not only describes computer structures solely from the programming viewpoint, but also for those who will eventually work with systems that involve a variety of equipment, interfacing, and communication facilities.

Course Content: Overview of Computer Hardware, History and technological milestones. Data representation: Codes, number systems, integer representation, sign magnitude, 1's complement, 2's complement. Boolean Algebra, Boolean expressions and their simplification. SOP and POS. Karnaugh Maps, Basic logic gates, logic diagrams. Combinational circuits: Half adder, Full adder, Subtractor, multiplexer, demultiplexer, decoder, encoder. Sequential circuits: Latches, Flip-flops, RS, JK, D, T types. Counter, shift registers etc. Basic Computer organization, Instruction set, Register transfer language, CPU: Control unit construction, Instruction cycle. Memory organization: Memory hierarchy, Cache, Main memory, auxiliary memory. IO organization, interfacing, Polling, interrupt, Vectored and daisy interrupt structures. DMA, microinstructions, control memory. Computer Arithmetic, Floating point numbers underflow, overflow, precision consideration.

Recommended Books:
1. V. Carl Hamacher, Zvonko G. Vranesic, Safwat G. Zaky, Computer Organization, McGraw-Hill International Edition, 1996.
2. Computer System Architecture, Morris M. Mano, Computer System Architecture, Prentice Hall

CA521 PROGRAMMING METHODOLOGY

Prerequisite: Nil

Aim: To inculcate problem-solving skills and to introduce basics of programming through C language to entry-level computer science students.

Course Content: Problem Analysis, flow Charts, decision tables. Pseudo codes and Algorithms, High level language and Programmer's Model of Computer System. Algorithmic Programming Language: Representation of integers, reals, characters, constants and variables, arithmetic expressions and their evaluation using rules of hierarchy. Assignment statements, Logical constants variables and expression Control structures - sequencing alteration, iteration. Arrays, Manipulating vectors and matrices. Subroutines overhead cost, interpretation of the variances. Compiling, debugging and testing in integrated development environment.

Books:
1. Kerninghan, BW. and Richie, DM.: The C programming language, PHI, 2nd edition, 1999.
2. Michael Schneider; Introduction to problem solving and programming through pascal.
3. Drmey R.G.: How to solve it by Computer.
4. Gries D.: Science of programming.
5. Niklaus Wirth.: Data Structures + Algorithms = Programs.

CA522 DATA AND FILE STRUCTURES

Prerequisite: CA521, a basic course in programming, or approval from instructor.

Aim: This is a first level course that describes various structuring methods of data, their practical use and introduces the concepts of external data storage schemes.

Course Content:
Module I: Fundamental Notations: Primitive and Composite Data types, Time and Space Complexity of Algorithms, Sorting Algorithms. Data Structures: Stacks, Queues, Arrays, Linked Lists, Trees and Graphs.

Module II: Fundamental File Structure Concepts; Organizing Files for Performance; Keysorting; Indexing; Consequential Processing and the Sorting of Large Files; B-Trees and Other Tree-structured File Organizations; The B+ Tree Family and Indexed Sequential File Access; Hashing; Extendible Hashing.

Course format: Lectures, Tutorials and Programming assignments.

Books:
1. Wirth, Nicolaus: Algorithms + Data structures = Programs. Prentice-Hall International, 1975.
2. Horowitz, E., and Sahni.S: Fundamentals of Data structures. Computer Science Press, 1978.
3. Knuth, D.: The Art of Computer Programming, Vols. 1-2. Addison-Wesley, 1970-80.
4. Aho, A. V., Hopcroft, and Ullman, J.E.: Data Structures with Pascal, Prentice-Hall International, 1985.

5. Tanenbaum, A.M., and Augenstein, M.J.: Data Structures with Pascal, Prentice-Hall International, 1985.
6. Stubbas, D.: Data Structures with Abstract Data Types and Modula2, Brooks & Cole Pub. Co. 1987.
7. Trembley & Sorenson: An Introduction to Data Structures with Applications; Tata McGraw Hill.
8. Kruse, R. L., Leung, B. P., and Tondo, C. L.: Data Structures and Program Design in C; Prentice-Hall of India, 1999.
9. Weiss, M. A.: Data Structures and Algorithm Analysis in C++; Addison-Wesley, 1994.
10. Michael J. Folk and Bill Zoellick, "File Structures" (Second Edition).

CA523 OPERATING SYSTEMS

Prerequisite: Computer Organization and Programming Methodology.

Syllabus:

- History, Evolution and Philosophy Hardware evolution Economic Forces and constraints Structuring methods : Layered model, object - server model Application needs and significant case histories
- Tasking and Processes Tasks, processes Structures; ready list, process control block etc. Despatching, content switches Role of interrupts
- Process co-ordination and synchronization Concurrent execution Sharing access, race conditions Deadlock: Causes, conditions, prevention Models and mechanisms (eg. Busy waiting, spin locks, Dekker's algorithm, semaphores, mutex locks, region, monitors)
- Scheduling and Dispatch Preemptive and non-preemptive scheduling schedules and policies
- Physical and Virtual Memory Organization Physical memory and registers Overlays, swapping, partitions Pages and segments Placement and replacement policies Thrashing, working sets
- Device Management Free lists, layout Servers, interrupts Recovery from failures
- File Systems and Naming File layout (eg. Indexed, contiguous) Directories, contents and structure Naming, searching, access, backups Fundamental file concepts; basic file Organizations, basic file manipulations, blocking and buffering Sequential files Non sequential files (eg. hashed files, tree-structured files, B-trees, multiple key files)
- Security and Protection Overview of System security with examples Security methods and devices, protection access, authentication Memory protection Recovery Management
- Communications and Networking Protocol suites Streams and datagrams Internetworking and routing Servers, services
- Distributed and Real time systems Synchronization and timing Failures, risks and recovery Special concerns in real-time systems

Text Books:

1. Silberschatz and Galvin, "Operating System Concepts" Addison Wesley fifth edition 1997
2. Tanenbaum "Modern Operating Systems" Prentice Hall India. 1992
3. Stallings "Operating System" PH I Second edition. 1994
4. Crowley "Operating Systems A design Oriented Approach" Tata MacGraw Hill 1998.

References:

1. Beck et al. "Linux Kernel Internals", Addison Wesley Longman, Second Edition 1998
2. U. Vahalia, " Unix Internals", Prentice Hall International 1997.

CA524 OBJECT ORIENTED PROGRAMMING

Prerequisite: CA521 or special approval from instructor

Aim: To introduce students to objects and object oriented concepts

Syllabus: Abstract data types, abstraction, encapsulation, objects and object hierarchies, inheritance, polymorphism, virtual functions. Differences between other programming paradigms and oop. Examples and programming exercises.

Books: To be identified.

CA525 SOFTWARE ENGINEERING

Prerequisite: CA521 Programming Methodology; CA522 Data and File Structures

Aim: To introduce the principles, concepts and practices of software engineering

Course Content: Introduction to System Concepts, Software Engineering Concepts, SE Methodology, Life Cycle Models, Software Development Approaches, Need for Management and Role of Management in SE, Requirements Analysis, SADT, Alternative Analysis Techniques, Formal Approaches in SE, Design Techniques, Role of PL in Software Development, Coding Principles and Programming Techniques, Software Testing, Software Configuration Management, Software Maintenance and Current and Future trends in SE.

Books:
1. R. Pressman: Software Engineering - a practioner's approach, McGraw Hill - 1992.
2. Ghezi, etal: Fundamentals of SE, PHI New Delhi 1995.
3. P. Jalote: An Integrate approach to SE, Narosa Publishers, 1992.
4. Yourdon: Modern Structured Analysis, PHI New Delhi 1995.
5. Harwiz kwiz: Systems Analysis and Design, PHI New Delhi 1995.
6. Jag Sodhi: SE - Management Application and Tools, McGraw Hill, 1987.

CA526 DATA BASE MANAGEMENT SYSTEMS

Prerequisites: CA521 Programming Methodology, CA522 Data and File Structures, CA523 Operating Systems.

Aim: To teach database theory and applications.

Course Content:
Lecture:
Introduction: Aims and Objectives, Technology involved and current uses of the technology.
Data Models: Entity-Relationship model, Network model, Hierarchical model.
Database design: Normalization principles and their uses. Secondary data storage and retrieval techniques.
Query Processing: Studies on query processing strategies and cost estimation.
Transaction Processing: Defining Properties and studies on recovery and concurrency. Security and Integrity.
Distributed Databases: Introduction, Issues on design, concurrency, recovery, deadlock handling and co-ordinator selection.
Practical:
1. Practice on database designs and SQL programming.
2. One or Two mini-projects on design and development of database applications.

References:
1. H. F. Korth and A. Silberschatz: Database Systems & Concepts, McGrawHill Publications.
2. R. Elmasri, S. B. Navathe: Fundamentals of Database Systems, Benjamin/Cummings Publishing Company.
3. Stefano Ceri, G. Pellagatti: Distributed Databases Principles & Systems, McGrawHill.

Software Systems:
Oracle DBMS and MSACESS Database Management System.

CA527 COMPUTER NETWORKS

Pre-requisites: CA520 Computer Organisation and Architecture, CA522 Data Structures (CA523 Operating Systems – would be beneficial)

Aims and Objectives: This is a first course in computer networks introducing all the essential concepts and builds a basis for further courses such as Internet Technologies, Electronic Commerce and Multimedia. This course should be (ideally) run with a course on Network Programming where the programming and systems aspects of the network concepts are consolidated in a practical sense. (The network programming course could also follow this in a subsequent semester.)

Syllabus:
Communications Model: Communications model, data communications tasks; networking, layering and design issues, ISO-OSI model, protocols, services, standards, network goals and applications.

- Data Communication: Physical layer; transmission media, encoding, interfaces, switching and signaling methods, multiplexing and medium access control.
- Data Link Layer: Framing, error control, flow control, data link protocols, retransmission strategies and their performance.
- Network Layer: Routing and congestion control algorithms, inter-networking principles, Internet Protocol, bridges etc. devices.
- Transport Layer: Transport services, connection management, TCP, UDP, quality of service parameters, TCP/IP over ATM networks.
- Network Security: Data encryption strategies, authentication protocols, firewalls.
- Basic applications: telnet, rlogin, FTP. TFTP, NFS, DNS, SMTP, MIME, SNMP, HTTP etc.
- Network Infrastructure for advanced applications: E-commerce, multimedia, mobile and wireless computing.

Books and References:
1. Bertsekas, D and Gallager, B.: Data Networks, Prentice Hall of India 1992. (2nd Edition)
2. Black, U.D.: TCP/IP and Related Protocols, MacGraw Hill New York 1995.
3. Black, U.D.: Computer Networks, Protocols Standards and Interfaces, Prentice Hall International
4. Comer (includes Comer and Stevens, D.L. three Volumes): Internetworking with TCP/IP Principles protocols and architecture, Prentice Hall of India, 1995.
5. Goralski, W.J.: Introduction to ATM networking, McGraw Hill New York, 1995.
6. Keshav, S.: Computer Networks: an Engineering Approach, Addison-Wesley, Reading, 1997.
7. Stallings, W.: Network and Internetwork security, Prentice Hall International 1995.
8. Stallings, W. Data and Computer Communication 5th Edition, Prentice Hall of India, 1997.
9. Stevens, W.R: TCP/IP Illustrated (Three Volumes), Addison-Wesley, Reading, Mass. 1995
10. Tanenbaum, A.S.: Computer Networks Third Edition, Prentice Hall of India, 1997.

CA528 THEORY OF COMPUTATION

Prerequisite: Nil

Aim: First course in theory of computation leading up to the concepts of complexity and undecidability.

Course Content: Introduction, Graph Notation, Set theory, grammar and relations. Finite Automata: DFA, NFA, Regular Expressions and their Equivalencies, Moore and Melay machines. Regular

Expressions: Properties, Pumping lemma, Minimizing the Automata. Context Free Grammars: Definitions, Derivation tree, Ambiguity, Chomsky and Greibach - Normal forms, Pumping Lemma for CFL. PDA: Definition and Equivalence of PDA and CFL. Introduction to Turing Machines, undecidability and complexity theory.

Book: Aho, Hopcraft & Ullman: Automata, Languages and Computation; Narosa.

CA529 ALGORITHMICS

Prerequisite: CA522 Data and File Structures

Aim: This course builds on Data Structures and emphasizes design and analysis of algorithms.

Course Content: Efficiency of algorithms; Asymptotic Notation; Analysis of Algorithms; Solving recurrences; Application of data structures; Greedy Algorithms, Spanning trees, shortest paths, knapsack problem, scheduling problem; Divide-and-conquer, binary search, sorting; Dynamic programming principle of optimality; Graph Algorithms, BFS, DFS, Back tracking, Branch and Bound; Computation Complexity, reductions and introduction to NP-completeness; Examples and brief overview of heuristic, probablistic and parallel algorithms, String Matching methods.

Books:
1. Fundamentals of Algorithms, G.Brassard and P.Bratley, PH India 1997.
2. Fundamentals of Computer Algorithms, E.Horowitz and S.Sahani, Galgotia Publications.
3. Introduction to Algorithms, T.H.Cormen, CE Leigerson, R.Rivest, PH India 1998.

CA545 INTERNET TECHNOLOGIES

Pre-requisite: Computer Networks

Aims and Objectives: This is a first course on Internet and the World Wide Web. This exposes students to tools that could transform how we do the work in different domains of applications: Communication, Education, Information Access, Commerce, Healthcare etc.

Course Content: Review of computer networks, The Internet, Domains and addresses, options for connecting, S/W, modems etc., The internet toolkit: Electronic email, ftp, telnet, finger, etc. WWW, IRC, talk, MUDS, providing resources via internet. HTML, Javascript, CGI, Pearl and Introduction to JAVA.

Recommended Books:
1. Glee Harrah Cady, Pat McGregor: Mastering the Internet, BPB, Sybex 1996.
2. Alan Simpson: HTML Publishing Bible, IDG Books, Comdex Computer Publishing, A Division of Pusthak Mahal, 1996.
3. Bryan Pfaffenberger: Publish on the Web, AP Professional, 1996.
4. Clayton Walnum: Java by Example, Que 1996.
5. Marty Hall: The Core Web Programming, Prentice-Hall, 1998.
6. J. Niederst: Web Design in a Nutshell, O'Reilly Associates, 1999.

CA546 DATA WAREHOUSING

Prerequisite: CA522 Data and File Structures, CA526 Database Management Systems

Aim: The course emphasis will be on Algorithms and Database theory.

Course Content: General Introduction: Historical Perspective, characteristics of data warehousing. Data Warehousing: its architecture, logical design, multidimensional data model, OLAP, Data mart. Data mining vs Database, data mining as a component of data warehouse.

Text Books: The topics will be covered from a collection of research papers and textbooks. The students are expected to read research articles and undertake some programming assignments.

CA547 COMPUTER GRAPHICS AND VISUALIZATION

Prerequisite: CA521 Programming Methodology, CA522 Data and File Structures

Aim: This is first course introducing basics of computer graphics and various visualization techniques.

Course Content: Introduction: History, Advantages, Application, I/O Devices Graphic Packages, Languages. 2D Graphics: Drawing Elementary figures, Polygon Filling, Transformations, Windowing and clipping, Display file segmentation. Interactive Graphics: Interactive input techniques, Event handling, Input functions; 3D Graphics and Realism: Mathematical Preliminaries, Curves and Surfaces, Clipping, Hidden line and surface removal, rendering, real-time graphics; Introduction to Visualization, Tools for Visualization, Applications etc.

Books:
1. D. Hearn and M. P. Baker: Computer Graphics, IEEE, 1989.
2. Rogers: Mathematical elements for Computer Graphics, McGraw-Hill, 1985.
3. Newman and R. F. Sproull: Principles of Interactive Graphics, McGraw-Hill, 1979.
4. Harrington, Computer Graphics: A programming approach, McGraw-Hill, 1987.
5. M. Berger: Computer graphics with Pascal, Benjamin/Cummings, 1986.
6. Foley & A. Van Dam: Fundamentals of Interactive Computer Graphics, Addison Wesley, 1982.

CA548 INTRODUCTION TO AI

Aim: First course introducing the principles of AI.

Course Content: General introduction of AI, Intelligent systems, etc., Applications, Search techniques, Constraint satisfaction problems, Logic, modus ponens, Satisfiability, Resolution, Refutation, Unification. AI–planning, Uncertainty in AI, Case Studies of Applications.

Books:
1. N.J.Nilson: Principles of Artificial Intelligence, Narosa Publications.
2. D. W. Patterson: Introduction to AI & Expert System, PHI.
3. S. Russell and P. Norvig. AI: A Modern Approach, 2nd Edn., McGraw-Hill, 2003.

LAB COURSES (MCA)

CA510 Software Lab -I

Syllabus:
Intro to UNIX & C, H/W Installation

CA511 Software Lab - II

Syllabus:
ALP, C++ & Java

CA512 DBMS Lab

Syllabus:
DBMS Programming

CA513 Computer Networks Lab

Syllabus:
Network Programming

MCA PROJECT

CA519 Project

For Project guidelines, see also MTech guidelines. For external projects, when approved, students need to identify an internal guide also.

CORE COURSES: MTech (CS)

CS700 FOUNDATIONS OF COMPUTER SCIENCE

Prerequisites: None (required for ALL M.Tech students with Non-CS Background)

Aim: Make students with *non-CS background* acquire the thinking of a student with CS background. Also, introduce non-CS students to fundamental CS concepts and subjects that a fresh CS student entering into the M.Tech programme is expected to know.

Course Content: The course contains four major parts: Computer Organization, Operating systems, Data structures and Algorithms, each of roughly 6-8 classes each.

Computer Architecture and Organization (CO): Von Neumann Architecture, Instruction Cycles, Interrupt Processing, Memory Mapped and I/O Mapped I/O, Bus-based Interconnections, Cache, Internal and External Memories, Memory Addressing Modes.

Operating Systems (OS): Introduction to different types of operating systems, OS Functions, Layered Design, Hardware Interface, System Calls, Functions and Utilities, Process Management, Memory Management, I/O Management.

Data Structure (DS): Primary Data structures, Structured Data Types, Linear and Non-Linear Data Structures, Arrays, Linked Lists, Trees, Graphs.

Algorithms (ALGO): Introduction to Problem Solving Techniques and Analysis, Big-OH, Omega and Theta Notation, Different Types of Algorithms and such as Greedy, Divide-and-Conquer, Dynamic Programming, Branch-and-Bound, Backtracking.

Books: No suitable text exists. However, extracts from the following books are used
1. William Stallings: Computer Architecture.
2. Peterson and Silberschatz: Operating System Concepts, Addison Wesley.
3. Trembley and Sorenson: An Introduction to Data Structures with Applications, Tata McGraw-Hill.
4. T.W. Pratt and M.V. Zelkowitz: Programming Language, Prentice Hall India.
5. D. E. Knuth: The Art of Computer Programming - Vol. I, Addison Wesley.
6. Brassard and Bratley: Fundamentals of Algorithmics, Prentice Hall India.
7. D. E. Knuth: Selected Papers on Computer Science, Cambridge University Press

Course Format: Classroom lectures, reading assignments and group discussions.
Typical break-up is CO: 6 Classes, OS-8 Classes, DS-7 Classes, and ALGO 7 Classes.

CS720 OPERATING SYSTEMS

Syllabus is similar to CA523 with advanced topics and additional lab assignments

CS721 ALGORITHMS

Syllabus is similar to CA529 with some advanced topics.

CS722 COMPUTER NETWORKS

Syllabus is similar to CA527 with some advanced topics.

CS723 SOFTWARE ENGINEERING

Prerequisite: Programming Methodology

Aim: This course emphasizes software engineering principles and leans more toward the theoretical foundations.

Course Content: Introduction to System Concepts, Software Engineering Concepts, SE Methodology, Life Cycle Models, Software Development Approaches: Waterfall model, Boehm's spiral model. Requirements Analysis, Specifications verification and validation, Coding Principles and Programming Techniques, Software Testing, Future trends in SE.

Books:
1. Ian Sommerville: Software Engineering, Addison-Wesley, 5th edition, 1998.
2. R. Pressman: Software Engineering - a practioner's approach, McGraw Hill - 1992.
3. Carlo Ghezzi, etal: Fundamentals of SE, PHI New Delhi 1995.
4. P. Jalote: An Integrate approach to SE, Narosa Publishers, 1992.

CS724 DATA BASE MANAGEMENT SYSTEMS

Syllabus is similar to CA526 with some advanced topics (See IT Syllabus).

CS725 NETWORKS AND DISTRIBUTED COMPUTING

See IT syllabus

CS726 SYSTEMS SECURITY

See IT Syllabus

LAB COURSES (MTech – CS)

CS710 RESEARCH METHODS IN CS

Aim: To introduce students to software packages that are useful in research, final year project and general problem-solving; to learn skills needed for reading, analyzing and reviewing research papers; and, the scientific temper and ethics.

Syllabus: research papers, journal articles, critical reviews, ethics, plagiarism, citations, etc.

CS711 SOFTWARE ENGINEERING PRACTICES

Syllabus: Software engineering practices to be emphasized.

MTECH (CS) PROJECT

CS718 & CS719 MTECH PROJECT

The following general guidelines are suggested for MTech projects.

- Title and Extended Abstracts: All students are to submit tentative title and abstract duly endorsed by the supervisor to the M.Tech project co-ordinator. This should be done before the commencement of the summer vacation at the latest. Abstract must have "Problem Statement" which should not be more than a paragraph. Maximum of 3 pages can be used to build the background and motivation. Extended abstracts on A4 sized paper with double-spaced text should be printed using 12-point font. Students should list hardware and software requirements for doing the project.
- Citation of Related Work: Each student is expected to do independent work. More than one student may collaborate for a large project under the same supervisor. However the division of work has to be made clear and each student shall submit a separate project report. All previous work (including software) and help received should be documented and appropriate acknolwdgement/refrences made. While writing the project report, the students should cite the work of other related project reports, and clearly describe how their work is different from others.
- Project Work Done Off-Campus (External Project Work): There are two categories here.
  - Faculty supervisor with additional Off–Campus Guide: Before commencement of External Project work, the abstracts must be approved by the advisory committee in writing. In case of commercial/ scientific benefits of such off campus projects DCIS will have equal rights over the source code/documentation etc. In case of such projects an advisory committee shall view the final project demonstration of the working of the project. An internal supervisor may not be allocated in this case.
  - Only Off–Campus Guide: In case of projects being done outside the campus at recognised institutions (as mentioned in the University prospectus) under the supervision of a recognised external guide, there need not be an internal supervisor however there shall be an advisory committee that ensures the proper completion of the project.
- Progress Report: It is the student's responsibility to submit to the Dept. a monthly report of progress endorsed by the supervisor(s). In the Gate scholarship form the supervisor certifies that the students' progress is satisfactory. The above report should now form the basis of such certificates.
- Demonstration of Project Work: All project work needs to be demonstrated. Here again there are two categories: a) Largely Theoretical Work b) Largely Implementation Work. All MTech students should aim at giving a seminar in the Dept. based on their work. The department may organize a "Trade Fair" where every student does a poster presentation (Theoretical or otherwise).
  - For the theoretical work a Departmental seminar presentation will be given by the student.
  - For the implementation work, in co-ordination with the placement officer, a "Trade Fair" is to be organised in which the implemented projects can be demonstrated to visitors external to Dept. and comprising visitors from other Departments, Industry, and other R&D institutions.
- Project Reports: Soft copies and hard copies of all project work, including documented source code has to be submitted to the Department. Project Reports shall have a good standard of writing (including grammar and spell checking), and have a definite presentation format (an appropriate style file for LateX or Document Template for MSWord is being developed.) It shall include also: A Certification by the supervisor(s), (the members of the advisory committee shall also be acknowledged on a separate certificate to be included in the final project report), A single page Abstract, Table of Contents, References (in the IEEE standard format), A User Manual (for installation, demonstration and use of implementation), Other relevant Appendixes for supporting information. Reports have to be hard bound in the prescribed colour (light blue).

CORE COURSES (MTech – AI)

AI720 PROBLEM SOLVING METHODS

Prerequisite: Basic computer science background or instructor's permission.

Aim: First course introducing the principles of AI.

Course Content: General introduction of AI, Intelligent systems, etc., Applications, Search techniques, Constraint satisfaction problems, Logic (avoiding overlap with AI-712 Knowledge Representation and Reasoning), modus ponens, Satisfiability, Resolution, Refutation, Unification. AI–planning, Distributed AI, Market-oriented programming. Other related topics such as speech, vision, neural networks, etc.

Books:
4. N.J.Nilsson: Principles of Artificial Intelligence, Narosa Publications.
5. D. W. Patterson: Introduction to AI & Expert System, PHI.
6. S. Russell and P. Norvig. AI: A Modern Approach, 2nd Edn., McGraw-Hill, 2003.

AI721 KNOWLEDGE REPRESENTATION AND REASONING

Prerequisite: Basic computer science background or instructor's permission.

Aim: First course introducing the principles of knowledge representation and reasoning.

Course Content: Survey of Representation techniques: representation schemes: Logic: Procedural representations: Semantic networks: Conceptual structures: Production systems: Analogical representation: Semantics primitives: Frames and Scripts: conceptual Dependency: Applications of Knowledge Representation.
Languages, Syntax and well-formed formulas (wffs), Semantics, Properties of Wffs. Formal deduction - Inference Rules, Logical Axioms, Formal Proofs, Theories and Theorem Proving Lowentheim-skolem Theorems, Classical first order logics-Propositional logic, Predicate Calculus. Non-classical Logics and their application to knowledge representation and processing.
Brief Introduction - Many sorted Logics, Non-monatonic Logics, Multi-valued Logics, Fuzzy Logic, Model Logic, Temporal Logic, Intentional Logic.

AI722 MACHINE LEARNING

Prerequisite: Basic computer science background or instructor's permission.

Aim: First course introducing various techniques of machine learning.

Course Content: Review Basic Tasks, Methods and underlying problems of Machine Learning. Learning methods such as role, analogical, EBG, EBL, Chunking. Learning by examples - Version space algorithm and ID3 algorithm . Important systems and applications to the problem of knowledge acquisition for expert system.

Books:
1. Michalsky, T. Mitchell, J.Corbonell, Machine Learning Springer-Verlag.
2. T. M. Mitchell. Machine Learning, McGraw-Hill, 1997.

AI723 HUMAN COMPUTER INTERACTION

Syllabus given by Dr. Girija to be typed here.

AI724 COMPUTATIONAL INTELLIGENCE

Prerequisites: Calculus, Differential equations, Linear algebra (Vectors, matrices), Logic, Set theory, Programming skills (familiarity with Matlab or any programming language)

Aim: This course introduces the concepts of computational intelligence / softcomputing including neural networks (NN), evolutionary and genetic algorithms (GA), fuzzy logic, neuro-fuzzy techniques and rough set theory. The coverage of topics will be in the following proportion: 60% NN, 20% GA and 20% Fuzzy and Rough Sets.

Syllabus:

Introduction to Computational Intelligence / Softcomputing: Soft versus Hard Computing, Various paradigms of computing

Foundations of Biological Neural Networks: Introduction to Neural Networks, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN (Learning, Generalization, Memory, Abstraction, Applications), McCulloch-Pitts Model, Historical Developments

Essentials of Artificial Neural Networks: Introduction, Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity (Feed forward, feedback, Single and Multi-layer), Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules (Error Correction, Hebbian, Competitive, Stochastic), Types of Application (Pattern Classification, Pattern Clustering, Pattern Association / Memory, Function Approximation, Prediction, Optimization)

Neural Architectures with Supervised Learning: Single Layer Feed Forward Neural Networks (Perceptron), Multilayer Feed forward Neural Networks (Backpropagation learning), Radial Basis Function Networks, Support Vector Machines, Simulated Annealing, Boltzmann Machine, Feedback (Recurrent) Networks and Dynamical Systems

Associative Memories: Matrix memories, Bidirectional Associative Memory, Hopfield Neural Network,

Neural Architectures with Unsupervised Learning: Competitive learning, Principal Component Analysis Networks (PCA), Kohonen's Self-Organizing Maps, Linear Vector Quantization, Adaptive Resonance Theory (ART) Networks, Independent Component Analysis Networks (ICA)

Reinforcement Learning: Markov Decision Processes, Value Functions, Bellman Optimality Criterion, Policy and Value Iterations, Q-Learning, TD Learning

Fuzzy Logic: Basic concepts, fuzzy set theory, basic operations, fuzzification, defuzzification, neurofuzzy approach, applications

Evolutionary and Genetic Algorithms: Basic concepts of evolutionary computing, genetic operators, fitness function and selection, genetic programming, other models of evolution and learning, ant colony systems, swarm intelligence, applications

Rough Set Theory: Basic concepts, indiscernability relation, lower and upper approximation, decision systems based on rough approximation, applications

Partial Set of References:
1. Jacek M. Zurada. Introduction to Artificial Neural Systems, Jaico Publishers, 1992.
2. S. Haykin. Neural Networks: A Comprehensive Foundation, Prentice Hall, 1999
3. P. S. Churchland and T. J. Sejnowski. The Computational Brain. MIT Press, 1992.
4. A. M. Ibrahim. Introduction to Applied Fuzzy Electronics. PHI, 2004
5. Z. Pawlak. Rough Sets, Kluwer Academic Publishers, 1991.

LAB COURSES: MTech (AI)

AI711 AI PROGRAMMING AND TOOLS

Syllabus: LISP; PROLOG; SCRIPTING (PYTHON, PERL); ES SHELLS

MTECH (AI) PROJECT

See Guidelines given in MTech (CS) Project.

SYLLABUS OF ELECTIVES

CS770 NETWORK PROGRAMMING

Prerequisite: CA527 Computer Networks, CA523 Operating Systems, CA521 Programming Methodology (or their equivalents)

Syllabus: Unix operating systems, processes, process control block, system calls for process control, inter-process communication, synchronization primitives, sockets, socket options, daemons, network applications, client-server architectures.

Books:
1. Unix Network Programming Vols. I and II, Richard W. Stevens
2. Advanced Unix Programming, Richard W. Stevens

CS771 LANGUAGE PROCESSORS

Prerequisites: CA528 Theory of Computation, CA522 Data and File Structures, CA521 Programming Methodology

Aim: To teach basics of compiler principles and design.

Course Content: Analysis–Synthesis model of a compiler, lexical analysis, syntactic analysis, DCFGs, LL & LR grammars & parsing techniques, syntax directed translation, code generation, code optimization, introduction to assemblers, linkers, loaders, macro processors, etc.

Course Format: Students to implement all major algorithms covered. Also, a compiler for a subset of a programming language should be developed by each student using tools such as LEX and YACC.

Books:
1. V. Aho, Ravi Sethi, and J. D. Ullman: Compilers: principles, techniques and tools, Addison-Wesley Publishers.
2. Holub: Compiler design in C.

CS772 MATHEMATICAL ALGORITHMICS

Need to retype the syllabus given by Prof. K. Viswanath

CS773 DECISION SUPPORT SYSTEMS

Prerequisite: Nil

Aims and Objective: This course deals with mainly model building for decision situations in functional areas of management like, finance, marketing, production, planning and control etc. As such the emphasis is on model building and using a computer as a tool. The course emphasises substantial code writing on a pertinent application programme as well.

Course Content:
Open systems and closed systems. Conversion of open system into a closed system. Problems involved in dealing with the quantitative parameters and qualitative parameters in such conversions from open system to closed system. Cost aspects involved in building a Decision Support System.
DIS versus MIS: The comparison and contrast of DSS with MIS. Emphasis of DSS as management of Models.
Application problems with DSS in functional areas of management as follows:

(i) Financial Management: Applications in investment theory. Applications in portfolio management.
(ii) Marketing : Applications in research areas of marketing like, significant forecasting models, eg., Box-Jenkins, ARIMA (Auto Regressive Integrated Moving Average) models.
(iii) Production Planning and Control : Applications in significant areas like, inventory management, assembly line balancing etc.,
(iv) Applications to macro-economic problems.

A class room project is envisaged as a vehicle through which the student will be working on a significant DSS application problem that calls for substantial amount of coding.

Course Format: Formal lectures aided by supplementary readings from original literature recommended by the course teacher.

CS774 GEOGRAPHICAL INFORMATION SYSTEM & SPATIAL DECISION SUPPORT SYSTEM

Prerequisite: As per instructor's permission

Aim: To learn aspects of geographical information storage and retrieval systems.

Course Content: GIS vs. IS, SDSS vs. DSS, Spatial Data Structure and Representation, Data input for GIS, Data Storage for GIS, Data analysis & algorithms for GIS, Terrain Analysis, Network Analysis,

Overlay Analysis, Digital Mapping & Cartography, Remote Sensing, Spatial Reasoning, KBGIS, Object oriented GIS, SDSS

Reading Material
Literature from Journals
- Int. Jr. of GIS
- IEEE Jr. Remote Sensing

CS775 GRAPH THEORY

Syllabus: includes graph problems, analysis of time-complexities of graph problems.

CS776 NUMBER THEORY

Syllabus: integers, primes and composites, fundamental theorem of arithmetic, factorization, discrete logarithm problem, etc.

CS777 FRACTALS AND CHAOS THEORY

Syllabus: need to retype the material given by Dr. Durga Bhavani

CS778 ENTERPRISE RESOURSE PLANNING

Pre-requisite: As suggested by the Course Co-ordinator

1. ERP Overview: Integrated management information systems, Supply chain management, Integrated data model, Benefits of ERP, Evolution of ERP and Modern enterprise, BPR (Business Process Reengineering) & ERP, Business modeling for ERP
2. Customer Service:
3. Production Planning and execution
4. Purchasing and goods receipt
5. Financial and other metrics
6. ERP Packages
7. Case studies
   Insurance industry, Banking industry, Pharmaceutical industry, Health care, Consumer products, Retail industry, University, Transport Industry, Telecom industry, Public Sector Industry

CS779 E-COMMERCE

Prerequisites: Students are expected to know basic Network concepts - ISO/OSI and TCP/IP architectures. LAN -Ethernet, Token ring, ATM, FDDI. Understanding of bridges, Routers and Gateways.

Introduction to Electronic Commerce
The Network Infrastructure for Electronic Commerce
Economics of Electronic Commerce
Transactions and Accounting Costs
Pricing of Goods and Services on the Internet
Electronic Retailing

Web Based Business Models
Purchasing Agents
Online Shopping
Marketing and Advertising on the Net
Emerging marketing and advertising models
Network Security
Firewalls
Encryption and Transaction Security (Secret Key and Public Key Cryptography)
Digital Signatures, Certificates, Certificate Authorities
SET and SSL protocols
Electronic Payment Systems
Tokenized vs. Notational systems
Credit Card based systems
Electronic Checks
Electronic Cash and Micro transactions
Smart Cards
Protocols and Standards

The Social Impacts of Electronic Cash
Privacy, Anonymity, and traceable E-money
Legal Issues
Electronic Contracting and Digital Signatures
Intellectual Property
Copyright, Trademark, and Patents
Cybercrime and Money Laundering
Public Policy Issues: What is the Government's role?
Electronic Commerce and Financial Services
Banking, Securities and Brokerage
International Issues in Electronic Commerce
Commodification of Information
Property Rights vs. Freedom of Information
Electronic publishing and digital copyrights

References:
"Electronic Money: Toward a virtual wallet", Tekla S. Perry, IEEE Spectrum, February 1997
"E-Money (That's What I Want)" by Steven Levy, Wired (2.12, 12/94)
A Framework for Global Electronic Commerce, National Information Infrastructure Task Force, Draft for Public Comment, and a response by the Internet Society.
Selected Tax Policy Implications of Global Electronic Commerce, Department of the Treasury Office of Tax Policy, November 1996 and from another perspective, Vince Cate's view of a "Tax free Cyberspace"
Options for Promoting Privacy on the National Information Infrastructure, Draft for Public Comment, Information Policy Committee, National Information Infrastructure Task Force, April 1997
"Electronic Commerce and the Banking Industry: The Requirement and Opportunities for New Payment Systems Using the Internet", Andreas Crede, Science Policy Research Unit University of Sussex
The Copyright Grab, Pamela Samuelson, published in Wired in reaction to the Administration's White Paper on Intellectual Property and the NII. See further Debate on the White Paper.
Trusted Systems (technology based intellectual property management), Mark Stefik, Scientific American, March 1997
A Politics of Intellectual Property James Boyle
“Frontiers of Electronic Commerce” , Ravi Kalakota , Andrew B. Whinston.

CS780 MULTIMEDIA TECHNOLOGIES

Syllabus: To be formulated when offered.

CS782 CURRENT TRENDS IN DATABASES

Prerequisite: CA526 Database Management Systems

Aim: The course emphasis will be on Algorithms and Database theory.

Course Content: General Introduction: Historical Perspective, characteristics of data mining and data warehousing. Data Warehousing: its architecture, logical design, multidimensional data model, OLAP, Data mart. Data mining vs Database, data mining as a component of data warehouse, data mining applications. Data mining Techniques: Association rules, clustering, decision trees, neural networks, fuzzy sets and rough sets. Overview of Advanced topics: Text mining, spatial mining, web mining, sequence mining. Data preparation and visualisation.

Text Books: The topics will be covered from a collection of research papers and textbooks. The students are expected to read research articles and undertake some programming assignments.

CS783 CURRENT TRENDS IN PROGRAMMING

Prerequisites: CA521 Programming Methodology, CA524 Object-oriented programming

Aim: Advanced level course introducing the current trends in programming such as object oriented programming, etc.

Course Content: Object Oriented Design, Object modeling technique, Unified modeling technique, Object oriented programming, C++, JAVA, Usages of CASE tool in OOD. Theory of object-oriented programming, Quality in object oriented S/W. Introduction to software pattern and distributed object programming, Re-engineering, OOD to Real-time application, Fault-tolerance
Assertion based prog, Agent based prog.

Books:
1) Any C++ book
2) Naughton et al.: The complete reference Java.
3) Netscape & Java Script, Omder pub.
4) Java in nutshell
5) Rambough et al.: Object Oriented Design .
6) UML reference Manual

CS783 CURRENT TRENDS IN INFORMATION TECHNOLOGY

Syllabus: To be formulated when offered.

CS785 ADVANCED COMPUTER NETWORKS

Should retype the syllabus given by Ms. P. Anupama.

CS745 THEORY OF COMPUTATION
Prerequisite: Nil

Aim: Introductory course on theory of computation with advanced topics suitable for MTech students.

Course Content: Syllabus is similar to CA528 (Theory of Computation) with the following additional topics: Turing machine and computability, undecidability, Chomsky hierarchy, computational complexity theory.

Books: (in addition to books recommended for CS-515 Theory of Computation)
1. H. R. Lewis and C. H. Papadimitriou: Elements of Theory of Computation, PHI.
2. P. Ling: An introduction to formal languages and automata, 2nd edition, Narosa.

CS746 SOFTWARE TECHNOLOGY AND MANAGEMENT

Prerequisites: CS723 or equivalent

Aim: This course is more applied in nature, emphasizing the technological and management aspects of software projects.

Course Content: Software Selection, Software Quality Assurance and Standards - ISO standards, IEEE standards, as also the CMM of CMU Software Tools and Software Re-engineering. Advances in SE such as OOA, OOD, OOSE, etc., Software Metrics.
Software Projects: Risk analysis and Risk Management in Software Projects. Productivity circle laws and cost-estimation models. Basics of software technology for the internet applications and web site development software products, development and marketing strategies.

Books: (as on CS-712 Software Engineering)
1. Handbook of SE
2. Handbook on SQA
3. Research Papers on SE and Software Management

Course format: Formal lectures, reading assignments from current literature, a class project of some depth dealing with any of the topics.

CS747 FORMAL METHODS IN SOFTWARE ENGINEERING

Prerequisites: CA521 Programming Methodology, CA500 Mathematical Foundations of Computer Science or equivalents.

Aims: at introducing mathematical concepts in software design and development.

Course Content: Introduction: Formal Specifications, Structured Analysis & Design, Uses of formal specifications, scope and motivation of the study. Applicative Specifications: Basic concepts on types, modules, axioms, binding, products, functions, sets, lists, maps, subtypes, variants. Case, let expressions. Union, sort, overloading and user defined operators, under specifications and non-determinism. Imperative specifications: Assignment, sequencing, repetitive expressions, Functions, Quantification on states, Pre and post conditions. Concurrency: Basic concepts, channel, function with channel access, communication expressions, composing parallel expressions, hiding channels, internal and external choice, specifying distributed systems. Uses of formal specifications in system development Refinement of Schemes, Objects, Variables, Channels, and modules. Verification and validation. Structured Analysis & Formal Methods, Formal methods in object modelling techniques and structured analysis. Uses of formal specifications in Web computing, Business re-engineering and software testing. The above concepts are introduced through RSL specification language supported by United Nations University/ International Institute of Software Technology, Macau.

Practical: Writing Formal Specifications in RSL. Writing of Hybrid specifications using both Structured Analysis Technique and RSL. Translating formal specifications to Java. Developing tools for different uses of formal specifications like translating to Prog. Language and Test Case generation.

Books:
1. The RAISE Specification Language, The RAISE Group.
2. The RAISE Development Method, The RAISE Group.
3. Z Specification Language.
4. UNITY: A Specification Language, Jaydev Mishra and K.M.Chandy

Journals:
1. IEEE Tr. Software Engineering.
2. ACM Transactions on Programming Language and Systems.
3. And similar journals and conference proceedings on software engineering.

CS748 MOBILE COMPUTING

Need to retype the syllabus given by Prof. Mohanty

CS749 EMBEDDED SYSTEMS

Prerequisite: CS720 Operating Systems or equivalent

1. A Review of Basics: What is Embedded System? Categories, Requirement, Challenges, Trends and Applications, Analog and Digital Circuits, Data Representation etc.
2. Computer Hardware: CPU, Memory, I/O Interfaces, Architecture Issues
3. Microprocessors and Interfacing
    a. CSIC, RISC architecture based, 80XXX processors, DSP Processors and systems
    b. System interfacing techniques
4. Real-time operating systems: Task Management, IPC facility, real-time clock server, interrupt services, kernel architecture, scheduling, synchronization, types of embedded OS
5. Embedded System Development Process
    a. Requirement Specification: Co-design
    b. Design of system architecture
    c. Choosing an OS
    d. Choosing the development environment
    e. Testing
6. High-level Language Support
    a. C and C Cross compilers uses
    b. Java 2
    c. Jini
7. Programming Embedded Controllers
    a. Characteristics of embedded routines
    b. Initialization of hardware
    c. Perform error recovery, exception processing
    d. Scheduling of tasks
    e. Sequencing
    f. Co-routines
    g. Pre-emptive
    h. Foreground/ Background task etc
8. Application of Embedded Systems
    a. Consumer electronics
    b. Data Communication
    c. Networking and Telecommunication

   d. Biomedical Systems
9. Case Studies

BOOKS:

1. Real Time Systems, Pearson Education, Asia
2. Building Embedded Linux Systems, O'Relly
3. Micro C/OS-II: The Real Time Kernel, R&D Books, Jean J. Labrosse
4. Linux Device Drivers, O'Relly
5. Real Time Systems Design & Analysis, PHI
6. Designing Embedded Hardware, O'Relly
7. Programming Embedded Systems in C & C++, O'Relly
8. Programming for Embedded Systems, Wiley Dreamtech

CS750 SIMULATION AND MODELLING

Prerequisites: CA501 Computer based Numerical and Statistical Techniques or equivalent

Aim: To design, develop and analyse simulation systems

Course Content: Lectures: Introduction: Models, Behaviours, Uses of simulations and motivations. Analytical system simulation techniques: Monte-Carlo methods, Numerical computation techniques, Lag models, distribute lag model and cob-web model. Discrete system simulation: Different Queuing models and studies. Simulation languages: Simscript and GPSS. Simulation system building paradigms: time-oriented and event-oriented, message-oriented, knowledge–based. Simulation engine development. Analysis of simulation output: Estimation methods, simulation statistics, replication of runs, batch means, regenerative techniques, time series analysis, spectral analysis and autoregressive means. Simulation of business applications: equipment maintenance, warehouse management, facility utilisation, workflow management, project management.

Course Format: Assignments on computations, literature collection, study and seminar presentations.

References:
Books:

1. G. Gordon: System simulation, Prentice Hall
2. J. M. Caroll: Simulation using personal computers; 001.64044, C239.
3. B. S. Gottfried: Elements of stochastic process simulation, 001.424, G71E

Journals:

1. Simulation
2. Proceedings of Conferences on Simulation.

CS751 PARALLEL COMPUTING

Introduction to Parallel Computing: Why Parallel Computing & Scope of Parallel Computing, Sieve of Eratosthenes, Control and Data Approach, PRAM model of parallel computation, Relative strength of the models, Design paradigms of Parallel Computing, examples

Classification: Taxonomies: MPP, SMP, CC-NUMA, cluster: dedicated high performance (HP), high availability (HA), CoPs, PoPs, CoWs; distributed, on-demand, high-throughput, collaborative, data-intensive computing, Interconnection networks, Flynn's Taxonomy

An overview of Parallel Programming Paradigms: Programmability Issues, Programming Models: Message passing, client-server, peer-to-peer, broker computing, code shipping, proxy computing, mobile agents.

Storage and file problems: Network RAM, RAID and software RAID. Distributed File systems: NFS, AFS, OSF-DSF, RSF

Message passing standards: PVM (Parallel Virtual Machine), MPI (Message Passing Interface) Message Passing Interface (MPI) and its routines, Advanced Features of MPI: MPI advanced point-to-point communication MPI Communication modes; MPI Collective Communication and Computations; MPI Derived Datatypes;

Performance Metrics & Speed Up: Types of Performance requirements, Basic Performance metrics; Workload Speed Metrics; Performance of Parallel Computers-Parallelism and interaction overheads; Overhead Quantification and measurement methods; Performance of parallel programs; Performance metrics; Scalability and Speed-up Analysis

Overview of Programming with Shared Memory: OpenMP (History, Overview, Programming Model, OpenMP Constructs, Performance Issues and examples, Explicit Parallelism: Advanced Features of OpenMP),

Cluster Computing: Clustering of Computers, Beowulf Supercomputer, Use of MPI in Cluster Computing. Debugging, Evaluating and tuning of Cluster Programs, Partitioning and Divide and Conquer Strategies.

Applications: Cluster Based algorithms and applications for Sorting, Numerical Algorithms like Matrix Addition, Matrix Multiplication, Solving linear system, Image Processing Algorithms. Shared Memory Programming

References:

1. Quinn, M. J., Parallel Computing: Theory and Practice (McGraw-Hill Inc.)
2. Bary Wilkinson and Michael Allen: Parallel Programming Techniques using Networked of workstations and Parallel Computers, Prentice Hall, 1999.
3. R. Buyya (ed.) High Performance Cluster Computing: Programming and Applications, Prentice Hall, 1999.
4. Ernst L. Leiss, Parallel and Vector Computing A practical Introduction, McGraw-Hill Series on Computer Engineering, Newyork (1995).
5. William Gropp, Rusty Lusk, Tuning MPI Applications for Peak Performance, Pittsburgh (1996)
6. Ian T. Foster, Designing and Building Parallel Programs, Concepts and tools for Parallel Software Engineering, Addison-Wesley Publishing Company (1995).
7. Kai Hwang, Zhiwei Xu, Scalable Parallel Computing (Technology Architecture Programming) McGraw Hill Newyork (2004)
8. David E Culler,Jaswinder Pal Singh with Anoop Gupta, Parallel Computer Architecture, A Hardware/Software Approach, Morgan Kaufmann Publishers, Inc, (1999)
9. W.Gropp, E. Lusk, N.Doss, A. Skjellum, A high performance portable implementation of the message passing Interface (mpi) standard, Parallel Computing 22 (6), Sep 1996.
10. Akl, S.G., The Design and Analysis of Parallel Algorithms (PHP)
11. Gibbons, A., W. Rytter, Efficient Parallel Algorithms (Cambridge Uni. Press)
12. Kumar V., et al., Introduction to Parallel Computing, Design and Analysis of Parallel Algorithms, Benjamin/Cummings, 1994

CS752 GRID COMPUTING

Prerequisite: Knowledge of Introductory Algorithms, Networks, Java/C/C++, and Unix/Linux.

Objective: This course is proposed for M.Tech. (CS/AI/IT/CT) and MCA students. By the end of the semester, students should be able to develop the following skills:

(i) Should be able to write and deploy web services using Java or other technology.
(ii) Should be able to write and deploy grid services using Globus toolkit.
(iii) Given a practical application, identify the issues and apply suitable techniques studied in the course to it effectively.

More specific objectives will also be given later for each lecture.

Course Outline: Here is a preliminary and non-exhaustive list of topics we will be or might be covering. This is subject to change with advanced notice, partly based on the understanding of the students.

Introduction to High Performance Computing: Why Parallel Computing, Control and Data Approach, PRAM model of parallel computation, Classification: Taxonomies: An overview of Parallel Programming Paradigms: Programmability Issues, Programming Models: Message passing MPI (Message Passing Interface) Message Passing Interface (MPI) and its routines Overview of Programming with Shared Memory OpenMP

Client-Server Architecture: Definitions, Basic Mechanics of Client-Server, Issues, concurrency Protocol, Error Checking, Logging, Stateful vs Stateless services, Distributed Objects, Basics RMI Introduction, RMI Configuration, Remote Object Activation.

Web Services: Extensible Mark-up Language XML Introduction, some key aspects of XML–Document-centric XML Data-centric XML, XML-based Web Services, Simple Object Access Protocol (SOAP), Web Service Definition Language (WSDL), UDDI (Universal Description Discovery and Integration) The topics covered include: Web software architectures; languages and standards for data and applications on the World Wide Web; protocols for data exchange, program invocation, self-description, and discovery that form a basis for Web Services. Technologies include HTML, HTTP, XML, SOAP, and WSDL. The development platform will be Java Web Services platform. The use of these technologies for creating simple/advanced client-server and distributed applications will also be discussed.

Grid Services: Introduction to Grid Computing with Globus Toolkit, Overview of Grid Middleware Distributed Object Technology for Grid computing (OGSA, WSRF) Grid Middleware: JavaCoG, GSI etc. Developing Grid Services.

Applications: Deployment of web and Grid based services for Geo Applications using Geon Portal, design of framework for grid services, design of Grid Portals.

Web sites: (Not Exhaustive)
http://www.w3.org/TR/soap/
http://www.w3schools.com/xml/xml_whatis.asp
http://gdp.globus.org/gt4-tutorial/multiplehtml/v
http://www3.niu.edu/mpi/
http://www.pankaj-k.net/axis4tag/
http://www.ammai.com/webservices

Assignments: Students will be given assignments based on the course contents. They are expected to write and deploy web services, multi threaded web services on multiple machines in LAN or on Grid for some real applications like GEON.

CS757 AGENT TECHNOLOGIES

Syllabus to be formulated when offered.

CS758 INTELLIGENT AND COOPERATIVE INFORMATION SYSTEMS

Pre-requisites: CA526 Data Base Management systems or equivalent

Desirable: Problem Solving Techniques OR Expert Systems OR Foundations of AI, Computer Networks and Distributed Processing.

1. Review of DBMS Concepts, Distributed Data bases, File systems, Replication and Partitioning, Transaction Processing.
2. Intelligent Data base access and interaction, Query processing and Optimisation.
3. Distributed Intelligent systems, Distributed Problem Solving. Multi-Agent systems, Problem Decomposition, Co-ordination and Collaboration, Negotiation, Decision making and Inference.
4. Enhancement of DBMS to support Co-operative Problem Solving, Expert Data bases, Knowledge Base management.
5. Performance enhancement for real-time applications, Approaches to planning, inference etc, representing temporal information.
6. Case studies.

References:
1. Distributed systems (ed Sape Mullender), ACM Press, 1990
2. Distributed Artificial Intelligence (Vols 1 and 2), (ed Michalel Huhns) Morgan Kaufmann, 1987 and 1988.
3. Decentralised Artificial Intelligence (Vols 1 to 3), (ed Yves Demaxeau and J-P Muller), Springer Verlag, 1990-93.
4. Readings in Distributed Artificial Intelligence (ed Gasser and Bond), Morgan Kaufmann, 1988.

Articles from Journals
1. International Journal of Intelligent and Cooperative Information Systems
2. IEEE Transactions on Knowledge and Data Engineering
3. Journal of Parallel and Distributed Computing
4. Decision Support Systems
5. Journal of Software Engineering and Knowledge Engineering
6. IEEE Trans on SMC
7. Artificial Intelligence

CS759 CRYPTOGRAPHY

Topics
Basics of Number theory
Basics of Algebra
Classical cryptography
Introduction to Information Theory
DES
Differential Cryptanalysis
Primality
RSA Crypto System
Discrete log problem, ElGamal Crypto System
Elliptic Curve System
Knapsack System with Shamir's attack
Attacks on RSA, ElGamal

Signature Schemes
Signature and Hash functions
Secret sharing schemes

Pseudo Random Number generation
Zero Knowledge proofs
Topics of Interest

Text Books
Douglas Stinson, "Cryptography: Theory and Practice"
Buchmann Johannes "Introduction to Cryptography"
Alfred J Menezes "Hand Book of Applied Cryptography"
Lawrence C Washington "Elliptic Curves Number Theory and Cryptography"

ARTIFICIAL INTELLIGENCE ELECTIVES

AI745 NATURAL LANGUAGE PROCESSING

Prerequisites: Data Structures, Theory of Computation, Programming Methodology (programming skills).

Aim: To develop a good understanding of all aspects of Natural Language Processing (NLP) from both linguistic and statistical point of view and to provide solid grounding in selected topics.

Course Content: Introduction, origins and history. Current status and future challenges. Corpus processing, computational lexicography, morphology and syntax with an emphasis on English as well as Indian Languages. Selected topics in semantics and pragmatics. Applications to MT, NL interfaces, Information Retrieval (IR), etc.

Course Format: Lectures and Lab assignments.

Books:
1. James Allen: Natural Language Understanding, The Benjamin/Cummings Publishing Co, Inc.
2. Eugene Cherniak: Statistical Language Learning, MIT Press, 1993.
3. Michael P. Oakes: Statistics for Corpus Linguistics, Edinburgh University Press, 1998.

AI746 PATTERN RECOGNITION

One Semester Course (Approx. 30 lecture hours, 1.5 hours each)

Part - 1 STATISTICAL PATTERN RECOGNITION

Introduction, Gaussian model, discriminant functions, classifier performance, risk and errors;
Supervised learning using parametric and nonparametric approaches: ML estimation, Bayesian parameter estimation approach, Parzen Windows, k-nn estimation;
Unsupervised learning and clustering: the clustering concept, c-means algorithm, learning vector quantization, clustering strategies, a hierarchical clustering procedure.

Part - 2 SYNTACTIC PATTERN RECOGNITION

Introduction to formal languages;
String languages for pattern recognition: selection of pattern primitives, patterns grammars, PDL,. Transition network grammar for pattern description, Automated transition nets (ATNs);
Higher dimensional grammars: Web and graph grammars, tree grammars, grammar describing 3-D objects;
Syntax analysis as a recognition procedure: parsing, top-down parsing, bottom-up parsing, Cocke-Youngee Kasami (CKY) parsing algorithm, Earley's parsing algorithms, LL(k) and LR(k) grammars;

Stochastic languages for syntactic pattern recognition: basic formulation, probability measures associated with linear and context-free grammar, languages accepted by stochastic automata, stochastic programmed and indexed grammars.

Part - 3 STRUCTURAL PATTERN RECOGNITION

Imaging model: radiometric models, geometric models, sampling and quantization, tessellation, image models;
Graphs and grid: fundamentals of graph theory, basic algorithms for graphs, fundamentals of discrete geometry, connectivity and topology;
Segmentation: edge, region and texture;
Boundary representation: projection, Fourier descriptors;
Region representation: shape descriptors, mask and moments, thinning, MAT: Scene analysis methods.

Text Books: R.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons, NY, 1992.

Reference Books:

1. Duda R O and P E Hart, Patten classification and scene analysis, John Wiley & Sons, NY 1973
2. K.S.Fu, Syntactic pattern recognition and applications, Prentice Hall, NJ, 1982
3. T.Pavlidis, Structural pattern recognition, Springer-Verlag, NY, 1977
4. D.H.Ballad and C.M.Brown, Algorithms for computer vision, Prentice Hall, 1982

AI747 DOCUMENT ANALYSIS AND RECOGNITION

Prerequisite: This is an advanced level course where some knowledge of AI and or Neural Networks will be beneficial.

Aim: The aim is to provide an overview of methods in document processing technology.

Course Content:
Introduction to documents and processing: Introduction; to documents and models of document processing, top-down, bottom up approaches, document understanding approaches, image extraction and foreground background separation, layout analysis, text and graphics separation, form document processing. Classification Principles: Patterns and feature vectors, Bayesian classification, clustering, neural classifiers, other classifiers, including string and edit distances. Optical Character Recognition: Categories of text, printed and handwriting, printed fixed and variable font methods, numeral recognition, recognition of hand-written cursive scripts, holistic and analytic methods. Graphics Recognition Methods: Region segmentation, vectorization, feature extraction, graphics recognition and interpretation. Tools and Techniques: Statistical PR Lib, OCR Software, Image Processing Library Applications: Application to Kannada, Devanagari Scripts, multi lingual form analysis, Forensic document examination: examining signatures, handwriting, obliterations erasures and overwriting etc.,

Course Format: Students will be required to make independent reading of reference material and actively participate in class discussions, presentations etc., Credit will be given for mini project implementations.

Books:

1. Duda and Hart: " Pattern Classification and Scene Analysis", J.Wiley and Sons.
2. Earl Gose et al: "Pattern Recognition and Image Analysis", Prentice Hall of India, New Delhi, 1998.
3. Chen, Pau and Wang (Eds): "Handbook of Pattern Recognition", World Scientific Press, Singapore 1993, Chapters 1.1, 1.2, 1.5, 3.6
4. Baird, Bunke and Yamamoto. (Eds): "Structured Document Image Analysis", Chapters on understanding of printed documents and graphics recognition. Springer Verlag 1992.

5. L. O'Gorman and R. Kasturi: "Document Image Analysis: An Executive Briefing", IEEE Computer Society Press 1998.
6. H. Bunke and P. S. P. Wang (Eds.): "Handbook of Character Recognition and Document Image Analysis" World Scientific Press, Singapore 1997.

AI748 LOGIC AND ENGINEERING

Prerequisite: As per instructor's approval.

Aim: In this course, a survey is done of various applications of logic in Computer science, and Artificial Intelligence.

Course Content: We study various applications from the main areas; databases, logic programming, program specification, and verification, and knowledge representation. We will be selecting the study material from the research monographs, and journals, and conference proceedings.

The following are the suggested journals, and books.
1. P. Smets, et al: Non-standard Logics for Automated Reasoning, Academic Press, 1988.
2. R. Demolombe, Imielinski, P.: Nonstandard queries, and Nonstandard answers, Oxford University Press, 1994.
3. S. Ceri, G. Gotlab, L. Tanca: Logic programming and databases, Springer Verlag, 1989.
4. Pascal van Hentenryck: Constraint satisfaction in Logic programming, MIT Press, 1987.
5. Z. Manna, A Pneuli: The Temporal logic of reactive, and concurred systems, Springer Verlag, 1991.

Journals
IEEE Trans. Software Engineering; Journal of AI

AI749 NEURAL NETWORKS

Introduction: History of Neurocomputing (The Beginning First Successes, The Quest Years Neurocomputing Takes off). The biological prototype, The neural node (MCP Neuron)
The Perception, linear separable function, Madaline

Learning Laws: Self Adaption Equations (Training), Coincidence Learning, Performance Learning, Competitive Learning, Filter Learning, Spatiotemporal Learning.

Associative Networks: Linear Associator Network, (feedforward) autoassociativity Recurrent Associate Networks (The Hopfield Nets, The Brain state in a Box Network, Associative Network Theorem) BAM's (hetro associativity)

Multilayer-Network: The Backpropagation Networks, Self-organizing Maps, Counter propagation Networks, GMDH (Group Method of Data Handling), Hamming Network.
Frontiers of Neurocomputing: Spatio temporal, Stochastic (Boltzmann) and Hierarchical Networks (Neocognitron) – Knowledge-Based Neural Networks.

Neurocomputers: Machines for Implementing Neural Network.

Neurocomputing Applications

Suggested Readings:

1. Artificial Neural Networks, B.Yegnanarayana, Publishers PHI, 1999
2. Artificial Neural Networks by Robert J Schalkoff, McGraw Hill, 1997
3. Introduction to Neural Computing, Igor Alek Sander & Helen Morton Chapman & Hall, 1990
4. Neural Computing: Theory & Practice, P.D.Wasserman, Van Nostrand Reinhold, NY, 1989 Explorations in Microstructure of Cognition

5. Parallel Distributed Processing: Vol. 1&2, D.E.Rumelhart and J.L.McCelland(Ed) MIT Press, 1986
6. Artificial Neural Networks: Theoretical Concepts, IEEE Computer Society Press, NJ, 1988, Vemuri, V.(Ed.)
7. The Computing Neuron, R.Durbin, C.Miall, G.Mitchison(Eds.) Addison-Wesley Publishing Company, Reading, MA, 1989
8. Neural Networks an Natural Intelligence, S.Grossberg (Ed.) MIT Press, 1988
9. Artificial Neural Systems: Special Issue, IEEE Computer, March 1988
10. Neurocomputing, J.Anderson & E.Rosenfeld (Eds.), MIT Press, 1988
11. Neurocomputing Robert Hecht-Nieisen, Addison-Wesley Pub. Co., 1990
12. Carpenter G.A.Grossberg S "Pattern Recognition by Self-organizing Neural Networks", 1991 Cambridge, MA MIT Press
13. Introduction to Artificial Neural System: Jacek M. Zurada A Jaico Book, 1994.

AI750 DATA MINING

Syllabus: Formulated when offered.

AI751 BIOINFORMATICS

OLD ONE TO BE RETYPED

AI752 INFORMATION RETRIEVAL & WEB SEARCH

OLD ONE TO BE RETYPED

AI753 COMPUTER VISION

OLD ONE TO BE RETYPED

AI754 TEXT PROCESSING

Prerequisite: Data Structures, Theory of Computation, Programming Methodology (programming skills)

Aim: To develop a good understanding of all aspects of Text Processing and to provide solid grounding in selected topics.

Course Content:
String Processing - Efficient techniques for string processing. String searching algorithms - Knuth-Morris-Pratt, Boyer-Moore and Rabin-Karp algorithms. Processing binary strings. Incremental search techniques. Pattern Matching - Regular Expressions, regular grammars, deterministic and non-deterministic finite state machines for pattern matching. Corpus Analysis - Corpus creation. Storage and indexing tgechniques. Morpheme, word and sentence level statistics. Zipf's law. Corpus indexing techniques. Word and sentence level n-grams. Analysis for Hidden Morkov models. Text tagging. Computational Techniques in Lexicography - From corpus to lexicon. Lexical knowledge bases - Electronic dictionaries and thesauri. Efficient storage and retrieval - B-Trees, TRIE, and Hashing. Dictionary analysis tools. Internal consistency and validation techniques. Dictionary updation and maintenance tools. Word Processing - Text layout - Justification, placement of figures, equations, etc. Paragraph and page formatting. Table of Contents, Index, and Bibliography creation. Footnotes and cross references. Spell Checking, Grammar Checking and Style Checking - Statistical and linguistic

approaches to better writing tools. Isolated and context dependent spell and grammar checking tools. Introduction to Grammars and Parsers. Active Chart Parsing. Acceptance based, Relaxation based and Expectation based techniques. Multi-Script and Multi-lingual text processing - Scripts and Fonts - Multi-Script processing and GIST technology. Fonts and font libraries. Bilingual and Multi-lingual dictionaries, thesauri and word processors. Cryptology - Techniques for text encryption and decryption. Text Compression for efficient storage and transmission of textual data.
Applications to Natural Language processing, Speech Recognition, Optical Character Recognition, Information Retrieval and Office Automation.

Books & References:

1. Gerald Salton, "Automatic Text Processing", Addison-Wesley, 1989.
2. Bran Boguraev, Ted Briscoe (Eds), Computational Lexicography for Natural Language Processing, Longman, 1989.
3. Robert Sedgewick, "Algorithms in C", Addison Wesley, 1990-
4. J.E. Hopcroft and J.D.Ullman, "Automata Theory, Languages and Computation", Narosa, 1992.
5. A V Aho, Ravi Sethi, J D Ullman, "Compilers: Principles, Techniques and Tools", Addison-Wesley, 1986.
6. S.N. Srihari, "Computer Text Recognition and Error Correction", IEEE Computer Soceity Press, 1984.

AI755 SPEECH PROCESSING-I

Signal Processing Background

1.Propaedeutic

Review of DSP Concepts and Notation, Review of Probability and Stochastic Processes, Topics in Statistical Recognition, Information and Entropy, Phasors and Steady-State Solutions.

Speech Production and Modeling

2.Fundamentals of Speech Science

Preamble, Speech Communication, Anatomy and Physiology of the Speech Production System Phonemics and Phonetics

3.Modeling Speech Production

Preamble, Acoustic Theory of Speech Production, Discrete-Time Modeling.

Analysis Techniques

4.Short-Term Processing of Speech

Introduction, Short-Term Measures from Long-Term Concepts, Example Short-Term Features and Applications

5.Linear Prediction Analysis

Preamble, Long-Term LP Analysis by System, How Good is the LP Model? Short-Term LP Analysis, Alternative Representation of the LP Coefficients, Applications of LP in Speech

6.Crystal Analysis

Introduction, “Real” Cepstrum, Complex Cepstrum, A Critical Analysis of the Cepstrum

References

Text Books:

1. Discrete Time Processing of Speech Signals, John R Deller, Jr., John G.Proakis and John H.L.Hansen, Macmillian Publishing Company, 1993.
2. Speech Communication: Human and Machine, Douglass O’Shaughnessy, Addison Wesley 1987.
3. Digital Processing of Speech Signals, L.R.Rabiner and R.W.Schafer, Englewood Cliffs, N.J., Prentice Hall, 1978.
4. Fundamentals of Speech Recognition, L.Rabiner and B.H.Juang, Englewood Cliffs, Prentice Hall,1993.

Journals:

1. IEEE Transactions of Speech Processing
2. Speech Communication

AI756 SPEECH PROCESSING-II

Coding, Enhancement and Quality Assessment

1.Speech Coding and Synthesis

Introduction, Optimum Scalar and Vector Quantization, Waveform Coding, Vocoders Measuring the Quality of Speech Compression Techniques.

2.Speech Enhancement

Introduction, Classification of Speech Enhancement Methods, Short-Term Spectral Amplitude Techniques, Speech Modeling and Wiener Filtering, Adaptive Noise Canceling, Systems based on Fundamental Frequency Tracking, Performance Evaluation.

3.Speech Quality Assessment

Introduction, Subjective Quality, Objective Quality Measures, Objective Versus Subjective Measures

Recognition

4.The Speech Recognition Problem

Introduction, The "Dimensions of Difficulty", Related Problems and Approaches

5.Dynamic Time Warping

Introduction, Dynamic Programming, Dynamic Time Warping Applied to IWR, DTW Applied to CSR, Training Issues in DTW Algorithms.

6.The Hidden Markov Model

Introduction, Theoretical Developments, Practical Issues, First View of Recognition Systems Based on HMMs.

7. Language Modeling

Introduction, Formal Tools for Linguistic Processing, HMMs, Finite State Automata, and Regular, A "Bottom-UP" Parsing Example, Principles of "Top-Down" Recognizers, Other Language Models, IWR As "CSR", Standard Databases for Speech-Recognition Research, A Survey of Language-Model-Based Systems.

8.The Artificial Neural Networks

Introduction, The Artificial Neuron, Network Principles and Paradigms, Applications of ANNs in Speech Recognition.

References

Text Books:

1. Discrete Time Processing of Speech Signals, John R Deller, Jr., John G.Proakis and John H.L.Hansen, Macmillian Publishing Company, 1993.
2. Speech Communication: Human and Machine, Douglass O'Shaughnessy, Addison Wesley 1987.
3. Digital Processing of Speech Signals, L.R.Rabiner and R.W.Schafer, Englewood Cliffs, N.J., Prentice Hall, 1978.
4. Fundamentals of Speech Recognition, L.Rabiner and B.H.Juang, Englewood Cliffs, Prentice Hall,1993.

Journals:

1. IEEE Transactions of Speech Processing
2. Speech Communication

AI757 IMAGE PROCESSING (IP)

Prerequisites: Data Structures (or FOCS), Mathematics at Engineering Level including Linear Systems Theory (Fourier Analysis).

Aim: Image processing is an advanced course offered as elective to students interested in learning the theory, techniques and applications of the subject. It also aims to stimulate interest in current research areas in image processing and in developing tools for use in research as well as in multimedia applications.

Course Content: Introduction to Image processing, Fundamentals of Imaging, Imaging systems, Projection Geometry, Image File Formats, Colour Maps and Tables, Spatial Operations including point Processes, Frequency Domain Operations, Mathematical Morphology, Basic Algorithms, Advanced Topics and Applications. Advanced Topics and Applications change each time the course is offered based on hot areas of research, projects available in the department, etc.

Course Format: There are two distinct parts - Class-room lectures during the first part, Student seminars, presentations and group discussions during the second part. The second part covers advanced topics and applications. In addition, there is a lab component where students implement 2-3 short projects on advanced topics and applications. Typical break-up is classroom lectures: 12, seminars and discussions: 12, lab classes: 3.

Books: Textbooks are used only during the first part (see course Format below)

1. Digital Image Processing by Gonzalez and Woods, Addison-Wesley.
2. Fundamentals of Digital Image Processing by A.K. Jain, Prentice Hall India.
3. Extracts from various journals and periodicals for seminars and group discussions.

AI758 COLOUR IMAGE PROCESSING

Prerequisite: Image Processing
(meet the instructors if you want to take the course but did not do image processing earlier)

Syllabus

1. Introduction to colour: the physical basis of colour, the human vision system, and the concepts of colour and intensity of light
2. Colour representation: tristimulus responses, colour models and colour spaces, CIE chromaticity diagram, Munsell's colour chart, and description by primary colours and combinations
3. Digital representation of colour: different colour representations such as RGB,CMY, CMYK, HSV, etc., their origins, strengths and weaknesses
4. Quantization and dithering: the need to reduce colour information, quantization and dithering algorithms, and their uses in reduced-colour images, photocopiers, colour faxes, etc.
5. Colour image enhancement and restoration: why mere extensions from grayscale processing such as histogram stretching and equalization are unsuitable, new operations such as colour polarization, saturation and hue corrections, colour noise removal, etc.
6. Spatial colour filters: extensions of smoothing, sharpening and edge-detecting filters, and new operations specific to colour images
7. Colour similarity: measuring colour similarities and differences (much more complex than measuring intensity differences), MacAdam ellipses, perceptual uniformity and perceptually uniform colour spaces, various colour distance measures
8. Interesting colour image processing examples: colour image processing filter that mimics a physical filter, transforming a colour image into a cartoon-type colouring scheme, newsprint/teletype filter, day-time to night-time filter, and others
9. Applications of colour image processing: colour similarity measures in Content Based Image Retrieval, forensic analysis of documents, watermarking and steganography, and others

Useful Websites:

1. Munsell Color Science Laboratory, Rochester Institute of Technology, http://www.cis.rit.edu/mcsl
2. Charles Poynton's Color Links, http://www.poynton.com
3. Color Science, http://members.cox.net/astro7/color.html

AI759 APPLIED ARTIFICIAL INTELLIGENCE

Prerequisites: Efficiency in Programming, Understandings on Data structures, Operating systems are required. Further, candidate must have courses on knowledge representation and reasoning.

Aim: To teach building of Knowledge Base Systems and their applications.

Course Content:
Lectures: Introduction to Knowledge based systems, AI Problem-solving concepts, Expert systems: Match-Select-Act cycle, uncertainty management, explanation Knowledge engineering: knowledge acquisition and compilation. Expert system development process, Real-time expert system design and development, 2nd generation expert systems. Networking of expert systems, Object oriented expert systems.
Practical: Laboratory: Two Mini Projects on Design and Development of a Knowledge–based system and an application of the developed systems. Seminar & Assignments: Talks on trends of knowledge-based system development technique and their uses in databases, software engineering, internet, and business reengineering.

References:
Books:
1. DW Rolston: Principles of AI & Expert Systems, McGrawHill.
2. B. Buchanan, E. Shortliffe (eds): Rule-based expert systems, Addison-Wesley.
3. D. Lenat, R. Davis: Knowledge–based systems in Artificial Intelligence, McGraw Hill.
4. H. W. Winston: Artificial Intelligence, Addison Wesley.
Journals:
IEEE Expert, Artificial Intelligence,
IEEE Tr. on Knowledge & Data Engineering.

M.Tech. (IT)

Orientation Course on Banking

Purpose and Scope:

As most of the students are fresh graduates in Engineering or Post Graduates in Science, Mathematics and Computers, they would not have been exposed to the various types of banking operations and the activities in the Banks and Financial Institutions, which takes place at different levels.

A basic understanding and knowledge in banking would enhance capabilities to apply Information Technology in the domain of Banking Technology and Information Security. Further, this orientation course has been designed to make students understand the various facets of the banking with emphasis on the paradigm shift in the banking industry, especially consequent to the introduction of various IT enabled services.

The course deals with evolution of banking, types of activities - both domestic and international, the basic accounting procedures, emerging delivery channels and their impact on the banking, the regulatory measures, the various subsidiary services, rules governing systems and procedures of banks, the roles and responsibilities of regulatory authorities and various legislations impacting banking in India.

After this orientation programme, students would acquire knowledge of banking activities and should be able to easily understand and correlate with the security and technology aspects, which would be taught in the main M.Tech. (IT) course.

Prerequisite: Nil

Contents :

Evolution of Banking – Indian Banking Scenario; Banking Structure, Organisation – Roles and Responsibilities; Types of Customers, their relationship with Banks, Rights & Obligations; Types of Deposits – Current Accounts, Savings Bank Accounts, Time Deposit Accounts, Special Schemes, Customer Service and Satisfactions Relationship Banking; Capital Adequacy – Basel II & Treatment of Operational Risks; Various charges created on the securities offered to the bank-legal implications Retail and Corporate Banking Services; Recent Trends in the Currency Management; Role of RBI as Banker to Government and to Banks and role in Payment Systems; International Trade and Foreign Exchange; Various Legislations Effecting Banks in India; Regulatory Measures – IRAC Norms, NPA Provisions; Recent Developments in Banking Regulation/Supervision; Types of Advances – Principles of lending, Term loans, Cash Credits and Overdrafts, Special schemes and subsidies – DICGC; Basic Accounting Procedures and Art of Book-keeping and Accounting Systems – Performance & Review – Remittances and Reconciliation; Financial Sector Reforms; Delivery Channels; Capital Markets;

References :

1. Banking Law and Practice in India – Trivedi, I V Srivastava, Sheela
2. Banking Theory, Law and Practice – Gordon E: Natarajan K.
3. Practice and Law of Banking I – Jeevanandam C.
4. Banking Theory and Practice by Reddy P.N; Appnaiah, H R
5. Practice and Law of Banking – II – Indian Institute of Bankers (IIB)
6. Practice and Law of Banking – I – Indian Institute of Bankers (IIB)
7. Publications from RBI : www.rbi.org.in
8. Publications from NIBM : www.nibm.com
9. Tannan's Banking Law and Practice in India – Tannan, M.L.; Datta, C.R.

10. Tannan's Banking Law and Practice in India. Volume 1 – Tannan, M.L.; Datta, C.R.
11. Tannan's Banking Law and Practice in India. Volume 2 – Tannan, M.L.; Data, C.R.
12. Reserve Bank of India Functions and Working (November 2001) – 5th Edition.
13. Monthly magazines from NIBM, IBA, Institute of Bankers.

Banking Technology

Purpose and Scope:

This course is intended to provide the students an insight into the role played by technology in enhancing the effectiveness of the banking sector and also to provide a strong foundation in the various technologies used for delivering Banking & Financial Services.

Apart from tracing the evolution of Banking Technology, this course will focus on the current technologies as well as banking technologies of the future. Ultimately, it will enable the student to envision the current and future requirements, architecture of banks and accordingly develop roadmap and strategies. It will help students appreciate the fact that technology cannot be viewed in isolation, which will be a crucial step in integrating the technology and business goals of banks.

Pre-requisite: Orientation Course in Banking

Contents :

Module A: Branch Operations and Core Banking

Evolution of Banking Technology, Branch Automation Impact of Technology on Banking Operations, Centralized Banking-concepts and opportunities, challenges, implementation and management issues.

Module B: Delivery Channels

Products, Services and Delivery Technologies at the branches, ATM-Technology and Operations, Electronic cards-Debit and Credit, Smart cards in banking/e-Money, Internet Banking- Architecture and Implementation, Internet Banking / Mobile banking business management, Phone Banking and Call centers, Electronic Delivery Channels Integration

Module C: Back-Office Operations

Credit Appraisal System, Forex Management/SWIFT, Treasury Management , Asset Liability Management, Risk Management – Operational risk, MIS / DSS / EIS for Banks, Data Centre, Business Continuity and Disaster Recovery , Internal Operations -Mail Messaging System, Corporate Intranet and Workflow, Technology and Human Resources Management

Module D: Inter bank Payment Systems

National Payment System Architecture, Structured Financial Messaging System, Cheque Clearing System and MICR technology, Electronic Clearing Services and Electronic Funds Transfer (EFT / SEFT / NEFT), Real Time Gross Settlement System, Negotiated Dealing Systems and Securities Settlement System

Module E: Information System Audit

Overview of Information Systems Auditing, Operations Management Controls, Boundary Controls, Input Controls, Communication Controls, Processing Controls, Database Controls, Output Controls

References:

1. Financial Services Information Systems - Jessica Keyes
2. Banking Technology - Indian Institute of Bankers Publications
3. New Technology of Financial Management – D.N. Chorafas
4. Information Systems Audit- Ron Weber PH
5. Information System Audit and Assurance –D.P. Dube and V.P. Gulati, TMH, New Delhi, 2004.
6. Auditing in a computerized environment TMH - Bhatia Mohan TMH

Cryptography

Purpose and Scope:

Cryptography helps to protect data transmitted in the likely presence of an adversary. A cryptographic transformation of data is a procedure by which plaintext data is disguised, or encrypted (ciphertext) and does not reveal the original input. The original plaintext can be recovered from the ciphertext only by the corresponding decryption key. Cryptographic techniques have many applications in electronic data transmissions, financial transactions, identifications, etc.

This course deals with fundamental concepts and design principles of various cryptographic techniques with specific examples and tutorials relevant to Banking and Financial Sector. It covers basics on number theory, secret key cryptography, public key cryptography and authentication and key agreement protocols. Every module includes examples and exercises to develop both theoretical and practical skills that handle various real life financial problems.

Pre-requisite : Nil

Contents :

Module A : Introduction to Number Theory

Groups, Rings, and Fields, Prime Numbers, Modular Arithmetic, Euclid's Algorithm, Finite Fields of the Form GF *(p),* Polynomial Arithmetic, Finite Fields of the Form GF (2"), Fermat's and Euler's Theorems, Testing for Primality, Random Number Generation, Integer Factorization, Discrete Logarithms.

Module B : Classical Encryption Techniques

Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography, Block Cipher Principles, The Data Encryption Standard (DES), The Strength of DES, Block Cipher Design Principles, Stream Ciphers.

Module C : Contemporary Symmetric Ciphers & Advanced Encryption Techniques

Characteristics of Advanced Symmetric Block Ciphers, Triple DES, Advance Encryption Standards (AES), Evaluation Criteria for AES, Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Differential and Linear Cryptanalysis.

Module D : Public Key Cryptography

Principles of Public-Key Cryptosystems, The Diffie-Hellman Key Exchange, Message Authentication Code (MAC), MD5 Message Digest Algorithm, Secure Hash Algorithm, HMAC, The RSA Algorithm, Elliptic Curve Cryptography (ECC).

Module E : Authentication & Key Agreement Protocols

Digital Signature Standard (DSS), Digital Signature Algorithm (DSA), ECDSA, Key Distribution and Management.

References :

1. A course in number theory and cryptography (2nd edn.), Koblitz, Neal.
2. An introduction to cryptography, Mollin, Richard A.
3. Applied cryptography: protocols, algorithms, and source code in C (2nd edn.) Schneier, Bruce
4. Basic methods of cryptography Van Der Lubbe, Jan C.A.

5. Cryptography and network security: principles and practice (3rd edn.) Stallings, William

6. Cryptography: theory and practice Stinson, Douglas R.

7. Handbook of applied cryptography, Alfred J.; Van Oorschot, Paul C.; Vanstone, Scott A.

Computer Networks and Distributed Computing

Purpose and Scope:

This course will review some of the computer networks concepts and then will involve an in-depth study of the TCP/IP protocol stack and the various protocols involved in the operation of the internet. It will then cover the basics of distributed computing, distributed shared memory, distributed scheduling, distributed file systems etc. There associated lab exercises will help to get hands-on experience with networking concepts.

Contents :

Module-A: OSI seven-layer model review. LAN concepts, protocols and standards for Medium Access Control (MAC). Application layer protocols – HTTP, SMTP, DNS, SFTP, POP3, NFS and NIS.

Module-B: Transport layer concepts – reliable and unreliable service. Flow control and Congestion control concepts. TCP and its internals. UDP datagram service. Socket programming introduction using Java.

Module-C: Network layer concepts and Routing Issues. IP datagram, addressing, CIDR, IP routing. IPv6 concepts. Routing algorithms. Autonomous systems. Interior and Exterior gateway protocols – RIP, OSPF and BGP.

Module-D: Architectures of distributed systems. Resource management in distributed file systems. Elements of distributed shared memory and distributed scheduling.

Module-E: Concurrency in Distributed Computing. Distributed Objects. Scalability. Fault Tolerance. Computing Taxonomies. Computer Clusters. Grid Computing. Distributed Computing Infrastructure.

Reference :

1. Computer Networks, Andrew Tanenbaum
2. Internetworking with TCP/IP vol. I, Douglas Comer
3. TCP/IP Illustrated vol. I, W.Richard Stevens
4. Computer Networking, Kurose and Ross
5. Networks for Computer Scientists and Engineers, Youlu Zheng and Shakil Akhtar
6. Computer Networking with Internet Protocols, William Stallings
7. Distributed Systems, Andrew Tanenbaum
8. Advanced Concepts in Operating Systems. Mukesh Singhal and Niranjan G. Shivaratri
9. Distributed Systems- Concepts and Design 3rd Edition. George Coulouris et.al., 2000
10. Distributed Computing: Principles and Applications by M.L. Liu (Paperback -- 2003)
11. Distributed Computing : Fundamentals, Simulations, and Advanced Topics (Wiley Series on Parallel and Distributed Computing) by Hagit Attiya, Jennifer Welch ,2004

Advanced Database Management Systems

Purpose and Scope:

The course deals with various aspects of database design, data storage and retrieval. It also focuses on issues pertaining to concurrency in transaction management and database security. Current developments in database systems such as Distributed, Parallel, Object-Oriented and Mobile databases along with their application are discussed. It is intended to cover several case studies relating to database design and implementation for different real-life application scenarios.

Prerequisite : Basic database concepts & exposure to any database package.

Contents :

Module-A : Review of DBMS concepts & Relational Data Model :

Review of database concepts, Normal Forms, DBMS architecture, data modeling using ER and extended ER, data base access methods, static and dynamic hashing, indexing technique for files including B-Tree and B + tree data structures.

The Relational model and Relational DBMS: integrity constraints, updation operations, operations of relational algebra, overview of the SQL language, Relational schema design Relational calculus and an overview of the QBE language, Case study: Oracle/DB2/MS-SQL.

Module-B : Data Base Design :

Formalisms, normalization including functional and other types of dependencies and normal forms for relations, Multi-valued and join dependencies, physical database design issues.

DBMS system architecture; centralized and client server architecture; Techniques used for processing and optimizing queries specified in HL database log SQL query option.

Module-C : Transaction Management & Security :

Serialisability, recoverability, Concurrency Control, lock-based time-stamp and validation-based protocols, database failures and recovery, log-based, shadow paging, buffer management.

Database Security issues, access control, Security mechanisms; multilevel database security; confidentiality and integrity requirements.

Module-D : Distributed Data Base :

Distributed database concepts, distributed DBMS architecture, distributed database design, top-down and bottom design, fragmentation, fragment allocation, distributed query processing, transaction management in distributed database, distributed concurrency control, reliability issues in distributed DBMS.

Module-E : Parallel, Object-Oriented and Mobile Data Base Systems :

Parallel database systems: database servers, parallel architecture, parallel DBMS techniques, query parallelism, query optimization, load balancing.

Object-oriented database: object-oriented data model, object-relational database, nested relations, complex types.

Mobile database: directory management, caching, broadcast data, query processing and optimization, transaction management.

References

1. Database System Concepts – Abraham Silberschatz, H F Korth and S Sudarshan, McGraw Hill.
2. An Introduction to Database Systems – Date, C.J., Addison-Wesley
3. Principles of Distributed database systems- M. tamer Ozsu, P Valduriez, Prentice Hall
4. A First Course in Database Systems – Ullman, Jeffrey D.; Widom, Jennifer, Prentice Hall International, Inc.
5. Models and languages of Object-oriented databases- G lausen, G. Vossen, Addison-Wesley.

Quantitative Techniques in Finance

Purpose and Scope:

The course on Quantitative Techniques in Finance (QTF) deals with fundamental concepts and models of quantitative measures required for scientific decision making with specific examples and case studies relevant to the Banking and Financial Sector. It covers basic statistics, probability, numerical techniques and operations research models with examples, exercises and case studies to develop necessary skills to understand, formulate, analyze and handle important real-life financial problems. Analytical tools such as MS-EXCEL and MATLAB will be used for the analysis and solution of formulated problems.

Prerequisite : Mathematics and Statistics

Contents :

Module-A : Valuation Techniques :

Bond Characteristics and valuation, Cash flows, Simple and Compound Interest, Discounting, Present and Future value for single and multiple periods, Yield Curves, Financial Ratios, Asset pricing techniques, Rate of Return, Statistical measures, Continuous and Discrete Probability distributions, Introduction to Spreadsheet Tool and Matlab.

Module-B : Forecasting Techniques

Linear and Non-linear Interpolation, Regression, Time series, Financial Risks, Balance sheet analysis, Profit and Loss Account Analysis, Asset Liability Management using GAP and DGAP Models, VAR, Simulation and its applications to Demand distribution, Service Queues, Future inventory requirements.

1. Module-C: Linear and Non-Linear Programming Techniques

LPP and NLPP Formulation and Solution, Application to various financial problems, Network optimization problems, Multi-Stage Financial Decisions, Dynamic Programming, Supply Chain Management and Currency Flows, Portfolio Problems, Solution using spreadsheet (MS-Excel Tools) and Matlab.

Module-D: Multiple Objective and Dynamic Optimization Techniques

Pareto Optimality, Multiple Objective Decision Making models for selection of technology, software, personnel , facility location and portfolios, Goal Programming, Analytical Hierarchy Process, Data Envelopment Analysis, Economic Optimal Control Problems.

Module-E: Stochastic Programming Techniques

Formulation of SP Models for linear and Non-linear Type, SP models for ALM, Risks and Investment Problems, Multi-objective SP, Financial Games.

References :

1. Methods for business analysis and forecasting: text and cases, Tryfos, Peter, John Wiley & Sons, 1998.

2. Financial Engineering and Computation, Yuh-Dauh Lyuu, Cambridge University Press, 2002.

3. Quantative Analysis for Management, Barry Render, Ralph M.Stair Jr., Michael, Pearson Education Inc., Delhi, 2003.

4. Quantitative business methods using Excel, Whigham, David, Oxford University Press, 1998.

5. Operations research: an introduction, Taha, Hamdy A., Prentice Hall of India, new Delhi, 2001.

6. Principles of operations research with application to managerial decisions, Wagner, Harvey M.., Prentice-Hall of India, New Delhi, 1996.

7. Decision Making and Information System Analysis, Krishna Chandra, Sarup & Sons Publ., New Delhi, 2002.

8. Introduction to Management Science, Prentice Hall, Taylor, B. W. , 2002.

9. Mathematical modeling: case studies from industry, Cumberbatch, Ellis; Fitt, Alistair, Cambridge University Press, 2001.

10. Valuation of Financial Assets, A.S.Ramasasrti, Response Books, New Delhi, 2000.

11. Operations Research, Kanti Swaroop, P.K.Gupta and Man Mohan, Wiley, 2000.

12. Operations Research, S.Dharani Venkatakrishnan, Keerthi Publishing House Pvt. Ltd, Coimbatore, 1992.

13. Quantitative models for supply chain management, Tayur, Sridhar; Ganeshan, Ram;, Magazine, Michael, Kluwer Academic Publishers, 1999.

14. Monte Carlo Methods in Finance, Jaeckel, Peter, John Wiley & Sons, 2002.

15. Monte Carlo Methods in Financial Engineering, Glasserman, Paul, Springer-Verlag, 2003.
16. Financial Engineering, John F.Marshall and Vipul K.Bansal, Prentice Hall of India, New Delhi, 1996.

Java and Scripting Languages Lab

Purpose and Scope:

The objective of this course is to provide an insight into Object Oriented Programming Concepts and Java Programming. This course also introduces a scripting language PERL and the scope of the course is to:

- Discuss the Object-Oriented Programming concepts
- Introduction to Java as OOP language.
- Explain the inheritance and overriding concepts.
- Explore the standard packages and interfaces provided by JAVA
- How is exception handling done in Java?
- What is multithreading and how is it achieved using java.
- Discuss the database programming through java.
- Explore the graphical user interface using AWT & Swings.
- Discuss the applets and servlets.
- Explore the PERL concepts
- Introducing PERL regular expressions

Pre-requisites : Knowledge of any programming language

Contents:

Module-A: Object-Oriented Programming and Java

Object-Oriented Programming concepts-Abstraction, Encapsulation, Polymorphism, Inheritance; Introduction to Java Programming Language-Byte-code, Features of JAVA; Java Language Basics, Packages and Interfaces.

Module-B: Database Management

Exception handling; Database Management through JDBC, Connecting to a database for creation or manipulation; Multithreading Programming.

Module-C: Graphical User Interface

Graphical User Interface(GUI) through AWT and Swings, Applets, Input/Output Streams, save or retrieve data to or from a permanent storage area;

Module-D: Applets and Servlets Programming

Applet fundamentals and Architecture, I/O Basics, Native Methods, Life Cycle of Servelets, Servelet API, Java Servelet Packages, Handling http requests and responses, Cookies and Session tracking.

Module-E: Perl

Perl (Practical Extraction and Report Language) : Variables – scalars – Perl regular expressions – perl unicode - Perl functions – built-in data types – lists – arrays – associative arrays – conditionals – control structures - if then else – iterators – while/ do loops – for loops - for each loops – subroutines – file test operators – file management – files and formats – exit.

References

1. Java 2: the complete reference By Naughton, Patrick; Schildt, Herbert

2. Java How to program By Deitel, H.M.; Deitel, P.J.

3. Learning Perl, Schwartz, Randal L.; Christiansen, Tom, O'Reilly/Shroff Publishers, 1999.

Systems Security

Purpose and Scope :

The objective of Systems Security course is to systematically introduce the theories, principles and techniques of information systems security. The course covers concepts such as fundamentals of computer security, security mechanisms, operating system security, network security, data base security, security vulnerabilities and secure design principles. After completion of the course, students should be able to explain the basic components of information systems security and the risks faced by computer systems, identify and analyze security problems in information systems, explain how security mechanisms in computer systems work, use cryptography algorithms and protocols to achieve computer system security, design security mechanisms to protect information systems, and implement key security mechanisms like Access Control, Sandbox, SetUID, Encrypted file systems.

Prerequisite: Networks, Operating Systems

Contents :

Module-A : Security Models and Assessment, Security Evaluation, Vulnerability Analysis

Need for security awareness, Definitions, Data Versus Information, Identification and Authentication Essentials, Access Control and Access Control Structures, Security Policies, Security Models and Confidentiality, Organization Security Architecture, Security Audit, Network Audit, Security Policy, Risk Mitigation, Incident Handling, Legal Support, Computer Forensics, Risk Analysis, Vulnerability Analysis, Security Audits and Risk Management, Security Assurance and Evaluation Criteria.

Module-B : Physical Security

Traditional Security, Access Control Systems using Swipe Cards, RFID, Biometrics

Module-C : Operating System and Application Security

PGP, Security Protocols such as IPSec, PKI, Digital Signatures, Web Server Security, Access Control of objects, Authentication, Processes, Files, Users, Buffer Overflow Attacks, Kernel Flaws, Logging, Backups

Module-D : Network Security

TCP/IP Security, Internet Security Procedures, PPP, ECP. TLS EAP, DESE-bis, Firewall, IP Sec Architecture and Protocols, Dial in Operations, RAS PAP, CHAP, RADIUS, DIAMETER, Key distribution, IKE, Certification and Management, Intrusion Detection Systems, VLANs and VPNs, Email security, Network Attacks and DNS protection, DMZ setup, Proxy services etc. Encryption techniques :Cryptography Techniques, RSA, DES, 3DES

Module-E : Databases and Distributed Systems Security

Relational Databases, Statistical Database Security, Multi-level Secure Databases, Concurrency Control and Multi-Level Security, Authentication, Secure APIs, CORBA Security.

LAB Exercises

Configuring safe http and ftp servers, password and user management, hardening of servers (port and service blocking), using pgp and digital signatures, setting up of tripwire like warning mechanisms. Field Trips to Service Installations (Depending on availability and permissions).

References :

1. Hacking Exposed - Linux (Hatch and Lee, Tata McGraw Hill)
2. Practical UNIX and Internet Security - Garfinkel and Spafford, Oreilly
3. Computer Security - Matt Bishop, Pearson Publications, 2003.
4. Internet Security Protocols- Uyless Black, Pearson Publications,2000.
5. Computer Security - Dieter Gollmann, John Wiley and Sons, 1999.
6. Information Security Handbook- Caelli.J, Longley D. and Shain M., MacMillan 1991.
7. Hacking Exposed : Network Security Secrets and Solutions - Macclure S., Scambray J. and Kurtz G., McGraw-Hill, 1999.
8. Security of Computer Networks- Davice and Price, Wiely 1989.
9. Foundations of Security Analysis and Design : Tutorial Lectures - Riccardo Focardi and Roberto Gorrieri, Springer LNCS Series,2001.
10. Information Security Policies, Procedures and Standards – Guidelines for Effective Information Security Management, Thomas R Peltier, Auerbach Publications,2002.
11. Network Security, A PRIVATE Communication in a PUBLIC World – Charlie Kaufman, Radia Perlman et.al, Pentice Hall Series in Computer Networking and Distributed Systems, 1995.
12. Security in Distributed Computing- Glen Bruce and Rob Dempsey, A Pentice Hall Title,1997.
13. Computer and Intrusion Forensics- George Mohay, Alison Anderson et.al., Artech House Publications , 2003.
14. Security in Computing - Charles P.Pfleeger,Shari Lawrence Pfleeger, Pearson Education, 2003.
15. RFCs and other reading material as announced in class from time to time.
16. Latest research papers relevant to the topics.

Software Engineering

Purpose and Scope:

The course covers different software development life cycle stages and activities including cost estimation models and software metrics. The emphasis of the course is on development of object-oriented systems. It deals with different modeling and design approaches using UML and tools such as Rational Suite.

Different software testing approaches along with software quality and software reliability issues are also dealt in detail. Allied areas such as software re-engineering, reverse engineering, component-based software engineering, client-server software engineering, Web and Mobile Software engineering are also covered.

Prerequisite : System concepts and Object-Oriented Programming

Contents

Module-A : Software Development Models & Metrics:

A critical view on Software Life Cycle models: waterfall, rapid prototyping, incremental, and spiral models, Object-oriented system development approach, Reusability, portability and interoperability, software planning and cost estimation: metrics, COCOMO, Software standards.

Module-B : Object-Oriented System Modeling

Requirements engineering, object-oriented requirements, requirement specification document, informal and formal specification, object-oriented analysis and modeling using UML, object modeling, dynamic modeling and functional modeling

Module-C : Object-Oriented Design Approaches

Object-oriented design using UML, action-oriented design, data-oriented and object-oriented design techniques, architectural design, formal techniques, real-time design techniques, design patterns.

Module-D : Software Testing and Configuration Management

Implementation and testing: module reuse, object-oriented testing, test case design for OO software, black-box module testing, glass-box module testing, code walkthroughs and inspections, Maintenance of object-oriented software, software configuration management.

Module-E : Advanced Software Engineering Concepts

Software re-engineering, reverse engineering, component-based software engineering, client-server software engineering, Web and Mobile engineering: framework and design for Web and Mobile based application, software quality, software reliability.

References :

1. Classical and Object-Oriented Software Engineering with UML and Java, Stephen R. Schach, McGrawHill.

2. Object-Oriented Software Engineering, Ivar Jacobson, Addison-wesley
3. Object-Oriented Software Engineering, George Wilkie, Addison Wesley
4. Software Engineering principles and practice, Hans Van Vliet, Wiley.
5. Software Engineering, R S Pressman.
6. Metrics and models in software quality engineering, Stephen H Kan, Pearson

Electronic Commerce and Payment Systems

2. Purpose and Scope

This course aims to expose students to current trends in electronic commerce and payment systems. It will cover a broad range of issues from B2C, B2B, and C2C electronic commerce and would introduce them to modern electronic payment systems currently in practice. It will equip students with appropriate skills to implement electronic needs for business concerns.

This course deals with the convergence of computer and communications technologies for business needs. While the way business is conducted undergoes radical change with the introduction of internet networking technologies, the basic rules for businesses haven't changed. Businesses still have to deliver quality products within budget and on time.

Born in 1990s with the Internet, the EC encompasses inter- and intra organizational segments. EC is the totality of transformations in the organizational processes and inter-organisational collaborations and exchange. Implementing EC makes organizations flexible to adapt or respond to changing needs of consumers. This course will expose students to the various mechanisms that enable EC – the technical, economic and managerial aspects.

The technology that makes possible electronic commerce - the creation of static and dynamic web pages, the underlying internetworking infrastructure and protocols that enable computer-to-computer communication would be discussed.

Modern electronic payment systems, electronic money, electronic funds transfer and modernization of banking operations such as real time gross settlement facilitate EC. Moreover, EC raises many legal and public policy issues – how to contract electronically, freedom of speech and censorship, taxation for the transient transactions, cultural sensitivity on the global web, regulation, etc.

At the end of this course, the students would be conversant in

- Electronic Commerce
- Electronic Payment Systems
- Technologies to implement EC
- Electronic Trading

Contents

Module A : Introduction to Electronic Commerce

Introduction to Electronic Commerce, Business Models, Market Research and E-Commerce, Advertising in E-Commerce, Legal and Public Policy Issues relating to E-Commerce

Module B: Technologies for Electronic Commerce

Creating Web pages, Java Servlets and JSP, XML, DTD, FSML, IFX, OFX, XBRL, Schemas, J2EE, Web Services –WSDL, SOAP

Module C: Payment Systems

Introduction to Payment Systems, Payments through the Internet – privacy issues – Card Based, net based payment systems, SET Protocol MICR, ECS, EFT, Global Payment Scenario – Inter bank / Intra bank, RTGS, History of Money / Electronic Money / Electronic Cheques, Micro payments

Module D: Mobile Commerce

Introduction to mobile commerce, Mobile payment systems, Mobile banking, Mobile micro payments and mobile macro payments

Module E: Electronic Trading

Auctions, Agents in E-Commerce, E-Trading, B2B, B2C

References

1. Efraim Turban, Jae Lee, David King, H. Michael Chang, Electronic Commerce A Managerial Perspective, Pearson Education, New Delhi, 2001.

2. Bhasker, Bharat, Electronic Commerce, Tata McGraw-Hill, New Delhi, 2003.

3. Comer, Douglas E., Internetworking with TCP/IP, Principles, Protocols and Architectures, Pearson Education, 2000

4. Martin et al., Professional XML, Wrox Publishers, 2000.

5. Mogha and Preetham, Java Web Services Programming, Wiley, 2003.

6. Sadeh, Norman, M-commerce: technologies, services, and business models, John Wiley & Sons, 2002

7. W3C resources on XML Schema, WSDL, SOAP.
8. Mohany, D., Piece M., Tiwari, H., “Electronic Payment Systems for E-Commerce”

Soft Computing in Finance

Purpose and Scope:

Soft Computing (SC) methodologies handle imprecision, uncertainty, complexity and partial truth of information arising in real life systems, which include Fuzzy logic (FL), Neural Networks (NN), and Evolutionary Computation (EC) as core methodologies and chaos computing, fractal theory, wavelet transformation, cellular automaton, percolation models, and immune network theory as synergistic and complementary methodologies. SC methods have proved to be very useful for machine intelligence, automation and technology based Applications demanding high Computational Intelligence.

This course covers fundamentals of some important methodologies of Soft Computing and focuses on their application to Economics, Finance and Banking Management Problems such as Risk Management, Portfolio and Investments, Asset Liability Management, financial time series, Decision Making Problems of Risk Management, Credit Rating, Classification and Clustering. The course deals with Matlab and its relevant toolboxes such as Optimization toolbox, fuzzy logic toolbox, neural network toolbox and control system toolbox along with relevant problems and case studies.

Contents :

Module-A: Basics of Fuzzy Logic :

Evolution and Methods of Uncertainty modeling, Introduction to Matlab Toolboxes - Optimization toolbox and fuzzy logic toolbox. Fundamentals of Logic and Fuzzy Logic, computing with words, Fuzzy Set Operations, Fuzzy membership functions of Linear and Non-linear type, Fuzzy relations and measures, fuzzy constraint based reasoning; fuzzy decision operations, fuzzy preference relations, fuzzy inference mechanism,

Module-B: Fuzzy Logic applications:

Fuzzy Optimization of LPP, NLPP, Goal programming and MCDM, fuzzy rule base design and analysis, fuzzy control system, Fuzzy segmentation and clustering, Fuzzy feature selection, fuzzy regression, fuzzy games, fuzzy negotiation, Fuzzy expert systems, Rule based and Model based Fuzzy logic applications in Risk, Portfolio, ALM, Decision Making, use of Fuzzy logic and Control system Toolbox.

Module-C: Neural Networks :

Supervised and Unsupervised learning, Single and Multi Layer Perceptrons, Back propagation algorithm for MLP, Radial Basis Function neural networks, General regression neural networks, Probabilistic neural networks, Kohonen's Self-organizing Feature Map, ART theory and networks, Application of these NN architectures to various financial problems, use of Neural Network toolbox.

Module-D: Genetic Algorithms :

Basics of GA, Simulated Annealing, Threshold Accepting and Differential Evolution and their applications in finance.

Module-E: Soft Computing and Applications:

Essentials of Soft Computing, Architectures of Neuro-Fuzzy, Neuro-GA and Fuzzy-GA systems, Evolving Connectionist Systems and their applications, Formulation and solution of various Economic, Financial and Banking Problems in soft computing paradigm.

References:

1. Fuzzy Logic for Business, Finance and Management, George Bojadziev and Matria Bojadziev, World Scientific, London, 1999.
2. Soft Computing in Financial Engineering, R.A.Riberio, H.J.Zimmermann, R.R.Yager and J.Kacprzyk, Springer Verlag, 1999.
3. Fuzzy Sets and Fuzzy Logic : Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall of India, New Delhi, 1997.
4. Neural Networks in Computer Intelligence, LiMin Fu, McGraw Hill, New Delhi, 1994.
5. Neural Networks in Business : Techniques and Applications, Kate Smith and Jitender Gupta, Idea Group Publ., 2002.
6. Advanced financial analysis: financial statistics, probabilistic models and fuzzy engineering, Chorafas, Dimitris N.,, Euromoney Pub.,, 200.
7. Neural Networks and Fuzzy Systems, Bart Kosko, Prentice Hall, New Jersey,
8. Nuural Networks in Business Forecasting, G. Peta Zhang, Idea Group Publ.,2003.
9. Neural Networks for Modelling and Control of Dynamic Systems, M.Nargaard, O.Ravn, N.K.Poulsen and L.K.Hansen, Springer, 1999.
10. Neural network and fuzzy logic applications in C/C++, Welstead, Stephen T., John Wiley and Sons, New Delhi, 1994.
11. Fundamentals of artificial neural networks, Hassoun, Mohamad H.,, Prentice Hall of India, New Delhi, 1998.
12. Applications in finance, investments, and banking, Ho, Diem; Schneeweis, Thomas, Kluwer Academic Publishers, 1998.
13. Neural networks in finance and investing: using artificial intelligence to improve real-world performance, Trippi, Robert R.; Turban, Efraim , Irwin Professional Pub. 1996.
14. Genetic algorithms and fuzzy logic systems: soft computing perspectives, Sanchez, Elie; Shibata, Takanori, World Scientific, 1997.
15. Evolving Connectionist Systems: Theory and applications; N. K. Kasabov, Springer Verlag, 2002.

Data Warehousing and Data Mining

Course Objectives and Scope

The main objective of the course is to provide students a good overview of the ideas and the techniques, which are behind recent developments in the fields of data warehousing and Online Analytical Processing (OLAP), in terms of data models and conceptual design methodologies, and project implementation strategies.

The data mining part aims to define and characterize data mining applications, and present data mining techniques and tools. Both data warehousing and data mining are advanced recent developments in database technology, which aim to address the problem of extracting information from the overwhelmingly large amounts of data which modern societies are capable of amassing.

Data warehousing focuses on supporting the analysis of data in a multidimensional way and Data mining focuses on inducing compressed representations of data in the form of descriptive and predictive models.

Prerequisites: Good knowledge in Database Management Systems

Contents:

Module-A: Data Warehouse Basics

Data Warehouse (DW) Introduction & Overview; Data Marts, DW components; Data warehouse architecture; ETL - Data Transformation – Extracting, Conditioning, cleansing, Scrubbing, Merging, etc.,

Module-B: OLAP

Multi-dimensional modeling - Fact table, dimensions, measures, examples; Schema Design – Star and Snowflake; OLAP - OLAP Vs OLTP, ROLAP, MOLAP, HOLAP; tools

Module-C : Materialized views

View selection algorithms – Greedy, MVPP

Module-D: Data Mining

Introduction to Data Mining (DM), DM concepts, DM Process; CRISP-DM Methodology, Preprocessing techniques – Feature Selection and Transformation; Association Rules – Algorithms, Applications, Analytical CRM, Clustering, Hierarchical and Partition clustering – Techniques and applications; Classification – Decision Trees, k-NN, Neural Networks, etc.

Module-E: Advanced Mining Techniques

Text Mining, Web Mining, Visualization, etc .

References :

1. Data warehouse lifecycle toolkit: expert methods for designing, developing, and deploying data warehouses - Kimball, Ralph; Reeves, Laura et al, John Wiley & Sons, 1998

2. Understanding and Implementing Successful Data Marts – Douglas Hackney, Addison-Wesley Developers Press, 1997

3. Data Mining Techniques – A. K. Pujari, University Press, 2001

4. Data mining: concepts and techniques - Han, Jiawei; Kamber, Micheline, Morgan Kaufmann Publishers, 2001.

5. S. Chaudhuri and U. Dayal, An overview of data Warehouse and OLAP Technology, ACM SIGMOD Record, March 1997.

6. L. Bellatreche, K. Karlapalem and M. Mohania, Some Issues in Design of Data Warehousing Systems, Chapter VI, In book *Developing Quality Complex Database Systems: Practices, Techniques and Technologies* – Shirley A. Becker, IDEA GROUP PUBLISHING, 2001.

7. A.K. Jain, M. N. Murthy and P. J. Flynn , Data Clustering: A Review, IDRBT Digital Library.

8. U. M. Fayyad, G. Piatetsky-Shapiro, P. Smyth and R. Uthurusamy, Advances in Knowledge Discovery and Data Mining, AAAI/MIT Press, 1996.

Middleware Technologies

Purpose and Scope:

This course deals with middleware technologies that are essential for developing distributed enterprise applications. Middleware technologies abstract away the underlying network and operating systems and give developers a common platform to develop distributed applications. RPC, COM, RMI, CORBA etc are some such platforms.

This course takes the students through various middleware technologies that spread from basics of TCP/IP to the most recent web services; and from grid computing to the future smart cards with proper lab exercises, assignments and case studies.

Prerequisites: Networks

Contents :

Module A : Message – Oriented Middleware, Transaction Middleware, Peer-to-Peer Middleware

Introduction, Message Queues, Messaging Models, Common MOM Services, Java Message Service, Service-Oriented Architectures, Summary; Introduction, Transaction Processing Fundamentals, Distributed Object Transactions, Messaging Transactions, Web Transactions, Advanced Transactions, Conclusion; Introduction, JXTA, P2P Messaging System, Conclusion

Module B : Principles of Mobile Computing Middleware, Applications of Middleware Technologies to Mobile Enterprise Information Services

Introduction, Mobile Distributed Systems, Middleware Systems: A Reference Model, Fault Tolerance, Heterogeneity, Openness, Scalability, Resource-Sharing, Conclusions; Introduction, Wireless Technologies, Middleware Technologies for Enterprise Application Integrations, An Integrated Architecture for Mobile Enterprise Information Services, J2EE-Based Middleware in Mobile EIS, Data Representation and Presentation in Mobile Enterprise Information Services, Challenges and Future Directions, Summary and Conclusions

Module C : Middleware for Smart Cards, Application-Oriented Middleware for E-Commerce

Introduction, ISO 7816, Data Structures on Smart Cards, Java Cards, PC/SC : Data Communications, Open Card Framework, Java Card RMI, PKCS #11 Security Tokens, Smart Cards as Distributed Objects, Smart Card Middleware for Mobile Environments, Jini Card, Smart Cards on the Internet, Conclusion; Introduction, Previous Work on Networked Smart Card Applications, A Public Transport Ticketing System for e-Commerce, Advanced Ticketing Management Using Middleware, The Application Prototype, Summary and Conclusions

Module D : Grid Middleware

The Grid, Grid Architecture, Grid Middleware Software, Grid Middleware Challenges, Grid Middleware Standardization, Grid Middleware Services, Grid Middleware Toolkits, Portal Middleware for Grids, Applications Using and Enhancing Grid Middleware, Concluding Remarks

Module E : Concepts and Capabilities of Middleware Security, Middleware for Scalable Data Dissemination

Introduction, Security in CORBA, .NET, and J2EE, RBAC and MAC using CORBA and JINI, Conclusion; Introduction, Architecture Overview, Background and Historical Notes, Middleware Components, Building Block Integration, Conclusions.

References

1. Middleware for Communications, Qusay H. Mahmood, John Wiley & Sons, New Jersey, 2004.

2. Distributed Systems, Andrew S.Tannenbaum and Maarten Van Steen, Pearson Ed., Indian Ed., Delhi, 2002.

Network programming and Web Services Lab

Purpose and Scope:

To provide the basics of networking and security from a practical perspective that complements the ` laid in the first semester.

Contents :

Module A: Network Programming:

Server and client programming using sockets. Using ndis3nt kind of software to intercept the data passing through network stack.

Module B: Network Infrastructure:

Hardware: configuration of network devices like switches and routers – system utilities and commands-routing protocols like RIP, OSPF etc. – configuring routing – commands used - types of NAT – ACLs - types of ACLs essentials of a LAN and setting up a LAN.

Software: DNS Forward lookup zone – Reverse Lookup zone – Records – Primary DNS – Secondary DNS – Primary zone – Secondary zone – DHCP – need for DHCP –

Security: firewalls – configuring PIX and ISA; IDS – configuring an IDS

Network Management:– SNMP – Unicentre TNG

Module C: Network Simulation software NS2 and Brite etc

Module D: WLANs – Setting up wireless LANs, Grid Computing – Configuring and setting up grids using s/w like Globus, Sensor Networks and MANET simulations

Module E : XML Technologies – DOM and SAX parsers, XSD, XSL and XML; **Web services –** setting up web services on .Net and open source platforms like Apache-Axis, querying a web service and invoking a web service; **UDDI –** setting up UDDI, publishing services, deleting services etc

References:

1. "Designing TCP/IP internetworks", Geoff Bennett; *Galgotia* publishers, 1998.
2. "Internetworking with TCP/IP. Volume 1. Principles, protocols and architecture" (4th edition), Douglas E. Comer; *Pearson Education Asia* publishers, 2000.
3. "TCP/IP and related protocols", Uyless Black; *McGraw Hill* publishers, 1995.
4. "DHCP: a guide to dynamic TCP/IP network configuration", Berry Kercheval; *Prentice Hall-PTR* publishers, 1999.
5. "Windows 2000 DNS Server", William Wong; *Tata McGraw Hill* publishers, 2000
6. "IP routing primer", Robert Wright; *Techmedia* publishers, 1999.
7. "Firewalls: a complete guide", Marcus Goncalves; *Tata McGraw Hill* publishers, 2000.
8. "Inside network perimeter security: the definitive guide to firewalls, VPNs, routers, and intrusion detection systems", Stephen Northcutt et al.; *Pearson education Asia* publishers, 2003.

APPENDIX-I: M.Tech. (Computational Techniques in Physics)

M.Tech.(Computational Techniques in Physics)
Course Structure

M.Tech.(CT) is a four semester programme with course work in the first two semesters and project work in the next two semesters. The course work in I and II semesters comprises following courses:

I Semester: (total no. of credits = 24)

Core Courses	Credits	Discipline
Mathematical Techniques – I	4	Phy
Mathematical Techniques – II	4	Phy
Numerical Techniques	4	Phy
Computing Laboratory	4	Phy
Computer Organisation (including lab. Equivalent of 1 credit)	4	CS
Programming Methodology	4	CS

II Semester: (total no. of credits = 24)

Core Courses	Credits	Discipline
Data and File Structures	4	CS
Algorithmics	4	CS

Elective Courses (Three from Group-1 and One from Group-2)

Group-1(Phy; each carrying 4 credits)	Group-2 (CS; each carrying 4 credits)
Quantum Computing	Image Processing
Wavelet Transforms	Speech Recognition
Evolutionary Computing	Pattern Recognition
Dynamical Systems and Chaos	Computer Graphics
Monte Carlo Techniques and Molecular Dynamics	Machine Learning
Bioinformatics	Parallel Computing
Cryptography (Classical and Quantum)	Cryptography
Direct Discrete Methods	Grid Computing
Introduction to Disorder	Colour Image Processing
	Computer Networks

III and IV Semesters: (total no. of credits = 24+24=48)

Project work

Grand total of credits in 4 semesters = 96

M.Tech.(Computational Techniques in Physics)

List of proposed changes in the course-structure of the programme:
The changes pertaining to the courses in physics and computer science have been discussed and approved respectively in the faculty meetings of School of Physics and Department of Computer and Information Sciences.

Changes in physics courses:

(1) A new 4 credit core course entitled, Mathematical Techniques-II, has been introduced in the first semester.
(2) The course, earlier known as Advanced Mathematical Techniques has been renamed as Mathematical Techniques-I. This will run concurrently with Mathematical Techniques-II in the first semester.
(3) Monte Carlo Techniques and Molecular Dynamics, which was a core course in the second semester, has been made an elective course in the Group-1.
(4) The elective course called Cellular Automata from Group-1 has been dropped.
(5) The first semester core course, Advanced Scientific Computing [Lab course] has been renamed as Computing Laboratory.

Changes in computer science courses:

(1) The Group-2 elective course, File Structures, has been removed and merged with the first semester core course, Data Structures. The new course Data and File Structures, will now be a 4 credit core course in the second semester.
(2) Algorithmics (renamed Design and Analysis of Algorithms) has been reintroduced as a 3 credit core course in the second semester.
(3) Four courses have been added to the list of Group-2 elective courses. These are: Grid computing, Cryptography, Computer Networks and Colour Image Processing; each will carry a minimum of 3 credits.

Dr Vipin Srivastava
and

Dr S Bapi Raju

M.Tech.(CT) Course Coordinators

APPENDIX-II: M.Tech. (Bioinformatics)

No.	Title	Code	Brief Outline	Credits	Comments
1.	Computational Techniques	BI501	Basically to bring all the new students to a common level	Nil (Sem.I)	Note 1
2.	Intermediate Proteonics and Genomics	BI502	Introduction to computers	3 (Sem.I)	Common
3.	Basic Statistics	BI503	Mostly genomics that have not been covered at the M.Sc. level: Introduc-tory proteomics (mostly structure)	3 (Sem.I)	Common
4.	Basic Mathematics	BI504	Basic ideas that are essential for a clear understanding of various algorithms and some techniques	3 (Sem.I)	Common
5.	Introduction to Molecular modeling	BI505	Introductory in nature: familiarity with a couple of widely used tools	2 (Sem.I)	Common
6.	Analytical Proteomics and Genomics	BI506	Mostly about enzymes, receptors and their function and studies: some aspects of genomics	3 (Sem.II)	Common
7.	Databases	BI507	Introductory level concepts essential for Bioinformatics research	3 (Sem.II)	Common
8.	Bioinformatics	BI508	Mostly on sequence alignment and algorithms	3 (Sem.II)	Common
9.	Introduction to molecular mechanics	BI609	Detail study on one free molecular mechanics package (theory and use)	2 (Sem.II)	Common
10.	OPTIONAL	xxxxx	Free to choose course from other schools	2 (Sem.II)	Optional
11.	Drug design	BI510	Basic concepts involved in drug design	2 (Sem.III)	Note 2
12.	Advanced Bioinformatics	BI511	A mixed bag of tools and tricks	2 (Sem.III)	Note 2
13.	OPTIONAL	xxxxx	Free to choose an advanced level course from other schools (must be somehow related to the project)	2 (Sem.III)	Optional

Note 1: This course will be conducted for students who may not have sufficient experience computers or biology.

Note 2: These two courses will be offered for project related topics.