$16 \times 6 = \underline{\underline{96}}$

M.E. $(\underline{I}. T)$

UNIVERSITY OF MUMBAI

Scheme For

M.E. (Information Technology)

(Revised from Academic Year 2002-2003)

SCHEME FOR M.E. (Information Technology)(R 2002) University of Mumbai

Serial Number	Subject	TEACHING SCHEME			EXAMINATION SCHEME				
		Lecture Per week	Practical / Tutorial Per week	Theory Marks	Internal Assessment Marks	Viva-Voce	Duration of paper Hrs	Total Marks	
Sem – I									
1	Object Oriented Software Engineering	3P	2P	100	50	-	3	150	
2	Advanced Databases	3P	2P	100	50	-	3	150	
3	Principles of Network Architecture and Protocols	3P	2P	100	50	-	3	150	
4	Elective – I : From Group A	3P	2P	100	50	-	3	150	
5	Elective – II : From Group A	3P	2P	100	50	-	3	150	
	Total	15	10	500	250	-	-	750	
Sem – II									
1	Human Computer Interactions	3P	2P	100	50	-	3	150	
2	Distributed Operating System	3P	2P	100	50	-	3	150	
3	Software Architecture	3P	2P	100	50	-	3	150	
4	Elective – III : From Group B	3P	2P	100	50	-	3	150	
5	Elective – IV : From Group B	3P	2P	100	50	-	3	150	
	Total	15	10	500	250	-	-	750	
Sem – III #									
1	Seminar on Special Topics*	-	-	-	50	-	-	50	
2	Dissertation Seminar	-	-	-	50	-	-	50	
	Total	-	-	-	100	-	-	100	
Sem – IV #									
1	Pre-synopsis Dissertation Seminar	-	-	-	50	-	-	50	
2	Dissertation and Viva Voce	-	-	-	100	100	-	200	
	Total	-	-	-	150	100	-	250	
	Grand TOTAL			1000	750	100		1850	

Elective I & II (Any Two) (Group A)
1) Information Retrieval and Data Mining – L
2) Internetworking and Network Design – L
3) Telecommunication Network Performance Analysis
4) Management Information Systems – L
5) Document Design and Advanced Publishing Techniques
6) Analytic Models and Simulation of Systems

Elective III & IV (Any Two) (Group B)
1) Information Security
2) Mobile & Wireless Networking
3) Artificial Intelligence and Knowledge based system
4) Electronic Commerce
5) Image Processing and Applications
6) Web Engineering

Seminar on Special Topics – Each candidate should be assigned the seminar topic right in the beginning of the semester, and the student has to do exhaustive literature survey, case studies etc. which has to be presented at the end of the semester. The student has to be in association with a staff member for conducting the seminar. The student should present the seminar in front of the committee consisting of the faculty members of the department and has to be evaluated by the committee combinedly.
1. During III and IV semesters, the student should work full time for his/her Seminar and dissertation work.
2. Student teacher contact hours for dissertation and seminar during III and IV semesters will be 2 hours/teacher/week

M.E. (INFORMATION TECHNOLOGY)
SEMESTER - I

1.1 Object Oriented Software Engineering

System development as an industrial process -The system life cycle
Review of object-orientation. Object-oriented system development Object-oriented programming
System modelling using OMD concepts. Introduction to UML.
Architecture Analysis using OOSE. System modelling with UML.
Methods of analysis and Construction
Analysis and construction of Real-time specialization and Database specialization
Components – their properties, construction, development and deployment.
Case studies with present day component technologies like COM/ DCOM, Java Beans, EJB
Testing strategies
Applications of OOSE. Issues related to organisation and management of the new development process.
Introduction to project management techniques. Metrics for software project management activities. Use of tools for project management.
Capablity Maturity models and reliability studies.
Quality assurance metrics – Introduction to Six Sigma standards.

1.2 Advance Databases

Concepts of Distributed Database Systems, Distributed DBMS Architecture, Transparency Issues , Architectural Models (including Client/Sever Models)

Distributed Database Design Issues , Fragmentation, Allocation, Integrity Constraints Query Processing : Objectives of Query Processing , Review of Relational Algebra Layers of Query , Processing Query Decomposition and Data Localization Query Optimization Centralized Query Optimization Join Ordering , Distributed Query Optimization Algorithms. Effects of data models: object-oriented and deductive databases.

Distributed Transaction Management and Concurrency Control , Properties and Types of Transactions, Serializability Theory, Concurrency Control Algorithms

Distributed DBMS Reliability and Replication Techniques, Multidatabase Systems Problems in Heterogeneous Multidatabase Systems , Database Integration Strategies , Multidatabase System Architectures. Basic data management for emerging areas: internet applications, OLAP, data mining.

M.T. Ozsu, P. Valduriez (eds.): *Principles of Distributed Database Systems* (2nd Edition), Prentice Hall, 1999

M.E. (INFORMATION TECHNOLOGY)
SEMESTER - I

1.3 Principles of Network architecture and Protocols.

Communications fundamentals, transmission media, networking technologies (LAN, WAN and MANs)

Network protocols – case study of TCP/IP. application level protocols like HTTP, SMTP, POP3, FTP etc. Socket programming.

Design and development of computer communication networks

Distributed and failsafe routing in large and dynamic networks

Gateways and interconnection of heterogeneous networks

Flow control and congestion avoidance techniques

Network architectures, communication protocol standards

formal specification and verification of protocols, implementation and conformance testing of protocol standards

Architecture and features of Network Operating Systems

Issues in design and development of Multi user network applications with special reference to network load balancing and utilisation

Network security and web computing

Performance evaluation metrics for networks

Internet economics and policy-making.

Introduction to Wireless Networking

References :

Douglas Comer, Internetworking with TCP/IP Vol. I: Principles, Protocols, and Architecture, Prentice Hall, 2000.

Andrew Tanenbaum, Computer Networks, Prentice Hall, 1996

Bruce Davie, Larry Peterson and David Clark, Computer Networks: A Systems Approach, Morgan Kaufmann Publishers, 1999.

James McCabe, Practical Computer Network Analysis and Design, Morgan Kaufman, 1998

Srinivasan Keshav, An Engineering Approach to Computer Networking, Addison-Wesley Pub Co, 1997

Radia Perlman, Interconnections: Bridges, Routers, Switches, and Internetworking Protocols, Addison-Wesley Pub Co, 1999

Benny Bing, Wireless Local Area Networks: The New Wireless Revolution, John Wiley & Sons, 2002

M.E. (INFORMATION TECHNOLOGY)
SEMESTER - I
1.4 Elective I & 1.5 Elective II

Group A:

A-1 Information Retrieval and Data Mining

Data Mining and Data Warehousing
On-Line Analytic Processing (OLAP) - its architecture and use. Java implementations
Classification trees and Exploratory Data Analysis (EDA) .
EDA vs. Hypothesis Testing
Computational EDA Techniques
Basic statistical exploratory methods like distribution, correlation matrices, multiway frequency tables
Multivariate exploration techniques like Cluster Analysis, Factor Analysis, Discriminant Function Analysis, Multidimensional Scaling, Log-linear Analysis, Canonical Correlation, Stepwise Linear and Nonlinear, Regression, Correspondence Analysis, Time Series Analysis, and Classification Trees.
Graphical (data visualization) EDA techniques for function fitting, data smoothing, layering, tessealations, contour projections
Verification of results of EDA
Neural Networks for prediction.
Fundamentals of Genetic Algorithms for pattern seaching.
Applications and trends in data mining

References

Adriaans, Pieter & Dolf Zantinge . Data Mining. Addison-Wesley
Edelstein, Herbert A. Introduction to Data Mining and Knowledge Discovery
Bigus, Joseph P. Data Mining with Neural networks: Solving Business Problems - from application development to decision support. McGraw Hill.
Goldberg, David E. Genetic Algorithms in Search, Optimization, and Machine Learning. Addison Wesley.
Sholom M. Weiss. Predictive Data Mining. Morgan Kaufmann Publishers
Inmon, William . Building the Data Warehouse, Second Edition. John Wiley & Sons, Inc.
Thomsen, Eric (1997). Olap Solutions : Building Multidimensional Information Systems.John Wiley Sons,
Michael Berry & Gordon Linoff, Mastering Data Mining, John Wiley & Sons, 2000.
Jiawei Han, Micheline Kamber, Data Mining : Concepts and Techniques, Morgan Kaufmann, August 2000
David J. Hand, Heikki Mannila and Padhraic Smyth, Principles of Data Mining , MIT Press, Fall 2000

A-2   Internetworking and Network Design

Study of protocols
Internetworking principles. Heterogeneous networks
Issues in load analysis and traffic analysis
Network partitioning
Design issues for corporate / campus-wide network
WAN-WAN Design strategies
Issues for intranet based solutions, VOIP
High speed network design using FDDI,
broadband technologies - BISDN (Broadband Integrated Services Digital Network).
Asynchronous Transfer Mode, SONET, fast packet switching, high-speed network control, and traffic control
Network evaluation and maintenance

M.E. (INFORMATION TECHNOLOGY)
SEMESTER - I

A-3 Telecommunication Network Performance Analysis

Overview of probability and stochastic processes used for the analysis of computer networks.

Introduction to computer networks and network architectures, LAN, MAN, WANs
Delay models in data networks: Queuing models, Little's theorem, M/M/1 queue
M/M/m, M/M/_, M/M/m/m and other Markov systems
M/G/1 queues, priority queuing
Networks of transmission lines. Networks of queues - Jackson's theorem
Multiaccess communication: Satellite channels, multidrop lines, packet radio networks
Aloha systems: slotted and un-slotted. Splitting algorithms. Carrier sensing
Selecting alternate network topologies to meet performance and cost goals.
Call Processing in Digital Circuit-switching Systems.
Local area networks: CSMA/CD and Ethernet, high speed LANs, wireless LANs
Cellular and AdHoc Networks

References :

Wah Chun Chan, "Performance Analysis of Telecommunications and Local Area Networks", Kluwer, 2000
Wide Area Data Network, Performance Engineering, R.G. Cole, R. Ramaswamy, Artech House, 2000.
Wide Area Network, Performance and Optimization, R.loyd-Evans, Addison Wesley, 1996.
Performance Evaluation of Communication Networks, G.N. Higginbottom, Artech House
Practical Planning for Network Growth - John Blommers, PH
Joseph Hammond, Performance Analysis of Local Computer Networks, Addison Wesley, 1986.
Jeremiah Hayes, Modeling and Analysis of Computer Communications Networks, Plenum Pub Corp,
James McCabe, Practical Computer Network Analysis and Design, Morgan Kaufman
Mischa Schwartz, Telecommunication Networks: Protocols, Modeling, and Analysis, Addison-Wesley Pub Co, 1986
Thomas Robertazzi, Computer Networks and Systems: Queuing Theory and Performance Evaluation, Springer Verlag, 2000.

Introduction to Information Systems and Their Capabilities
Fundamental Concepts of Information Systems
Information Technology- Information Systems Hardware, Information Systems Software,
Database Management, Telecommunications, the Internet, and Information System
Architecture
Business Information Systems: Support of Individual and Group Knowledge Work
Transaction Processing and Management Reporting Systems.
Decision Support and Executive Information Systems.
Expert Systems and Applied Artificial Intelligence for decision support functions
Business Reengineering, Information Systems Planning and Acquisition
Managing and Controlling Information Systems
Development Life Cycle and Systems Analysis. Performance analysis of MIS.
Ethical, Societal, and Global Issues in Information Systems
Information Systems for Enterprise wide systems with global reach.

K.C. Laudon. and J.P. Laudon. Essentials of Management Information Systems. Prentice
Hall,
K.C. Laudon. and J.P. Laudon. Management Information Systems: Organisations and
Technology, Macmillan,
McNurlin & Sprague , Information Systems Management In Practice 5E, Prentice Hall
V. Zwass. Management Information Systems, McGraw Hill

A-5 Document Design and advanced Publishing techniques

Document Models – introduction to components and editors (OpenDoc, OLE) , structure and style (SGML, etc.), Content and behaviors (Multivalent Documents), hypermedia and multimeda

Structure and Style Approaches : The core technologies for Markup(SGML), Adding style(DSSSL), Adding hypermedia. Technologies for the web- XML, XSL, CSS, XLINK, DOM

Layout Management - Scribe, TeX, LaTeX, Mozilla's NGLayout

Presentation tools like PostScript/Acrobat

Other Hypermedia/Multimedia Models

Active Documents Interfaces

Dynamic content management. Introduction to VRML.

Document Services Annotation (services and client support) Document interchange (ODA, RTF, JEDI) and Document Management (Document management systems, DMA) Digital libraries, document analysis, OCR, repositories, naming conventions

Web publishing, Issues in Content planning, content development, content management Hosting techniques. Hardware considerations for web hosting

A-6 Analytic Models and Simulation of Systems

Performance indices. Evaluation techniques. Measurement: instrumentation, design of experiments, interpretation of results. Simulation modeling: simulator design, model calibration, statistical analysis of output data.

Introduction to analytic modeling.

Workload characterization.

Tuning, procurement, and capacity planning application.

Program performance evaluation.

File and I/O system optimization.

CPU Scheduling and architecture performance analysis.

M.E. (INFORMATION TECHNOLOGY)
SEMESTER II

2.1 Human Computer Interactions

Interaction Design
Interaction Styles and Models
Psychology and the design of interactive systems
Design for Usability
Direct Manipulation and Graphic Interface
UI design issues in Business , commercial, scientific, entertainment applications.
Chioce of interactions and their management.
Issues in design of Forms, Layouts, Navigation, Presentation Dynamics
Interface Devices and Metaphors – handling of various devices like keyboard, pointing,
display, audio, etc and environments like desktop, notecards, rooms, ledger sheets, tables.
Visualization and Cognitive Processing Control Design
Design for Work Structure – interaction styles, dialog models, user centered design, task
analysis.
UI design issues for mobile devices.
Study of typical tools for implementation, testing and quality assessment.
Use of Natural Language and Speech for effective user interaction
Social Interfaces and Agents

HUMAN-COMPUTER INTERACTION , 2 ed, Dix, Finlay, Abowd and Beale

2.2 Distributed Systems

Distributed systems, their motivations, applications, and organization.
Introduction to Distributed system models - Client-Server (Web), Peer to Peer and Web
services, Pervasive (Ubiquitous) computing
Distributed system design characteristics , Fault Tolerance, System fault tolerance
models, Networking fault tolerance model;
Security - Network Security, Distributed System Security, Scalability, Adaptability
Distributed programming - Programming models: Communication models, Distribution
models, Mobile code models; Layered architectures and multi tier systems
Runtime System Support; Performance analysis
Web infrastructure- Performance analysis framework, Design and Implementation of
scalable Web Servers, Analysis of web caches and caching schemes,
Peer to Peer infrastructure- Design of directory services, Search techniques, Scalability,
Fault tolerance and Security

Ubiquitous computing, Operating systems for small devices, Middleware services for
network of sensors, Programming models, Applications ,
Middleware strategies- Middleware models : Communication Middleware , Object-based
Middleware, Component-based Middleware ; Adaptive and Reflective middleware;
Quality of Service; CORBA, COM and J2SE

2.3 Software Architectures

Overview of software engineering principles
Origins of software architectures
Introduction to software architectures
Scope of software architectures
Arriving at an architecture
Domain-specific software architectures (DSSA)
Architectural styles
Examples of domain- and style-specific architectures
Software connectors
Architecture description languages (ADLs)
Dynamism in software architectures
Architecture-based testing and analysis
Role of UML in software architectures
Software interconnection technologies
Middleware - CORBA , COM/DCOM
Middleware - JavaBeans
Intelligent agents and agent based computing
Current issues and future trends

References

Mary Shaw and David Garlan,
Software Architecture: Perspectives on an Emerging Discipline,
Prentice-Hall, 1996.

M.E. (INFORMATION TECHNOLOGY)
SEMESTER II
2.4 Elective III & 2.5 Elective IV

Group B

B-1 Information Security

Introduction to basic terms. Basic goals and concepts. Brief history of cryptography and cryptanalysis. Uses and misuses. Politics. Basic number theory. Divisibility. Primality. Bases, congruences, modular aritmetic. GCDs. Euclidian algorithm. Fermat & Euler theorems. Finding large primes, Pohlig-Hellman, RSA.

Basic Information Theory Entropy. Equivocation. Work factors. Key size vs. message size. Redundancy. Unicity distance. Perfect secrecy.

Elementary & historical ciphers. Caesar cipher. Transposition and substitution. Polyalphabetic ciphers. Product ciphers. DES. IDEA. Exponentiation ciphers. Cipher modes. Block ciphers. Stream ciphers. ECB, OFB, CFB, CBC.

Public vs. private keys. LFSRs. Diffie-Hellman key exchange.

Mental poker. Quadratic residues. Oblivious transfer. Zero-knowledge proofs. Authentication methods

One-way ciphers. Authentication functions. Message digests. MD5, SHA, Kerberos, Privacy-enhanced communication

Privacy, non-repudiation, digital signatures. Certificate hierarchies, X.509. PGP. PKI.

Digital Watermarking. Digital cash. Digital voting. Contract signing.

Key Management Threshold schemes. Random number generation. Key escrow. Key recovery.

Introduction to Bio metrics for security- Signature verification, fingerprint recognition, voice recognition, Iris recognition systems

Textbook:
D. Denning, *Cryptography and Data Security*, Addison-Wesley, 1983

B-2 Mobile & Wireless Networking

Cellular system techniques and capacity, radio wave propagation and coverage, modulation formats and efficiency, RF system design, signal processing and coding techniques, and multiple access techniques.

Cellular telephone systems and the Global Positioning System concepts .

Issues in transmission, with illustrative examples from two existing wireless standards (e.g. GSM and W-CDMA).

Wireless Networking for Local Access. Wireless Local Loop technology.

Use of development systems for design of wireless applications using Bluetooth framework. PDA / mobile handset emulators for common handsets like Nokia, Siemens, Palm-7 etc

M.E. (INFORMATION TECHNOLOGY)
SEMESTER II

B-3   Artificial Intelligence and Knowledge bases systems

Knowledge Representation - Predicate calculus Semantic networks, Case frames, Conceptual dependency

Models of Memory and Inference- Inference rules, forward and backward, Frames, Scripts, Plans and goals

Natural Language and Story Understanding - Single sentence parsing, Expectation-based parsing, Context-guided story understanding: script-based and plan-based

Common sense Planning and Problem Solving - Models of memory for planning, Common sense planning, Goal detection, Metaplanning

Artificial Neural Networks, their architectures and applications. Learning mechanisms with implementations in Artificial Neural Networks for pattern matching applications.

Search strategies used in AI, Simulated Annealing. Data structures suitable for AI.

Propositional satisfiability, constraint satisfaction, planning and scheduling, diagnosis and repair.

Introduction to Genetic Programming and Genetic Algorithms. Introduction to Natural Language Processing and Vision systems

Basics of Knowledge Based Systems and Evolutionary Systems

Knowledge engineering, KB programming, knowledge acquisition methodology.

Textbooks:
S.J. Alvarado, *Understanding Editorial Text: A Computer Model of Argument Comprehension,* Kluwer Academic Publishers, 1990.
M.G. Dyer, *In-Depth Understanding: A Computer Model of Integrated Processing for Narrative Comprehension,* MIT Press, 1983.
R.C. Schank, *Dynamic Memory: A Theory of Reminding and Learning in Computers and People,* Cambridge University Press, 1982.
S. Slade, *The T Programming Language: A Dialect of LISP,* Prentice-Hall, 1987

B-4   Electronic Commerce

1. Introduction to Electronic Commerce – its impact, social cause and the business models. Classification of E-commerce application solutions

2. Infrastructure for Electronic Commerce – small scale, mid size, large size and enterprise wide applications development and deployment.

3 Web-Based Tools for Electronic Commerce

4 Electronic Commerce Software components

5 Security Threats to Electronic Commerce – firewalls, encryption, digital signatures, certificate authorities

6 Implementing Security for Electronic Commerce

7 Electronic Payment Systems – credit card authorisations, cyber cash, digital wallets, Electronic Checks and Microtransactions. SmartCards . Protocols and Standards

8 Strategies for Marketing, Sales, and Promotion, Identifying customer behaviour

9 Personalisation of web sites – profiling, , business intelligence gathering, recommendation systems

10. Strategies for Purchasing, Logistics, and Support Activities: From Electronic Data Interchange to Electronic Commerce. ECRM .

11 Strategies for Web Auctions, Virtual Communities, and Web Portals

12 The Environment of Electronic Commerce: Public policy issues, International, Legal, Ethics, and Tax Issues.

13 Planning for Electronic Business: Resource and Implementation Issues

References :
Electronic Commerce - Schneider, Perry, Thompson - 2000

M.E. (INFORMATION TECHNOLOGY)
SEMESTER II

B-5   Image Processing and Applications

Two-Dimensional Systems : Linear systems and shift invariance ,Convolution summation Fourier transforms

Image Perception : Perception of brightness ,Perception of spatial information , Color perception , Temporal properties of vision

Image Sampling and Quantization : Image scanning and television, Two-dimensional sampling theory , Practical li mitations in sampling and reconstruction , Image quantization, Visual quantization

Image Transforms : Two-dimensional orthogonal and unitary transforms , Discrete Fourier transform (DFT) , Discrete cosine transform (DCT) , Other transforms

Image Enhancement : Point operations , Histogram modeling, Spatial operations , Transform operations, Color image enhancement

Image Filtering and Restoration : Image observation models , Inverse and Wiener filtering , Generalized inverse methods , Coordinate transformation and geometric correction

Image Analysis: Spatial feature extraction , Edge detection, boundary extraction and representation , Structure ,   Texture , Scene matching and detection , Segmentation

Image Processing Systems : Image processing hardware , Image processing software

Introduction to Motion Picture Image and scene analysis

Introduction to Image file formats and Image Compression techniques

Laboratory Experiments:
Experiments using any IP software or IP tool kit like Matlab, chosen from:
Image sampling and quantization
Fast Fourier transform
Nonlinear point operations
Histogram equalization
Spatial filtering
Edge detection
Shape analysis
Texture analysis

Textbook:
A. K. Jain, *Fundamentals of Digital Image Processing*, Prentice-Hall, 1989.
R. C. Gonzalez and R. E. Woods, *Digital Image Processing* , Addison Wesley, 1993

B-6 Web Engineering

Architecture, design, and implementation of Internet-scale software infrastructure.
Issues of scalability, high availability, and robustness through modular software structure
Performance tradeoffs, including harvest vs. yield and consistency vs. availability.
Cluster-based runtime systems for Internet workloads,
Issues in Implementation, deployment and operating web service.
Extending Internet services to mobile and post-PC computing devices.
Phases in Building and deploying an Internet-scale service; Issues with the methods used
in interaction design, needs analysis, user observation, idea sketching, concept generation,
scenario-building, storyboards, user character stereotypes, usability analysis, and market
strategies.

Web-Based Information Architectures. Setting up B-B, B-C, P-P types of commerce
pipelines.
Web-based search engines: how to use them optimally, how to design e-commerce sites
that maximize customer attraction via search engines, how to analyze competition.
Creation of a search engines, including inverted-indexing, partial matching, query-
expansion and spidering technology.
Overview of typical Web Servers and their configuration.
Application Servers and related technologies.
Application Service Providers, IT enabled Service providers. Issues related to Data
centres and server farms.
Issues in web-based information architectures, including: automated text categorization,
cataloging, information extraction from web-pages, recommendation systems, larger-
scale text and data mining methods.
Issues in multi-lingual web access and distributed information retrieval.

M.E. (INFORMATION TECHNOLOGY)
SEMESTER IV

4.1   Project – Stage II (Design)

The term work comprises of the work done by the student towards completion of the project at this Second stage.

4.2   Project – Stage III (Implementation and Testing)

The term work comprises of the work done by the student towards completion of the project at this *Third* stage.

4.3   Dissertation

The final project report is submission and viva – voce seminar conducted towards completion of the project.