SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY ,VISHNUPURI,NANDED.

Curriculum and scheme of Examination of M.E. program in Computer Science and Engineering.

M.E.(CSE) First Year

SEMESTER - I

SR. NO.	SUBJECT	TEACHING SCHEME				EXAMINATION SCHEME			
		L	PR	TOTAL	PAPER	TW	TEST	ORAL	TOTAL
01	Mathematical Foundations of Computer Science	4		4	100		25		125
02	Data Structures and Algorithms	4		4	100		25		125
03	Database Management Systems	4		4	100		25	--	125
04	Advanced Computer Networks	4		4	100		25	--	125
05	Elective - I	4		4	100		25	--	125
06	Computer Lab – I		4	4		50		--	50
07	Computer Lab – II		4	4		50		--	50
08	Seminar – I	--	2	2	--	50	--	--	50
09	Comprehensive Viva – I	--	--	--	--	--	--	75	75
									850

SEMESTER - II

SR. NO.	SUBJECT	TEACHING SCHEME				EXAMINATION SCHEME			
		L	PR	TOTAL	PAPER	TW	TEST	ORAL	TOTAL
01	Advance Compiler Design	4	--	4	100		25		125
02	Operating System Design	4	--	4	100		25		125
03	Object Oriented Software Engineering	4	--	4	100		25		125
04	Advance Computer Architecture	4	--	4	100		25		125
05	Elective – II	4	--	4	100		25		125
06	Computer Lab – III	--	4	4	--	50	--		50
07	Computer Lab – IV	--	4	4	--	50	--		50
08	Seminar – II	--	2	2	--	50	--	--	50
09	Comprehensive Viva – II	--	--	--	--	--	--	75	75
									850

Elective – I

1 Image Analysis and Computer Vision.
2 Embedded Systems.
3 Soft Computing.
4

Elective - II

1 Cryptography and Network Security.
2 Mobile Computing
3 Data warehousing and Data Mining.
4 Multimedia Technology.

SEMESTER - I

1.Mathematical Foundations of Computer Science

1 Basics of integers and Number theory: 10Hrs

Divisibility, Binomial theorem,Congruence : Euler function, , solution of congruences , Chinese remainder theorem,. gcd: Euclids ,Extended Eculids algorithms, binary gcd algorithm ,prime numbers: primality testing, Fermat's theorem ,Wilson's theorem, prime number generation Miller Rabin algorithm.

2 Groups, Rings and Finite fields: 8Hrs

Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, rings, finite fields, polynomial arithmetic, quadratic residues, reciprocity, discrete logarithms

3 Partial order set and Boolean algbra : 4Hrs

Fundamentals of set theory, equivalence relations and partitions, partial order, lattices and Boolean algebra,

4 Finite Autmation I: 10Hrs

Introduction to Finite Automation. Primitives, regular Expressions, Properties of Regular Expressions, Finite Automata: - FSM, DFA, NFA, Equivalence of DFA &NFA. Finite Automata with O/P:- Mealy M/C, Moore M/C, Equivalence Of Mealy & Moore M/C, Pumping lemma Finite Automata Applications.

5 Finite Autmation II:8Hrs

Context Free grammer, PDA, Turing M/C.:Context Free grammar, CNF,GNF, Properties Of Context free grammar, Pummping Lemma,

References

1. Niven, H.S. Zuckerman and Montgomery, *An Introduction to the Theory of Numbers,* 3/e, John Wiley and Sons, New York, 1992.
2. R. P. Grimaldi, *Discrete and Combinatorial Mathematics: An Applied Introduction*,3/e, Addison-Wesley, New Delhi, 1994.
3. B. Kolman and R.C. Busby, *Discrete Mathematical Structures for Computer Science*, PHI, New Delhi, 1994.
4. C. L. Liu, *Elements of Discrete Mathematics*, McGraw Hill, 2/e, Singapore, 1985.
5. Daniel I.A. Cohen ,*Introduction to Computer Theory ,2/e,*WSE .
6. John E. Hopcroft ,Jeffery D. Ullman ,*Introduction to automata theory ,Languages and Computation, 1/e*, Narosa Publication.
7. John L.Martin , *Introduction to language and Theory of computation ,*2/e,TMH.

2.Data Structures and Algorithms

1. **Foundations: 6Hrs**
   Role of algorithms in Computing, Asymptotic notations, Recurrences : substitution ,recursion tree method ,the master method, Randomized Algorithms
2. **Basic Data Structures: 2Hrs**
   Linked lists, heaps, priority queues, trees, binary search trees, OBST
3. **Algorithm design and analysis techniques: 16Hrs**
   Dynamic programming, Greedy algorithms: theoretical foundations of greedy methods, task scheduling problem, Graph Algorithms: Shortest path algorithms, minimum cost spanning tree ,Amortized analysis
4. **Advanced data structures:10Hrs**
   B-trees,Binomial Heaps, Fibonacci Heaps, Data structures for disjoint sets
5. **Complexity classes:8Hrs**
   NP-Hard and NP-complete Problems, Cook's theorem, NP completeness reductions.
6. **Approximation algorithms: 4Hrs**
   Polynomial Time and Fully Polynomial time Approximation Schemes.

References

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, *Introduction to Algorithms*, Prentice Hall India, 1990.
2. Dexter Kozen, *The Design and Analysis of Algorithms*, Springer, 1992.
3. V. Aho, J. E. Hopcraft, J. D. Ullman, *The design and Analysis of Computer Algorithms*, Addison Wesley, 1974.
4. R. Motwani and P. Raghavan, *Randomized Algorithms*, Cambrdige University Press, 1995.
5. C. Lautemann. *BPP and the Polynomial Hierarchy*. Information Processing Letters, 17:215–217, 1983.

3. Database Management System

1. Relational Databases : 12Hrs

Relational Model, Database design principles, SQL, file organization, Overview of transactions, concurrency Control & recovery

2. Parallel Databases:6Hrs

Introduction, architecture, I/O parallelism, intra-query & inter-query parallelism, Interoperation & intra operation parallelism, and design of parallel systems

3. Distributed databases:6Hrs

Concepts, architecture, data fragmentation, replication, & allocation techniques for distributed database design, types of distributed database systems, Query processing, Distributed concurrency Control, Distributed recovery, an overview of client server architecture its relationships to distributed database, distributed database in oracle

4. Object oriented databases: 6Hrs

Objects, Encapsulation, Inheritance, User Defined ADTs, Object Identity and Reference types, Database Design for ORDBMS, OODBMS, Comparison of RDBMS With OODBMS and ORDBMS.

5. Advanced databases:10 Hrs

Data Warehousing and Data Mining, Web Databases, Active & deductive Databases, Spatial & Temporal Databases, Mobile Databases, Main Memory databases, Multimedia databases, Personal databases

References:

1. Raghurama Krishnan and J.Gehrke, Database Management System, TMH 2003.
2. Silberschatz A., Korth H. F., & Sudarshan S., Database System Concepts, Tata
3. McGraw Hill
4. Ullman J. D., Principles of Database Systems, Galgotia Publications.
5. Elmasri & Navathe, Fundamentals of Database Systems, Addison Wesley

4. Computer Networks

1. **Computer Network and the Internet:4 hrs**
   What is the Internet? The Network Edge, The Network Core, Network Access and Physical Media, ISPs and Internet Backbones, Delay and Loss in Packet-Switched Networks, Protocol Layers and Their Service Models, History of Computer Networking and the Internet.
2. **Application Layer**: **6 hrs**
   Principles of Application Layer Protocols, The Web and HTTP, File Trasfer: FTP, Electronic Mail in the Internet, DNS-The Internet's Directory Service, Socket Programming with TCP, Socket Programming with UDP, Building a simple Web Server, Content Distribution.
3. **Transport Layer**: **6 hrs**
   Introduction and Transport Layer Services, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection-Oriented transport: TCP, Principles of Congestion Control, TCP Congestion Control.
4. **Network layer and Routing**: **6 hrs**
   Introduction and Network Service Models, Routing Principles, Hierarchical Routing, The Internet Protocol (IP), Routing in the Internet, What's Inside the Router? IPv6, Multicast Routing, Mobility and the Network Layer.
5. **Link Layer and Local Area Networks**:**6 hrs**
   Data link Layer: Introduction and Services, Error-Detection and Correction techniques, Multiple Access Protocols, LAN Addresses and ARP, Ethernet, Hubs, Bridges and Switches, Wireless Links, PPP: The point-to-Point Protocol, Asynchronous Transfer Mode(ATM), Frame Relay.
6. **Multimedia Networking**:**5 hrs**
   Multimedia Networking Applications, Streaming Stored Audio and Video, Making the Best of the Best-Effort Service: An Internet Phone Example, Protocols for real-Time Interactive Applications, Beyond Best-Effort, Scheduling and policing Mechanisms. Integrated Services, RSVP, Differentiated Services.
7. **Security in Computer Networks**: **5 hrs**
   What is Network Security? Principles of Cryptography, Authentication, Integrity, Key Distribution and Certification, access Control: Firewalls, Attacks and Countermeasures, Security in Many Layers: Case Studies.
8. **Network Management**:**4 hrs**
   What is Network Management? The Infrastructure for Network Management, The Internet-Standard Management Framework, ASN.1.

References:

1. J. F. Kurose, K.W. Ross, " Computer Networking – A Top Down Approach Featuring the Internet " , Pearson Education.
2. B.A. Forouzan, " TCP/IP Protocol Suite" Tata McGraw Hill 3rd edition.
3. Douglas E Comer, "Internetworking With TCP/IP Volume 1: Principles Protocols, and Architecture", 5th edition, PHI.
4. Andrew S. Tanenbaum, "Computer Networks", 4th edition, PHI

5.Elective -I

(i).Image Analysis and Computer Vision

1. Introduction:2 hrs

What is Digital Image Processing?, Examples of fields that use Digital Image Processing., Stages of Digital Image Processing.,Components of a typical Image Processing System.

2. Digital Image Fundamentals:2 hrs

Image Sensing and Acquisition., Image Sampling and Quantization., Relationships among pixel positions.

3. Data Structures for Image Analysis.2 hrs

4. Matlab for Image Processing and Image Analysis.3 hrs

5. Image Pre-Processing.7 hrs

Image Enhancement in the spatial Domain. , Image Enhancement in the Frequency Domain. , Fourier transform and Wavelet. , Feature Extraction & Analysis , Image restoration.

6. Image Segmentation :6 hrs

Detection of Discontinuities., Edge linking and Boundary Detection. Thresholding, Region-Based segmentation.

7. Morphological Image Processing : 6 hrs

Dilation and Erosion , Opening and Closing., The Hit or Miss Transformation, Basic Morphological ,Algorithms.

8. Introduction to Computer Vision:3 hrs

Achieving Simple Vision Goals, High level & Low level Capabilities., A range of representations., The role of Computers., Computer Vision Research & Applications.

9. Image Representation and Description:7 hrs

Representation, Boundary Descriptions, Regional Descriptions, Use of PCE, Relational Descriptors.

10. Object Recognition:7 hrs

Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.

Reference:

1. R.C. Gonzalez, R.E. Woods, " **Digital Image Processing"** 2nd Edition-Pearson Education(LPE)-2002.
2. M. Sonka, V. Hlavac, R. Boyle, " **Image Processing, Analysis & Machine Vision"** 2nd Edition-ITP Company-1998.
3. Scoot Umbaugh, " **Computer Vision & Image Processing- A Practical Approach Using CVIP tools"** S&S Company-1998.
4. R.C. Gonzalez, R.E. Woods, " **Digital Image Processing Using Matlab"** 1st Indian Reprint - Pearson Education(LPE)-2004.
5. D. Ballard & C. Brown, "**Computer Vision",** Prentice-Hall- 1982.

(ii).Embedded Systems

Prerequisites: Basic courses in digital hardware, algorithms, data structures, elementary calculus, and probability.

1. **Introduction :10Hrs**
    a. Introduction to embedded systems: classification, characteristics and requirements. Timing and Clocks in Embedded Systems.
2. **Module II: 10 Hrs**
    a. Task modeling and management. Real-time operating system issues. Signals: frequency spectrum, and sampling, digitization (ADC, DAC), signal conditioning and processing.
3. **Module III: 10 Hrs**
    a. Modeling and characterization of embedded computing systems. Communication strategies for embedded systems: encoding, and flow control.
4. **Module IV: 12 hrs**
    a. Fault Tolerance. Formal Verification

References

1. H. Kopetz, *Real-time Systems*, Kluwer, 1997.
2. R. Gupta, *Co-synthesis of Hardware and Software for Embedded Systems*, Kluwer 1995.
3. Jane W S Liu, *Real time systems*, Pearson Education Pte. Ltd., 2001.
4. Raj Kamal, *Embedded systems: architecture, programming and design*, Tata McGraw- Hill publishing Co. Ltd., 2003, (2005 reprint).

6. Computer Lab - I

Computer Lab-I shall be based on the subjects Data Structure and Algorithms and Database Management Systems.

Term Work :

The Term Work shall consist of a record of at least 8 programs/assignment or small project for each subject. The experiments shall be evenly spread over the entire syllabus.

7.Computer Lab - II

Computer Lab-I shall be based on the subjects Computer Networks and Elective- I

Term Work :

The Term Work shall consist of a record of at least 8 programs/assignment or small project for each subject. The experiments shall be evenly spread over the entire syllabus.

SEMESTER - II

1. Advances Compiler Construction

1. **Review of Compiler Fundamentals**.

2. **Lexical analysis**:
    a. Role of lexical analyzer, Specialization & Recognition of tokens, Finite automata.

3. **Parsing**:
    a. Role of the Parser, Top-down Parsing, Bottom-up Parsing, Operators precedence parsing, LR parsers, using ambiguous grammars.
4. **Syntax-directed translation & type checking**:
    a. Syntax directed definition, Construction of syntax trees, S-attributed & L-attributed definitions, top-down & bottom-up evaluation, assigning space at compiler construction time, type systems, simple type checker, equivalence of type expressions, type conversions.
5. **Compiler Algorithms Notation (1)**
6. **Intermediate code generation & Representation**:
    a. Intermediate languages, Boolean equation, back patching, Representing MIR, NIR & LIR in ICAN.
7. **Run-time (Storage management)/ Support & Symbol table Structure**:
    a. Source language issues, Storage allocation strategies, Parameter parsing, procedure prologues, Epilogues, Calls & Returns, Symbol tables, Dynamic Storage allocation techniques.
8. **2nd Module: Code Generation & Code improvement**:
9. **Issues in the design of code generator (Run-Time Storage Management):**
    a. Basic blocks 7 flow graphics, dag representation of basic blocks, Generating code from dags., peephole optimization.
10. **Control-flow Analysis**:
    a. DFS, Pre-order, Post-order & BFS, Loops & Strongly connected components, Reducibility, Interval analysis & Control trees, Structural analysis.
11. **Data Flow Analysis**:
    a. Interactive data flow analysis, Control-tree based analysis, Interval analysis, other approaches.
12. **Dependence analysis & Dependence graphs**:
    a. Dependence relations, Basic blocks dependence DAGS, Dependences in Loops, Dependence testing, Program dependence graph, Dependencies between Dynamically Allocate objects.
13. **Alias Analysis**: (The Alias Gatherer & propagator).
14. **3rd Module: Introduction to Optimizations**.
    a. Importance of Individual Optimizations Order & Representation of Optimization, Early Optimizations.
15. **Redundancy Elimination**:
    a. Common sub expression-elimination, redundancy elimination & Reassociation code hoisting (unification).
16. **Loop Optimizations**:
    a. Introduction, Variable-optimizations, Unnecessary Bounds-checking elimination.

17. **Procedure & Inter-procedural Optimization**:
    a. Procedural Integration, leaf-routine Optimization & Shrink corapping. Interprocedural control flow Analysis, Dataflow Analysis & Alias Analysis, Aggregation of Global references.
18. **Register Allocation**:
    a. Local Methods, graph coloring, priority based graph coloring, Interprocedural register allocation.
19. **Code Scheduling**:
    a. Instruction scheduling, S/w pipelining, Percolation Scheduling.
20. **Control flow & low-level optimizations**:
    a. Unreachable-code elimination, Straightening, If Simplifications, Loop Simplifications, Branch Optimizations, Dead-code elimination, Branch Prediction.
21. **Optimization for memory hierarchy**:
    a. Impact of data & Instruction caches, Instruction Cache Optimization, Data Cache Optimization.
22. **4th Module: Case Studies**: Sun Compiler for SPARC, IBM XL Compiler for the power & Power PC Architectures, DEC for Alpha.

References:

1. A. V. Aho, R. Sethi, & J. P. Ullman: Compilers: Principles, Techniques & Tools, Addision Wesley.
2. Steven S. Muchnick, Advanced Compiler Design Implementation, Morgan Kauffman publishers.

2. Operating System Design

1. **Introduction: 8 hrs**
   Introduction, Hardware, Hardware interface, Operating System interface. design problems, Operating system design techniques, Implementation process-The system call interface, system initialization, process switching, system call interrupt handling, program error interrupts, disk driver system, implementing waiting, flow of control through OS, signaling and interrupts, event table managers, process implementation. Parallel systems- Parallel hardware, OS for two processor systems, race conditions with shared processes, atomic actions, multiprocessor OS, threads.
2. **Inter process communication patterns :10 hrs**
   Competing & co-operating, problems, race conditions & atomic actions, new massage passing system calls, IPC pattern: mutual exclusion, signaling & rendezvous models, producer-consumer & client server models. Deadlocks- Conditions for deadlock, dealing with deadlocks, two-phase locking, message variations, synchronization, semaphores. Design techniques- some example design techniques. Memory management-levels of memory management, linking and loading process, memory management design, dynamic memory allocation, keeping track allocation of blocks, multiprogramming issues, memory protection, memory management system calls.
3. **Virtual memory: 4 hrs**
   Fragmentation and compaction, dealing with fragmentation-paging, swapping, overlay, page replacement-global and local page replacement algorithms, thrashing and load control, dealing with large page tables, sharing memory. Design techniques-examples of multiplexing and late binding.
4. **I/O devices :6 hrs**
   Devices and controllers, terminal devices, communication devices. I/O subsystems-I/O system software, disk devices driver access strategies, modeling disks, unification of files and device, generalized disk devices driver, disk caching. File System- File abstraction, naming, file system objects and operations.
5. **File system organization :10 hrs**
   Organization, file descriptors, locating file blocks on disks, implementation of logical to physical block mapping, file sizes, booting the OS, file system reliability, file security and protection. Recourse management and protection-recourses in an OS, resource management issues, types of resources, integrated scheduling, queuing authentication, mechanism for protecting hardware recourses, representation of protection information, mechanisms for software protection, Design techniques-Caching hierarchical names and naming of objects.
6. **Security: 02 hrs**
   Security threats, protection, intruders, malicious software, trusted systems, security features in UNIX and Windows 2000.

Reference:

1. Charles Crowley, Operating system- a design oriented approach, Tata McGraw-Hill edition, New Delhi, 1998.
2. Silberschatz and Galvin, Operating system concepts, Addison Wesley, 1998.
3. Tanenbaum Andrew S., Modern Operating system, Eaglewood Cliffs, NJ: Prentice Hall, 1992
4. Stallings W, Operating system- Internals and design principles, 4th Edition, PHI, 2002.

3. OBJECT ORIENTED SOFTWARE ENGINEERING

1. Introduction: 10Hrs

The Software Process: Requirements, Specification, Design, Implementation Integration and maintenance phases.

From Modules to Objects: Cohesion, Coupling, Data encapsulation Abstract data types, objects.

Reusability, Portability and Inter-operatability issues.

Module II: (10 hours)

2. The phases of Software life cycle:

Requirements phase – object oriented requirements.

3. Specification phase – Informal, structured and Semi formal Methods, E-R model, Finite State machines, petrinets and Z346.

4. Object-Oriented Analysis Phase – use_case modeling, Class modeling, dynamic modeling, CASE tools for Object Oriented Analysis.

Module III: (12 hours)

5. Design phase – Action oriented design, Data flow Analysis, Transaction Analysis. Data oriented, OO design methods, Formal techniques for detailed design. Real time design techniques. CASE tools for Design phase.

6. Implementation phase – Choice of Programming Language, 4GLs, Coding standards. Module reuse, Module Test Case selection, Black-box and Glass-box module Testing. Code walk throughs CASE tools for implementation phase.

Module IV: (08 hours)

7. Implementation and Integration phase – Top-down, Bottom-up and Sandwitch Implementation and Integration techniques. CASE tools for Integration phase. CASE tools for Complete Software Process.

References:

1. Stephen R. Schach, “Object-Oriented and Classical Software Engineering” 5th Edition,

Tata Mc Graw Hill.

2. Brend Bruegge, “Object-Oriented Software Engineering” conquering complex & changing systems, Pearson Education, Asia.

3. Grady Booch, James Rumbaugh, Ivar Jacobson, The Unified Modeling Language-

Reference manual, Pearson education, 1999.

4. Grady Booch, James Rumbaugh, Ivar Jacobson, Using Unified Modeling Language – Software engineering with objects & components, Pearson education, 2001.

4.Advanced Computer Architecture

Module I: 9Hrs
Performance evaluation, Processor architecture, pipelining, pipeline hazards, issues in pipelined processor implementation.
Module II: 12 Hrs
Instruction level parallelism, hardware and compiler support for branch prediction, out-of-order Instruction issue, speculative execution and other techniques for high-performance
Module III: 9 Hrs
Instruction and data cache organizations, multilevel caches, parallel memory systems, Support for virtual memory.
Module IV: 12 Hrs Multiple processor systems, Interconnection networks, shared memory system, memory models, cache coherence.

References
1. Hennessy J. L., D. Patterson, *Computer Architecture – A quantitative Approach*, Morgan Koffman (3/e), 2003
2. John Paul Shen, Mikko Lipasti. *Modern Processor Design – Fundamentals of Superscalar Processors*. McGraw Hill International Edition, 2005.
3. Dezso Sima, Terence Fountain, Peter Kacsuk. *Advanced Computer Architecture – A Design Space Approach,* Addison Wesley, 2000.

5.Elective –II

(i)Cryptography and Network Security

1. **Introduction :2 Hrs**
   a. Threats, Vulnerabilities, Attacks, Integrity,nfidentiality, Anonymity Authentication, Authorization, Non-repudiation Data Security vs Database Security,Cryptography ,cryptanalysis
2. **Secret Key Cryptography :4 Hrs**
   a. Block ciphers: DES, Triple DES, AES, RC5, and Blowfish.,Cryptanalysis of block ciphers,Attacks on symmetric block ciphers
3. **Public Key Cryptography :5 Hrs**
   a. RSA ,ECC ,Key Exchange (Diffie-Hellman) ,Attacks
4. **Integrity, Authentication and Non-Repudiation: :6Hrs**
   a. Hash Functions (Examples - MD5, SHA5) ,Message Authentication ,code (MAC) ,Digital Signature (RSA, DSA Signatures)
5. **Public Key Infrastructure:4Hrs**
   a. Digital Certificates ,Certification Authorities
6. **Protocols :10Hrs**
   a. Basic Authentication Protocols ,Attacks(Replay, Reflection, Man-in-the-middle) ,Needham Schroeder Protocol ,Kerberos ,Network Security with IPSec ,Web Security using SSL ,E-cash and Secure Electronic Transaction (SET)
7. **System Security using Firewalls and VPN's:4 Hrs**
8. **Miscellaneous :8 Hrs**
   a. Smart Cards and security ,Zero knowledge protocols ,Enterprise Application Security ,Database Access Control

References

1. William Stallings, *Cryptography and Network Security*. Third Edition PHI India.
2. Alfred *Menezes* , Paul. CVan Oorschot,Scott.A.vanstone Handbook of Applied Cryptography, 1996 ,CRC press.
3. Bruce Schneier. Applied Cryptography, Second Edition John Wiley & Sons, 1996
4. *Charlie Kauffman ,Network Security ,PHI Publication*

(ii)Mobile Computing

1. **Introduction**: **3 hrs**

   Evolution of Wireless Network, Wireless Data, Wireless LAN, Wireless PAN, Mobile Computing & it's Functions, Schematic representation of a Mobile Computing.

2. **Wireless Transmission**: **3 hrs**

   Frequencies for radio Transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread Spectrum, Cellular Systems.

3. **Medium access control**: **3 hrs**

   Motivation for specialized MAC, SDMA, FDMA & TDMA.

4. **Emerging Technologies**: 3 **hrs**

   Bluetooth, Radio frequency identification (RFID), Wireless Broadband (Wimax), Mobile IP, Internet Protocol Version 6 (IPv6), Java card.

5. **Global System for Mobile Communication (GSM)**: **4 hrs**

   GSM history, cell clusters in GSM, GSM architecture, GSM Entities, GSM Radio Subsystem, GSM Channel types, frame Structure for GSM, Signal Processing in GSM, Example of GSM call, PLMN interface, GSM addresses and identifiers, Network aspects in GSM, Handover, Mobility management, Authentication and security in GSM.

6. **General Packet radio Service (GPRS): 3 hrs**

   Introduction, GPRS and Packet data Network, GPRS Network architecture, GPRS Network operation, Data service in GPRS, Application for GPRS, limitation of GPRS, billing and charging in GPRS.

7. **CDMA and 3G:3 hrs**

   Introduction, Spread-spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Application on 3G.

8. **Wireless LAN:4 hrs**

   Introduction, Wireless LAN advantages, IEEE 802.11 standards, Wireless LAN Architecture, Mobility in Wireless LAN, Deploying Wireless LAN, Mobile AdHoc Network and sensor Network, Wireless LAN security, Niti Vs 3G.

9. **Internet Networks and Interworking**: **3 hrs**

   Introduction, Fundamentals of Call Processing, Intelligence in the Networks, SS#7 signalling, IN Conceptual model (INCM), Softswitch, Programmable Networks, Technologies and interfaces for IN.

10. **Mobile Computing Architecture**:**3 hrs**

    Architecture: for Mobile Computing, three-tier Architecture, Design Consideration for Mobile Computing.

11. Client Programming:**3 hrs**

Introduction, Moving beyond the desktop, Hardware overview, Mobile phones, PDA, Design constraints in applications for handheld devices.

12. Programming for the Palm OS: **3 hrs**

Introduction, History of Palm OS, Palm OS Architecture, Application development, Communication in Palm OS, Multimedia, and Enhancements in the current release.

13. Wireless devices with Symbian OS:**3 hrs**

Introduction to Symbian OS, Symbian OS Architecture, Application for Symbian, Control and compounds controls, active objects, Localization, Security on the Symbian OS.

14. Wireless devices with Windows CE:**2 hrs**

Introduction, different flavors of Windows CE, Windows CE Architecture, Windows CE development Environment.

15. Wireless Application Protocol (WAP): 2 **hrs**

Introduction, WAP, MMS, GPRS Applications.

16. Special topics in mobile Computing:**2 hrs**

Mobile Agent & its application, Mobile data management, security framework for mobile environment.

Reference:

1. **Mobile Computing**: Asoke K Talukder, TMH, New Delhi.
2. **Mobile Communication**: Jochen Schitler, Peasson Education, New Delhi.
3. **Wireless Communication**: T. S. Rappapost, Peasson Education, New Delhi.
4. **Wireless Networks**: Kareh Pallavan & P. Krishnamurthy, Peasson Education, New Delhi.

(iii)Data Ware House and Data Mining

Module I: (10 hours)

1. INTRODUCTION
What is data mining, Data mining-On what kind of data, data mining functionalities, data mining applications, classification, major issues in data mining, data mining tools

2. DATA WAREHOUSE AND OLAP
Data warehouse, Multidimensional data model, Data warehouse architecture, Data warehouse implementation, tools, case studies

Module II: (10 hours)

3. DATA PRE-PROCESSING
Need of pre-processing, Data cleaning, Data integration & transformation, data reduction, Discretization & concept hierarchy generation

4. DATA MINING PRIMITIVES & LANGUAGE
Primitives, DMQL

Module III: (10 hours)

5. CONCEPT DESCRIPTION: CHARACTERIZATION & COMPARISION
Concept description, data generalization & summarization based characterization, analytical characterization, mining class comparison, mining descriptive statistical measures in large databases.

6. ASSOCIATION RULE
Association rule mining, mining single dimensional, mutil-level association rules from transactional databases, mining multi-dimensional association rules from relational databases, correlation analysis, and constraint based association mining

Module IV: (10 hours)
7. CLASSIFICATION & PREDICTION
Definition, Issues, Classification by decision tree induction, Bayesian classification, Classification by back propagation, other classification methods, Prediction, classifier accuracy

8. CLUSTER ANALYSIS
Definition, types of data in cluster analysis, categorization of clustering methods, partitioning methods, hierarchical methods, density based methods, grid-based methods, model based methods, outlier analysis

References:

1. Jiawei Han, Micheline Kamber, Data Mining Concepts and Techniques, Morgan Kauffmann Publishers, 2000.
2. Arun K Pujari, Data mining techniques, Universities Press (India) Pvt Ltd, 2001
3. Sam Anahory,Dennis Murray, Data warehousing in the real world, Pearson education,1997
4. C.S.R. Prabhu, Data warehousing, PHI, 2nd edition, 2002

(iv)Multimedia Technologies

1. Introduction to Multimedia.
2. Multimedia Data Representation.
   Text,Audio and Speech,Images and Graphics,Video and Animation
3. Multimedia Data Compression.
   Lossless Compression Algorithms,Lossy Compression Algorithms,Image Compression Standards,Video Compression Techniques,Audio Compression Techniques
4. Multimedia Database Systems.
   Characteristics and Architecture of MMDBS,Logical Design,Physical Design (Storage Structure and Access methods, Indexing and Clustering, etc.)
5. Multimedia Indexing and Retrieval.
   Computer Vision and Image Processing Techniques,Image and Video Indexing Techniques,Image and Video Retrieval Techniques
6. Multimedia Network Communications and Applications.
   Quality of Multimedia Data Transmission,multimedia over IP,Multimedia over ATM Networks,Transport of MPEG 4 ,Media – on – Demand (MOD)

Reference:

1. Ze-Nian Li and Mark Drew, " **Fundamental of Multimedia"** Prentice Hall, 2004.
2. Fred Halsall, " **Multimedia Communication Applications, Networks, Protocols and Standards"** Pearson Education-2003.
3. P. Apers, H. Blanken and M. Houtsma (Eds) Springer Verlag, " **Multimedia Databases in Perspective"** 1998.

6.Computer Lab - III

Computer Lab-I shall be based on the subjects Object Oriented Software Engineering and Operating System Design.

Term Work:

The Term Work shall consist of at least 8 programs/assignment or one small projects for each subject, The experiments shall be evenly spread over the entire syllabus.

7.Computer Lab – IV

Computer Lab-I shall be based on the subjects Advance Compiler Design and Elective - II

Term Work :

The Term Work shall consist of a record of at least 8 programs/assignment or small projects for each subject, the student to understand the concepts of the above syllabus

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SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY ,VISHNUPURI,NANDED.

Curriculum and scheme of Examination of M.E. program in Computer Science and Engineering.

M.E.(CSE) Second Year

Semester-III

Sr.No	Subject Name	Teaching Scheme			Examination Scheme			
		Theory	practical	Total	Paper	Term work	Oral/Presentation	Total
1.	Dissertation Part-I	-	20*	20	-	100	100	200

***** This is the minimum number of hours student should work for his /her dissertation, however the teaching load for guide is 4 hrs/student/week.

Semester-IV

Sr.No	Subject Name	Teaching Scheme			Examination Scheme			
		Theory	practical	Total	Paper	Term work	Oral/Presentation	Total
1.	Dissertation Part-II	-	20*	20	-	100	200	300

*This is the minimum number of hours student should work for his /her dissertation, however the teaching load for guide is 2 hrs/student/week.

Dissertation Shall consist of

Research work done by the candidate in the areas related to the computer science and engineering

Or

Design and /or development of a software (product) related to the computer science and engineering.

Following shall be guidelines for evaluation of dissertation part-I

Dissertation Part-I

1. Dissertation Part-I shall consist of the following components (whichever applicable)
2. Extensive literature survey,
3. Data collection from R&D organizations, industries,etc
4. Study of the viability, applicability and scope of the dissertation.
5. Detailed Design (H/W and S/W as applicable)
6. Partial implementation.

etc

A candidate should prepare the following documents for the examination

1. A term paper in the format of any standard journal based on the work.
2. A detailed report of the work done by the candidate related to dissertation.

Every candidate should present himself (for about 30 min) before the panel of examiners(which will evaluate the dissertation-I for term work and oral marks) consisting of

1. Head of the Department
2. M.E. Coordinator.
3. All guides
4. At least one examiners from outside the Department.

Dissertation Part-II

The dissertation shall be assessed internally by a panel of examiners before submission to the university. The candidate shall submit the dissertation in triplicate to the Head of the institution, duly certified that the work has been satisfactory completed. The practical examination (viva-voce) shall consist of a defense presented by the candidate or his /her in the presence of examiners appointed by the university one of whom will be guide and the other an external examiner.