M.E. COMPUTER SCIENCE & ENGG. SEM. I & II

Syllabus of M.E. Sem. I (Computer Science & Engineering)

1RMEF1/1RME1 ADVANCED COMPUTER ARCHITECTURE

Unit I: Fundamentals: Technology & Computer usage trends, costs, Performance measurements. Quantitative principles of Computer design. Concepts of memory hierarchy. Instruction set architectures. Memory addressing. Operations in the instruction set. Encoding. Role of compilers. DLX architecture.

Unit II: Pipelining: Basic principles & DLX. Various hazards: Pipelines, data, control hazards. Implementation issues. Multicycle operations. Crosscutting issues. Instruction set design and piplelining. MIPS R4000 pipeline architecture.

Unit III: Advanced pipeline and instruction - level parallelism: concepts & challenges. Data hazards & dynamic scheduling. Dynamic Hardware prediction. Compiler support for ILP. Hardware support for parallelism. Studies of ILP. Power PC620.

Unit IV: Memory- hierarchy design : Basics of caches, Reducing cache miss & hit time. Main memory. Virtual memory. Protections Examples of virtual memory. Issues in the design of memory hierarchies. Alpha APX 21064 Memory hierarchy.

Unit V: Storage Systems: Types of storage devices, Buses & their types, performance I/O performance measures. Reliability, Availability and RAID. Interfacing to an Operating system. Designing an I/ O system. Unix file system performance.

Unit VI: Interconnection networks: Introduction & basic concepts, Computer connection to interconnection network. Interconnection network media. Practical issues. Examples of interconnection networks. Issues for interconnection networks. Internet working. An ATM network of workstation.

Text Book:

Hennessy J.L. & Patterson D.A.”Computer Architecture : A Quantitative Approach” 2/e (Harcourt Asia).

Reference Books:

1. Hayes J.P., “Introduction to Computer Architecture”, (McGraw Hill)).
2. Tenanbaum A. S., “Computer Organisation and Architecture”, (PHI).
3. Hwang K., “Advanced Computer Architecture”, (McGraw Hill).
4. Hamacher V.C, “Computer Organization”, (McGraw Hill).

1RMEF2/1RME2 ALGORITHMICS

Unit I: Introduction: Mathematical Notations, Proof techniques, Elementary algorithmics, Efficiency of algorithms : Examples. Asymptomatic notations: conditional asymptomatic notations. Notation with several parameters. Operations on asymptomatic notations.

Unit II: Algorithm analysis: Analysing control structures. Examples. Average-case analysis. Amortized analysis. Solving recurrences. Review of data structures: Arrays, Stacks, Queries, Records & Pointers, Lists, Graphs, Trees, Associative tables, Heaps.

Unit III: Greedy Algorithms: Some characteristics, Graphs: Minimum spanning trees, Shortest paths. The knapsack problem, Scheduling, Divide & Conques : Introduction - general template,
Binary search, sorting, median finding & matrix multiplication. Exponentiation. Cryptograph.

Unit IV: Dynamic programming: Examples, Principle of optimality, Knapsack problem & shortest paths. Chained matrix multiplication, Recursion, Memory function. Graphs: Travarsing trees. Depth-first-search : Directed & undirected graphs : Breadth-first-search. Back tracking. Branch-and-Bound. Minimax principle.

Unit V: Probability algorithms: Introduction, pseudorandom generation. Numerical probabilistic algorithms. Monte Carlo algorithms. Las Vegas algorithms. Parallel algorithms: Basic techniques. Work & efficiency. Examples. Parallel evaluations of expressions. Parallel sorting networks & parallel sorting.

Unit VI: Computational complexity. Introduction. Information-theoretic arguments. Adversary arguments. Linear reduction, Introduction to NP-completeness. Heuristic algorithms. Approximate algorithms. NP-hard approximation problems. Approximation schemes.

Text Book:
G. Brassard, P.Bratley, “Fundamentals of Algorithmics”, (PHI).

Reference Books:
1. Horowitz & Sahni, “Fundamentals of Algorithms”, (Galgotia).
2. Aho, Ullman, “Analysis & Design of Computer Algorithms”, (Addison-Wesley).
3. Donald E.Knuth, “The Art of Computer Programming”, Vol.I, Vol.II, Vol.III, (Addison-Wesley).

1RMEF3/1RME3 OPERATING SYSTEM DESIGN

Unit-I: Introduction to OS Internals. Overview of OS and Kernel, Linux and classic UNIX kernels. Kernel Source tree. Process management in Linux: Process descriptor and task structure, process creation, implementation of threads, process termination, process scheduling.

Unit-II: Process Scheduling in Linux: The Linux Scheduling Algorithm, Preemption and Context Switching, Real-Time, Scheduler-Related System Calls, System Calls: Handler, Implementation and Context. Interrupts and Interrupt Handlers.

Unit-III: Kernel Synchronization in Linux: Critical Regions and Race Conditions, Locking, Deadlocks, Contention and Scalability. Kernel Synchronization Methods: Spin Locks, Semaphores, Completion Variables. Preemption Disabling.

Unit-IV: Time Management in Linux: Kernel Notion of Time, Hardware Clocks and Timers, The Timer Interrupt Handler, Delaying Execution. Memory Management in Linux: pages, zones, kmalloc, vmalloc, slab layer allocator, statically allocating on the stack, high memory mapping. Per-CPU Allocations.

Unit-V: The Virtual File System in Linux: common file system interface, file abstraction layer, UNIX file system, VFS, dentry object, Super block object, file object, data structure associated with file systems and with a process. The Block I/O Layer and I/O Scheduler in Linux.

Unit-VI: The Process Address Space, the Memory Descriptor, Memory Areas, Page Tables. The Page Cache and Page Write back: Page Cache, Radix Tree, Buffer Cache. Linux Kernel Modules: Building, installing, Loading and managing. Portability in Linux.

Text Book:

Robert Love, “Linux Kernel Development” Pearson Education, (2/e).

Reference Books:

i. Daniel Bovet, “Understanding the Linux Kernel” O’Reilly Publications 2/e.
ii. Rubini and J. Corbet . “Linux Device Drivers.” O’Reilly and Associates, 2001.
iii. Mosberger & Eranian. “IA-64 Linux Kernel: Design & Implementation” PHI.
iv. McKusick & Neil . “The FreeBSD Operating System” Addison- Wesley, 2004.

1RMEF4/3RME1 EXPERT SYSTEM DESIGN

Unit I: Introduction to Expert Systems, An Overview of Artificial Intelligence, Knowledge Representation: Principles and techniques, STRIPS planner, Subgoaling in MYCIN, Evaluating and comparing expert Systems.

Unit II: Rule Based Systems: Canonical systems, Production systems for problem solving, Conflict resolution. Associative Nets and Frame Systems: Graphs, trees and networks, The rise of associative networks, Representing typical objects and situations. Object-oriented analysis and design for expert systems.

Unit III: Representing Uncertainty: Sources of uncertainty, Expert systems and probability theory, Vagueness and possibility, The uncertain state of uncertainty. Knowledge Acquisition: Theoretical analyses of knowledge acquisition, Expert system shells, Knowledge acquisition methods, Knowledge-based knowledge acquisition.

Unit IV: Heuristic Classification (I): Classifications of expert system tasks, Classification problem solving, Classification versus construction. Heuristic Classification (II): Mapping tools to tasks, Heuristic classification in MUD and MORE, Making strategy more explicit.

Unit V: Hierarchical Hypothesize and Test: Managing complexity, Structured objects in CENTAUR, Model-based reasoning in INTERNIST, TDE as knowledge engineering workbench. Constructive Problem Solving (I): Motivation and overview, A case study: R1/XCON, Elicitation, evaluation and extensibility.

Unit VI: Tools for Building Expert Systems: Overview of expert systems tools, Expert System Shells, High-level programming languages, potential implementation problems, More maxims on expert system development. Truth Maintenance Systems: Keeping track of dependencies, Revising propositional theories,
Nonmonotonic justifications, Maintaining multiple contexts.

Text Book:

Peter Jackson, “Introduction to Expert systems”, Pearson Education,
3rd Edition, 2003.

Reference Books:

1. J. L. Ermine, “Expert Systems: Theory and Practice”, Prentice Hall, 2003.
2. Hayes Roth, “Handbook of Expert System Design” (Addison- Wesley).
4. Donal A. Waterman, “A Guide to Expert systems”, Pearson Education, 2001.
5. E. Turban, “Expert Systems and Applied Artificial Intelligence”, Macmillan, 2004.

1RMEF5/3RME2 DATABASE PROCESSING

Unit I: Introduction to Database Processing, File Processing Systems, Definition of Database. The Entity-Relationship (E-R) Model: Element of the E-R Model, E-R Diagrams, Examples, Database as Models of Models. The Semantic Object Model: Semantic Objects, Creating Data Models with Semantic Objects, Types of Objects, Comparison of the Semantic Object and the E-R Model.

Unit II: The Relational Model and Normalization: The Relational Model, normalization, First through Fifth Normal Forms, Domain Key Normal Forms, The Synthesis of Relations, Multi-Value Dependencies, Iteration, Optimization.

Unit III: Database Design using Entity-Relationship Models: Transformation of Entity Relationship Models into Relational Database Designs, Example Design. Trees, Networks. Database Design with Semantic Object Models: Transformation of Semantic Objects into Relational Database Design, Sample Objects.

Unit IV: Defining Relational Data, Relational Data manipulation, Relational Algebra. SQL: Querying a Single Table, Querying Multiple Tables, Exist and Not Exists, Changing Data. Database Application Design: Creating, Reading, Updating and Deleting View Instances, Form Design, Report Design, Enforcing Constraints, Security and Control, Application Logic.

Unit V: Managing Multi-User Databases: Database Administration, Concurrency Control, Database Security, and Database Recovery. Managing Database with Oracle: Creating an Oracle Database, Application Logic, Data Dictionary, Concurrency Control, Oracle Security, Backup and Recovery.

Unit VI: Networks, Multi-Tier Architecture, and XML: Network Environments, Multi-Tier Architecture, XML-Extensible Markup Language. ODBC, OLE DB, ADO. The Web Server Data Environment, Open Database Connectivity (ODBC) Standard, JDBC, JSP with reference to databases.

Text Book:

David M. Kroenke: Database Processing- Fundamentals, Design and Implementation, 8th Edition (PHI).

Reference Books:

1. C.J. Date: Database Processing, (Addison Wesley).
2. R. Ramakrishnan: Database Management Systems, (McGraw Hill).
3. R Elmasri and S B. Navathe: Fundamentals of Database Systems, 2nd Edition.(Wiley)
4. Korth and Silberschatz " Database Processing Concepts" (McGraw Hill).

SECOND SEMESTER

2RMEF1/2RME1 COMPUTER COMMUNICATION NETWORKS

Unit I: The need for speed and quality of service. Advanced TCP/IP and ATM Networks. The need for a protocol architecture. The TCP/IP protocol architecture. The OSI model. Internetworking, TCP, UDP, Ipv6.

Unit II: Pacekt-switching networks. Frame relay networks. ATM protocol architecture. ATM logical connections. ATM cells. ATM service categories. ATM Adaptation Layer (AAL). The emergence of
high-speed LANs. Ethernet. Fibre channel. Wireless LANs.

Unit III: Overview of probability and Stochastic processes. Probability. Random variables. Stochastic processes. Queuing analysis. Why queuing analysis. Queuing models. Single-server queus. Multiserver queues. Queues with priorities. Networks of queues. Other queuing models. Estimating model parameters. Selfsimilarity. Self-similar data traffic. Examples of self-similar data traffic. Performance implications of self-similarity.

Unit IV: Congestion control in data networks and internets. Effects of congestion. Congestion and control. Traffic management. Congestion control in Packet-Switching networks. Frame relay congestion control. The need for flow and error control. Link control mechanisms. ARQ performance. TCP flow control. TCP
congestion control performance of TCP over ATM.

Unit V: Overview of graph theory and least-cost paths. Elementary concepts of graph theory. Shortest path length determination. Internet routing principles. Distance-Vector protocol. RIP. Link- State protocol. OSPF. Path-Vector protocols. BGP and IDRP. Multicasting.

Unit VI: Integrated Services Architecture (ISA). Queuing discipline. Random early detection. Differentiated services. Real-Time traffic. Resource Reservation : RSVP. Multiprotocol label switching. Real-Time Transport Protocol (RTP).

Text Books:
Willam Stallings - High Speed Networks and Internets – Performance and Quality of Service, 2nd Ed., (Pearson Education).

Reference Books:
1. Andrew S. Tanenbaum - Computer Networks, 4th Ed., Pearson Education.
2. James F. Kurose, Keith W. Ross - Computer Networking: A Top- Down Approach Featuring the Internet.
3. William Stallings - Data and Computer Communications, 7th Ed., Pearson Education.
4. Andrew S. Tanenbaum - Computer Networks, 4th Ed., Pearson Education

2 RMEF2/2 RME2 ADVANCED COMPILING TECHNIQUES

Unit I: Symbol-Table Structure: Storage Classes, Visibility, and Lifetimes, Symbol Attributes and Symbol-Table Entries, Local Symbol-Table Management, Global Symbol-Table Structure, Storage Binding and
Symbolic Registers, Approaches to Generating Loads and Stores.

Unit II: Intermediate Representations: Issues in Designing an Intermediate Language, High-Level, Medium-Level and Low-Level Intermediate Languages, Multi-Level Intermediate Languages, Sample Intermediate Languages: MIR, HIR, and LIR, Representing MIR, HIR and LIR. ICAN Naming of Data Structures, Routines to Manipulate Intermediate Code.

Unit III: Run-Time Support: Data Representations and Instructions, Register Usage, The Local Stack Frame, The Run-Time Stack, Parameter- Passing Disciplines, Procedure Prologues, Epilogues, Calls, and
Returns, Code Sharing and Position-Independent Code, Symbolic and Polymorphic Language Support.

Unit IV: Producing Code Generators Automatically: Introduction, need and applications to Automatic production of Code Generators, a Syntax- Directed Technique. Introduction to Semantics-Directed Parsing,
Tree Pattern Matching and Dynamic Programming.

Unit V: Control-Flow Analysis: Various Approaches, Depth-First Search, Preorder Traversal, Post order Traversal, Breadth-Firs Search, Dominators and Post dominators, Loops, Strongly Connected Components, Reducibility, Interval Analysis, Control Trees, Structural Analysis.

Unit VI: Data-Flow Analysis: Basic Concepts, Taxonomy of Data-Flow Problems, Solution Methods: Iterative, Lattices of Flow Functions Chains, Ud-Chains, Webs, SSA Form. Dealing with Arrays, Structures, and Pointers. Automating Construction of Data-Flow Analyzers.

Text Book:
Steven S. Muchnick, “Advanced Compiler Design Implementation” (Hartcourt Asia- Morgan Kaufman).

Reference Books:
1. Aho, Sethi, Ullman, “Compilers: Principles Techniques and Tools” (Pearson).
2. D. M. Dhamdhere, “Compiler Construction” (2/e), Macmillan.
3. Cooper & Torczon, “Engineering a Compiler” Elsevier.
4. K C. Louden, “Compiler Construction: Principles and Practice” Cengage.

2RMEF3/4RME1 REAL-TIME SYSTEMS

Unit-I: Typical Real-time applications, Hard versus Soft Real-time systems: Jobs and Processors, Release Times, Deadlines and Timing Constraints, Hard and Soft Timing Constraints, Hard Real-time systems, Soft Real-time systems. A Reference Model of Real-time system: Processors and Resources, Temporal
Parameters of Real-time Workload, Periodic Task Model, Precedence Constraints and Data Dependency, Other types of Dependencies, Functional Parameters, Resource Parameters of Jobs and Parameters of Resources, Scheduling Hierarchy.

Unit II: Commonly used approaches to Real-time Scheduling: Clock driven Approach, Weighted Round-Robin Approach, Priority Driven Approach, Dynamic versus Static Systems, Effective Release Times and Deadlines, Optimality of the EDF and LST Algorithms, Non optimality of the EDF and LST Algorithms,
Challenging in Validating Timing Constraints in Priority-Driven Systems, Off-Line versus On-Line Scheduling.

Unit III: Clock-Driven Scheduling: Notation and Assumptions, Static, Timer Driven Scheduler, General Structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of Aperiodic Jobs, Scheduling Sporadic Jobs, Practical Consideration and Generalizations, Algorithms for Constructing
Static Schedules, Pros and Cons of Clock-Driven Scheduling.

Unit IV: Priority-Driven Scheduling of Periodic Tasks: Static Assumption, Fixed-Priority versus Dynamic-Priority Algorithms, Maximum Schedulable Utilization, Optimality of the RM and DM Algorithms, A Schedulability Test for Fixed-Priority Tasks with Short Response Times, Schedulability Test for Fixed-Priority
Tasks with Arbitrary Response Times, Sufficient Schedulability Conditions for the RM and DM Algorithms.

Unit V: Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumption and Approaches, Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth, and Weighted Fair Queuing Servers, Scheduling of Sporadic Jobs, Real-time Performance for Jobs with Soft Timing Constraints.

Unit VI: Resources and Resource Access Control: Effects of Resource Contention and Resource Access Control, Non preemptive Critical Sections, Basic Priority-Inheritance Protocol, Basic Priority-Ceiling Protocol, Stack-Based Priority-Ceiling (Ceiling- Priority) Protocol, Use of Priority-Ceiling Protocol in Dynamic- Priority Systems, Preemption-Ceiling Protocol, Controlling Accesses to Multiple-Unit Resources.

Text Book:
Jane W.S. Liu: Real-Time Systems, (Pearson Education).

Reference Books:
1. R Buhr and D Bailey “Introduction to Real-Time Systems” (Addison Wesley).
2. C. M. Krishna and K. G. Shin: Real-Time Systems, (McGraw-Hill), 1997.
3. Phillip A. Laplante: “Real-Time Systems Design and Analysis” (Wiley India).
4. K.V.K. Prasad “Embedded Real –Time Systems” (Wiley- India/ Dreamtech).

2RMEF4/4RME2 ELECTIVE NETWORK SECURITY

UNIT- I Introduction: Security, Attacks, Computer criminals, Method of Defense
Cryptography: Substitution ciphers, Transpositions, Symmetric and asymmetric systems, cryptanalysis ,data encryption standard (DES) AES Encryption algorithms Public Key Cryptography, RSA Algorithms , Uses of Encryptions.

UNIT- II Program Security: Secure programs, Non-malicious program errors, Computer Viruses and Other malicious code, Targeted malicious code, controls against program threats.

UNIT- III Operating System Security: Protected Objects and methods of protection, Memory address protection, Control of access to general objects, File protection Mechanism, User Authentication**:**
Authentication basics, Password, Biometrics,

UNIT- IV Trusted Operating System, Security Policies, models of Security, Trusted Operating System, Design, Design elements , security features of ordinary and Trusted Operating System, Kernalised design , separation , virtualizations , Layered design , typical OS Flows assurance method , Open Source Evolutions

UNIT- V Database Security: Security requirements for Database , Reliability and integrity, sensitive data, interface, multilevel database, Proposals for multilevel security : separations , design of Multilevel secure databases , Trusted Front-end Practical issues.

UNIT-VI Networks Security: Threats in networks, Network security controls, Firewalls Intrusion detection systems, Secure E-mail.
Administrating Security: Planning, Risk Analysis, Organization security policies, Physical security

Text Book:
C.P. Pfleeger and S.L.Pfleeger, “Security in Computing”, Pearson Education (LPE)

Reference Books:
1. Stallings, “Cryptography and Network Security:” Pearson Education (LPE)
2. Matt Bishop, “Computer Security: Art and Science”, Pearson Education
3. Kaufman, Perlman, Speciner, “Network Security” PHI.
4. Eric Malwald, “Network Security: A Beginner’s Guide”, TMH