

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
PET Syllabus(2016-17)
(Computer Science and IT)

Section A: Research Methodology

Unit I

Research Methodology an Introduction: What is Science, Computer Science, Computer Science objective and methods (Modeling, Theoretical, Experimental, Simulation, etc.), Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method.

Unit II

Overview of Research Domain in Computer Science: Signal & Image Processing, Pattern Recognition, Artificial Intelligence, Machine Learning, HCI, Computer Network & Parallel Computing, Geo Spatial Technology, Advanced Data Structure, Theory of Computation, Embed System and Robotics, Biometrics and Network Security, Data Mining& WareHousing.

Unit III

Research Design & Modeling: Literature Survey, Finding Research Papers, information gathering, How to select Research Topic, Reading and understanding research papers, Critical Reading, Evaluation of Paper, Developing a Literature Review, Formulating a Research Problem, Constructing Hypotheses, Research & Sampling Design

Unit IV

Empirical and deductive methods in computer science: Traditional Methods: Methods of Data Collection, Processing and Analysis of Data, Sampling Fundamentals, Testing of Hypotheses, Chi-square Test, Analysis of Variance and Covariance, Multivariate Analysis Techniques, Classification Technique, Validation, Interpretation of Data, Empirical and deductive methods

Computer Science Methods: Choosing or proposing a project, Commercial and economic considerations in CSIT research, CSIT industry and Professional Organization. Review of legal, ethical, social and professional (LSEP) issues including data protection and standards, Quality Research Strategies, Standard Measures & Parameters of research outcomes (impact factor, citation, various indexing parameters like I-index, H-index, P-index, i10-index, etc.), what is citation and how we can search citation?

Unit V

Technical Writing: Kinds of Publication, How to write the first draft, Research Proposal, Paper Writing Formats (IEEE, Springer, ACM, etc.), Presentation skills, Processing and Displaying Data, written and oral, referencing, bibliographies, Writing Ethics, Report Writing, Thesis Writing, Book Writing, Project Writing, Patent Writing, Plagiarism concept.

Section B: (Core Subjects)

Unit-I

Digital Electronics and Microprocessor: Combinational Circuit Design, Sequential Circuit Design, Hardwired and Micro programmed processor design, Instruction formats, Addressing modes, Memory types and organisation, interfacing peripheral devices, interrupts. Microprocessor architecture, Instruction set and Programming (8086, P-III/P-IV), (8051 Microcontroller), Microprocessor & microcontroller applications.

Data Communication and Network : Analog and Digital transmission, Asynchronous and Synchronous transmission, Transmission media, Multiplexing and Concentration, Switching techniques, Polling. Topologies, Networking Devices, OSI Reference Model, Protocols for-(i) Data link layer, (ii) Network layer, and (iii) Transport layer, TCP/IP protocols, Networks security, Network administration.

Computer Graphics: Display systems, Input devices, 2D Geometry, Graphic operations, 3D Graphics, Transformations, Clipping, Animation, Graphic standard, Scan Conversion, Shading, Curves and surfaces, Solid and Colour modelling

Unit-II

Programming language concepts: Paradigms and Models. Data, Data types, Operators, Expressions, Assignment, Flow of Control-Control structures, I/O statements, User-defined and built-in functions, Parameter passing. Principles, classes, inheritance, class hierarchies, polymorphism, dynamic binding, reference semantics and their implementation. Principles, functions, lists, types and polymorphisms, higher order functions, lazy evaluation, equations and pattern matching. Principles, horn clauses and their execution, logical variables, relations, data structures, controlling the search order,

Object, messages, encapsulation, aggregation, abstract classes generalization as extension and restriction, Object oriented design. Multiple inheritance, metadata.

HTML, DHTML, XML, Scripting, Java, Servlets, Applets.

Principles of parallelism, Architecture of parallel system, co-routines, communication and execution, Parallel Virtual Machine (PVM) and Message Passing Interface (MPI) routines and calls. Parallel programs in PVM paradigm as well as MPI paradigm for simple problems like matrix multiplication.

Preconditions, post-conditions, axiomatic approach for semantics, correctness, de-notational semantics.

Theory of Computation: Formal language, Need for formal computational models, Non-computational problems, diagonal argument and Russel's paradox. Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA), Regular languages and regular sets. Equivalence of DFA and NFA. Minimizing the number of states of a DFA. Non-regular languages and Pumping lemma. Pushdown Automata (PDA), Deterministic Pushdown Automata (DPDA), Non-equivalence of PDA and DPDA. Context free Grammars: Greibach

Normal Form (GNF) and Chomsky Normal Form (CNF), Ambiguity, Parse Tree Representation of Derivations, Equivalence of PDA's and CFG's. Parsing techniques for parsing of general CFG's-Early's, Cook-Kassami-Younger (CKY) and Tomita's parsing. Linear Bounded Automata (LBA): Power of LBA. Closure properties.

Turing Machine (TM): One tape, multi-tape. The notions of time and space complexity in terms of TM, Construction of TM for simple problems. Computational complexity. Chomsky Hierarchy of languages: Recursive and recursively-enumerable languages.

Compiler structure, compiler construction tools, compilation phases. Finite Automata, and languages accepted by these structures. Grammars, Languages-types of grammars-type 0, type 1, type 2 and type 3. The relationship between types of grammars and finite machines. Lexical Analysis, regular expressions and regular languages, LEX package on Unix. Conversion of NFA to DFA. Compilation and Interpretation. Bootstrap compilers. Representation of parse (derivation) trees as rightmost and leftmost derivations. Bottom up parsers-shift reduce, operator precedence and LR, YACC package on Unix system. Top-down parsers-left recursion and its removal. Recursive descent parser, Predictive parser, Intermediate codes-Quadruples, triples, Intermediate code generation, code generation, Code optimization.

Unit III

Operating System: Introduction to Operating System, Memory Management, Virtual Memory Management, Support for Concurrent Process, Process management, Scheduling, System Deadlock, Multiprogramming System, I/O Management, Distributed Operating Systems, Synchronization Techniques.

Linux : Operating System, Structure of Linux Operating System , Linux Commands, Kernel Modules, Process Management (Fork, exec, PID, etc), File System, System Calls, filtering, Shell Programming

Windows : Windows Environment, Unicode, Documents and Views, Drawing in a Window, message handling, Scrolling and Splitting views, Docking toolbars and Status Bars, Common dialogs and Controls, MDI, OLE, Active X Controls, ATL, Database access, Network Programming.

Multithreading: using Windows and OpenMP.

Linear Programming:

Problem (LPP) in the standard form, LPP in canonical form, Conversion of LPP in standard form to LPP in Canonical form Simplex-Prevention of cyclic computations in Simplex and Tableau, Big Method, dual simplex and revised simplex. Complexity of simplex algorithm(s) Exponential behaviour of simplex. Ellipsoid method and karmakar's method for solving LPPs, Solving simple LPPs through these methods. Comparison of complexity of these methods. Assignment and Transportation Problems : Simple algorithms like Hungarian method, etc.

Shortest Path Problems : Dijkstra's and Moore's method, Complexity.

Network Flow Problem : Formulation, Max-Flow Min-Cut theorem, Ford and Fulkerson's algorithm. Exponential behaviour of Ford and Fulkerson's algorithm, Malhotra-Pramodkumar-Maheshwari (MPM) Polynomial algorithm for solving Network flow problem. Bipartite Graphs and matching's; Solving matching problems using Network flow problems.

Matroids : Definition, Graphic and Cographic matroids, Matroid intersection problem.

Non-Linear programming : Kuhn-Tucker conditions, Convex functions and Convex regions, Convex programming problems, Algorithms for solving convex programming problems-Rate of convergence of iterative methods for solving these problems.

Unit IV

Database Management System: Database Concepts, ER diagrams, Data Models, Design of Relational Database, Normalisation, SQL and QBE, Query Processing and Optimisation, Centralised and Distributed Database, Security, Concurrency and Recovery in Centralised and Distributed Database Systems, Object Oriented Database, Management Systems (Concepts, Composite objects, Integration with RDBMS applications).

Data Structures: Definition, Simple and Composite structures, Arrays, Lists, Stacks, Queues, Priority queues, Binary trees, B-trees, Graphs. Sorting and Searching Algorithms, Analysis of Algorithms, Interpolation and Binary Search, Asymptotic notations-big Ohm, omega and theta. Average case analysis of simple programs like finding of a maximum of n elements, Recursion and its systematic removal. Quicksort-Non-recursive implementation with minimal stack storage. Design of Algorithms (Divide and Conquer, Greedy method, Dynamic programming, Back tracking, Branch and Bound). Lower bound theory, Non-deterministic algorithm-Non-deterministic programming constructs. Simple non-deterministic programs. NP-hard and NP-complete problems.

Advanced Software Engineering :Software development models, Requirement analysis and specifications. Software design, Programming techniques and tools, Software Testing ,Software validation and quality assurance techniques, Software maintenance and advanced concepts, Software project management.

Object Oriented Software Concepts: An Overview of UML, Use Case Diagrams Class Diagrams, Interaction Diagrams, State Machine Diagrams, Activity Diagrams. Modeling Concepts: Systems, Models, Views, Data Types, Abstract Data Types, and Instances,Classes, Abstract Classes, and Objects, Event Classes, Events, and Messages,Object-Oriented Modeling, Falsification and Prototyping . Software development models, Requirement analysis and specifications. Software design, Programming techniques and tools, Software validation and quality assurance techniques, Software maintenance and advanced concepts, Software management.

Unit V

Artificial Intelligence Foundations: Definitions, AI approach for solving problems. Automated Reasoning with propositional logic and predicate logic fundamental proof procedure, refutation, resolution, refinements to resolution (ordering/pruning/restriction strategies). State space representation of problems, bounding functions, breadth first, depth first, A, A*, AO*, etc. Performance comparison of various search techniques. Frames, scripts, semantic nets, production systems, procedural representations, Knowledge representation and Acquisition techniques.

Neural Networks: Introduction to Neural Networks, foundation for connectionist network, Perceptron model, Linear Separability and XOR problem. Two and three layered neural nets, Backpropagation-Convergence, Hopfield nets, Neural net learning and Applications. Fuzzy Systems: Definition of a Fuzzy set, Fuzzy relations, Fuzzy functions, Fuzzy measures, Fuzzy reasoning and applications of Fuzzy systems. Information Theory Foundations

Models for Information Channel: Discrete Memory less Channel, Binary Symmetric Channel (BSC), Burst Channel, Bit-error rates. Probability, Entropy and Shannon's measure of

information, Mutual information, Channel capacity theorem, Rate and optimality of Information transmission.

Variable Length Codes: Prefix Codes, Huffman Codes, Lempel-Ziv (LZ) Codes, Optimality of these codes, Information content of these codes.

Error Detecting and Correcting Codes: Finite fields, Hamming distance, Bounds of codes, Linear (Parity Check) codes, Parity check matrix, Generator matrix. Decoding of linear codes and Hamming codes.

Image Processing Foundations: Image Registration, Spatial Fourier transforms, Discrete Spatial (2-dimensional) Fourier Transforms, Restoration and Lossy Compression of images (pictures).

Data Compression Techniques: Representation and compression of text, picture and video files (based on the JPEG and MPEG standards)

Mobile Computing: Mobile connectivity-Cells, Framework, wireless delivery technology and switching methods, mobile information access devices, mobile data internetworking standards, cellular data communication protocols, mobile computing applications, Mobile database protocols, scope, tools and technology, M-business.

Data warehousing and Mining Foundations :

Data Warehousing: Data Warehouse environment , architecture of a data warehouse methodology, analysis, design, construction and administration. Data Warehousing Concepts, Types of Digital documents, Issues behind document Infrastructure, Corporate data Warehouses.

Data Mining: Extracting models and patterns from large databases, data mining techniques, classification, regression, clustering, summarization, dependency modelling, link analysis, sequencing analysis, mining scientific and business data.

Software Agents: Characteristics and Properties of Agents, Technology behind Software Agents (Applets, Browsers and Software Agents).



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