Dr. Babasaheb Ambedkar Marathwada University,
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Ph.D. Entrance Test Syllabus
Computer Engineering

Paper I		Research Methodology
Unit – I	:	**Research Problems and Research Design** Meaning of research, types of research, steps in involved in research process, criteria of good research, importance of ethics in research, codes and policies for research ethics. Selection of research problem, steps involved in defining research problem, need for research design, types of research designs, basic principles of experimental design, formal and informal experimental design.
Unit – II	:	**Sampling Design** Need for sampling, steps in sampling design, different types of sampling designs, sampling distributions, concept of central limit and standard error, sources of errors, population mean and proportion, sample size calculations, tests of measurements for validity, reliability and practicality
Unit –III	:	**Data Collection, Processing and Analysis** Meaning and Need for Data, Primary and Secondary Data, Sources of Secondary Data, Documentary Sources of Data, Electronic Sources, Precautions in Using Secondary Data, Merits and Limitations of Secondary Data, Methods for collection of Data, Data processing operations, statistics in research, confidence level, measures of central tendency, Spearman's and Pearson's coefficient of correlation, simple & multiple regression analysis, analysis of variance, Meaning and History of Probability, Probability Rules, Bayes' Theorem, Types of Probability Distribution, Random Variables, Discrete Probability Distribution, Binomial Distribution, Poisson Distribution, Continuous Probability Distribution, Normal Distribution
Unit – IV	:	**Hypothesis Test & Report Writing** Hypothesis- Meaning of Hypothesis, Types of Hypothesis, Criteria for Workable Hypothesis, Stages in Hypothesis, Testing of Hypothesis, Uses of Hypothesis, Research Design-Functions of Research Design, Components of a Research Design Interval

		Estimation, Confidence Limits, Confidence Interval and Confidence Co-efficient, Testing Hypothesis, Level of Significance, Type-I and Type-II Errors and Power of a Test, Two-tailed and One-tailed Tests, Student's t-distribution, t-test, Chi-Square Test, significance of research report writing, types of reports, structure of the research report, steps in report writing, precautions and ethics in writing report.
Unit – V	:	**Intellectual Property Rights** Origin and evolution of IPR to its present form and use, Different Tools of IPR and what is the nature of these rights, Balancing Rights and Responsibilities, Societal implications of IPR, Concept of inventions/discoveries, patents protect, benchmarks for patentability of inventions, Exceptions to patentability, Patenting issues in computer based inventions, process to apply for patents in India and in other countries, steps to granting of a patent, Opposing grant of a patent, term of a patent, rights of a patent holder, challenging validity of a patent licensing of patent rights, using patent rights in the market place.
Reference Books	:	1. Research Methodology: Methods and Techniques, Second Edition, New Age International publishers by C.R. Kothari 2. The Craft of Research by Wyne C. Booth, Colomb, William, University 3. Research Methods and Statistics, Pearson Education by Bernard C. Beins & Maureen A. McCarthy 4. Intellectual Property Rights-Unleashing the Knowledge Economy, Tata Mc GrawHill, by Ganguli Prabuddha

	Paper - II	
Sr. No.	Chapter Name	
1	Unit - I	**Data Structure and Algorithm, Programing Languages** Complexity of algorithm, analyzing algorithm, Asymptotic notations Linear data structures – Array, stack, queue, Linked list Non-linear data structures – Tree, Graph Searching, Sorting and hashing algorithms Language Design and Translation Issues: Programming Language Concepts, Paradigms and Models, Programming Environments, Virtual Computers and Binding Times, Programming Language Syntax, Stages in Translation, Formal Transition Models. Reference books 1. Data structures using C : Tenenbaum, Aaron M 2. Concepts of Programming Languages, Robert W. Sebesta
2	Unit- II	**Computer Network, Cryptography and Network Security** Overview of Networking: Definition, uses, and history of computer networks, Network Models: OSI and TCP/IP models, Types of Networks: LAN, WAN, MAN, PAN, Network Topologies: Star, Ring, Bus, Mesh, Hybrid, Networking Devices: Routers, Switches, Hubs, Bridges, and Gateways. Transmission Media: Wired (Coaxial, Twisted Pair, Fiber Optics) and Wireless (Wi-Fi, Bluetooth), Switching Techniques: Circuit, Packet, and Message Switching, Routing Algorithms: Distance Vector, Link State, Path Vector, RIP, OSPF, BGP, Transport Layer Protocols: TCP, UDP, Flow Control, Congestion Control, Application Layer Protocols: HTTP, FTP, SMTP, DNS, DHCP, Classical Cryptography: Caesar Cipher, Monoalphabetic Cipher, Vigenère Cipher, Symmetric Key Cryptography: DES, 3DES, AES, Block Cipher Modes of Operation, Asymmetric Key Cryptography: RSA, Diffie-Hellman, ElGamal., Cryptographic Hash

			Functions: MD5, SHA-1, SHA-256, HMAC, Digital Signatures: RSA, DSA, Elliptic Curve Digital Signature Algorithm (ECDSA), Public Key Infrastructure (PKI): Certificates, Certificate Authorities, Trust Models.
			Reference books
			1. Computer Network: Tenenbaum, Andrew S 2. Cryptography and Network Security: Principles and Practice, by William Stallings. (3rd edition)
3	**Unit - III**		AI and Machine Learning, IP AI and Machine Learning, Problem Solving: Uninformed search, Informed search, local Search, Online search; Knowledge and Reasoning: Propositional and Predicate Calculus, Semantic Nets, Frames, Scripts, Probabilistic Reasoning Learning: Introduction to machine learning paradigms: unsupervised, supervised, reinforcement learning, Naive Bayes, Decision Tree, Fundamental of Neural Networks and Deep Learning Evolutionary Computation: Genetic algorithms, Multi objective optimization, Differential Evolution, Particle Swarm and Ant Colony Optimization linear regression, logistic regression ML Techniques overview, Validation Techniques (Cross-Validations) Dimensionality reduction, Principal components analysis (Eigen values, Eigen vectors, Orthogonality) Clustering - Distance measures, Different clustering methods (Distance, Density, Hierarchical), Iterative distance-based clustering; Dealing with continuous, categorical values in K-Means, Constructing a hierarchical cluster, K-Medoids, k-Mode and density-based clustering, Measures of quality of clustering Classification - Naïve Bayes Classifier, K-Nearest Neighbors, Support Vector Machines, Decision Trees, Ensembles methods Association Rule mining Reference books: 1. S. Russel and P. Norvig. Artificial Intelligence: A Modern Approach (Third Edition), Prentice Hall, 2009 2. T. Mitchell. Machine Learning. McGraw-Hill, 1997.

		3. A. K. Jain and R. C. Dubes. Algorithms for Clustering Data. Prentice Hall, 1988
		Image Processing
		Introduction to Digital Image Processing & Applications, Sampling, Quantization, Basic Relationship between Pixels, Imaging Geometry, Image Transforms, Image Enhancement, Image Restoration, Image Segmentation, Morphological Image Processing, Shape Representation and Description, Object Recognition and Image Understanding, Texture Image Analysis, Motion Picture Analysis, Image Data Compression
		Reference books
		1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson
		2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall
4	Unit - VI	**Computer Architecture and Operating System**
		Basics of Computer Architecture: Definitions, Historical Development, Von Neumann Architecture: Components and Operation, Performance Metrics: Throughput, Latency, CPI, MIPS, Instruction Set Architecture (ISA): RISC vs. CISC, Addressing Modes, Instruction Formats, Data Representation: Binary, Hexadecimal, Floating Point, Character Encoding, CPU Organization: ALU, Control Unit, Registers, Buses, Instruction Cycle: Fetch, Decode, Execute, Memory Access, Write Back, Pipelining: Concepts, Hazards (Data, Control, Structural), Hazard Mitigation Techniques, Superscalar and VLIW Architectures: Out-of-Order Execution, Speculative Execution, Multithreading: Simultaneous Multithreading (SMT), Hyper-Threading, CPU Scheduling: Scheduling Criteria, Algorithms (FCFS, SJF, Priority, Round-Robin, Multilevel Queue), Process Synchronization: Critical Section Problem, Semaphores, Mutexes, Monitors, Deadlocks: Conditions, Deadlock Prevention, Avoidance (Banker's Algorithm), Detection, Recovery, Inter-process

		Communication (IPC): Pipes, Message Queues, Shared Memory, Sockets. Refernce Book 1. Computer organization and architecture by William Stallings. 2. Operating System Concepts" by Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne
5	**Unit - V**	DBMS and Data Science. Database System Concepts and Architecture: Data Models, Schemas, and Instances; Three-Schema Architecture and Data Independence; Database Languages and Interfaces; Centralized and Client/Server Architectures for DBMS. Data Modeling: Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations and Dealing with Constraint Violations; Relational Algebra and Relational Calculus; Codd Rules. SQL: Data Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection. Normalization for Relational Databases: Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Object and Object-Relational DatabasesData Warehousing and Data Mining: Data Modeling for Data Warehouses, Concept Hierarchy, OLAP and OLTP; Association Rules, Classification, Clustering, Regression, Support Vector Machine, K-Nearest Neighbour, Hidden Markov Model, Summarization, Dependency Modeling, Link Analysis, Sequencing Analysis, Social Network Analysis. Big Data Systems: Big Data Characteristics, Types of Big Data, Big Data Architecture, Introduction to Map-Reduce and Hadoop; Distributed File System, HDFS. NOSQL: NOSQL and Query Optimization; Different NOSQL Products, Querying and Managing NOSQL; Indexing and Ordering Data Sets; NOSQL in Cloud. Data Science Information Gain and Entropy, Probability Theory, Probability Types, Probability distribution functions, Bayes Theorem, Inferential Statistics, data retrieval, data

		analysis, Linear Regression, Logistic Regression, Multinomial Logistic Regression, Decision Trees, Naive Bays, SVM, Clustering.
		Reference books
		Fundamentals of Data Science, Dr. Aijaz Ali Khan,Anita Rani Mehta,Vandana Ahuja,Dr. S. Thilagamani
		Database System The Complete Book by Hector Garcia- Monila, Jennifer Widom and Jeffrey D. Ullman.