Pre Ph.D. Eligibility Test Syllabus : Computer Applications

UNIT – I:

Introduction to Computing and It's Applications

Computer System, Classification of computers, Transistors, Integrated Circuits(LSI, VLSI), Operation of processor, Number System, Digital Circuits, ALU, Memory Chips(RAM, ROM, DRAM), storage Devices, Memory Hierarchy, I/O Devices, Bus System, Operating System: Windows and Linux, Network communication infrastructure, Protocols, Wireless LAN Mobile Computing, Web Technology, The Internetand Intranet, WWW, Java fundamentals, Multimedia Application, e-Commerce.

Business Data Processing and File Systems

Basic Ideas of the System: System and its Characteristics, Introduction Systems and Technology, Business system, data processing and technology, Business System Context, Environment. Framework for a system in Business, Role of IT in Business Data Processing. System Related Challenges for Business: Improving Business Processes. Benefiting from Trends and Innovations, Maximizing Benefit from Information, Extending Human Skills, Extracting the most from Surrounding Infrastructure, responding to System related Risk, Building and Maintaining Systems, Analyzing System in Business Terms: Need for Framework and Models, Business and BP as System, IS and Business Processes, Analyzing IS and Business Point of View, Strategy for Analyzing, Description and Evaluation of B-Process Architecture, Linking B-Process and Product Performances, Evaluation of B-Process Performances, Evaluation of B-Product Performances, Information Technology in Business, Information and its Determinations. IT and its Functions, IT Trend and Limitations, IT Performance Variable, Computer System Architecture and Trend, Software and Programming, Programming as a B-Process, Major Developments in Programming, Structured Programming, Principles and Techniques of Programming, Program Planning Tools, Testing and Verification, File System and BDP tools, File and other Structures, File Type, Organization and Operations, File Management, Introduction to Suitable BDP tools.

UNIT – II:

Mathematical Foundation

Discrete structures and Significance, Fundamental Discrete Structure, Sets, Sequences, Product Set, Relation and Computing Significance, Permutation, Combination, Recurrence Relations, Fundamental proof Techniques, Partial Orders and Poset, External Elements Lattices, Finite Boolean Algebras, Boolean Function and Polynomial, Propositions, Logical Connectives and Operation, Conditionals, Bi-conditionals, Contradiction, Contrapositive. Tautology, contingency and Contradiction, Transformation to Propositional Forms Reasoning Using Equivalence Transformation. Rules of Substitution and Inferences, Normal Forms: DNF, CNF, PDNF, PCNF, Graph, it's types and Computing Significance, Graph as a DATA Structure, Eulerian and Hamiltonian Paths, and Circuits. Alphabets, Strings and Languages, Discrete Automation.

Statistical Techniques

Probability and Probability Distributions Various definition of Probability, Additive and Multiplicative theorems, Independent event, Probability distribution, Mathematical expectation, Additive and Multiplicative theorems of expectation, Binomial, Poisson and Normal distributions, Fitting of probability distributions. Descriptive Statistics Measure of central tendency, Dispersion, Measures of dispersion, Moments. Product moment correlation coefficient, Rank correlation, Linear regression, Properties of regression coefficient, Multiple linear regression. Numerical Methods Transcendental and Polynomial Equation: Iterative method, Regula-Falsi method. Newton-Raphson method, Roots of Polynomial: Graeffe's and Bairstow methods, Solution of system of linear algebraic equations: Gauss

elimination, Gauss-Jordan method, Data fitting, Method of least squares. Tests of Significance Null and alternative hypotheses, one tail and two tail tests, Two types of error. Large sample tests, Small sample tests: Test of single mean, test of equality of two means, Paired test, Test of goodness of fit, test of independence of attributes, test of variance. Sampling Techniques and Analysis of Variance Sampling and Complete enumeration, Simple random sampling, Stratified random sampling, Proportional and Optimum allocations ANOVA: One way and two way classifications.

UNIT – III:

Programming in C Language

Algorithms and Flow-charts, Programming Languages, Compilation, Linking, Testing, Debugging and Documentation. Introduction to C language; Character set, Variables and Identifiers, Built in data type, Arithmetic operator and expression, Constant and Literals, Relational operator and logical connectivity, Sample assignment statement, Basic Input/ Output statement, Simple C program, Conditional statement and loops. Decision making within a program, Different conditional statement in C, Looping statement in C, Structured programming, Nested loop, Infinite loop. Array and Pointer, Static and Dynamic memory allocation, Function: Modular programming and Functions, Structure, Union and File system, Graphics in C.

Data Structure and Program Design

Basic Concepts of Data Representation: Abstract Data Types, Fundamental and Derived Data Types, Representation and Implementation, Different Data Structures, Algorithm Design and Comparison Algorithm. Array and Linked Lists: Representation of arrays and Linked Lists, Comparison of Array and Linked List. Stacks and Queues: Representation of Stack and Queues (Dynamic and Static), Operation on Stack and Queues, Applications of Stack and Queues. Trees: Representation of Trees (Static and Dynamic), Different types of trees, Operations on Trees, Tree Construction, Application of Trees. Searching And Sorting: Different method of Searching, Comparison of Different Searching Method, Different Methods of Sorting, Comparison of Different method of Representation, Operations of Graph, Minimal Spanning tree Algorithm, Shortest Path Algorithm.

Design and Analysis of Algorithm

Introduction: Algorithm, Performance Evaluation of Algorithms, Space & Time Complexity, Nation of Optimality. Divide & Conquer: Finding the Maximum & Minimum – Quick Sort – Selection – Stassen's Matrix Multiplication, etc. Greedy Algorithm: Knapsack Problem, (1 Knapsack, Fractional Knapsack), Activity Section Problem. Huffman's Codes, Minimum Spanning Tree, Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Algorithm, etc. Dynamic Programming: Knapsack Problem DP Solution, Activity Selection Problem DP Solution, All Pairs Shortest Paths, Travelling Salesman Problem. Randomized Algorithms & Amortized Analysis: Basic ideas of Randomized Algorithms (Las Vegas & Monte Carlo types). Simple examples (Randomized Quick Sort and it's analysis, Min – Cut Algorithm and it's Analysis), Amortized Analysis and its significance (Illustration through examples). Graph Algorithms: Breadth First Search (BFS), Depth First Search (DFS), Strongly Connected Components, Euler Tour, Minimum Spanning Tree, Kruskal's Algorithm, Prim's Algorithm, Single Source Shortest Path. Introduction to NP - Completeness: Basic Concepts.

UNIT – IV:

Object Oriented Programming

Introduce to Java, Java Buzzworld Data type and Variable, Operators, Control Statements, Arrays, Methods, Recursion, Constructors, This and Find keywords, Garbage collection, Object-Oriented Programming. Introduction Objects, Superclass's and Subclasses. Protected Members.

Relationship between superclass Object and Subclass Objects. Constructors and finalizes in Subclasses. Encapsulation. Inheritance, Polymorphism, Packages and Interfaces, Example of Packages and Interfaces. Exception Handling and Multithreading, Exception Types, Uncaught Exceptions. Using Try and Catch Nested Try Statement, Throw, Throws, finally. Java Thread Model, Thread Priorities, Synchronization, Main Thread. Advance Java. Overview of JDBC, Applets, Servers, Java Beans, EJB. Different types of Drivers. Jar files. Java Security Tools.

Object Oriented Analysis and Design

Introduction: Object oriented approach, its features & significance, S/W Complexity & its causes, S/W Crisis & the related issues need to be resolved. Modeling: Object Modeling: Objects & Classes, Links & Associations, Generalization & inheritance, Grouping Constructs, Advanced Objects Modeling Aggregation, abstract classes, multiple inheritance, Meta Data, Candidate Keys and Constraints. Dynamic Modeling: Events & states, operations, nested state diagram, concurrency. Functional Modeling: DFDS, specifying operation, constraints, Analysis and System design: Analysis: Object Modeling, Functional Modeling adding operations, iteration, System design: Subsystem, Concurrency, Allocation to processors and takes, management of data stores, control implementation, Boundary condition, Architectural framework, Object Design, Optimization, Implementation of control, Adjustment of inheritance, Design of associations, documentation, comparison of methodologies, Implementation: Using a programming language, using a database system, Programming styles: Object Oriented Style: Reusability, extensibility, robustness and Programming-in-the-language.

UNIT – V:

Database Management System

Database: Concept, Comparative view, goals etc. Data Independence, Consistency, Security & Integrity. DBMS models: Hierarchical, Relational and Network; Structured Query Language and Programming Interface; Database design and architecture: DBMS Applications: ORACLE/DB2/Progress/any other; Introduction to Distributed Database, Concurrency control and recovery, Assorted Topics in Database.

UNIT – VI:

Operating System

Definition, Components & types of Operating System, Operating System Services, System Calls, System Programs, System Structure, System Design & Implementation, System Generations. I/O Subsystem Overview, I/O H/R. Application I/O Interface, Kernel I/O Subsystem, Linux User & Program Interface. Process Concepts, Process State & Process Control Block, Process Scheduling. Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real Time Scheduling, Threads Introduction, Multithreading Models, Example System – Process Management in Linux. The Critical Sections Problem, Semaphores, Classical Problem of Synchronization, Example System-Inter Process, Communication in Linux, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined Approach to Deadlock. Storage Management, Logical versus Physical Address Space, Swapping, Contiguous Allocating, Paging, Segmentation, Segmentation with Paging, Virtual Memory, Demand Paging, Performance of Demand Paging, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing, Demand Segmentation, Example System Memory Management in Linux. Disk Scheduling, Disk Management, Swap Space Management, Disk Reliability, Stable Storage Implementation, File Concepts, Directory Structure, Protection File System in Linux.

Distributed System

Fundamentals: Definitions, Evolution of distributed computing system, Distributed Computing System

Models, Distributed Operating System, Designing a distributed Operating System, Introduction of distributed computing environment. Message Passing: Introduction Desirable features, Issues in IPC by message passing, synchronization, Buffering, Multi datagram messages, encoding and decoding message data. Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC mechanism, RPC message server management, parameter – passing and call semantic, Communication protocols for RPC's. Distributed Shared Memory: Introduction, Architecture of DSM Systems Design and implementation, granularly, structure of shared memory space consistency models, replacement strategy, Threashing Resource Management: Desirable feature, Task assignment approach, Load-balancing approach, Load sharing approach. Process Management: Process Migration, Threads Distributed File Systems: Intakes, Desirable features, File Models, File accessing models, file-sharing semantic, file- caching schemes, file replication Fault tolerance, Automatic Transactions, Design principle

UNIT – VII:

Computer Networks

Introduction to Computer Networks: Evolution of Computer Networks, Networks Goals, User & Applications, Network H/R and S/R; Protocol Hierarchies, Design Issues for the Layer, Reference Models, OSI & TCP/IP – Example Networks – Internal. Fundamentals of Data Transmission: Data Transmission System & Operations, Encoding, Standard Encoding Schemes, Transmission Media, Magnetic Media, Twisted wire-pair, Co-axial Cables, Fibre Optics, Wireless Media-Ratio & Microwave Transmission, Switching Message, Circuit & Packet Switching, Serial & Parallel Transmission – Asynchronous and Synchronous Transmission. The Data Link Layer: Need for Data Link Control, Service provided by the Data Link Layer. Frame Design Consideration. Flow Control Mechanism. Data Link Error Control, Error Control in Stop-and-Stop Mechanism & Sliding Windows Mechanism, Sequence Numbering. Piggybacking Acknowledgement. MAC layer& It's Different Protocols.

IEEE 802.3 Ethernet: Contention Access, CSMA, CSMA/CD, Physical Topology of Ethernet, Ethernet Repeater, Types of Ethernet. Bridges & Switches: LAN Bridge, Transparent Bridges, Spanning Tree Algorithm, Ethernet Switches. The Network layer: Network Layer Design Issue, Purpose of Network Layer, Functions of the Network Layer IP Address, Classful and Classless IP Address, NAT. Introduction to Internet Protocol: IPv4 & IPv6 Format, ARP, RARP, DHCP, ICMP. Routing Algorithms: Static Routing, Dynamic Routing, Distance Vector Routing Algorithm, Router Information Protocol, Link State Routing, OSPF Routing Protocol, Border Gateway Protocol, Congestion Control by Chock Packet, QoS, Leaky Bucket and Token Bucket. Introduction to Application Layer: Difference between TCP & UDP, Port Number, TCP Connection – Three ways Handshaking, Connection Termination – Half Close, Half Open. Introduction to Application Layer: Introduction of DNS, Email, SMTP, POP3 etc. Congestion: Congestion Control Algorithms, General Principle of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual Circuit Subnet & Datagram, Techniques for achieving good quality of service (QoS).

Cryptography and Network Security

Introduction: The OSI Security Architecture, Security attack, Security services, Security Mechanism, A Model for Network Security. Symmetric Cipher: Classical Encryption Techniques, Symmetric Cipher Model, Block Cipher Principles, DES, Differential and Linear Cryptanalysis, Block Cipher Design Principle, The Euclidean Algorithm, Finite field of Form GP(p), Advance Encryption Standard (AES), AES Cipher, Multiple Encryption and Triple DES, Stream Cipher and RC4, Placement of Encryption Function, Traffic Confidentiality, Key Distribution, Random number generation. Public Key Encryption and Hash function: Fermat's & Euler's Theorems, The Chinese Remainder Theorem, RSA Algorithm, Deffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication

Code, Security of Hash Functions and MAACs, Secure Hash algorithm, Whirlpool, HMAC, CMAC, Digital Signature. Network Security Applications: Kerberos, X.509 Authentication Service, S/MIME, IP Security Architecture, Encapsulating Security Payload, Secure Socket Layer (SSL), Transport Layer Security, Secure Electronic Transaction. System Security: Intrusion Detection, Password Management, Virus Countermeasure, Denial of Service Attack, Firewall design Principles, Trusted System

Wireless Networks

Introduction : Why wireless, IEEE802.11 802.11 MAC Fundamentals: Challenges for MAC, Access Mode, Contention Based access using DCF, Fragmentation and reassembly, Frame Format, 802.11 graming in detail(DS bits, BSSID, RTS, CTS, Control frame, management frame), Contation based data service, Frame processing and bridging, 802.11 to Ethernet WEP: WEP cryptographic operations, WEP data processing, Problem with WEP, User Authentication with 802.Ix. 802.11i Robust security networks, TKIP and CCMP: Temporal key integrity protocol, Counter mode with CCB-MAC, Robust security network operation Management Operations: Association, power conservation, timer synchronization, spectrum management Contention free service with PCF. Physical Layer: Physical layer architecture, Radio Link, RF with 802.11, Frequency, GFSK, PLSP, DSSS, HR/DSSS. 802.11a and 802.11j (OFDM Phy), 802.11g(extended rate Phy), 802.11n: MIMO-OFDM Experiencing on 802.11 on windows OS, Linux 802.11 Access point: Functions of AP, Power over Ethernet, Selecting AP. Security Architecture: Authentication and Access Point, Ensuring secrecy through encryption, selecting security protocols. Site Planning and Project Management : Network Requirement, PHY layer selection and design, Planning placing AP, Using Antennas to tailor Coverage. 802.11 Network analysis, 802.11 performance running

UNIT – VIII:

Software Engineering

Software & Software Projects: Concept of Program, Concept of Software Product & Types of Software, Concept of Software based system, Evolution of Software Engineering, Software Process, People & project, System Development Life Cycle (SDLC). Software Standards & Software Models: SEI – Capability Maturity Model, ISO, OMG, CORBA, IEEE, ANSI, Linear Sequential Model (Water Fall), Evolutionary model, Proto Typing Model, Spiral Model. Software Project Management: Initial Requirement Analysis, System Modeling, Function Point Analysis, Project Scheduling Gantt Chart, Project Estimation COCOMO, Project Control PERT, Risk Management, Software Team, Life Cycle Model Selection. Software Requirement Analysis: Functional Requirement, Non Functional Requirements, Requirement Gathering, Fact Finding Methods, Requirement Verification & Validation, Requirement Specification (SRS). Software Design: Design tools- UML, DFD, VTOC, HIPO, ERD, System Architecture Design, Object Oriented Design using UML tools, Coupling & Cohesion, System structure/modular design, Data Design (ERD), Process Design, I/O Design, User Interface Design, System Interface Design. Software Coding: Code Review, Code Documentation, Code Optimization.
Software Testing: Concept of Software Testing, Testing Strategies (Black Box & White Box), Testing methods (Coverage based Mutation Test), Test Cases (Test System), Alpha Test & Beta Test.
Software Implementation: Implementation Plan, Deployment Diagram, Implementation Method.
Software Quality Assurances: Software Reliability, Software Quality Standards, Software Quality Attributes. Software Maintenance: Perfective Maintenance, Corrective Maintenance, Adaptive Maintenance. Software Change Management: Software Configuration Item, Baseline, Software Change Implementation, Software Change Control, Software Re-Engineering, Clean Room Software Engineering.

Management & Information System

Management System: Types of Management System, Management System Requirement, Anagement

level Management Functions & Business Process: Sale and Order Processing, Finance & Budgeting, Human Resource Management, Production Plan & Control, Marketing Portfolio & IT Application: Portfolio Management Concept, Portfolio Management Method, Design & Implementation of Portfolio Management, Tools & Techniques. Enterprise Resource Plan (ERP) : Evolution of Enterprise Information System, Concept of ERP, Supply Chain Management, Customer Relationship Management, ERP Design & Implementation, ERP Tools: SAP, iCUBE

UNIT – IX:

Web Technology

Web Programming : Concept of JDBC (Java Database Connectivity), Working with SQL, Stored Procedure, Security in Java, Class Loader, Byte Code Verification, Security Manager and Permission, Digital Signatures, Code Signing, Encryption Introduction to J2EE: Its advantage, Enterprise Architecture Types, Understanding EJB, its architecture, EJB Roles, Benefits and limitations of Enterprise Beans, Session Beans: Stateful and Stateless Beans, Entity Beans, Beans Managed Persistence, Container Managed Persistance. Advanced Web Technology in J2EE: Understanding Directory Services and JNDI, Introduction to LDAP, LDAP Operation, Working with LDAP Server, Introduction to Web Containers and Web Applications, Introduction to HTTP Protocol, Web Application Life Cycle. Creating Web Applications: Understanding Servlet programming, Its life cycle, Servlet Configuration, Understanding Servlet sessions, Understanding of JSP and JSTL, JSP documents, Elements, tag extensions, tag libraries, validation, translation time mechanism, translation-time classes, Understanding JavaServer Pages, Standard Tag Library, tags in JSTL, core tag library, XML tag library, using Internationalization Actions. Web Application Deployment and Authentication: Enterprise Application Development Process, Deploying Web Application, Understanding CLASSPATH, Securing Web Applications, basic authentication with JAX-RPC example, Client certification Authentication over HTTP/SSL.

Data and Web Mining

Introduction to data mining, need for data warehousing and data mining, application potential, keywords and techniques. Data Warehousing and Online analytical Processing (OLAP): Aggregation operations, models for data warehousing, star schema fact and dimension tables, conceptualisation of data warehouse and multidimensional databases, Relationship between warehouse and mining.
Data Mining And Primitives: Data preprocessing, data integration, data transformation, Definition and specification of a generic data mining task. Description of Data mining query language with examples.
Association Analysis: Different methods for mining association rules in transaction based databases.
Illustration of confidence and support. Multidimensional and multilevel association rules. Classification of Association rules. Association rule algorithms – A period and frequent pattern growth.
Classification and Prediction: Different classification algorithms. Use of genie index, decision tree induction, Bayesian classification, neural network technique of back propagation, fuzzy set theory and genetic algorithms Clustering: Partition based clustering, hierarchical clustering, model based clustering for continuous and Discrete data. Scalabilty of clustering algorithms. Parallel approaches for clustering. Web Mining: web usage mining, web content mining, web log attributes. Data mining issues in object oriented data bases, spatial data bases and multimedia databases and text data bases.

UNIT – X:

Computer Architecture

Review of Number Systems; Combinational System, Switching algebra and logic circuits, Karnaugh map, Logic gates, simplification of expressions, implementation using gates, One bit Adder, One bit ALU(add sub, AND, OR), Encoders, multiplexers, Tri-state logic gates, Sequential System, Latches and Flip-Flops, Registers, Counters, Half-adders, Full-adders. Introduction to Computer Design:

Design levels, data paths, Registers, Busses. Instruction Set Design: Instructions Formats, Addressing Modes, Assembly Language, RISC Machine, Control Design. Hardwired and Microprogramming. Memory & I/O Memory organization, Cache Memory, Memory Management, I/O, Interrupts, DMA, Pipelining, Parallel Processor, Recent development in computer Architecture. Performance and Cost: Selecting Computers based on Benchmarks.

Parallel Computing

Introduction to Parallel Computing, Supercomputers and grand challenge problems, Modern Parallel Computers, Data Parallelism, Functional Parallelism, Pipelining and Data Clustering, Minsky Conjecture Performance Analysis : Introduction, SpeedUp, Super Linear Speedup and Efficiency, Arridahl's Law, Gustafson Law, Gustafson-Barsis's Law, The Karp-Flatt Metric, The Isoefficiency Metric, Isoefiiciency Relation, Cost and Scalability. Inter-Connection Networks: Tree, Diamond Network, Mesh, Linear Array, Ring, Star, Hypercube, Chordal ring, Cube-connected-cycles,Pefect Shuffle network, ILLIAC IV, Torus, Butterfly, Mesh-of-tree, Pyramid, Generalized Hyperbus, Twisted Cube Folded Hypercube, Incomplete Hypercube, Enhanced incomplete Hypercube, Cross Connected Cube, Bansyan Hypercube Parallel Computational Model : PRAM, CRCW, CREW EREW, Simulating CRCW on CREW &SREW, PRAM algorithms, P-Complete problems. Introduction to Parallel Algorithms: PVM,MPI Paradigms, Simple parallel programs in MPI/PVM environments, Parallel algorithms on network, Addition of Matrices, Multiplication of Matrices, Systolic Array.