DETAILED SYLLABUS FOR SCREENING TEST OF LECTURER 10+2 COMPUTER SCIENCES

SYLLABUS FOR SCREENING TEST OF LECTURER 10+2 COMPTUER SCIENCE

1. Computer Fundamentals and Applications

(i) Generation of Computers, PC Family of Computers, Different I/O devices; Introduction to Operating System, Overview of different Operating Systems, Functions of Operating System; Fundamentals of Disk Operating System (DOS), Understanding DOS prompt, Working with DOS commands, Config.sys and Autoexec.bat files.

(ii) Introduction to Windows, Working with Accessories (Notepad, WordPad and Paint); Personalizing Windows, Installing and Removing Applications; Boot Options and Concept of Registry.

(iii) Introduction to Office Tools: Word Processing, Advantages of Word Processing, Fundamentals of MS-Word, Working with Menus and Toolbars, Introduction to Macros. Overview of Excel, Working with Cells, Creating Worksheets, Working with Formulae Bar. Introduction to PowerPoint, Creating and Designing Slides, Working with Hyperlinks & Animation.

(iv) PC Management: Disc Management Tools, PC Tools, Norton Utilities, Disk Doctor; Introduction to Computer Security, Viruses, Virus Detection, Prevention & Cure Utilities. Using Internet: Shared Folders; Browsers, E-Mails, Attachments; Search Engines.

2. Programming Language Principles

(i) The role of Programming Languages : Towards Higher Level Languages programming paradigms, Language implementation, Language Description : Syntactic Structures, Expression Notations, Abstract Syntax Trees, Lexical Syntax, Context Free Grammars, Grammars for expression . Imperative Programming : Structured Programming, Syntax directed control flow, Design considerations, handling special cases in loops, programming with invariants , proof rules for partial correctness, control flow in C

(ii) Data Representation : The role of types, basic types, arrays , records, unions and variant records, Sets, Pointers, Two String Tables, Type and error checking. Procedure Activations : Introduction to Procedures, parameter passing methods, score rules for names, nested scope in source text, activation records, lexical scope : procedures as in C

Objected Oriented Programming : Constructs for program structuring, Information hiding, Program design and modules, modules and defined types, class declarations in C++, dynamic collection in C++, templates : Parameterized types, Implementation of Objects in C++ . Inheritance, derived classes and information hiding.

(iii) Functional Programming : Language of expressions, types, values and operations , approaches to expression evaluation, lexical scope, type checking, Function declaration by cases, Functions as first class values, Implicit types, data types exception handling, Scheme, a dialect of Lisp, the structure of lists, list manipulation, Simplification of Expressions. Logic Programming, Computing with relations, Introduction to Prolog, data structures in Prolog, Programming techniques, Controls in Prolog, Cuts

(iv) An introduction to concurrent Programming, Parallelism in Hardware, Streams : implicit synchronization, concurrency as interleaving, Liveliness properties, safe accesses to shared data concurrency in ADA. Language Description : Semantic Methods, Synthesized Attributes, Attribute Grammars, natural semantics, Denotational Semantics, Equality of Pure Lambda terms, Substitution revisited, Computation with pure lambda terms, programming constructs as lambda terms, the typed lambda calculus, polymorphic types.

3. Database Management Systems

(i) Elementary Database Concepts. Hierarchical, Relational, Network and OO Database Architectures and their comparison. Data Modeling. Relational model – Concept. Algebra and Constraints. Use of SQL as a Relational database language in data definition and query formulation.

(ii) Comparison of DBMS : MySQL, DB2, MS SQL Server, Oracle 8i/9i/10g – their strength and weaknesses. Summary of

Normalization techniques used with RDBMS – relative comparison and applications. Concept and use of indexes; Clustering – Effects on performance.

(iii) Database backup, recovery and management using Oracle RMAN. DBMS performance tuning; goals, principles & benchmarks. DBMS Storage management. Oracle Enterprise Manager: Console functions, Database Administration tools – DBA Studio. Oracle SQL * Net capability – architecture & operations.

(iv) Oracle Enterprise Security Manager – use authentication and privilege management. Integrity Management – Locking techniques; implementation using Latches. Database Replication Management – Multiple master technique; types of propagation & replication; conflict resolution. Programmatic interfaces to Oracle RDBMS; Case Study of SQLJ, JDBC and related Java capabilities in Oracle.

4. Data and File Structures

(i) Introduction : Introduction to Data Structure; Primitive and non-primitive data structure; Linear and non-linear data structure; Recursion Function and its examples.

String Manipulation, String Matching Techniques & Applications; Markov theorem and its applications; Sparse array and its implementation.

(ii) Concept of Stack and Queue. Single and Doubly – Linked Lists. Circular linked List, their implementation and comparison. Array based and Linked List based Implementation of stack and Queues and their applications.

(iii) Searching : Sequential and Binary Search on Array – based ordered lists and their time; complexity; Concept of Hash Functions, Hash- tables and Hashing with Chaining. Sorting Techniques : Insertion Sort, Selection Sort, Quick Sort, Heap Sort. External Sorting : K-way Merge Strategy. File Structure : Sequential Files, Indexed Files, Direct Files.

(iv) Binary Trees, their implementation and traversal. Binary Search Trees: Searching, Insertion and Deletion of nodes. Height Balance and Concept of AVL Trees. Concept of purpose of B-Trees. Graphs : Definition, Terminology and representation using Adjacency Matrix and

linked list. Shortest Path Algorithms and their implementation. Graph Traversals; BFS and DFS Algorithms and their implementations.

5. Programming Concepts in C/C++

(i) Arrays : Declaration; initialization; 2- dimensional and 3-dimensional array, passing array to function, strings and string functions, and character arrays.
Pointers : variables, swapping data, swapping address v/s data, misuse of address operators, pointers and arrays, pointers to pointers, strings, pointer arithmetic, additional operators, portability, pointers to functions, using pointers with arrays, void pointers. Structures and unions: syntax and use, members, structures as function arguments, structure pointers, array of structures as arguments, passing array of structure members, call by reference.

(ii) Functions; prototype, passing parameters, storage classes, identifier visibility, Recursive functions. Command-line arguments. Scope rules, multi-file programming, Introduction to macros. File processing in C and C++. Introduction to Graphics, graphic initialization, graphic modes, drivers, basis drawing functions, Animations – concept and implementation, Building graphical user interface.

(iii) Introduction to classes and objects; Constructor; destructor; Operator overloading; Function Overloading; function overriding; friend function; copy constructor;
Inheritance: Single, Multiple and Multilevel Inheritance; Virtual function and Polymorphism: Dynamic binding, Static binding; Virtual functions; Pure virtual function; Concrete implementation of virtual functions; Dynamic binding Call mechanism, Implementation of polymorphism, virtual destructors.

(iv) Templates: Function Templates, Class Templates, Member Function Template and Template Arguments, Exception Handling, Standard Template Library; Containers, Algorithms, Iterators and Function Objects.

6. Software Engineering and Management

(i) Introduction : Software Engineering, Evolving role of Software, Concept of Software, Changing nature of Software, Software Myths, Software Importance, Characteristics, Software Components, Software crises, Software Engineering Challenges (Scale, Quality Productivity, Consistency and Repeatability, Change), Software standard, Software Engineering Approach.

(ii) Software Process Management : Software Process, phase's framework, capability maturity model integration (CMMI), Process patterns, process assessment, personal and team process models (PSP, TSP) process technology, characteristics of software process, Introduction to Software process models waterfall, incremental process models, Evolutionary process model. Process planning, Estimation, COCOMO Model, Project Scheduling and staffing, Risk Management (concepts, Risk assessment , and Risk control)

(iii) Introduction to Software Requirement Analysis and Specification: Software requirement, (need for SRS requirement process), problem analysis (informal approach, data flow modeling, Object oriented modeling, prototyping), requirement specification (characteristics, components), Concept of Use Cases, Concept of validation.

(iv) Design Engineering: Function oriented design, Design principles, Coupling and Cohesion, Design Notations & Specifications, Structured Design Methodology; Object – Oriented Design, OO Concepts, Design Concepts, Design Methodology (Dynamic and Functional Modeling), Design Verification.

CASE (Computer Aided Software Engineering) Concept, Scope, CASE Support in Software Life Cycle, Documentation, Project Management.

7. Operating Systems

(i) Overview of an Operating System, Resource Management, Operating System Interface, Process Management concepts, Inter-Process Communication, Process Scheduling, Synchronization, Deadlocks.

(ii) Memory Management, Linking, Loading, Memory Allocation, Design Issues and Problems, Virtual Memory, Fragmentation, Implementing Virtual Memory Paging, Segmentation, Virtual

Memory Design Techniques, Buffering Techniques, Spooling.

(iii) File Management – File Systems & I/O Device Drivers, Access Strategies, File Systems, File System Organization, Design Techniques.
Multiprocessor Systems, Types of Multiprocessor Operating Systems, Design and Implementation Issues.

(iv) Case Studies, Unix/Linux Operating Systems, Users View, Design Principles, Implementation, Process Management, File System, I/O System, Windows NT.

8. Unix/Linux Programming

(i) Unix Basics : Introduction to Unix/Linux, Basic Commands, Text Processing Commands, Data Processing in Unix/Linux, Unix Administration – creating and managing users, managing printing.

(ii) Introduction to Shell : Unix/Linux Shells, Shell variables, Environment variables, Arithmetic, Relational and Logical Operators.
Programming with Shell : Shell Programming, Different Shell constructs, looping statements, decision statements, keywords, solving arithmetic expressions.

(iii) GUI Development in Unix/Linux : Accessing Unix and Linux in GUI mode, Introduction to X windows. Introduction to GUI development in Unix and Linux, Introduction to Qt as development tool. Introduction to various controls and forms in Qt. Designing simple forms in Qt, manipulating various controls in Qt.

(iv) Database Basics with Unix and Linux : Basics of Database, Introduction to MySQL, Basic commands of MySQL e.g. insert, delete, update etc. Connecting to database with Qt. Develop Small application using Qt and MySQL.

9. Compiler Design

(i) Compiler Structure : Compilers and Translators, Analysis – Synthesis Model of Compilation, Various Phases of Compiler, Pass Structure, Bootstrapping & Compiler Construction Tools.
Lexical Analysis : Interface with input, parser and symbol table, token, lexeme and patterns, difficulties in lexical analysis, Error Reporting, Regular definition, Transition diagrams, LEX.

Capabilities of Lexical Analyzer

(ii) Finite Automata : Nondeterministic Finite Automata, Deterministic Finite Automata, Subset Construction, Thompson's Construction, DFA State Minimization.
The Syntactic Specification of Programming Languages: CFG, Derivation and Parse tree, Ambiguity, Capabilities of CFG.

(iii) Basic Parsing Techniques : Top-Down parsers with backtracking, Recursive Descent Parsers, Predictive Parsers, Nonrecursive Predictive Parsers, Bottom-up Parsers, Shift-Reduce Parsing, Operator Precedence Parsers, LR parsers.
YACC, Syntax Directed Definitions, Type checking.

(iv) Run Time Memory Management : Static and Dynamic storage allocation, stack based memory allocation schemes, Symbol Table Management.
Error Detection and Recovery : Lexical phase errors, Syntactic phase errors, Semantic errors.
Intermediate Code Generation : Different Intermediate forms : three address code, Quadruples & Triples.

(v) Sources of optimization, Local Optimization, Loop optimization, Peephole optimization, Issues in the design of Code Generator, Basic Blocks and Flow Graphs, Transformations on Basic Blocks, DAG, Code Generation Algorithm, Register Allocation and Assignment.

10. Java Programming

(i) An overview to Java, Comparison with other languages (C & C++) , Java and Internet, Features of Java, Introduction to Java Virtual Machine, Object Oriented Programming Concepts (Abstraction, Encapsulation, Inheritance, Polymorphism).
Data types : Integers, Floating Point, Character type, Boolean.
Variables : Assignment, Initialization and Conversions.
Operators : Arithmetic, Assignment, Modulus, Relational, Boolean, Bitwise, Precedence Summary, Unicode Character Set.

(ii) Arrays : Single and Multidimensional. Input, Output, Error Statements, Control Statements and Looping Structures. Typecasting, Classes & Objects: Class Fundamentals, Declaring Objects, Exploring new operator, Creating Methods, Constructors, types of constructors, using this keyword,

Finalizers, Acces specifiers, static, the final modifier, abastract, the native modifier, the transient modifier, the synchronized modifier, volatile modifier, Command Line arguments & Argument passing. Inheritance : Basics of Inheritance, Super class, Member Access, Creating a Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch & Abstract Class.
Packages and Interfaces : Defining and importing packages, Understanding Class path,

(iii) Defining and implementing interfaces. Exception Handling: Fundamentals of Exceptions, Exception types, using Try and Catch, Throwing Exceptions, Built-in Exceptions in Java, User defined Exceptions. Multithreaded Programming: Java Thread Model, Creating & working with threads, Threat priorities, Introduction to Synchronization and Dead Locks. String Handling: String Constructor, String Operations, Character Extraction, String Searching & Comparison, String Buffer Class, String Buffer v/s String Class. Land Package: Simple Type Wrappers, Runtime & Introduction to Memory Management.

(iv) File Handling, File Class, Streams : Stream Classes, Reading & writing to Console, Accessing Files & Directories, File Input and Output Stream, Byte Array Input & Output Stream. Applets: Overview, Life cycle of an Applet, HTML tag, Parameter Passing, Applet vs Applications. Introduction, working with AWT Controls and Layout Manager, Event Handling. Introduction to Swings, JDBC.

11. Theory of Computation and Formal Languages

(i) Basic concepts of theory of computation: Alphabets, Strings, and Representations, Formal Languages and Grammars, Finite Stage Transducers, Finite-State Automata and Regular Languages, Limitations of Finite-Memory Programs, Closure Properties for Finite-Memory Programs, Decidable Properties for Finite –Memory Programs.

(ii) Recursive finite –domain programs, Recursion, Pushdown Transducers, Context –Free Languages, Limitations of Recursive Finite-domain Programs, Closure Properties for Recursive Finite –Domain Programs.

(iii) Turing Machines. Programs and Turing Transducers, Non-Determinism versus Determinism, Universal Turing Transducers, Un-decidability. Decidable Properties for

Recursive Finite –Domain Programs.

(iv) Introduction to resource-bounded computation, Time and Space, A Time Hierarchy, Nondeterministic Polynomial Time, More NP-Complete Problems, Polynomial Space, P-Complete Problems.

12. Optimization Techniques

(i) Linear Programming Problem (LPP) and Duality: Formulating LPPs. Simplex Algorithm, Dual Linear Programs, Duality Theorem, Dual Simplex Method, Sensitivity Problems.

(ii) Transportation and Assignment Problems : Formulation of Transportation problem (TP). Various methods of selecting in initial basic feasible solution. Degeneracy in TP and its resolution. Assignment problem, Algorithm Unbalanced Assignment Problem.

(iii) Inventory Models and Game Theory. Inventory Problems and their analytical structures, deterministic economical lot size model, Stochastic and deterministic order level system. Game theory : Definition and explanation of important terms: saddle points. Dominance mixed strategies : games without saddle points 2Xn games.

(iv) Replacement and Sequencing models. Replacement of terms that fail. Replacement of items that deteriorate. Sequencing of n jobs on two machines and three machines with no passing.
CPM – Determination of critical tasks. PERT – probability of completing the project on schedule.

13. Artificial Intelligence and Neural Network

(i) Searching State –spaces: Use of states and transitions to model problems , Breadth – first, depth – first and related types of search, A * search algorithm, Use of heuristics in search.
Reasoning in logic : Brief revision of propositional and predicate logic. Different characterizations of reasoning, Generalized modus ponens Resolution, Prolog, Forward and backward chaining.

(ii) Knowledge Representation : Diversity of knowledge, Inheritance hierarchies , Semantic Networks, Knowledgeable ontologies

Handling uncertainty : Diversity of uncertainty, Probability theory in intelligent systems, Dempster-Shafer theory.
Machine Learning : Introduction of knowledge , Decision tree learning algorithms.

(iii) Intelligent agents : An architecture for intelligent agents
Multi-agent systems
Nature and Goals of Neural Computing : Comparison with rule-based AI Overview of network architectures and learning paradigms
Binary Decision Neurons : The McCullough – Pitts Model
Single-layer perceptrons and their limitations

(iv) The Multilayer Perception : The sigmoid output function, Hidden units and feature detectors, Training by error backpropagation, The error surface and local minima, Generalization, how to avoid 'overtraining'
The Hopfield Model : Content Addressable memories and attractor nets Hopfield energy function, Setting the weights, Storage capacity Topographic maps in the brain Self-Organising Nets : The Kohonen self – organizing feature map.

14. Modeling & Simulation

(i) Concepts of Systems, Models, and Simulation. Distributed Lag Model, Cobweb Models, The process of a simulation Study. Exponential Growth Models, Exponential Decay Models, Type of Simulation, Discrete – Event Simulation: Time-Advance Mechanisms, Components and Organization of a Discrete – Event Simulation Model. Monte Carlo Method. Simulation of Single-Server Queuing System, Simulation of an Inventory System.

(ii) Continuous Simulation : Pure – pursuit Problem.
Random Number Generators : Linear Congruential Generators, Other kinds of Generators, Testing Random – Number Generators.
Generating Random Variates : General Approaches , Continuous and Discrete distributions.

(iii) Introduction to GPSS, General Description, GPSS block-diagram, Simulation of a Manufacturing Shop. SNA, Function, Simulation of a Supermarket, GPSS Model of a Simple Telephone System

(iv) Output Data Analysis for a Single System: Transient and

Steady-State Behaviour of a Stochastic Process, Type of Simulations with regard to output Analysis and Statistical Analysis for Testing Simulation. Verification and Validation of Simulation. An introduction of different types of simulation languages.

15. Wireless and Mobile Communication

(i) Classification and types of Wireless telephones, Introduction to Cordless, Fixed Wireless (WLL), Wireless with limited mobility (WLL-M) and (Fully) Mobile Wireless phones. Introduction to various generations of mobile phone technologies and future trends. Wireline vs. Wireless portion of mobile communication networks. Mobile-Originated vs. Mobile –Terminated calls. Mobile – Phone numbers vs. Fixed-Phone numbers, Billing issues.

(ii) Electromagnetic spectrum, its use and allocation to well – known bands, Concept of cells, sectorization, coverage area, frequency reuse, Cellular networks and handoffs.

(iii) Wireless Transmission concepts: types of antennas, signal propagation, multipath propagation, Comparison of FDM, TDM and CDM techniques. Basic concepts of Spread Spectrum (SS) technique; Direct Sequence SS versus Frequency Hopping SS.

(iv) Simplified implementation of IS-95 CDMA using chip sequences. Concept of CDMA (PCS & Cellular) channel; Forward and Reverse CDMA channel for a cell/sector. Concept of (Walsh) Code Channels within a CDMA Channel. Purpose of Pilot, Sync, Paging, Forward Traffic Channels. Purpose of Access & Reverse TCs. Comparison of Cellular and PCS CDMA networks; frequencies and cell sizes. Advantages/ Disadvantages of smaller cell size. Concept of Voice Coding Components of Mobile Network Infrastructure : MS, BTS, BSC, MSC; their basic functions and characteristics. Types of handoffs in GSM. Use of HLR and VLR in mobile networks.