SYLLABUS

Subject: COMPUTER SCIENCE AND APPLICATIONS

Note:

There are two Papers for each of the subjects. Paper – I on Teaching and Research aptitude, Paper – II based on the syllabus of concerned subjects. Details are furnished below:

PAPER – I

Subject: General Paper on Teaching & Research Aptitude

The Test is intended to assess the teaching/research aptitude of the candidate. They are supposed to possess and exhibit cognitive abilities like comprehension, analysis, evaluation, understanding the structure of arguments, evaluating and distinguishing deductive and inductive reasoning, weighing the evidence with special reference to analogical arguments and inductive generalization, evaluating, classification and definition, avoiding logical inconsistency rising out of failure to see logical relevance due to ambiguity and vagueness in language. The candidates are also supposed to have a general acquaintance with the nature of a concept, meaning and criteria of truth, and the source of knowledge. There will be 50 questions for Paper – I.

1. The Test will be conducted in objective mode. The Test will consist of two Papers. All the two Papers will consists of only objective type questions and will be held on the day of Test in two separate sessions as under:

<table>
<thead>
<tr>
<th>Session</th>
<th>Paper</th>
<th>Number of Questions</th>
<th>Marks</th>
<th>Duration</th>
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</thead>
<tbody>
<tr>
<td>First</td>
<td>I</td>
<td>50 question</td>
<td>$50 \times 2 = 100$</td>
<td>1 Hours</td>
</tr>
<tr>
<td>Second</td>
<td>II</td>
<td>100 questions</td>
<td>$100 \times 2 = 200$</td>
<td>2 Hours</td>
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2. Candidates who appear in two Papers and secure at least 40% aggregate marks for candidates belonging to General Category and at least 35% aggregate marks for candidates belonging to reserved categories will be declared qualifies for Eligibility for Assistant Professor by following the reservation policy of the State Government.

3. The Syllabus of Paper – II and Paper – III will be combined for Paper – II of each subject.
COMPUTER SCIENCE AND APPLICATIONS

PAPER–II

1. Discrete Structures

Computability: Models of computation–Finite Automata, Pushdown Automata, Non-determinism and NFA, DPDA and PDAs and Languages accepted by these structures. Grammars, Languages, Non-computability and Examples of non-computable problems.


Groups: Finite fields and Error correcting/detecting codes.

2. Computer Arithmetic
Propositional (Boolean) Logic, Predicate Logic, Well-formed-formulae (WFF), Satisfiability and Tautology.


Representation of Integers: Octal, Hex, Decimal, and Binary. 2’s complement and 1’s complement arithmetic. Floating point representation.

3. Programming in C and C++


4. Relational Database Design and SQL
E-R diagrams and their transformation to relational design. normalization– 1NF, 2NF, 3NF, BCNF and 4NF. Limitations of 4NF and BCNF.

SQL: Data Definition Language (DDL). Data Manipulation Language (DML), Data Control Language (DCL) commands. Database objects like– Views, indexes, sequences, synonyms, data dictionary.

5. Data and File structures
Data, Information, Definition of data structure. Arrays, stacks, queues, linked lists, trees, graphs, priority queues and heaps.


6. Computer Networks
Network fundamentals: Local Area Networks (LAN), Metropolitan Area Networks (MAN). Wide Area Networks (WAN), Wireless Networks, Inter Networks.

Reference Models: The OSI model, TCP/IP model.

Internetworking: Switch/Hub, Bridge, Router, Gateways, concatenated virtual circuits, Tunnelling, Fragmentation, Firewalls.


7. System Software and Compilers

Loading, linkig, relocation, program relocatability, Linkage editing.

Text editors, Programming Environments, Debuggers and program generators.

Compilation and Interpretation. Bootstrap compilers. Phases of compilation process. Lexical analysis. Lex package on Unix system.

Context free grammars. Parsing and parse trees. Representation of parse (derivation) trees as rightmost and leftmost derivations. Bottom up parsers—shift-reduce, operator precedence, and LR. YACC package on Unix system.


8. Operating Systems (with Case Study of Unix)
Main functions of operating systems. Multiprogramming, multiprocessing, and multitasking.

Memory Management: Virtual memory, paging, fragmentation.

Concurrent Processing: Mutual exclusion. Critical regions, lock and unlock.


UNIX
The Unix System: File system, process management, bourne shell, shell variables, command line programming.

Filters and Commands: Pr. head, tail, cut, paste, sort, uniq, tr, join, etc., grep, egrep, fgrep, etc., sed, awk, etc.

System Calls (like): Creat, open, close, read, write, isseek, link, unlink, stat, fstat, umask, chmod, exec, fork, wait, system.

9. Software Engineering

Software Metrics: Software Project Management.

Software Design: System design, detailed design, function oriented design, object oriented design, user interface design. Design level metrics.


10. Current Trends and Technologies
The topics of current interest in Computer Science and Computer Applications shall be covered. The experts shall use their judgement from time to time to include the topics of popular interest, which are expected to be known for an application development software professional, currently, they include:

Parallel Computing
Parallel virtual machine (pvm) and message passing interface (mpi) libraries and calls. Advanced architectures. Today’s fastest computers.

Mobile Computing
Mobile connectivity–Cells, Framework, wireless deliv-
Windows Programming

Introduction to windows programming—Win32, Microsoft Foundation Classes (MFC), Documents and views, Resources, Message handling in windows.

Windows Programming

Scrolling, splitting views, docking toolbars, status bars, common dialogs.

Advanced Windows Programming

Multiple Document Interface (MDI), Multithreading, Object linking and Embedding (OLE), Active X controls. Active Template Library (ATL). Networking programming

PAPER–III(A)

CORE GROUP

Unit–I

Combinational Circuit Design, Sequential Circuit Design, Hardwired and Microprogrammed processor design, Instruction formats, Addressing modes, Memory types and organisation, Interfacing peripheral devices, Interrupts.

Microprocessor architecture, Instruction set and Programming (8085, P-III/P-IV), Microprocessor applications.

Unit–II

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) ORACLE.

Unit–III

Display systems, Input devices, 2D Geometry, Graphic operations, 3D Graphics, Animation, Graphic standard, Applications.

Unit–IV
Programming language concepts, paradigms and models.
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, program development in prolog, implementation of prolog, example programs in prolog.
Principles of parallelism, coroutines, 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, denotational semantics.
Compiler structure, compiler construction tools, compilation phases.
Finite Automata, Pushdown Automata. Non-determinism and NFA, DPDA, and PDAs 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. Pushdown Automata and Context Free Grammars.
Lexical Analysis–regular expressions and regular languages. LEX package on Unix. Conversion of NFA to DFA. Minimizing the number of states in a DFA. Compilation and Interpretation. Bootstrap compilers.
Context free grammars. Parsing and parse trees. Representation of parse (derivation) trees as rightmost and leftmost derivations. Bottom up parsers–shift-reduce, operator precedence, and LR. YACC package on Unix system. Topdown parsers–left recursion
Unit–V
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.
Unit–VI
Definition, Simple and Composite structures, Arrays, Lists, Stacks queues, Priority queues, Binary trees, B-trees, Graphs.
Unit–VII
Object, messages, classes, encapsulation, inheritance, polymorphism, aggregation, abstract classes, generalization as extension and restriction. Object oriented design. Multiple inheritance, metadata.
HTML, DHTML, XML, Scripting, Java, Servelets, Applets.
Unit–VIII
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–IX
Introduction, Memory management, Support for concurrent process, Scheduling, System deadlock, Multiprogramming system. I/O management, Distributed operating systems, Study of Unix and Windows NT.

Unit–X
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, Prolog programming.
Components of an expert system, Knowledge representation and Acquisition techniques, Building expert system and Shell.
RTNs, ATNs, Parsing of Ambiguous CFGs. Tree Adjoining Grammars (TAGs).
Systems approach to planning. Designing, Development, Implementation and Evaluation of MIS.
Decision-making processes, evaluation of DSS, Group decision support system and case studies, Adaptive design approach to DSS development, Cognitive style in DSS, Integrating expert and Decision support systems.

PAPER–III(B)
[ELECTIVE/OPTIONAL]

Elective–I
Theory of Computation: Formal language, Need for formal computational models, Non-computational problems, diagonal argument and Russel’s paradox.
Deterministic Finite Automaton (DFA); Non-deterministic Finite Automaton (NFA), Regular languages and regular sets, Equivalence of DFA and NFA. Minimizing the number of states of a DFA.

Elective–II
Variable Length Codes: Prefix Codes, Huffman Codes, Lempel-Ziev (LZ) Codes. Optimality of these codes. Information content of these codes.
Error Correcting and Detecting Codes: Finite fields, Hamming distance, Bounds of codes, Linear (Parity Check) codes, Parity check matrix, Generator matrix, Decoding of linear codes, Hamming codes.
Data Compression Techniques: Representation and compression of text, sound, picture, and video files (based on the JPEG and MPEG standards).

Elective–III

Complexity of simplex algorithm(s). Exponential behaviour of simplex.

Ellipsoid method and Karmarkar’s method for solving LPP. Solving simple LPPs through these methods. Comparison of complexity of these methods.

Assignment and Transportation Problems: Simple algorithms like Hungarian method, etc.


Elective—IV


Elective—V

Unix: Operating System, Structure of Unix Operating System, Unix Commands, Interfacing with Unix, Editors and Compilers for Unix, LEX and YACC, File system, System calls, Filters, 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, Multithreading, OLE, Active X controls, ATL, Database access, Networking programming.