જા.ક્ર. ૮૯/૨૦૧૬-૧૭

જગ્યાનું નામ :સરકારી કોલેજોમાં કોમ્પ્યુટર સાયન્સ વિષયના મદદનીશ પ્રાધ્યાપક, વર્ગ-૨

ભાગ-૧ અને ભાગ-૨ ના ૧૫૦ મિનિટના સંયુક્ત પ્રશ્નપત્રની પ્રાથમિક કસોટીનો અભ્યાસક્રમ

પ્રાથમિક કસોટીનો અભ્યાસક્રમ ભાગ-૧ માધ્યમ: ગુજરાતી	કુલ ગુણ :૧૦૦
૧	ભારતની ભૂગોળ- ભૌગોલિક, આર્થિક, સામાજિક, કુદરતી સંસાધન અને વસ્તી અંગેની બાબતો- ગુજરાતના ખાસ સંદર્ભ સાથે
૨	ભારતનો સાંસ્કૃતિક વારસો- સાહિત્ય, કલા, ધર્મ અને સ્થાપત્યો- ગુજરાતના ખાસ સંદર્ભ સાથે
૩	ભારતનો ઈતિહાસ- ગુજરાતના ખાસ સંદર્ભ સાથે
૪	ભારતની અર્થવ્યવસ્થા અને આયોજન
૫	ભારતીય રાજનીતિ અને ભારતનું બંધારણ: (૧) આમુખ (૨) મૂળભૂત અધિકારો અને ફરજો (૩) રાજ્યનીતિના માર્ગદર્શક સિદ્ધાંતો (૪) સંસદની રચના (૫) રાષ્ટ્રપતિની સત્તા (૬) રાજ્યપાલની સત્તા (૭) ન્યાયતંત્ર (૮) અનુસૂચિત જાતિ, અનુસૂચિત જનજાતિ અને સમાજના પછાત વર્ગો માટેની જોગવાઈઓ (૯) એટર્ની જનરલ (૧૦) નીતિ આયોગ (૧૧) પંચાયતી રાજ (૧૨) નાણા પંચ (૧૩) બંધારણીય તથા વૈધનિક સંસ્થાઓ- ભારતનું ચૂંટણી પંચ, સંઘ લોક સેવા આયોગ, રાજ્ય લોક સેવા આયોગ, કોમ્પ્ટ્રોલર એન્ડ ઓડિટર જનરલ; કેન્દ્રીયસતર્કતા આયોગ, લોકપાલ તથા લોકાયુક્ત અને કેન્દ્રીય માહિતી આયોગ
૬	સામાન્ય બૌદ્ધિક ક્ષમતા કસોટી
૭	સામાન્ય વિજ્ઞાન, પર્યાવરણ અને ઈન્ફર્મેશન એન્ડ કોમ્યુનિકેશન ટેકનોલોજી
૮	ખેલ જગત સહિત રોજબરોજના પ્રાદેશિક, રાષ્ટ્રીય અને આંતરરાષ્ટ્રીય મહત્વના બનાવો

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Syllabus of Preliminary Test

part-1

Medium: Gujarati Total Marks- 100

1	Geography of India-Physical, Economic, Social, Natural Resources and population related topics- with special reference to Gujarat
2	Cultural heritage of India-Literature, Art, Religion and Architecture- with special reference to Gujarat
3	History of India with special reference to Gujarat
4	Indian Economy and Planning
5	Indian Polity and the Constitution of India: (1) Preamble (2) Fundamental Rights and Fundamental Duties (3) Directive Principles of State Policy (4) Composition of Parliament (5) Powers of the President of India (6) Powers of Governor (7) Judiciary (8) Provisions for Scheduled Castes, Scheduled Tribes and backward classes of the society (9) Attorney General (10) NITIAayog (11) Panchayati Raj Institutions (12) Finance Commission (13) Constitutional and Statutory Bodies: Election Commission of India, Union Public Service Commission, State Public Service Commission, Comptroller and Auditor General; Central Vigilance Commission, Lokpal and Lokayukta, Central Information Commission
6	General Mental Ability
7	General Science, Environment and Information & Communication Technology
8	Daily events of Regional, National and International Importance including Sports

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જાહેરાત ક્રમાંક ૮૯/૨૦૧૬-૧૭

ભાગ-૨ સંબધિત વિષયનો અભ્યાસક્રમ

જગ્યાનુંનામ :સરકારી કોલેજોમાં કોમ્પ્યુટર સાયન્સ વિષયના મદદનીશ પ્રાધ્યાપક, વર્ગ-૨

કુલ પ્રશ્નો ૨૦૦ **કુલ ગુણ ૨૦૦** **Medium: English**

1. Discrete Structures:

Sets, Relations, Functions. Pigeonhole Principle. Inclusion-Exclusion Principle. Equivalence and Partial Orderings, Elementary Counting Techniques, Probability. Measure(s), for Information and Mutual Information

Compatibility: Models of computation—Finite Automata, Pushdown Automata, Nondeterminism and NFA. DPDA and PDAs and Languages accepted by these structures, Grammars, Languages, Non-computabllity and Examples of non-computable problems

Graph: Definition, walks, paths, trails, connected graphs, regular and bipartite graphs, cycles and circuits. Tree and rooted tree. Spanning trees. Eccentricity of a vertex radius and diameter, of a graph. Central Graphs. Centre(s) of a tree. Hamiltonian and Eulerian graphs, Planar graphs.

Groups: Finite fields and Error correcting/detecting codes.

2. Computer Arithmetic:

Prepositional (Boolean) Logic. Predicate Logic, Well-formed-formulae (WFF), Satisfiability and Tautology

Logic Families: TTL, ECL and C-MOS gates. Boolean algebra and Minimization of Boolean, functions. Flip-flops—types, race condition and comparison. Design of combinational and sequential circuits.

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++:

Programming in C: Elements of C—Tokens, identifiers, data types in C. Control, structures in C. Sequence, selection and iteration(s). Structured data types In C—arrays, struct, union, string, and pointers

O-O Programming Concepts: Class, object. Instantiation. Inheritance, polymorphism and overloading.

C++ *Programming:* Elements of C++—Tokens, Identifiers. Variables and constants. Data types, Operators, Control statements. Functions parameter passing. Class and objects. Constructors and destructors. Overloading. Inheritance, Templates, Exception handling.

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.

File Structures: Fields, records and files. Sequential, direct, index-sequential and relative files, Hashing, Inverted lists and multi-lists. B trees and B+ trees.

6. Computer Networks:

Network fundamentals: Local Area Networks (LAN) Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless Networks. Intel Networks, Reference Models: The OSI model. TCP/IP model.

Data Communication: Channel capacity. Transmission media—twisted pair, coaxial cables, fibre-optic cables, wireless transmission—radio, microwave. Infrared and millimeter waves, Lightwave transmission. Telephones— local loop, trunks multiplexing, switching, narrowband ISDN. Broadband ISDN, ATM, High speed LANS. Cellular Radio. Communication, satellites—geosynchronous and low-orbit.

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

Routing: Virtual circuits and datagrams. Routing algorithms. Conjestlon control.

Network Security: Cryptography—public key, secret key. Domain Name System (DNS) — Electronic Mall and Worldwide Web (WWW). The DNS. Resource Records, Name servers, E-mall-architecture and Serves.

7. System Software and Compilers:

Assembly language fundamentals (8085 based assembly language programming), Assemblers—2-pass and single-pass. Macros and macroprocessors,

Loading, linking, 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.

Topdown parsers—left recursion and its removal. Recursive descent parser. Predictive parser, Intermediate codes—Quadruples. Triples, Intermediate code generation. Code generation, Code, optimization.

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.

Scheduling: CPU scheduling, I/O scheduling. Resource scheduling. Deadlock and scheduling algorithms. Banker's algorithm for deadlock handling.

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, iseek, link, unlink, stat, fstat, umask, chmod, exec, fork, wait, system.

9. Software Engineering:

System Development Life Cycle (SDLC): Steps, Water fall model, Prototypes, Sprial model, Software Metrics: Software Project Management.

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

Coding and Testing: Testing level metrics. Software quality and reliability, Clean room, approach, software reengineering.

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 delivery technology and switching methods, mobile information access devices, mobile data internetworking standards, cellular data, communication protocols, mobile computing applications. Mobile databases- protocols, scope, tools and technology. M-business.

E-Technologies:

Electronic Commerce: Framework, Media Convergence of Applications, Consumer, Applications, Organisation Applications. *Electronic Payment Systems:* Digital Token, Smart Cards, Credit Cards, Risks in Electronic, Payment System. Designing Electronic Payment Systems, *Electronic Data Interchange (EDI):* Concepts, Applications, (Legal, Security and Privacy), issues, EDI and Electronic Commerce. Standardization and EDI, EDI Software Implementation, EDI Envelope for Message Transport, Internet-Based EDI, *Digital Libraries and Data Warehousing :* Concepts, Types of Digital documents, Issues behind, document Infrastructure, Corporate Data Warehouses, *Software Agents :* Characteristics and Properties of Agents, Technology behind Software, Agents (Applets, Browsers and Software Agents), *Broadband Telecommunications :*

Concepts, Frame Relay, **Cell** Relay, Switched Multlmegabit, Data Service, Asynchronous Transfer Mode.

Main concepts In Geographical Information System (GIS). E-cash, E-Business, ERP, Packages, Data *Warehousing:* Data Warehouse environment, architecture of a data warehouse, methodology, analysis, design, construction and administration, 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.

Windows Programming:

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

Simple Applications (in windows):

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). Network programming.

11. Combinational Circuit Design, Sequential Circuit Design, Hardwired and Microprogrammed, processor design, Instruction formats, Addressing modes, Memory types and organization, Interfacing peripheral devices, Interrupts. Microprocessor architecture, Instruction set and Programming (8085, P-III/P-IV), Microprocessor applications.

12. 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.

13. Display systems, Input devices, 2D Geometry, Graphic operations, 3D Graphics, Animation, Graphic standard, Applications, Concepts, Storage Devices, Input Tools, Authoring Tools, Application, Files.

14. 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, 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 pf 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 and its removal, Recursive descent parser. Predictive parser, Intermediate codes—Quadruples, triples, Intermediate code generation, code generation. Code optimization.

15. Analog and Digital transmission Asynchronous and, 1 Synchronous transmission, Transmission media Multiplexing and Concentration, Switching techniques Polling, Topologies, Networking Devices. OSI Reference Model, Protocols for—(1) Data link layer, (ii) Network layer, and (iii) Transport layer. TCP/IP protocols, Networks security. Network, administration.

16. 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.

17. 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, Servlets. Applets.

18. 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.

19. Introduction, Memory management. Support for concurrent process, Scheduling. System**,** deadlock Multiprogramming system. I/O management. Distributed operating systems Study**,** of Unix and Windows NT.

20. Definitions. AI approach for solving problems, *Automated Reasoning* with prepositional 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.

21. **Theory of Computation :** Formal language Need for formal computational models. Noncomputational, 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. Non-regular languages, and Pumping lemma, Pushdown Automaton (PDA), Deterministic Pushdown Automaton (DPDA), Nonequivalence, of PDA and DPDA, *Context free Grammars:* Grelbach 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 Tomlta's parsing, *Linear Bounded Automata (LBA) :* Power of LBA. Closure properties, *Turing Machine (TM):* One tape, multitape. 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.

22. **Models for Information Channel:** Discrete Memoryless 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, Huffmann 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, *Image Processing:* Image Registration, Spatial Fourier Transforms, Discrete, Spatial (2-dlmenslonal) Fourier Transforms, Restoration, Lossy Compression, of images (pictures), *Data Compression Techniques:* Representation **and** compression of text, sound, picture, and video files (based on the JPEG and MPEG standards).

23. *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-M 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 Matchlngs; Solving matching problems using Network flow, problems, *Matroids :* Definition. Graphic and Cographic matrolds. 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.

24. *Neural Networks:* Perceptron model Linear separability and XOR problem. Two and three**,** layered neural nets, Backpropagatlon—Convergence. Hopfleld nets Neural net learning, Applications, *Fuzzy Systems:* Definition of a Fuzzy set Fuzzy relations. Fuzzy functions, Fuzzy**,** measures. Fuzzy reasoning, Applications of Fuzzy systems.

25. *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 Network programming.