UNIVERSITY GRANTS COMMISSION
NET BUREAU

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Code No. : 87

Subject : COMPUTER SCIENCE AND APPLICATIONS

SYLLABUS AND SAMPLE QUESTIONS

Note :

There will be two question papers, Paper–II and Paper–III (Part–A & B). Paper–II will cover 50 Objective Type Questions (Multiple choice, Matching type, True/False, Assertion-Reasoning type) carrying 100 marks. Paper–III will have two Parts–A and B. Paper–III (A) will have 10 short essay type questions (300 words) carrying 16 marks each. In it there will be one question with internal choice from each unit (i.e., 10 questions from 10 units; Total marks will be 160). Paper–III (B) will be compulsory and there will be one question from each of the Electives. The candidate will attempt only one question (one elective only in 800 words) carrying 40 marks. Total marks of Paper–III will be 200.

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PAPER–II

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.

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.

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.

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2. Computer Arithmetic

Propositional (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, Inter Networks.

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

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Data Communication : Channel capacity. Transmission media—twisted pair, coaxial cables, fibre-optic cables, wireless transmission—radio, microwave, infrared and millimeter waves. Lightwave transmission. Thelephones—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. Conjestion control.

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

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

9. Software Engineering

System Development Life Cycle (SDLC) : Steps, Water fall model, Prototypes, Spiral 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.

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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 Multimegabit 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.

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UNIVERSITY GRANTS COMMISSION
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Code No. : 88

Subject : ELECTRONIC SCIENCE

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PAPER-II and III (Part A & B)

Unit–I

Electronic Transport in semiconductor, PN Junction, Diode equation and diode equivalent circuit. Breakdown in diodes, Zener diodes, Tunnel diode, Semiconductor diodes, characteristics and equivalent circuits of BJT, JFET, MOSFET, IC fabrication—crystal growth, epitaxy, oxidation, lithography, doping, etching, isolation methods, metalization, bonding, Thin film active and passive devices.

Unit–II

Superposition, Thevenin, Norton and Maximum Power Transfer Theorems, Network elements, Network graphs, Nodal and Mesh analysis, Zero and Poles, Bode Plots, Laplace, Fourier and Z-transforms. Time and frequency domain responses. Image impedance and passive filters. Two-port Network Parameters. Transfer functions, Signal representation. State variable method of circuit analysis, AC circuit analysis, Transient analysis.

Unit–III

Rectifiers, Voltage regulated ICs and regulated power supply, Biasing of Bipolar junction transistors and JFET. Single stage amplifiers, Multistage amplifiers, Feedback in amplifiers, oscillators, function generators, multivibrators, Operational Amplifiers (OPAMP)—characteristics and Applications, Computational Applications, Integrator, Differentiator, Wave shaping circuits, F to V and V to F converters. Active filters, Schmitt trigger, Phase locked loop.

Unit–IV

Logic families, flip-flops, Gates, Boolean algebra and minimization techniques, Multivibrators and clock circuits, Counters—Ring, Ripple. Synchronous, Asynchronous, Up and down shift registers, multiplexers and demultiplexers, Arithmetic circuits, Memories, A/D and D/A converters.

Unit–V

Architecture of 8085 and 8086 Microprocessors, Addressing modes, 8085 instruction set, 8085 interrupts, Programming, Memory and I/O interfacing, Interfacing 8155, 8255, 8279, 8253, 8257, 8259, 8251 with 8085 Microprocessors, Serial communication protocols, Introduction of Microcontrollers (8 bit)—8031/8051 and 8048.

Unit–VI

Introduction of High-level Programming Language, Introduction of data in C. Operators and its precedence, Various data types in C, Storage classes in C, Decision-making and forming loop in program, Handling character, Arrays in C, Structure and union, User defined function, Pointers in C, Advanced pointer. Pointer to structures, pointer to functions, Dynamic data structure, file handling in C, Command line argument, Graphics-video modes, video adapters, Drawing various objects on screen, Interfacing to external hardware via serial/parallel port using C, Applying C to electronic circuit problems. Introduction to object-oriented Programming and C++.

Introduction of FORTRAN language, programming discipline, statements to write a program, intrinsic functions, integer-type data, type statement, IF statement, Data validation, Format-directed input and output. Subscripted variables and DO loops. Array, Fortran Subprogram.

Unit–VII

Maxwell's equations, Time varying fields, Wave equation and its solution, Rectangular waveguide, Propagation of wave in ionosphere, Poynting vector, Antenna parameters, Half-wave antenna, Transmission lines, Characteristic of Impedance matching, Smith chart, Microwave components-T, Magic-T, Tuner. Circulator isolator, Direction couplers, Sources—Reflex Klystron, Principle of operation of Magnetron, Solid State Microwave devices; Basic Theory of Gunn, GaAs FET, Crystal Defector and PIN diode for detection of microwaves.

Unit–VIII

Basic principles of amplitude, frequency and phase modulation, Demodulation, Intermediate frequency and principle of superheterodyne receiver, Spectral analysis and signal transmission through linear systems, Random signals and noise, Noise temperature and noise figure. Basic concepts of information theory, Digital modulation and Demodulation; PM, PCM, ASK, FSK, PSK, Time-division Multiplexing, Frequency-Division Multiplexing, Data Communications—Circuits, Codes and Modems. Basic concepts of signal processing and digital filters.

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Unit–IX (a)

Characteristics of solid state power devices—SCR, Triac, UJT, Triggering circuits, converters, choppers, inverters, converters. AC - regulators, speed control of a.c. and d.c. motors.

Stepper and synchronous motors; Three phase controlled rectifier; Switch mode power supply; Uninterrupted power supply.

Unit–IX (b)

Optical sources—LED, Spontaneous emission, Stimulated emission, Semiconductor Diode LASER, Photodetectors—p-n photodiode. PIN photodiode, Phototransistors, Optocouplers, Solar cells, Display devices, Optical Fibres—Light propagation in fibre, Types of fibre, Characteristic parameters, Modes, Fibre splicing, Fibre optic communication system—coupling to and from the fibre, Modulation, Multiplexing and coding, Repeaters, Bandwidth and Rise time budgets.

Unit–X (a)

Transduces—Resistance, Inductance Capacitance, Peizoelectric, Thermoelectric, Hall effect, Photoelectric, Techogenerators, Measurement of displacement, velocity, acceleration, force, torque, strain, speed and sound temperature, pressure, flow, humidity, thickness, pH, position.

Measuring Equipment—Measurement of R, L and C, Bridge and Potentiometers, voltage, current, power, energy, frequency/time, phase, DVMs, DMMs, CRO, Digital storage oscilloscope, Logic probes, Logic State Analyser, Spectrum Analyzer, Recorder, Noise and Interference in instrumentation, Instrumentation amplifiers, Radio Telemetry.

Analytical Instruments—Biomedical instruments—ECG, blood pressure measurements, spectrophotometers, Electron Microscope, X-ray diffractometer.

Unit–X (b)

Open-loop and close-loop control system. Error amplifier, on-off controller, Proportional (P), Proportional-Integral (PI), Proportional-Derivative (PD), PID controllers, Dynamic Behaviour of control systems—servomechanism characteristics parameters of control systems—Accuracy, Sensitivity, Disturbances, Transient response, Stability, Routh-Hurwitz criterion, Bode plots, Nyquist criterion, Controlling speed. Temperature and position using analog/digital control circuits.