Maharashtra Public Service Commission

Civil Services Exam – Mains Optional

Electronics Engineering

(Code No : 407)

Paper - I

Standard : Degree in Electronics Engineering **Total Marks** : 200
Nature of Paper : Conventional Type **Duration** : 3 Hours

Note :
1) Answers to this paper must be written in English only
2) This paper will test the candidate's ability to comprehend, to analyse, to interpret, to criticise and to appraise subject matter related to the topics/sub topics mentioned below.
3) For judging candidates' conceptual understandings, appropriate numbers of numerical problems will be asked.
4) It is expected from candidates to study the latest and recent developments and happenings pertaining to the topics/sub topics mentioned below.

Section - A (Marks : 50)

BASIC ELECTRONICS - MATERIALS AND DEVICES

1) Materials and Components :

.01) Structure and properties of Electrical Engineering materials, Conductors, Semiconductors and Insulators, magnetic, Ferroelectric, Piezoelectric, Ceramic, Optical and Super-conducting materials.

.02) Passive components and characteristics Resistors, Capacitors and Inductors, Ferrites, Quartz crystal, Ceramic resonators, Electromagnetic and Electromechanical components.

2) Physical Electronics, Electron Devices and ICs :

.01) Electrons and holes in semiconductors, Carrier Statistics, Mechanism of current flow in a semiconductor, Hall effect; Junction theory;

.02) Different types of diodes and their characteristics;

.03) Bipolar Junction transistor; Field effect transistors;

.04) Basics of ICs - bipolar, MOS and CMOS types, basic of Opto-electronics.

.05) **IC Technologies :** Fabrication techniques

.06) Basic CMOS VLSI, Full custom VLSI design, Inverter analysis, layout rules, layout of basic gates, circuit extraction, Layout of basic data path.

Section - B (Marks : 50)

ELECTRONICS CIRCUITS AND APPLICATIONS

3) Analog Electronic Circuits :

.01) Transistor biasing, bias stabilization and Small signal and frequency response analysis of transistor circuits.

.02) Power amplifiers.

.03) Feedback amplifiers, Tuned amplifiers, Wide-banding techniques. Transistor oscillators.

.04) Diode rectifiers, regulators and power supplies.

.05) Operational Amplifiers, Phase Locked Loops and other linear integrated circuits with applications.

.06) Pulse shaping circuits and waveform generators.

4) Industrial Electronics :

.01) Thyristor family, principle of operation, commutation circuits

.02) Controlled rectifiers, single phase and three phase with different loads.

.03) **DC choppers :** step-up and step-down choppers, chopper circuits, switched mode regulators, effect of source and load inductance.

.04) **Cyclo-converters:** Single and three phase cyclo-converters.

.05) **Inverter circuits:** Single phase bridge inverters, three phase inverters, voltage control of three phase inverter, harmonic reduction.

.06) **Industrial applications:** Induction and dielectric heating, Basic concepts of speed control of DC/AC drives.

Section – C (Marks : 50)

SIGNALS AND SYSTEMS

5) Signals and Systems :

.01) **Classification of signals and systems:** System modeling in terms of differential and difference equations; State variable representation and solution of state of variable equations for continuous and discrete time systems.

.02) Fourier series, Fourier transforms, properties and their applications to system analysis.

.03) **Laplace transform :** properties and its application to system analysis.

.04) Convolution integral, superposition integral and their applications.

.05) **Z-transform :** properties and its applications to the analysis and characterisation of discrete time systems.

.06) Discrete time signals and systems, System Classification, stability, DTFT, DFT, FFT algorithms: Decimation in time and frequency. Linear and circular convolution.

.07) Designing of Digital filters – FIR and IIR filters, Butterworth and Chebycheff filters.

6) Network theory :

.01) Network analysis techniques; Network theorems, transient and sinusoidal steady state response.

.02) Network graphs and their applications in network analysis; Tellegen's theorem.

.03) Two port networks; Z, Y, h and transmission parameters.

.04) Analysis of two port networks, Network functions, parts of network functions, obtaining a network function from a given part.

.05) **Transmission criteria:** delay and rise time, Elmore's and other definitions, effect of cascading.

.06) Elements of one-port and two-port network synthesis.

Section - D (Marks : 50)

INSTRUMENTATION AND CONTROL

7) Electronic Measurements and instrumentation :

.01) Basic concepts, standards and error analysis; Measurements of basic electrical quantities and parameters.

.02) Analog and digital electronic measuring instruments, their principles of

working : their comparison, characteristics and applications.

.03) **Transducers:** Electronic measurements of non-electrical quantities like temperature, pressure, humidity .

.04) Basics of telemetry for industrial use.

8) Control Systems :

.01) Transient and steady state analysis of systems.

.02) Block diagram reduction and signal flow graphs, Mason's gain formula.

.03) Effect of feedback on the performance of systems.

.04) Absolute and relative stability of systems.

.05) **Frequency response analysis :** Bode diagram, Root Locus, Principle of argument and Nyquist criteria.

.06) Constant-M and Constant-N Loci. Nichol's Chart.

.07) Stability analysis of continuous time systems with respect to the state space model and Jury's stability criterion for the stability of discrete time systems.

Paper - II

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Section - A (Marks : 50)

1) DIGITAL ELECTRONICS AND MICROPROCESSORS :

.01) Transistor as a switching element. Boolean algebra, Number theory.

.02) Simplification of Boolean functions, Karnaugh maps and applications. IC Logic gates and their characteristics.

.03) **IC logic families:** DTL, TTL, ECL, NMOS, PMOS and CMOS gates and their comparison.

.04) **Combinational logic Circuits:** Half adder, Full adder; Digital comparator; Multiplexer, Demultiplexer; ROM and their applications and Design.

.05) Flip flops. R-S, J-K, D and T flip-flops; Different types of counters and registers, Design using flip flops.

.06) Waveform generators. A/D and D/A converters. Semiconductor memories.

.07) Digital design-POS, SOP minimization, PAL and PLAs, PLDs, FPGA

.08) **Sequential machine design :** Mealy and Moore machines, Asynchronous machines-Analysis and design: Races and Hazards.

.09) **Microprocessors:** Architecture and instruction set of Microprocessors 8085 and 8086, Assembly language Programming.

.10) **Microprocessor based system design:** typical examples, PLCs.

.11) Personal computers and their typical uses.

Section - B (Marks : 50)

2) COMMUNICATION SYSTEMS :

.01) Random signals and probability, Correlation functions; Spectral density; Response of linear system to random inputs.

.02) Basic information theory.

.03) Sampling, quantisation and introduction to coding techniques.

.04) **Analog Modulation and demodulation techniques:** AM, FM and PM, Radio broadcast transmitters and receivers.

.05) **Digital modulation and demodulation techniques, data recovery:** integrator, matched filters, correlation receivers and their error probability analysis.

.06) Time division and frequency division multiplexing.

.07) Equalization.

.08) **Telephone networks:** Modern telephone exchanges, switching techniques.

.09) Elements of Mobile communication.

.10) Satellite Communication, Multiple access techniques –FDMA, CDMA.

Section - C (Marks : 50)

ELECTROMAGNETICS AND MICROWAVE ENGINEERING

3) Electromagnetic Theory :

.01) Analysis of electrostatic and magneto static fields; Laplace's and Poisson's equations.

.02) Boundary value problems and their solutions; Maxwell's equations.

.03) Wave propagation through bounded and unbounded media.

.04) **Transmission lines:** basic theory, standing waves, stub matching techniques. Microstrip lines.

.05) Propagation of signals at HF, VHF, UHF and microwave frequency.

.06) Elements of antenna theory.

4) Microwave Engineering :

.01) Analysis of Microwave Tubes. Solid state microwave devices and their applications.

.02) Analysis of wave guides (rectangular and cylindrical).

.03) Microwave Components and Circuits.

.04) Microstrip circuits.

.05) Microwave Measurements.

.06) Microwave Antennas.

.07) **Optical Communication:** Basics of optical fibre: Numerical aperture, cone of acceptance, rectilinear and curvilinear propagation of light waves through fibre single mode and multi- mode propagation, Optical fibre as a cylindrical wave guide, dispersion and attenuation, splicing techniques, fibre losses, link length calculations, Optical sources and amplifiers, optical detectors, dispersion management in optical fibres.

.08) Microwave Communication Systems (terrestrial and Satellite based).

Section - D (Marks : 50)

5) Data structures and computer algorithms :

.01) Data representation, Programming, Elements of a high level programming language C.

.02) Use of data structures such as stacks, queues, linked lists, trees and graphs. Algorithms for insertion and deletion of elements in these data structures.

.03) Complexity of algorithms, sorting and searching techniques, Spanning trees, shortest path, Knapsack problem, Traveling sales person's problem, NP-Hard, NP-

Complete.

.04) Design techniques (Greedy/Dynamic programming/ Divide and conquer).

6) Computer Organisation :

.01) Fundamentals of computer architecture.

.02) Processor design; Control unit design.

.03) Memory organisation, I/O System Organisation.

.04) Advanced architectures- Parallel processing.

7) Computer Networks :

.01) ISO/OSI model, packet switching, congestion in communication networks

.02) Sliding window protocol.

.03) LAN technologies (Ethernet/UDP), TCP, Internet Protocol.

.04) Basic concepts of switches, gateways and routers,

.05) Internet technologies.

.06) Network security.

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