Module 1

Measurement Systems and characteristics of Instruments (20 marks)

a. Measurement methods, Essential elements of Instruments, Classification of Instruments, Functions of Instruments and measurement systems, Applications of measurement systems, Elements of generalized measurement system.

b. Static characteristics Accuracy, Precision, sensitivity, Resolution, threshold, Dead zone, Repeatability, Reproducibility, Drift, Error, Scale Range, Span, Linearity and Hysteresis.

c. Dynamic characteristics, Speed of response, Dynamic error, Fidelity, measuring Lag

d. Limiting Errors, Relative limiting error, Gross error, Systematic error and Random error

e. Units, Systems and Dimensions – Absolute units, fundamental and derived units, Dimensions of mechanical units, practical units, Base units, Derived units, Absolute units, standards and classifications

f. Analog instruments, classifications, Operating forces of Electromechanical indicating instruments, Types of Damping

Module 2

Basics of Electrical Engineering (10 marks)

a. Resistance, Resistivity, Conductivity, Ohm's Law, Resistance in series and Parallel, Electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC, Frequency, Time period, RMS, Peak, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents.

b. Absolute and Relative permittivity of medium, Electric Field, Field density, Potential and potential difference

c. Capacitance, Parallel plate capacitor, Capacitors in series and parallel, Dielectric constant, charging and discharging of capacitor

d. Magnetism and Electromagnetism, Absolute and relative permeability, Field intensity, Magnetic Potential, Flux and Flux density, Comparison between Magnetic and Electric circuits, Electromagnetic induction,

Faraday's Laws, Self-inductance, Coefficient of self-inductance, Mutual inductance, Coefficient of Mutual inductance, Coefficient of coupling.

e. Insulators, conductors and semiconductors, Active and Passive Components, Resistors; types of resistors, their construction & specific use, color-coding, power rating. Equivalent Resistance of series parallel circuits. Distribution of Volage and current in series / parallel circuits. Principles of induction, inductive reactance. Concept of Resonance - RC, RL & RLC series and parallel circuit.

Module 3

Basics of Electronics Engineering (12 marks)

a. PN Junction diode: Intrinsic and extrinsic semiconductors, Principle of operation, V-I characteristics, principle of working of Zener diode, Photo diode, Rectifiers, Filters, varactor diode

b. Transistor, Construction, working of a PNP and NPN Transistors, purpose of Emitter, base and collector Terminals. Significance of α and β. Need for Biasing of Transistor. Different Voltages and Currents, Junction Temperature, junction capacitance, frequency of operation. Transistor applications as switch and amplifier. Transistor input and output characteristics. Transistor power ratings & packaging styles and use of different heat sinks

c. Amplifiers, Classification of amplifiers, Voltage amplifiers - voltage gain, Single stage CE amplifier, Emitter follower circuit and its advantages. RC coupled amplifier.

d. UJT, FET, MOSFET, DIAC, TRIC, SCR, IGBT symbols and circuits of FET Amplifier, SCR using UJT triggering, snubber circuit, light dimmer circuit using TRIAC, UJT based free running oscillator.

Module 4

Fundamentals of Digital Electronics & microcontrollers (6 Marks)

a. Number Systems – Decimal, Binary, Octal, Hexadecimal, conversions, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Half Adder, Full adder.

b. Microcontroller fundamentals – Memory organization, Addressing modes, Registers, Interrupts.

Module 5

Power sources and Renewable energy systems (5 marks)

a. SMPS, Switch mode power supplies and their working principles. Various types of chopper circuits

b. Inverter, principle of operation, power rating, change over period.

c. UPS, Concept of Uninterrupted power supply. Types of UPS: Off line UPS, On line UPS, Line interactive UPS & their comparison, UPS specifications.

d. Solar Power, Need for renewable energy sources, Solar energy as a renewable resource. Materials used for solar cells. Principles of conversion of solar light into electricity. Basics of photovoltaic cell. Module, panel and Arrays. Factors that influence the output of a PV module

Module 6

Basics of Computer Hardware and Software (10 Marks)

a. Types of Computers - Micro, Mini, Mainframe and Super Computer, Architecture of a Computer System–Processor (CPU) - Types and their specifications (Intel: Celeron, P4 family, Xeon, dual core, quad core, core 2 duo, i3, i5, i7 and AMD), ALU, Memory - Types, Storage, Semiconductor memories: RAM, ROM, PROM, EMPROM, EEPROM, Static and Dynamic, Cache Memory, Secondary Storage Devices -Types, Capacity, Standards, Interface.

b. Concept of Operating System–Types of Operating Systems, Functions of an Operating System, Need of OS, Batch Processing, Multi-processing, Single user & Multi user OS, Introduction to Unix, Linux, Windows systems.

c. Introduction to Computer Networks – Definition, Advantages, Architecture: Peer-to-Peer and Client/Server Network. Network Topologies – Star, Ring, Bus, Tree, Mesh, Hybrid. Types of Networks – Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), Intranet and Internet. Wi-Fi, Bluetooth.

Module 7

Basics of indicating Instruments (4 marks)

a. Fundamentals of analog Ammeters, Voltmeters and Galvanometers, Measurement of Power and Energy, Measurement of Resistance, Potentiometers, Multi meters and Cathode Ray Oscilloscopes.

Module 8

Basics of Transducers and Instrumentation (20 marks)

a. Transducers, Classification of Transducers, Resistive Transducers, Sensitivity, Types of Potentiometers, Strain Gauges, Gauge factor, Piezoresistive effect, Types of strain gauges,

b. Resistance Temperature detectors, Thermistors and Thermocouple, Seebeck effect, Peltier effect

c. Variable inductance transducers, LVDT, Capacitive transducers, types, uses.

d. Piezo-electric transducers, Hall effect transducers, Tachometers, Stroboscope

e. Measurement of displacement, Types, Load cells, Measurement of Pressure, Types of instruments, Measurement of Torque, measurement of Vibration and acceleration.

f. Density, Viscosity and PH measurements, Conductivity meter, Calorimeter, Gas analyser

g. Photo-electric transducers, Bolometer, Thermopile, Pyrometers

h. Measurement of Flow, Turbine, Electromagnetic and ultrasound flowmeter, different types of Liquid Level measurement.

i. Types of Radiation, Geiger muller counter, Ionization Chamber, Scintillation counter.

Module 9

Data Acquisition and Telemetry (5 Marks)

a. Components of Data Acquisition system, Multiplexing, Recorders and Data Logging, General Telemetry system, Types, Voltage Telemetry, Current Telemetry, Position Telemetry, Radio frequency Telemetry, Transmitters

b. Fibre optic communication: - Introduction to optical fibre, optical connection and various types, its advantages, properties of optic fibre, testing, losses, types of fibre optic cables and specifications.

Module 10

Basics of Biomedical, Control system and Process control (8 marks)

a. Open loop and closed loop control system, Transfer function, Gain, Bandwidth, Stability, Order of system, Force-voltage analogy, Laplace Transformation, Transient response.

b. Automatic control, variables, process, Feedforward control, Offset, ON-OFF control, PID controller, PLC fundamentals, PLC Block diagram, Ladder Diagram, Pneumatic and Hydraulic controller, I/P and P/I converters, Final control elements, DCS & SCADA

c. Bio electric potentials, ECG, The Sino-atrial node, Oximeter, Blood pressure measurements. Blood flow measurements, Biosensors

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.