DETAILED SYLLABUS FOR THE POST OF INSPECTOR OF LEGAL METROLOGY IN LEGAL METROLOGY

(CATEGORY NO.613/2025)

(Total 100 Marks)

PART I (A) : BASICS OF ELECTRONIC MEASUREMENT SYSTEM (10 Marks)

Section A

Classification of instruments- Deflection and null type
Static and Dynamic characteristics of measuring instruments
Errors in measuring instruments
Scale range and scale span, Signal to noise ratio.

Section B

Indicating Instruments- Different torques, damping system
Moving coil and Moving iron instruments
Galvanometer into ammeters and voltmeters
Extention of range using multipliers,Ohm meters, Energy meters-
Single phase induction typeWattmeters

Section C

DC and AC Bridges, Wheatstones bridge, Kelvin's double bridge,
Hay's Bridge, Maxwell's bridge, Scherring bridge, Wein bridge

Section D

Cathode Ray Oscilloscope
General block diagram, Lissajous pattern, frequency measurement,
Phase angle measurement, Dual trace and DSO

PART I (B) : BASICS OF COMPUTER (10 Marks)

INFORMATION SECURITY - ETHICAL AND SOCIAL ISSUES &

IT in communication, Business, Governance, Medicine, Ofice Automation and Health Care, Education, Science, Entertainment, Engineering Manufacturing, IT Policy in the State Ethical and social issues related to systems- Key Technology Trends that Raise Ethical Issues - Ethics in an information Society - Basic Concepts: Responsibility, Accountability and Liability.
Ethical Analysis - Candidate Ethical Principles - Professional Codes of Conduct Information Rights: Privacy and Freedom in the Internet Age Property Rights: Intellectual Property, Accountability, Liability and Control, System Quality Computer Security: Security concepts - Security aspects in communication – Security requirements
Cryptography: Symmetric encryption Algorithms - Authentication Methods - Access control Principles, Policies, Requirements Intrusion and Detection – Malicious Software – Denial of Service – Firewall Operating System Vulnerabilities: Windows OS vulnerabilities - Linux OS vulnerabilities Countermeasures

MS OFFICE AND INTERNET

Windows - Desktop, Taskbar, Start Menu, My Computer, Windows Explorer, Recycle Bin – Accessories - Calculator, Notepad, Paint, Wordpad.
MS Word - Text Formatting Features - Paragraph Change Case, Font, Tabs, Drop Cap, Bullets and Numbering, Advanced Formatting Features - Boarders and Shading, Autoshape, Caption, Columns, Text Box, Footnote, Tables and Drawing Features - Insert Table, Draw Table, Formula, Sort, Forms Graphics - Word Art and Clip Art, Tools - Mail Merge, Spelling and Grammar, Thesaurus, Autocorrect MS Excel - Worksheets, Cell, Cell Range Operations, Fill Series, protecting Worksheets Functions - sum, average, if. Financial and Statistical Functions, Mathematical Functions.
Database Operations - Sort, Filter - Auto filter and Advanced filter. Subtotals, Table, Validation Charts - Column, Pie, XY, Line, Scatter.

PART II (A) PHYSICS (30 MARKS)

Module 1 Measurement

Physical quantities, Units, SI and CGS systems, dimensional analysis, Measurement of quantities, accuracy, precision, errors, absolute, systematic, random, relative and percentage errors, Estimating and reporting of errors, error bars and graphical representation, errors with reading scales, screw gauge, vernier callipers, common balance, least count of measuring instruments, significant figures.

Module II Mechanics

Motion in one dimension, position, distance, displacement, speed, velocity, acceleration, uniform velocity and uniform acceleration, linear momentum. Newton's laws of motion, law of conservation of linear momentum, force, work, energy, power.

Gravitation, Newton's law of gravitation, mass, inertia, acceleration due to gravity and its variation with height depth and latitude.

Rigid body-centre of mass, centre of gravity, moment of inertia.

Rotational motion, period, frequency, angular celocity (frequency), torque, angular momentum, law of conservation of angular momentum, centripetal and centrifugal force.

Couple, moment of a force, Mechanical equilibrium, concurrent forces, translational and rotational equilibrium, moment bar.

Simple harmonic motion, Spring and spring constant, Oscillations of spring.

Module III Properties of matter

Elasticity-stress, strain, stress-strain diagram, Hooke's law, moduli of elastcity, bending of beams (uniform and non niform) cantilever, Torsion, Static torsion, Torsional oscillations.

Fluids, upthrust, pressure, Pascal's law, hydraulic lift, buoyancy, law of foatation, Archimede's principle, Streamline and turbulent flow, equation of continuity, Bernoulli's theorem and applications., viscosity, Newton's law of viscosity, Stoke's formula, Poiseuille's formula and applications, temperature dependence of viscosity.

Surface tension, surface energy, angle of contact, capillary rise,excess pressure in curved liquid surface, shape of liquid drops. Temperature dependence of surface tension.

Module IV Heat and thermodynamics

temperature – Celsius, Fahrenheit, Kelvin scales, thermometers, Transper of heat-Conduction – thermal onductivity, convection, radiation-black body radiation, Planck's law, Wein's displacementlaw, Stefan's law.

Thermal expansion-Linear expansion of solids, linear expansivity, Ideal gas, kinetic theory of gases, pressure of a gas, ideal gas equation, Specific heat capacity of gases, Maye's relation.

Thermodynamics-system and surroundings, thermodynamics processes, vaiables, indicator diagram, work done in thermodynamics, cyclic process, isothermal, adiabatic processes, reversible and irreversible process, heat engine, Crnot cycle, diesel engine, efficiency, second law of thermodynamics, refrigerator, entropy and disorder, third law of thermodynamics.

Module V Optics

Reflection-Laws of reflection, plane and spherical mirrors, principal focus and focal length, mirror equation, uses of spherical mirrors.

Refraction-Snell's law, total internal reflection, refraction at spherical surfaces, convex and concave lens, focal length, Lens maker's formula, spherical and chromatic aberration, combination of lenses, prism, equation for refractive index of the prison.

Interference-principle of superposition, coherent sources, Young's double slit experiment, colour of thin films. Fringes of equal thickness/inclination. Newton's rings.

Diffraction – Fresnel and Fraunhoffer diffraction, Fresnel diffraction, Fresnel diffraction at straight edge, Fraunhoffer diffraction at narrow slit, Diffraction gratings.

Optical instruments – microscope (simple and compound) and telescope (reflecting and refracting) – resolving power.

Scattering – Rayleigh scattering – colour of the sky, colour of morning and evening sun, Raman scattering.

Polarisation – polarised and unpolarised light, planes of polarisation and vibration, polarisation by reflection, Brewster angle, Malu's law, polarisation by scattering,polaroids, optical activity.

Spontaneous and stimulated emissions, population inversion, LASER,Ruby LASER.

Electromagnetic spectrum.

Module VI Electrostatics and current electricity

Electrostatics-Coulomb's law in electrostatics, electric field, electric flux, Gauss' theorem, electric potentional, electric dipole, capacitor, energy stores in the capacitor, serial and parallel combination of capacitors.

Current eectricity-emf,electric current, Ohm's law, resistance, resistivity, series and parallel combination of resistors, cells-dry cells and storage cells, internal resistance of cells, Joule heating, electrical power, power rating of electrical instruments, ammeter, voltmeter, multimeter.

Kirchoff's laws, Wheatston's bridge, Voltage and current sources, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

Module VII Magnetism

Magnetism – magnetic field, magnetic flux, Biot-Savart law Ampere's circuital theorem, magnetic dipole, magnetic moment, current loop, Lorentz force, force acting on a current carrying conductor in a magnetic field, force between curret carrying conductors, terrestrial magnetism, Horizontal magnetic field, vertical magnetic field and dip at place.

Module VIII Electromagnetic induction and alternating current

Electromagnetic induction – Faraday's law, Lenz's law, Self and mutual induction, Eddy currents and applications, Transformer, Speedometer.

Alternating current (AC) – generation of AC, frequency, instantaneous, peak, mean and rms value of ac, AC circuits, inductive and capacitive reactance, impedance, LCR circuit, electrical resonance, selection and rejection of frequencies, tuning.

Module IX Electronics

Electronics-band theory of semiconductors, intrinsic and extrinsic semiconductors, pn junction, diode, diode characteristics, diode equation, half wave and full wave rectified, zener diode and characteristics, avalanche and zener break down, zener voltage regulation, LED, photo diode.

Transistors-npn and pnp transistors, Transistor biasing, dc and ac load line, operating point, CE amplified-gain and freequency response, RC phase shift oscillators.

Digital electronics – Binary number system, Logic gates, OR, AND, NOT, NOR,NAND,XOR,XNOR,universal gates, half adder, full adder, Boolean algebra, De Morgan's theorem.

Module X Atoms

Atomic structure, Bohr atom model, Hydrogen spectra, vector atom model and quantum numbers, Pauli's exclusion principle.

Part II (B) : CHEMISTRY (Total 30 marks)

1. States of matter
2. Solid state: Crystalline and amorphous solids, types of crystals, X-ray diffraction - Braggs’s equation, Imperfection in crystals
   Liquid state: Vapour pressure, surface tension, viscosity
   Gaseous state: Ideal gas equation, Kinetic theory of gases, Types of molecular velocities (average, most probable and RMS), formulas and inter relations
   2. Solutions
   Concentration-Molarity, Molality, Normality and Mole fraction
   Raoult’s law, Colligative properties
   3. Electrochemistry
   Specific, equivalent conductance and Molar conductance and its variation with dilution
   Electrochemical cells-types- electrolytic and galvanic with examples
   Reference electrodes-standard hydrogen electrode, calomel electrode
   Cell reaction, Nernst equation, fuel cells

4. Analytical principles

Inorganic qualitative analysis : Common ion effect and solubility product.
Quantitative Analysis: Theory of acid-base titration, acid-base indicators
Basic principles of gravimetry
Chromatography- Column chromatography, thin layer chromatography, Gas chromatography and HPLC

5. Polymers

Classification of polymers, Homopolymers and copolymers, Addition and condensation polymers, thermoplastics and thermosets
Preparation and uses of polyethylene, PVC, Teflon phenol-formaldehyde resin, epoxy resin, nylon-66, Dacron, synthetic rubbers – SBR and nitrile rubbers

6. Chemistry in everyday life

Cement: chemical composition of Portland cement, setting and hardening of cement
Paints: Primary constituents, binders and solvents
Soaps and detergents: composition and cleansing action
Food additives

7. Fuels, Propellants, Explosives

Fuels: calorific value, petroleum products, natural gas, biogas, LPG composition
Propellants and Explosive compounds, Examples-TNT, TNG, Urea nitrate, Hydrazine derivatives

8. Nanomaterials

Definition, classification, Preparations of nanoparticles using Top-down approaches and Bottom to top approaches. Carbon nanotubes and fullerenes. Properties of nanoparticles: optical, magnetic and catalytic property with examples.
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9. Spectroscopy

UV–Visible spectroscopy: Beer-Lambert's law, types of electronic transitions, bathochromic, hypsochromic shifts, hyperchromic and hypochromic effects.
IR spectroscopy : Molecular vibrations, Functional group and finger print region, effect of hydrogen bonding on hydroxyl stretching frequency, Factors influencing carbonyl stretching frequency NMR spectroscopy: Principle of proton NMR, shielding and deshielding effect, chemical shift.

10. Environmental chemistry

Air pollution: Composition of air, causes of air pollution, carbon monoxide, carbon dioxide, oxides of Nitrogen and sulphur , CFC
Acid rain, Greenhouse effect, ozone layer depletion
Water pollution: causes, BOD , COD
Soil pollution: pesticides, fertilizers, Industrial waste, Plastic.
Major environmental disasters :Minamata, Itaiitai, Bhopal disaster, Chernobyl incident
Green chemistry: Principles of green chemistry, atom economy, super critical fluids.

PART II (C)

MATHEMATICS (20 Marks)

Unit 1 : Mental Ability and Reasoning

coding and Decoding, Classification, Letter and Numberseries, Sequences, Clock and Calendar.

Unit 2 : Quantitative Aptitude

Numbers, Simplification, Percentage, Simple Interest, Compound Interest, Work, Time and Distance.

unit 3 : Mensuration

Area of plane figures such as circles, squares, rectangles, triangles, quadrilaterals, Volume of solids such as spheres, cube, cylinder, cone and parallelopiped.

Unit 4 : Quadratic equations

Quadratic equation, Examples, Solution, Nature of roots, Discriminant, Relation between Roots and Coefficients, Simple Applications.

Unit 5 : Matrices and Determinants

Matrices : Examples and Properties, Types of Matrices, Operation of Matrices, Inverse of matrix. Rank of a Matrix, Determinants, Properties of Determinants, Applications of Determinants.

Unit 6 : Systems of linear equations

systems of linear equations – both Homogeneous and Non-Homogeneous, Consistency of the system, Solution Methods _ Guass Elimination, Matrix inversion and Cramer's rule.

Unit 7 : Permutations and Combinations
Permutations and Combinations – Simple Examples, Properties, Relations, Applications in rearrangement of letters and numbers, Binomial Expansion, Calculation of coefficients in a binomial expansion.

Unit 8 : Applications of Differentiation

derivative, Properties, Geometrical meaning of Derivative, Derivative as Rate of Change, Velocity and Acceleration, Increasing and Decreasing function, Related rates, Maxima and Minima.

Unit 9 : Applications of Inegration

Integrals, Properties, Geometric Meaning of Integration, Calculation of area under curve, calculation of volume of solid of revolution.

Unit 10 : Differential Equations

Differential equations, Definition and examples, Degree, Order, Solution of First order Differential Equation – Variable Separable, Exact Equation, Linear Equation, Second order Linear Differential Equations.

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.