

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

(Cat.No.: 158/2020, 485/2022)

(Total Marks – 100)

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

<p>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.</p>	2 marks
<p>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 type Wattmeters</p>	3 marks
<p>Section C DC and AC Bridges, Wheatstones bridge, Kelvin's double bridge, Hay's Bridge, Maxwell's bridge, Scherring bridge, Wein bridge</p>	2marks
<p>Section D Cathode Ray Oscilloscope General block diagram, Lissajous pattern, frequency measurement, Phase angle measurement, Dual trace and DSO</p>	3 marks

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

INFORMATION SECURITY - ETHICAL AND SOCIAL ISSUES & (5 Marks)

IT in communication, Business, Governance, Medicine, Office 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 (5 Marks)

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 - Borders 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 (B) : CHEMISTRY (Total 30 marks)

1. States of matter (3 marks)

Solid state: Crystalline and amorphous solids, types of crystals, X-ray diffraction-Bragg'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 (3 marks)

Concentration-Molarity, Molality, Normality and Mole fraction

Raoult's law, Colligative properties

3. Electrochemistry (2 marks)

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 (3 marks)

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 (3 marks)

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 (3 marks)

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 (2 marks)

Fuels: calorific value, petroleum products, natural gas, biogas, LPG composition

Propellants and Explosive compounds, Examples-TNT, TNG, Urea nitrate, Hydrazine derivatives

8. Nanomaterials (3 marks)

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.

.

9. Spectroscopy (4 marks)

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(4 marks)

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 (a) PHYSICS (30 MARKS)

Module I Measurement (2 Marks)

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 (4 marks)

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 velocity (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 (3 Marks)

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

Fluids, upthrust, pressure, Pascal's law, hydraulic lift, buoyancy, laws of floatation, 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 a curved liquid surface, shape of liquid drops. Temperature dependence of surface tension

Module IV Heat and thermodynamics (3 Marks)

Temperature- Celsius, Fahrenheit, Kelvin scales, thermometers, Transfer of heat- Conduction – thermal conductivity, convection, radiation- black body radiation, Planck's law, Wein's displacement law, 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, Mayer's relation

Thermodynamics-system and surroundings, thermodynamic processes, variables, indicator diagram, work done in thermodynamic processes, Zeroth law of thermodynamics, internal energy, First law of thermodynamics, cyclic process, isothermal, adiabatic processes, reversible and irreversible processes, heat engine, Carnot cycle, diesel engine, efficiency, second law of thermodynamics, refrigerator, entropy and disorder, third law of thermodynamics.

Module V Optics (5 Marks)

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 prism,

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 Fraunhofer diffraction, Fresnel diffraction at straight edge, Fraunhofer 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 (4 Marks)

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

Current electricity-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 (2 Marks)

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 current carrying conductors, terrestrial magnetism, Horizontal magnetic field, vertical magnetic field and dip at a place.

Module VIII Electromagnetic induction and alternating current (2 Marks)

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 (4 Marks)

Electronics-band theory of semiconductors, intrinsic and extrinsic semiconductors, pn junction, diode, diode characteristics, diode equation, half wave and full wave rectifiers, 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 amplifier-gain and frequency 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 (1 Mark)

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

SYLLABUS

Inspector of Legal metrology in Legal metrology

CHEMISTRY

(Total 30 marks)

1. States of matter (3 marks)

Solid state: Crystalline and amorphous solids, types of crystals, X-ray diffraction- Bragg'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 (3 marks)

Concentration-Molarity, Molality, Normality and Mole fraction

Raoult's law, Colligative properties

3. Electrochemistry (2 marks)

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 (3 marks)

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 (3 marks)

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 (3 marks)

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 (2 marks)

Fuels: calorific value, petroleum products, natural gas, biogas, LPG composition

Propellants and Explosive compounds, Examples-TNT, TNG, Urea nitrate, Hydrazine derivatives

8. Nanomaterials (3 marks)

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.

9. Spectroscopy (4 marks)

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(4 marks)

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.

Syllabus for the selection to the Post of Inspector of Legal Metrology

Department: Legal Metrology

Subject: Mathematics

Unit 1: Mental Ability and Reasoning (1 Question)

Coding and Decoding, Classification, Letter and Number series, Sequences, Clock and Calendar.

Unit 2: Quantitative Aptitude (2 Questions)

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

Unit 3: Mensuration (2 Questions)

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

Unit 4: Quadratic Equations (2 Questions)

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

Unit 5: Matrices and Determinants (3 Questions)

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

Unit 6: Systems of linear equations (2 Questions)

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

Unit 7: Permutations and Combinations (2 Questions)

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 (2 Questions)

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 Integration (2 Questions)

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

Unit 10: Differential Equations (2 Questions)

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