Motion

Motion in a Straight Line: Frame of reference, Motion in a straight line, Elementary concepts of differentiation and integration for describing motion, uniform and non- uniform motion, and instantaneous velocity, uniformly accelerated motion, velocity - time and position-time graphs. Relations for uniformly accelerated motion (graphical treatment).

Motion in a Plane: Scalar and vector quantities; position and displacement vectors, general vectors and their notations; equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors, Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of vectors. Motion in a plane, cases of uniform velocity and uniform acceleration-projectile motion, uniform circular motion.

Laws of Motion: Intuitive concept of force, Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion. Law of conservation of linear momentum and its applications. Equilibrium of concurrent forces, Static and kinetic friction, laws of friction, rolling friction, lubrication. Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).

System of Particles and Rotational Motion: Centre of mass of a two-particle system, momentum conservation and Centre of mass motion. Centre of mass of a rigid body; centre of mass of a uniform rod. Moment of a force, torque, angular momentum, law of conservation of angular momentum and its applications. Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions. Moment of inertia, radius of gyration, values of moments of inertia for simple geometrical objects (no derivation).

Work, Energy and Power Work

Done by a constant force and a variable force; kinetic energy, work energy theorem, power. Notion of potential energy, potential energy of a spring, conservative forces: non-conservative forces, motion in a vertical circle; elastic and inelastic collisions in one and two dimensions.

Sound and Waves

Velocity of sound, noise and sound Intensity measurement, echo, reverberation, Sabine's Formula, absorption coefficient and it's measurement, sound absorbing materials, transmission of sound and transmission loss, Musical sounds and their characteristics,

Consonance and Dissonance. Sound, Production of Sound, Propagation of Sound, Reflection of Sound, Range of Hearing. Applications of Ultrasound, Structure of Human Ear, Transverse and longitudinal waves, displacement relation in a progressive wave, the speed of a travelling wave, the principle of superposition of waves, Reflection of waves, Beats, Doppler effect.

Density and Specific Gravity

Definition, Computation, Representation, SI Unit, Application.

Electrostatics

Frictional electricity, charges and their conservation; Coulomb's law – forces between two-point electric charges. Forces between multiple electric charges – Superposition principle. Electric field – Electric field due to a point charge, electric filed lines; Electric dipole, electric filed intensity duc to a dipole – behaviour of dipole in a uniform electric field – application of electric dipole in microwave oven. Electric potential – potential difference – electric potential due to a point charge and due a dipole. Equipotential surfaces – Electrical potential energy of a system of two-point charges.

Electric flux – Gauss's theorem and its applications to find field due to (1) infinitely long straight wire (2) uniformly charged infinite plane sheet (3) two parallel sheets and (4) uniformly charged thin spherical shell (inside and outside)

Electrostatic induction – capacitor and capacitance – Dielectric and electric polarisation – parallel plate capacitor with and without dielectric medium – applications of capacitor – energy stored in a capacitor. Capacitors in series and in parallel – action of points – Lightning arrester – Van dc Graaff generator.

Effects of Electric Current

Heating effect. Joule's law – Experimental verification. Thermoelectric effects – Seebeck effect – Peltier effect – Thomson effect – Thermocouple, thermoemf, neutral and inversion temperature. Thermopile.

Magnetic effect of electric current – Concept of magnetic field. Oersted's experiment – Biot-Savart law – Magnetic field due to an infinitely long current carrying straight wire and circular coil – Tangent galvanometer – Construction and working – Bar magnet as an equivalent solenoid – magnetic field lines.

Amper's circuital law and its application.

Force on a moving charge in uniform magnetic field and electric field – cyclotron – Force on current carrying conductor in a uniform magnetic field, forces between two parallel current carrying conductors – definition of ampere.

Torque experienced by a current loop in a uniform magnetic field-moving coil galvanometer – Conversion to ammeter and voltmeter – Current loop as a magnetic dipole and its magnetic dipole moment – Magnetic dipole moment of a revolving electron.

Surface Tension and Viscosity

Surface Tension: Intermolecular forces, Cohesive force, Adhesive force, Molecular range and sphere of influence, Surface tension of a liquid, Molecular theory of surface tension, Surface energy, Pressure difference across a liquid surface, Excess pressure, Factors affecting surface tension, Applications of surface tension.

Viscosity: Co-efficient of viscosity, Stroke's Law, Terminal Velocity, Viscous Force, Velocity Gradient and Coefficient of Viscosity.

Optics

Ray Optics, Wave Optics and Optical Instruments

Ray Optics: Reflection of light, spherical mirrors, mirror formula, refraction of light, total internal reflection and optical fibers, refraction at spherical surfaces, lenses, thin lens formula, lens maker's formula, magnification, power of a lens, combination of thin lenses in contact, refraction of light through a prism.

Wave optics: Wave front and Huygen's principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle. Interference, Young's double slit experiment and expression for fringe width (No derivation final expression only), coherent sources and sustained interference of light, diffraction due to a single slit, width of central maxima (qualitative treatment only).

Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Magnetism and Matter: Bar magnet, bar magnet as an equivalent solenoid (qualitative treatment only), magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis (qualitative treatment only), torque on a magnetic dipole (bar magnet) in a uniform magnetic field (qualitative treatment only), magnetic field lines. Magnetic properties of materials- Para-, dia- and ferro – magnetic substances with examples, Magnetization of materials, effect of temperature on magnetic properties

Electromagnetic waves: Electromagnetic Waves Basic idea of displacement current, Electromagnetic waves, their characteristics, their transverse nature (qualitative idea only). Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Introduction Fundamentals of Forensic Science: Definition, History & Development, Scope, Ethics in Forensic Science, Physical Evidence, Scene of Crime, Courts: Types,

powers and jurisdiction, Admissibility of evidence in Courts, Definition of Experts, Court Procedures pertaining to Expert Testimony & Witness Forensic aspects of new laws: Bharatiya Nagrik Suraksha Sanhita (BNSS), Bharatiya Sakshya Adhiniyam (BSA), Bharatiya Nyay Sanhita (BNS), Organization of Forensic Science Laboratories of Centre and State, NCRB and NICFS, Police Organizations, Roles and Responsibilities.

Introduction to Forensic Physics: Introduction, Definition, Physical Evidence: Nature, Collection, Preservation and Forwarding for Scientific Examination, General Overview of Instruments used in Forensic Physics.

Building Material: Introduction, Cement: Types and Composition, Determination of Adulterants by physical, chemical and instrumental methods, examination of brick, Analysis of cement ,mortar, cement concrete, and stones, forensic examination of electric appliances.

Tool Marks: Introduction, Types of Tool Marks, Class & Individual Characteristics, Tracing, Photography, Lifting and Casting of Tool Marks, Examination, Identification and Comparison of Tool Marks.

Foot/Footwear/Tyre Impression: Introduction, Collection, Tracing, Lifting, Casting of Impressions, Enhancement, Analysis & Comparison of Impressions, Moulds, Identification Characteristics, Skid Marks.

Paint: Introduction, Composition and Use of Paint, Types of Paint, Resins and Binders, Lacquers, Plasticizers, Water Based Polymers & Emulsions, Additives, Solvents, Pigment Types, Microscopic & Macroscopic Examination, Micro Chemical Tests, Differential Solubility and TLC, IR Spectroscopy, Pyrolysis GC-MS, Elemental Analysis of the Pigments.

Fiber analysis: Forensic significance, Classification, Textile Fibers, Yarns, Fabric construction, Fabric characteristics, Microscopy characteristic, Birefringence.

Soil: Introduction, Formation & Types of Soil, Composition & Color of Soil, Sample P reparation, Removal of Contamination, Microscopic Examination, Particle Size Distribution, Ignition Test, Density Distribution, pH Measurement, Differential Thermal Analysis (DTA), Elemental Analysis, Interpretation of Soil Evidence.

Glass: Introduction, Types of Glass and their Composition. Forensic Examination of Glass Fractures under different conditions. Physical Measurement of Glass, Color and Fluorescence, Physical Matching, Density Comparison, Refractive Index Measurement (RI), Elemental Analysis and Interpretation of Glass Evidence. Introduction, Location, Collection, Packaging, Forwarding and Laboratory Examination of Fiber, Paper, Ink, Cement & Mortar, Polymers, etc.

Instrumentation-Microscopes, Scanning Electron Microscope, EDX, TEM, XRF, AAS, ICPMS, LIBS, GRIM, Abbe's Refractometer, Spectroscopy(FT-IR,UV-Visible Spectroscopy, Pyrolysis GC-MS.

Forensic Speaker Identification: Introduction to human voice, Human Vocal Cord Anatomy, Production of Voice, Speaker and Speech Identification and Authentication, Voice Analysis, Forensic Significance., Speaker Identification and Tape Authentication: Voice Production Theory, Speech Signal Processing and Pattern Recognition, Acoustic Parameters of Sound, Fourier Analysis, Frequency and Time Domain Representation of Speech Signal, Analogue to Digital Conversion-Sampling and Quantization, Fast Fourier Transform, Speech Enhancement, Authentication of Audio-Video Signal.

Image Analysis: Formation of Image, Image Sampling and Quantization, Basics of Full-colour Image Processing, Image Enhancement Techniques, Filters for Image Enhancement, JPEG, PNG, Header Data Analysis, Noise Analysis, Linkage of Camera. Image Steganography, Image Forgery Detection, Detection of Steganography from Image, Digital Watermark, Multimedia IPR, Forensic Analysis of Multimedia Files.

Video Analysis: Forensic Video Analysis, Enhancement Techniques, Specific Frame Analysis, Resolution, Scope & its Forensic Application in the Field of Security.