Syllabus for JEE Main

The detailed syllabus is given as follows:

JEE Main Physics Syllabus:

- The JEE Main syllabus contains two sections. Section A pertains to the Theory Part having 80% weightage, while Section B contains Practical Components (Experimental Skills) having 20% weightage.

SECTION A:

UNIT 1: Physics and Measurement

- Physics, technology, and society
- S.I. units, Fundamental and derived units.
- Least count, accuracy and precision of measuring instruments, Errors in measurement, Significant figures.
- Dimensions of Physical quantities, dimensional analysis, and its applications.

UNIT 2: Kinematics

- Frames of reference.
- Motion in a straight line: Position-time graph, speed, and velocity. Uniform and non-uniform motion, average speed and instantaneous velocity
- Uniformly accelerated motion, velocity-time, position- time graphs, relations for uniformly accelerated motion. Scalars and Vectors, Vector Addition and Subtraction, Zero Vector, Scalar and Vector products, Unit Vector, Resolution of a Vector.
- Relative Velocity, Motion in a plane, Projectile Motion, Uniform Circular Motion.

UNIT 3: Laws of Motion

- Force and Inertia, Newton's First Law of motion; Momentum, 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.
- Dynamics of uniform circular motion: Centripetal force and its applications.

UNIT 4: Work, Energy, and Power

- Work done by a constant force and a variable force; kinetic and potential energies, work-energy theorem, power.

- The potential energy of a spring, conservation of mechanical energy, conservative and non-conservative forces; Elastic and inelastic collisions in one and two dimensions.

UNIT 5: Rotational Motion

- Centre of the mass of a two-particle system, Centre of the mass of a rigid body; Basic concepts of rotational motion; the moment of a force, torque, angular momentum, conservation of angular momentum and its applications; a moment of inertia, the radius of gyration.
- Values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications. Rigid body rotation, equations of rotational motion.

UNIT 6: Gravitation

- The universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth. Kepler's laws of planetary motion.
- Gravitational potential energy; gravitational potential.
- Escape velocity.
- Orbital velocity of a satellite.
- Geostationary satellites.

UNIT 7: Properties of Solids and Liquids

- Elastic behaviour, Stress-strain relationship, Hooke's Law, Young's modulus, bulk modulus, modulus of rigidity.
- Pressure due to a fluid column; Pascal's law and its applications.
- Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, Reynolds number.
- Bernoulli's principle and its applications.
- Surface energy and surface tension, the angle of contact, application of surface tension - drops, bubbles and capillary rise. Heat, temperature, thermal expansion; specific heat capacity, calorimetry; change of state, latent heat.
- Heat transfer-conduction, convection and radiation, Newton's law of cooling.

UNIT 8: Thermodynamics

- Thermal equilibrium, zeroth law of thermodynamics, the concept of temperature.
- Heat, work and internal energy.
- First law of thermodynamics.
- The second law of thermodynamics: reversible and irreversible processes.
- Carnot engine and its efficiency.

UNIT 9: Kinetic Theory of Gases

- The equation of state of a perfect gas, work done on compressing a gas.
- Kinetic theory of gases - assumptions, the concept of pressure.

- Kinetic energy and temperature: RMS speed of gas molecules; Degrees of freedom, Law of equipartition of energy, applications to specific heat capacities of gases; Mean free path, Avogadro's number.

UNIT 10: Oscillations and Waves

- Periodic motion - period, frequency, displacement as a function of time.
- Periodic functions. Simple harmonic motion (S.H.M.) and its equation; phase; oscillations of a spring -restoring force and force constant; energy in S.H.M. - kinetic and potential energies; Simple pendulum - derivation of expression for its time period; Free, forced and damped oscillations, resonance.
- Wave motion. Longitudinal and transverse waves, the speed of a wave.
- Displacement relation for a progressive wave.
- Principle of superposition of waves, reflection of waves, Standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect in sound

UNIT 11: Electrostatics

- Electric charges: Conservation of charge, Coulomb's law-forces between two point charges, forces between multiple charges; superposition principle and continuous charge distribution.
- Electric field: Electric field due to a point charge, Electric field lines, Electric dipole, Electric field due to a dipole, Torque on a dipole in a uniform electric field.
- Electric flux, Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell.
- Electric potential and its calculation for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field.
- Conductors and insulators, Dielectrics and electric polarization, capacitor, the combination of capacitors in series and in parallel, the capacitance of a parallel plate capacitor with and without dielectric medium between the plates, Energy stored in a capacitor.

UNIT 12: Current Electricity

- Electric current, Drift velocity, Ohm's law, Electrical resistance, Resistances of different materials, V-I characteristics of Ohmic and nonohmic conductors, Electrical energy and power, Electrical resistivity, Colour code for resistors; Series and parallel combinations of resistors; Temperature dependence of resistance.
- Electric Cell and its Internal resistance, potential difference and emf of a cell, the combination of cells in series and in parallel. Kirchhoff's laws and their applications. Wheatstone bridge, Metre bridge. Potentiometer - principle and its applications.

UNIT 13: Magnetic Effects of Current and Magnetism

- Biot - Savart law and its application to current carrying circular loop.
- Ampere's law and its applications to infinitely long current carrying straight wire and solenoid.
- Force on a moving charge in uniform magnetic and electric fields.
- Cyclotron.
- Force on a current-carrying conductor in a uniform magnetic field.
- Force between two parallel current-carrying conductors-definition of the ampere.
- Torque experienced by a current loop in uniform magnetic field; Moving coil galvanometer, its current sensitivity and conversion to ammeter and voltmeter.
- Current loop as a magnetic dipole and its magnetic dipole moment.
- Bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferro- magnetic substances.
- Magnetic susceptibility and permeability, Hysteresis, Electromagnets and permanent magnets.

UNIT 14: Electromagnetic Induction and Alternating Currents

- Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents.
- Self and mutual inductance.
- Alternating currents, peak and RMS value of alternating current/ voltage; reactance and impedance; LCR series circuit, resonance; Quality factor, power in AC circuits, wattless current.
- AC generator and transformer.

UNIT 15: Electromagnetic Waves

- Electromagnetic waves and their characteristics.
- Transverse nature of electromagnetic waves.
- Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, Xrays, gamma rays).
- Applications of e.m. waves.

UNIT 16: Optics

- Reflection and refraction of light at plane and spherical surfaces, mirror formula, Total internal reflection and its applications, Deviation and Dispersion of light by a prism, Lens Formula, Magnification, Power of a Lens, Combination of thin lenses in contact, Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers.
- Wave optics: wavefront and Huygens' principle, Laws of reflection and refraction using Huygen's principle.
- Interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light.
- Diffraction due to a single slit, width of central maximum.

- Resolving power of microscopes and astronomical telescopes, Polarisation, plane polarized light; Brewster's law uses of plane polarized light and Polaroids.

UNIT 17: Dual Nature of Matter and Radiation

- Dual nature of radiation.
- Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation; particle nature of light.
- Matter waves-wave nature of the particle, de Broglie relation.
- Davisson-Germer experiment.

UNIT 18: Atoms and Nuclei

- Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum.
- Composition and size of the nucleus, atomic masses, isotopes, isobars; isotones.
- Radioactivity-alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

UNIT 19: Electronic Devices

- Semiconductors; semiconductor diode: I-V characteristics in forward and reverse bias; diode as a rectifier; I-V characteristics of LED, photodiode, solar cell and Zener diode; Zener diode as a voltage regulator.
- Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator.
- Logic gates (OR, AND, NOT, NAND and NOR).
- Transistor as a switch.

UNIT 20: Communication Systems

- Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation, Need for modulation, Amplitude and Frequency Modulation, Bandwidth of signals, Bandwidth of Transmission medium.
- Basic Elements of a Communication System (Block Diagram only)

SECTION B

UNIT 21: Experimental Skills

Familiarity with the basic approach and observations of the experiments and activities:

- Vernier callipers - its use to measure the internal and external diameter and depth of a vessel.
- Screw gauge-its use to determine thickness/diameter of thin sheet/wire.

- Simple Pendulum-dissipation of energy by plotting a graph between square of amplitude and time.
- Metre Scale -mass of a given object by principle of moments.
- Young's modulus of elasticity of the material of a metallic wire.
- Surface tension of water by capillary rise and effect of detergents.
- Co-efficient of Viscosity of a given viscous liquid by measuring terminal velocity of a given spherical body.
- Plotting a cooling curve for the relationship between the temperature of a hot body and time.
- Speed of sound in air at room temperature using a resonance tube.
- Specific heat capacity of a given (i) solid and (ii) liquid by method of mixtures.
- Resistivity of the material of a given wire using metre bridge.
- Resistance of a given wire using Ohm's law.
- Potentiometer - (i) Comparison of emf of two primary cells. (ii) Determination of internal resistance of a cell.
- Resistance and figure of merit of a galvanometer by half deflection method.
- Focal length of: (i) Convex mirror (ii) Concave mirror, and (iii) Convex lens using parallax method.
- Plot of angle of deviation vs angle of incidence for a triangular prism.
- Refractive index of a glass slab using a travelling microscope.
- Characteristic curves of a p-n junction diode in forward and reverse bias.
- Characteristic curves of a Zener diode and finding reverse break down voltage.
- Characteristic curves of a transistor and finding current gain and voltage gain.
- Identification of Diode, LED, Transistor, IC, Resistor, Capacitor from mixed collection of such items.
- Using multimeter to: (i) Identify base of a transistor (ii) Distinguish between NPN and PNP type transistor (iii) See the unidirectional flow of current in case of a diode and an LED. (iv) Check the correctness or otherwise of a given electronic component (diode, transistor or IC).