WBJEE Physics Syllabus

West Bengal Joint Entrance Examination

PHYSICS COMPONENT

TOTAL MODULES	PAPER WEIGHTAGE	TOTAL QUESTIONS	QUESTION TYPES
24 Units	50 Marks	40 MCQs	3 Categories

Class 11 Core Mechanics & Measurement

Modules 01 - 04

1 Physical World, Measurements, Units & Dimensions

- **Fundamentals:** Physical world, fundamental and derived units, units & dimensions of physical quantities.
- **Dimensional Analysis:** Applications, accuracy, precision, and errors in measurement.
- **Practical Calculations:** Rounding off, order of magnitude, significant figures, and their applications.

2 Kinematics: Motion in 1D and 2D

- **Frames of Reference:** Inertial and non-inertial frames, motion in a straight line.
- **Calculus & Kinematics:** Elementary differential and integral calculus for describing motion.
- **Graphical Analysis:** Position-time, velocity-time, and acceleration graphs for uniformly accelerated motion.
- **Variables:** Instantaneous velocity, speed, and analytical relations via graphical and calculus methods.

3 Motion in a Plane & Vector Analysis

- **Vector Algebra:** Scalars and vectors, 3D vector representation, dot and cross products and applications.
- **Vector Resolution:** Rectangular and non-rectangular resolution of vector components.
- **Complex Motion:** Relative velocity, uniform velocity/acceleration in 2D, projectile motion, and motion on inclined planes.

4 Laws of Motion & Friction Dynamics

- **Newtonian Dynamics:** Force, inertia, Newton's laws, impulse, impulsive forces, and momentum conservation.
- **Force Analysis:** Free Body Diagrams (FBD), equilibrium of concurrent forces.
- **Friction:** Static, kinetic, and rolling friction, laws of friction, coefficient of friction.
- **Circular Motion:** Dynamics of uniform circular motion, centripetal and centrifugal forces, banking of roads.

Energy, Rotational Dynamics, Gravitation & Matter

Modules 05 - 09

5 Work, Power, Energy & Collisions

- **Work-Energy Principle:** Work done by constant and variable forces, Work-Energy theorem.
- **Energy Conservation:** Kinetic (KE) and Potential Energy (PE), conservative and non-conservative forces, PE of a spring.
- **Complex Dynamics:** Motion in a vertical circle, elastic and inelastic collisions in 1D and 2D.

6 System of Particles & Rigid Body Dynamics

- **Center of Mass:** Two-particle systems, motion of connected systems, equilibrium of rigid bodies.
- **Rotational Dynamics:** Torque, angular momentum, and conservation of angular momentum with applications.
- **Moment of Inertia:** Radius of gyration, MOI of simple geometric bodies, parallel and perpendicular axis theorems.

7 Gravitation & Orbital Mechanics

- **Gravitational Laws:** Universal law of gravitation, acceleration due to gravity (g) and its variations.
- **Planetary Motion:** Kepler's laws of planetary motion and applications, gravitational potential and PE.
- **Satellites:** Escape velocity, orbital velocity, time period, and geostationary satellites.

8 Bulk Properties of Matter & Surface Tension

- **Elasticity:** Hooke's law, Young's, Bulk, and Shearing moduli, Poisson's ratio, elastic PE of stretched springs/strings.
- **Fluid Mechanics:** Pressure in fluid columns, buoyancy, Pascal's law, gravity effects on fluid pressure.
- **Surface Phenomena:** Surface energy, excess pressure in drops/bubbles, angle of contact, and capillary rise.

9 Viscosity & Fluid Dynamics

- **Viscous Flow:** Coefficient of viscosity, streamline vs. turbulent flow, Reynolds number.
- **Fluid Laws:** Stokes' law, terminal velocity, Bernoulli's theorem and its practical applications.

> 💡 **WBJEE Mechanics Weightage Note**
> Mechanics and Properties of Matter form over 35-40% of the total physics paper. Special emphasis should be placed on Calculus-based kinematics derivations, rotational MOI theorems, and fluid dynamics applications.

Thermal Physics, Waves & Electromagnetism

Modules 10 - 15

10 Thermal Physics, Heat Transfer & Radiation

- **Thermal Expansion:** Solids, liquids, gases, ideal gas laws, anomalous expansion of water.
- **Calorimetry:** Specific heat capacity, change of state, specific latent heat capacity.
- **Conduction & Radiation:** Heat conduction through slabs in series/parallel, Black body radiation, Kirchhoff's law, Newton's law of cooling, Wien's displacement law, Stefan's law.

11 Thermodynamics

- **Laws:** Zeroth law, 1st law (work, internal energy, heat), 2nd law (reversible/irreversible processes).
- **Gas Relations:** Cp and Cv relations, isothermal & adiabatic process equations, P-V diagrams, work done.
- **Heat Engines:** Carnot engine and efficiency, qualitative idea of refrigerator efficiency.

12 Kinetic Theory of Gases

- **Gas Kinetic Models:** Ideal gas state equation, assumptions, pressure and temperature concepts, RMS speed.
- **Energy Distribution:** Degrees of freedom, equipartition of energy, specific heat capacities, mean free path.

13 Oscillations & Acoustics

- **Simple Harmonic Motion:** Equations, phase, KE/PE, pendulum, loaded spring, liquid U-tube, forced & damped SHM, resonance.
- **Wave Motion:** Progressive waves, Laplace's correction, superposition, standing waves in strings/pipes, beats, Doppler effect.

14 Electrostatics & Capacitance

- **Fields & Potential:** Coulomb's law, electric dipole, Gauss's theorem applications, equipotential surfaces.
- **Capacitors:** Series/parallel combinations, parallel plate, spherical capacitors, energy storage, dielectrics.

15 Current Electricity & Circuits

- **Conduction:** Drift velocity, mobility, Ohm's law, temperature dependence, series/parallel cell combinations.
- **Instruments:** Kirchhoff's laws, Wheatstone bridge, Meter bridge, Potentiometer applications.

Magnetism, Optics & Modern Physics

Modules 16 - 24

16 Magnetic Effects of Current & Magnetism

- **Biot-Savart & Ampere's Laws:** Solenoids, toroids, forces on moving charges/conductors, cyclotron.
- **Magnetic Properties:** Earth's magnetic field, Dia/Para/Ferromagnetic materials, Hysteresis B-H loop.

17 EMI & Alternating Currents

- **Induction:** Faraday’s laws, Lenz's law, Eddy currents, self/mutual inductance.
- **AC Circuits:** LCR series circuits, phasors, resonance, power factor, wattless current, AC generator, transformers.

18 Electromagnetic Waves

- Displacement current, transverse nature of EM waves, spectrum characteristics, and applications.

19 Ray Optics & Optical Instruments

- Reflection, refraction, TIR, optical fibers, lens maker’s formula, conjugate points, prisms, optical instruments (telescopes/microscopes), eye defects.

20 Wave Optics & Quantum Dualism

- **Wave Optics:** Huygens' principle, Young's double slit interference, Fraunhofer single slit diffraction, Brewster's law, polarization.
- **Dual Nature:** Photoelectric effect, Einstein's equation, De Broglie matter waves.

21 Atomic & Nuclear Physics

- **Atoms:** Rutherford & Bohr models, hydrogen spectrum, X-rays (continuous/characteristic), Moseley’s law.
- **Nuclei:** Binding energy, radioactive decay laws, nuclear fission, fusion, mass defect.

23 Semiconductors & Electronic Devices

- Band theory, intrinsic/extrinsic semiconductors, P-N junction diodes, LEDs, Zener diode (voltage regulator), BJTs (CE amplifier/oscillator), Logic Gates (OR, AND, NOT, NAND, NOR).