PHYSICS

The syllabus for Physics at the Higher Secondary Stage has been developed with a view that this stage of school education is crucial and challenging as it is a transition from general science to discipline-based curriculum. The recommendations of National Curriculum Framework-2005 have been followed, keeping the disciplinary approach with rigour and depth, appropriate to the comprehension level of learners. Due care has been taken that the syllabus is not heavy and at the same time it is comparable to the international standards. The -syllabus provides logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding.

It is expected that the syllabus will help to develop an interest in the learners to study Physics as a discipline and inculcate in learners the abilities, useful concepts of Physics in real-life situations for making learning of Physics relevant, meaningful and interesting. The learner is expected to realize and appreciate - the interface of Physics with other disciplines.

RATIONALE

The higher secondary stage is crucial and challenging stage of school education as it is a transition from general science to discipline-based curriculum. Physics is being offered as an elective subject at the higher secondary stage of school education. At this stage, the students take up Physics, as a discipline, with a purpose of pursuing their future careers in basic sciences or professional courses like medicine, engineering, technology and studying courses in applied areas of science and technology at tertiary level. There is a need to provide the learners with sufficient conceptual background of Physics which would eventually make them competent to meet the challenges of academic and professional courses after the higher secondary stage.

The present effort of reforming and updating the Physics curriculum is an exercise based on the feedback received from the school system about existing syllabus and curricular material, large expansion of Physics knowledge, and also the educational and curricular concerns and issues provided in the National Curriculum Framework-2005.

The recommendations of National Curriculum Framework-2005 have been followed, keeping the disciplinary approach with rigour and depth, appropriate to the - comprehension level of learners. Due care has been taken that the syllabus is not heavy and at the same time, it is comparable to the international standards. Also, it is essential to develop linkages with other disciplines for better learning of Physics concepts and establishing relationship with daily-life situations and life-skills.

SALIENT FEATURES

- Emphasis on basic conceptual understanding of content.
- Promoting process-skills, problem-solving abilities and applications of Physics concepts/content, useful in real-life situations for making Physics learning more relevant, meaningful and interesting.
- Emphasis on use of SI Units, Symbols, nomenclature of physical quantities and formulations as per international standards.
- Emphasis on Physics-related technological/industrial aspects to cope up with changing demand of society committed to the use of Physics, technology and informatics.
- Providing logical sequencing of the 'Units' of the subject matter and proper placement of concepts with their linkages for better learning and matching the concepts/content with comprehension level of the learners.
- Reducing the curriculum load by eliminating overlapping of concepts/content within the discipline of Physics or with other disciplines; reducing the descriptive portion and providing suitable formulation/depth of treatment appropriate to the comprehension level of learners, making room for contemporary core - topics and emerging curricular areas in Physics.
- The syllabus is arranged in. Units spread over two year's duration. The Unit is so sequenced as to provide different dimensions of Physics as a discipline. The time allocation for learning Physics content per Unit in terms of instructional periods have been mentioned for each Unit to help the Textbook Development Team members to develop the instructional material so as to cover it within the time frame. Each Unit has been arranged with a topic, content related practical work (one core experiment, two activities to be evaluated) and suggested investigatory projects (one project to be evaluated). There is an imperative need for evaluating the learners through Continuous and Comprehensive Evaluation of various concepts covered in a Unit.

With this background, the Physics curriculum at the higher secondary stage attempts to:

- Strengthen the concepts developed at the secondary stage to provide firm ground work and foundation for further learning Physics at the tertiary level more effectively and learning the relationship with daily-life situations;
- Develop conceptual competence in the learners and make them realize and appreciate the interface of Physics with other disciplines;
- Expose the learners to different processes used in Physics-related industrial and technological applications;

- Develop process-skills and experimental, observational, manipulative, decision-making and investigatory skills in the learners;
- Promote problem-solving abilities and creative thinking to develop interest in the learners in the study of Physics as a discipline;
- Understand the relationship between nature and matter on scientific basis, develop positive scientific attitude, and appreciate the contribution of Physics towards the improvement of quality of life and human welfare;
- Physics teaching-learning at the higher secondary stage enables the learners lo comprehend the contemporary knowledge and develop aesthetic sensibilities and process skills, The experimental skills and process-skills developed together with conceptual Physics knowledge prepare the learners for more meaningful learning experiences and contribute to the significant improvement of quality of life. The learners would also appreciate the role and impact of Physics and technology, and their linkages with overall national development.

COURSE STRUCTURE
Class XI (Theory)

One Paper	Time 3 Hours	Max. Marks: 70
Units	**Titles**	**Weightage**
I	Physical World & Measurement	04
II	Kinematics	08
III	Laws of Motion	08
IV	Work, Energy & Power	08
V	Motion of System of particles & Rigid Body	06
VI	Gravitation	08
VII	Properties of Bulk Matter	10
VIII	Thermodynamics	06
IX	Behaviour of Perfect Gas & Kinetic Theory of Gases	04
X	Oscillations & Waves	08
	Total	**70**

(Total Periods: 180)

Unit I: Physical World and Measurement   (Periods 10)

Physics: Scope and excitement; nature of physical laws; Physics, technology and society. *Need for measurement:* Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and lime measurements; accuracy and precision of measuring instruments; errors in measurement; significant figures.

Dimensions of physical quantities, dimensional analysis and its applications.

Unit II: Kinematics: (Periods 30)

Frame of reference(Inertia and non-inertia frames), 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 and position-time graphs, relations for uniformly accelerated motion (graphical treatment);

Elementary-concepts of differentiation and integration for describing motion. *Scalar and vector quantities*: Position and displacement vectors, general vectors and notation, equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors. Relative velocity.

Unit vectors. Resolution of a vector in a plane -rectangular components.

Scalar and Vector products of Vectors. Motion in a plane. Cases of uniform velocity and uniform acceleration-projectile motion. Uniform circular motion.

Unit III: Laws of Motion   (Periods 16)

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 level circular road, vehicle on banked road).

Unit IV: Work, Energy and Power   (Periods 16)

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; conservation of mechanical energy (kinetic and potential energies); non-conservative forces; motion in a vertical circle, elastic and inelastic collisions in one and two dimensions.

Unit V: Motion of System of Particles and Rigid Body   (Periods 18)

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 uniform rod.

Moment of a force, torque, angular momentum, conservation of angular momentum with some examples.

Equilibrium of rigid bodies, rigid body rotation and equation of rotational motion, comparison of linear and rotational motions; moment of inertia, radius of gyration. Values of M.I. for simple geometrical objects(no derivation). Statement of parallel and perpendicular axes theorem and their applications.

Unit VI: Gravitation   (Periods 14)

Kepler's laws of planetary motion. The universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth.

Gravitational potential energy; gravitational potential. Escape velocity, orbital velocity of a satellite. Geostationary satellites.

Unit VII: Properties of Bulk Matter   (Periods 28)

Elastic behaviour, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus-, shear, modulus of rigidity, poisson's ratio; elastic energy.

Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes) . Effect of gravity on fluid pressure.

Viscosity, Stokes' law, terminal velocity, Reynolds's number, streamline and turbulent flow. Critical velocity, Bernoulli's theorem and its applications.

Surface energy and surface tension, angle of contact, excess of pressure, application of surface tension ideas to drops, bubbles and capillary rise.

Heat, temperature, thermal expansion; thermal expansion of solids, liquids, and gases. Anomalous expansion. Specific heat capacity: Cp, Cv — calorimetry; change of state — latent heat.

Heat transfer-conduction and thermal conductivity, convection and radiation. Qualitative ideas of Black Body Radiation, Wein's displacement law, and Green House effect.

Newton's law of cooling and Stefan's law

Unit VIII : Thermodynamics (Periods 12)

Thermal equilibrium-and definition of temperature (Zeroth law of Thermodynamics). Heat, work and internal energy. First law of thermodynamics. Isothermal and adiabatic processes.

Second law of thermodynamics: Reversible and irreversible processes. Heat engines and refrigerators.

Unit IX: Behaviour of Perfect Gas and Kinetic Theory (Periods 8)

Equation of state of a perfect gas; work done on compressing a gas.

Kinetic theory of gases : Assumptions, concept of pressure. Kinetic energy and temperature; rms speed of gas molecules; degrees of freedom, law of equipartition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

Unit X: Oscillations and Waves (Periods 28)

Periodic motion — period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion(SHM) and its equation; phase; oscillations of a spring - restoring force and force constant; energy in SHM — kinetic and potential energies; simple pendulum - derivation of expression for its time period; free, forced and damped oscillations (qualitative ideas only), resonance.

Wave motion. Longitudinal and transverse waves, speed of wave motion. 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

PRACTICALS

Total Periods 60

Section A

Experiments.
(Any 8 experiments out of the following to be performed by the students)

1. To measure diameter of a small spherical/cylindrical body using Vernier callipers.
2. To measure internal diameter and depth of a given beaker/calorimeter using Vernier callipers and hence find its volume.
3. To measure diameter of a given wire using screw gauge.
4. To measure thickness of a given sheet using screw gauge.
5. To measure volume of an irregular lamina using screw gauge.
6. To determine radius of curvature of a given spherical surface by a spherometer.
7. To determine the mass of two different objects using a beam balance,
8. To find the weight of a given body using parallelogram law of vectors.
9. Using a simple pendulum, plot L-T and L-T^2 graphs. Hence find the effective length of a second's pendulum using appropriate graph.
10. To study the relationship between force of limiting friction and normal reaction and to find the coefficient of friction between a block and a horizontal surface.
11. To find the downward force, along an inclined plane, acting on a roller due to gravitational pull of the earth and study its relationship with the angle of inclination (θ) by plotting graph between force and sin θ.

Activities

1. To make a paper scale of given least count, e.g. 0.2 cm, 0.5 cm.
2. To determine mass of a given body using a metre scale by principle of moments.
3. To plot a graph for a given set of data, with proper choice   scales and error bars.
4. To measure the force of limiting friction for rolling of a roller on a horizontal plane.
5. To study the variation in the range of a jet of water with the angle of projection.
6. To study the conservation of energy of a ball rolling down on inclined plane (using a double inclined plane).
7. To study dissipation of energy of a simple pendulum by plotting a graph between square of amplitude and time.

Section B

Experiments

(Any 7 experiments out of the following to be performed by the students)

1. To determine Young's modulus of elasticity of the material of a given wire.
2. To find the-force constant of a helical spring by plotting a graph between load and extension.
3. To study-the variation in volume with pressure for a sample of air at constant temperature by plotting graphs between P and V, and between P and 1/V.
4. To determine the surface tension of water by capillary rise method.
5. To determine the coefficient of viscosity of a given viscous liquid by measuring the terminal velocity of a given spherical body.
6. To study the relationship between the temperature of a hot body and time by plotting a cooling curve.   .
7. To determine specific heat capacity of a given (i) solid (ii) liquid, by method of mixtures.
8. (i) To study the relation between frequency and length of a given wire under constant tension using sonometer. .
   (ii) To study the relation between the length of a given wire and tension for constant frequency using sonometer.
9. To find the speed of sound in air at room temperature using a resonance tube by two resonance positions.

Activities

1. To observe change of state and plot a cooling curve for molten wax.
2. To observe and explain the effect of heating on a bi-metallic strip.
3. To note the change in level of Liquid in a container on heating and interpret the observations.
4. To study the effect of detergent on surface tension of water by observing capillary rise.
5. To study the factors affecting the rate of loss of heat of a liquid.
6. To study-the effect of load on depression of a suitably clamped meter scale loaded at (i) at its end (ii) in the middle.