PHYSICS OVERVIEW
GRADES XI AND XII

Delhi Board of School Education (DBSE)

Directorate of Education, Government of National Capital Territory of Delhi

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ABBREVIATIONS AND ACRONYMS

ASoSE	Ambedkar School of Specialised Excellence
DBSE	Delhi Board of School Education
TA	Term-end Assessment
IA	Internal Assessment
IB	International Baccalaureate
IGCSE	International General Certificate of Secondary Education
KP	Knowledge Partners
MYP	Middle Years Programme

1. Introduction

1.1. Importance of Physics

Science is an attempt to understand universe as an independent and external reality. Pure science helps in building common understanding of this external universe and applied science and engineering helps in developing new process and products to understand and ease human existence in this universe. However, it is difficult to draw boundaries around the two form of sciences. It is difficult to separate them in isolation.

During the senior secondary stage of school education, students transit from general approach towards sciences to discipline-based approach. They study theories, laws and hypotheses specific to their domain of study. The science is built upon experiments and Physics is the most fundamental of the experimental sciences.

1.2. Aims

- appreciate scientific study and creativity within a global context through stimulating and challenging opportunities with an emphasis on basic conceptual understanding of Physics
- acquire a body of knowledge, methods and techniques that characterize science and technology, such as use of SI units, symbols, nomenclature of physical quantities and formulations as per international standards.
- apply and use a body of knowledge, methods and techniques that characterize science and technology by promotion of process-skills, problem-solving abilities and applications of Physics concepts.
- develop an ability to analyse, evaluate and synthesize scientific information
- develop a critical awareness of the need for, and the value of, effective collaboration and
- communication during scientific activities
- develop experimental and investigative scientific skills including the use of current technologies
- develop and apply 21st-century communication skills in the study of Physics by promoting problem solving abilities and creative thinking in learners.
- become critically aware, as global citizens, of the ethical implications of using science and technology
- develop an appreciation of the possibilities and limitations of science and technology
- develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge by exposing the learners to different processes used in Physics-related industrial and technological applications.

1.3. Objectives of Physics Education

The objectives of Physics education encompass the factual, conceptual, procedural and metacognitive

dimensions of knowledge. These objectives relate directly to the assessment criteria used in assessments.

Followed a DBSE Physics senior secondary course, students will be expected to demonstrate the following.

Objective A – Knowledge and Understanding

Students would have knowledge and understanding of –

- facts, concepts and terminology
- methodologies and techniques
- communicating scientific information

Objective B – Application

Students would be able to apply:

- facts, concepts and terminology
- methodologies and techniques
- methods of communicating scientific information.

Objective C – Higher Order Thinking Skills

Students would be able to –

- hypothesise and make predictions
- evaluate and analyse methodologies and techniques
- give scientific explanations

Criteria D – Investigation and observation skills

Students would be able to use –

- science as investigative and exploration tool
- design and conduct experiments
- draw conclusions

2. Physics as a subject

2.1. Content areas in Physics

2.1.1 MECHANICS

Mechanics deals with energy and forces and their effect on bodies and its practical application is to design and construct machines or tools.

2.1.2 THERMODYNAMICS

Thermodynamics is the branch of Physics that deals with heat, work and temperature. In a broader context, thermodynamics deals with the transfer of energy from one form to another. The key concept is that the heat is a form of energy which corresponds to a definite amount of mechanical work.

2.1.3 VIBRATIONS AND WAVES PHENOMENA

A mechanical vibration is a to and fro motion of a particle when displaced from its equilibrium position. On the other hand, a wave is a disturbance or a vibration that travels and carries energy from one point to another.

2.1.4 ELECTROMAGNETISM

Electromagnetism is a branch of Physics that deals with the electromagnetic force experienced by electrically charged particles. The electromagnetic force is one of the four fundamental forces and exhibits electromagnetic fields such as magnetic fields, electric fields, and light.

2.1.5 RELATIVITY

"Special relativity" is limited to objects that are moving with respect to inertial frames of reference—i.e, in a state of uniform motion with respect to one another such that an observer cannot distinguish one from the other.

3. Curriculum overview for grades XI and XII

An academic year at DBSE consists of two terms. Grade XI and XII curriculum is clustered into units. These units are delivered in two terms of an academic year. Unit names, content, duration and the learning resources are provided in the subsequent sections.

3.1. Grade XI curriculum overview

Table 1: Unit names, content, duration and the learning resources in grade XI

Grade XI			
Term 1			
Unit	**Content**	**Duration**	**Resources**
UNITS AND MEASUREMENT INTRODUCTION TO VECTORS & FORCES	• Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. significant figures. Dimensions of physical quantities, dimensional analysis and its applications. • Scalars & Vectors • Geometrical & symbolic representation • Collinear vectors: like & unlike • Equal and Opposite Vectors, Free Vector • Multiplication of a vector by a scalar, Angle between vectors, Triangle Law, Parallelogram Law, Subtraction of vectors, Polygon Law, Maximum and minimum magnitude of resultant of two and three vectors • Unit vector, Standard unit vectors (i, j, k), Components of Vector, Addition and subtraction using components • Application of vectors: Forces in equilibrium, Some common Forces: Weight, Normal • Reaction, Tension • Angle of repose, F max & F min for no sliding on rough inclined plane • Multiplication of vectors: Dot product, Cross product, Work & power (basics), Torque (basics)	3 weeks	NCERT Books
KINEMATICS OF A PARTICLE	• Frame of reference, Motion in a straight line, distance, displacement, • Basic coordinate geometry • Elementary concepts of differentiation, integration (area under the graph),graphical meaning of derivative(maxima & minima) for describing motion , uniform and non- uniform	2 weeks	NCERT Books

	motion, average and instantaneous velocity, average and instantaneous acceleration, uniformly accelerated motion, motion under gravity, • Non uniformly accelerated motion (use of integration),velocity - time and position-time graphs. • Relations for uniformly accelerated motion (graphical treatment)		
RELATIVE VELOCITY	• Relative velocity-introduction and general examples, Overtake problems • Shortest distance between moving bodies Rain-man problems, Swimmer-river problems, Aeroplane - wind problems	2 weeks	NCERT Books
MOTION IN TWO DIMENSIONS	• Motion in a plane, cases of uniform velocity and uniform acceleration. • Projectile motion (ground to ground projectile and projectile on an inclined plane), • Circular motion: angular velocity, angular acceleration, Uniform circular motion: radial acceleration, Non-uniform circular motion: radial & tangential acceleration, • Radius of curvature, Relative motion in projectiles.	2 weeks	NCERT Books
DYNAMICS OF A PARTICLE	• Intuitive concept of force, four types of forces, 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, Pulley problems, lift problems, force on colliding ball, force on liquids, Static and kinetic friction, laws of friction, rolling friction, lubrication. block over block problem involving friction. Pseudo force, moving plane problems, • Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).string and wedge constraint problems, force by spring and cutting of spring problems.	3 weeks	
ENERGY & MOMENTUM	• Work done by a constant force and a variable force; kinetic energy, work energy theorem, power. • Notion of potential energy, equilibrium (stable ,unstable and neutral), potential energy of a	2 weeks	

	spring, conservative forces: non-conservative forces, motion in a vertical circle; elastic and inelastic collisions in one and two dimensions, coefficient of restitution, head-on collisions, Oblique collision, Oblique collision advanced problems (Particle wedge collision, string tightening etc.)		
Term 2			
ROTATIONAL MOTION	• Introduction: Rigid/Non-rigid body, Centre of mass of a two-particle system, momentum conservation and Centre of mass motion. • Centre of mass of a rigid body, finding COM of system of particles & continuous bodies, Displacement, velocity and acceleration of COM. • Moment of a force, torque, angular momentum, law of conservation of angular momentum and its applications. Angular momentum of a rigid body in pure translation, Torque and angular momentum relation. • FAOR*: Dynamics (torque equation about hinge), Conservation of energy, FAOR problems: hinged rod, hinge force calculation, fixed pulley. • Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparison of linear and rotational motions. • Moment of inertia, radius of gyration, Moment of Inertia of bodies: rod, ring, disc, sheet, sphere etc, Parallel axis and perpendicular axis theorem, • GRBM Dynamics (torque equation about COM), problems of rolling on horizontal and inclined surface, Rolling without slipping, Using instantaneous axis of rotation in writing torque equation and kinetic energy and energy conservation in GRBM. Rod particle collisions, Angular Impulse, Problems of angular impulse, Toppling. • *Fixed axis of rotation	3 weeks	NCERT Books
GRAVITATION	• Kepler's laws of planetary motion, universal law of gravitation. • Acceleration due to gravity and its variation with altitude, depth and latitude. • Gravitational potential energy and gravitational potential, escape velocity, Motion of satellite, Energy of satellite, circular and elliptical orbits, orbital velocity of a satellite.	2 weeks	NCERT Books

LIQUIDS	• Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes), Force and torque on container wall (point of application of force), Pressure variation in liquid in accelerating container, rotating container effect of gravity on fluid pressure. Equating pressure in U-tube problems, Barometer & manometer. Buoyant force, Archimedes Principle, Floatation, Centre of buoyancy, Buoyant force on bodies in accelerating container streamline and turbulent flow, critical velocity, equation of continuity, Bernoulli's theorem and its simple applications(Liquid coming out from a hole in container: velocity of efflux, max Range, reaction force, time of emptying the container, Velocity of efflux in case of two layers of liquid, venturimeter, pitot tube). • Surface energy and surface tension, angle of contact, excess of pressure, pressure difference across a spherical surface (excess pressure in liquid drop, air bubble, soap bubble, capillary rise, force to separate plates with trapped liquid layer) • Viscosity, Stokes' law, terminal velocity, Poiseuille's equation.	3 weeks	NCERT Books
PROPERTIES OF MATTER	• Elasticity, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity (qualitative idea only), Poisson's ratio elastic energy • Calorimetry: Temperature, Heat, Specific heat capacity, Heat capacity, Water equivalent, Principle of calorimetry, Latent heat, Heating curve (phase change) anomalous expansion of water • Thermal Expansion: basic formulae, Linear expansion: metallic scale, simple pendulum, bimetallic strip, Area expansion, Volume expansion: overflow problems, buoyancy problems • Heat transfer: Introduction to three modes, Conduction (Steady state one dimensional conduction formula), Conduction through rods (Ohm's law analogy: Rods in series and parallel), Differential formula of conduction (variable area and conductivity), Spherical and Cylindrical shells • Growth of ice, Convection: theoretical discussion (natural & forced convection), Radiation: Stefan's law, emissive power, absorptive power, Kirchhoff's law, spectral emissive power (blackbody radiation curve), Wein's law • Newton's law of cooling: exact and	3 weeks	NCERT Books

	approximate method, Elasticity: Longitudinal/ Shear/ Volumetric stress and strain, elongation of rod under own weight • Thermal stress, Elastic energy, Torsion		
GASEOUS STATE & THERMODYNAMICS	• Ideal gas equation, KTG, Pressure by gas on container, Translational KE, Degrees of freedom, Law of equipartition of energy, Internal energy of a gas, Avogadro's number. • Thermodynamics: definition of system, state, process etc., 1st Law of Thermodynamics, sign convention, Work done by Gas, Work from P-V graph, Change in internal energy, Molar Heat capacities: Cp, Cv and gamma for gases and gaseous mixture • Detailed discussion of 4 standard process: Isochoric, Isobaric, Isothermal, Adiabatic (discuss process equation, graphs, calculation of final P, T, V, delta U, work, delta Q , process setup), C for general polytropic process, Chamber with partition questions, questions on graphs. • Cyclic Process, efficiency of a cyclic process, Heat engine and refrigerator, Carnot cycle, Mean free path.	2 weeks	
SIMPLE HARMONIC MOTION	• Basics: Oscillatory and periodic motion, condition for SHM, Kinematics of SHM: Equation of SHM, mean position, extreme position, amplitude, phase, time period, frequency, questions of finding initial phase, distance travelled, Graphs: x-t, v-t, v-x, a-t, a-x, Kinetic Energy, Potential Energy, Total Energy. • Superposition of SHMs in same direction and mutually perpendicular directions, Analysis of forces in SHM: spring block system (horizontal and vertical), Combination of springs • SHM in spring pulley system, SHM of liquid in U tube, Block on liquid surface, Particle inside tunnel in earth, Angular SHM: Kinematics (anology with linear SHM), Dynamics of angular SHM, Simple pendulum • Physical pendulum, Torsional pendulum, Rolling bodies performing SHM, Pulley with mass, Damped Oscillations & Forced Oscillations	2 weeks	
WAVE MOTION	• Wave Motion: transverse & longitudinal wave, mechanical & non mechanical wave, String wave: equation of wave, condition for valid wave equation, Sine wave on a string: amplitude, time period, frequency, phase difference, wavelength Beats, Doppler's	2 weeks	

	Effect • Speed of transverse wave on string, Intensity of string wave, Interference of waves travelling in same direction, Standing wave: nodes, antinodes • Reflection and transmission of string wave, Vibrations of string fixed at both ends, Sonometer wire questions, Vibrations of string fixed at one end and free at other end • Sound waves: introduction, relation between displacement wave and pressure wave, Speed of sound, Intensity (loudness), Standing wave in sound: open and closed organ pipes • Beats, Doppler's Effect		

3.2. Grade XII curriculum overview

Table 2: Chapter names, content, duration and the learning resources in grade XII

Grade XII			
Term 1			
Unit	**Content**	**Duration**	**Resources**
Electrostatics	• Introduction of charge and its properties, Methods of charging, Coulomb's Law, Force due to multiple charges, SHM problems involving charged particles • Electric Field: Introduction, force on charged particle due to field, Electric field lines, Field due to point charge, Field due to system of point charges, electric dipole and variation of their Electric field with distance,, Field due to line charge: finite, semi-infinite and infinite. • Field due to ring, half ring, quarter ring at the center, Field on axis of ring and disc, Field due to infinite sheet of charge, Electric Flux, Gauss Law, Flux through hemisphere, cube (charge on center and corner), disc etc. • Use of gauss law to find field due to Point charge, Infinite line charge, Infinite sheet, Spherical shell, Solid sphere (discuss field inside cavity), Cylindrical shell, Solid Cylinder • Electric Potential: basics, Electric Potential due to a point charge, Potential due to continuous charge distribution: Ring, Spherical shell, Solid sphere • Potential difference: discuss infinite line charge and infinite sheet of charge, Field potential relation, Equipotential surface, Electric Potential Energy • Self energy of spherical shell and solid sphere, Energy density of electric field, Conductors: properties under electrostatic condition, induction of charges, cavity inside conductors, Electrostatic shielding • Multiple conducting shells, System of parallel conducting plates, Connecting two conductors, Earthing of a conductor • Electric Dipole: electric field and potential due to dipole, dipole in uniform electric field	4 weeks	NCERT Books
DC Circuits	• Current basics (Average and instantaneous current), Drift velocity, Mobility, Current density, Ohm's experimental law, Ohm's Law from drift velocity, Temperature dependence of resistivity for conductors, semi-conductors and super	3 weeks	NCERT Books

	conductors, Temperature dependence of resistance (considering thermal expansion) • Circuit Solving: Grouping of Resistors, Zero resistance wire problems, infinite ladder network, Calculation of resistance in case of varying resistivity or varying area of cross section. • Electric power consumed by resistor, Electric power supplied/consumed by cell, Bulbs, EMF and internal resistance of a cell, Kirchhoff"s Circuital law and Kirchhoff"s voltage law, Nodal analysis problems • Grouping of cells, Wheatstone bridge network, Symmetrical Circuits • Instruments: Ammeter, Voltmeter, Galvanometer, Conversion of Galvanometer to Ammeter and Voltmeter, Meter bridge, Potentiometer		
Capacitors	• Basics: Capacitance, Energy stored in capacitors, Types of capacitors: Parallel Plate, Spherical, Cylindrical, Isolated conductor as capacitor • Capacitor connected to a battery: change in C,Q ,V,E,U when connected/disconnected from battery, Grouping of capacitors: Series & parallel, wheatstone bridge • Basic symmetrical circuits, system of parallel plates as combination of capacitors, Using Kirchhoff's Laws in capacitors • RC circuit: charging and discharging with time, steady state circuits, connecting capacitors charge, energy and heat calculation • Dielectric inside capacitors, polarization of dielectric, combination OF dielectrics	4 weeks	NCERT Books
Magnetic Effect of Current	• Magnetic field introduction, Biot-Savart Law, Magnetic field due to straight wire (finite & infinite), Magnetic Field Lines, Field due to circular wire at its centre & axis, Field due to combination of straight & circular wires • Field due to Solenoid, Infinite sheet of current, Field due to isolated moving point charge, Field due to rotating point charge, ring and disc • Ampere's Circuital Law, Use it to derive field due to infinite wire, infinite sheet, hollow and solid cylinder (discuss cavity), long solenoid and toroid • Magnetic force on a moving charge, Motion of charged particle in magnetic field: no force, circular motion (radius and time period), helical motion (radius, time period and pitch) • Force on a moving charge in combined electric and magnetic field, Magnetic force on a current carrying wire, force between two long parallel	3 weeks	NCERT Books

	wires • Current loop in uniform magnetic field: force and torque, Current loop as a magnetic dipole: magnetic moment, torque & potential energy in a uniform field, Field due to magnetic dipoles, Magnetic moment of rotating charged bodies (gyromagnetic ratio)		
Electromagnetic Induction	• Magnetic Flux, Gauss law for magnetism, Faraday's Law, Lenz's Law (direction of induced current), Calculation of induced current: Varying B, Varying angle (rotating coil), varying area (loop being taken out of field) • Motional EMF, problems of motional EMF (rods sliding on rails), charge flown in loop • EMF due to rotation, Induced Electric Field • Mutual Inductance of two coils, Self-inductance of a solenoid, Potential drop across an inductor, Energy stored in an Inductor • RL circuit: growth & decay of current with time, Inductor in series and parallel • LC oscillations	2 weeks	

Term 2			
AC Circuits	• Basics: definition of AC, average & rms value, R-circuit, C-circuit, L-circuit: phase difference and reactance • Series R-C, R-L, LCR circuits using Phasor Diagrams: impedance, phase factor & power factor • Resonance in series LCR circuit, Parallel R-C, R-L, LCR circuits, mixed series parallel circuits • Transformers	2 weeks	NCERT Books
Ray Optics	• Introduction to light, Laws of Reflection, Angle of deviation in reflection, basic problems, Image formation by plane mirror: definitions of object and image, Field of view, Image of extended object, Velocity of image • Spherical Mirrors: basics, definition of focus, paraxial rays, Ray Diagrams, Image formation by spherical mirror: sign convention, mirror formula, magnification, longitudinal magnification, Velocity of image • Two mirror problems, Nature of image formed by concave and convex mirror by using graph, Refraction: Laws of refraction (Snell's Law), basic problems of refraction	3 weeks	NCERT Books

	• Image formation by refraction through plane surface (real and apparent depth, apparent velocity), Refraction through parallel surfaces: glass slab, Apparent shift by glass slab, Total internal reflection • Refraction through Prisms: min and max angle of deviation, TIR in prism, Dispersion through a prism, Combination of prisms (deviation without disperion, dispersion without deviation) • Image formation due to refraction at spherical surface, Lenses: basics, sign convention, Lens maker's formula, Lens formula, Types of lens, Ray Diagrams, 1st & 2nd Focus of a lens, Magnification, Velocity of image • Displacement Method to find focal length of a lens, Nature of image formed by concave and convex mirror by using graph, Image coinciding with object problems (lens + mirror), Combination of lenses • Combination of lens and mirror, Cutting of lens, Spherical/chromatic aberration combination of thin lenses in contact, refraction of light through a prism. • Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.		
Wave Optics	• Light as EM Wave: speed, energy density, intensity, Wavefront, Huygen's Principle, Laws of reflection and refraction using Huygen's principle • Introduction to Interference: coherent & incoherent source, phase difference & path difference, resultant amplitude & intensity, constructive & destructive interference, Young's Double Slit Experiment (YDSE): setup, fringe width, fringe pattern, no. of maxima's and minima's, Intensity variation on screen • Young's Double Hole Experiment, Variations in YDSE: source not placed symmetrically before two slits, use of white light, effect of change in slit width, thin glass slab covering slit (shift in fringe pattern) • Lloyd's mirror experiment, Fresnel biprism, Interference in thin films • 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	2 weeks	NCERT Books

	expression only), coherent sources and sustained interference of light, diffraction due to a single slit, width of central maxima (qualitative treatment only).		
Modern Physics	• Thompson's, Millikan's experiments, Photoelectric effect: Basics, I-V , I-i, Vc - v graphs, Einstein's equation • Power on a distant surface, Radiation pressure, Matter Wave, Atomic structure: Thomson, Rutherford model • Bohr Model, Atomic Line Spectrum, Use of reduced mass concept to include motion of nucleus • X-rays: Coolidge Tube, Continuous X-rays (min wavelength), Characteristics X-rays, Mosley's Law, Shielding effect to find Zeff • Laws of Radioactive decay: half life, mean life, simultaneous decay, successive decay, Nuclear Fission, Nuclear Fusion • Nucleus: radius, density, Mass defect, Nuclear stability, Binding energy, Nuclear forces, Nuclear reactions: conservation of nucleons, mass defect, Q-value, Types of Radioactive decay: alpha decay, beta(plus/minus) decay, gamma decay, electron capture, Nuclear stability: change in n/p ratio in different decays	2 weeks	NCERT Books
Experiments & Errors	• Error analysis, Combination of errors, Significant figures, Experiments: Vernier Callipers, Screw Gauge· • Determination of g using simple pendulum, Young's modulus by Searle's method, Specific heat of a liquid using calorimeter, focal length of a concave mirror and a convex lens using uv method, Speed of sound using resonance column, Verification of Ohm's law using voltmeter and ammeter, specific resistance of the material of a wire using meter bridge and post office box • Semiconductors; semiconductor diode: I-V characteristics in forward and reverse bias; diode as a rectifier; I-Vcharacteristics 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 • Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation,	3 weeks	NCERT Books

	Need for modulation, Amplitude and Frequency Modulation, Bandwidth of signals, Bandwidth of Transmission medium, Basic Elements of a Communication System (Block Diagram only) • Electromagnetic waves and their characteristics. Transverse nature of electromagnetic waves, Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X rays, gamma rays), Applications of.e m. waves • Bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field • Magnetic susceptibility and permeability, Para-, dia- and ferro- magnetic substances, Hysteresis, Electromagnets and permanent magnets • Human eye, Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers • 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		

4. Assessment Overview

Criterion based assessments enable students to self-monitor and build self-belief as they can see the evidence of the progress they are making over time. Students can track their progress using level descriptors; they can clearly understand how their work can be improved over time.

The four core criteria assessed in Physics Education are:

1. Criterion A – Knowing and understanding
2. Criterion B – Applying
3. Criterion C – Higher Order Thinking Skills
4. Criterion D – Observation and Investigation Skills

The assessment tasks and methods used in internal assessment are criterion related, student-centric and provide feedback for further enhancement of learning. There are two types of assessments used for reporting student performance.

- Internal assessments (IA) (20%)
- Term-end assessments (TA) (80%)

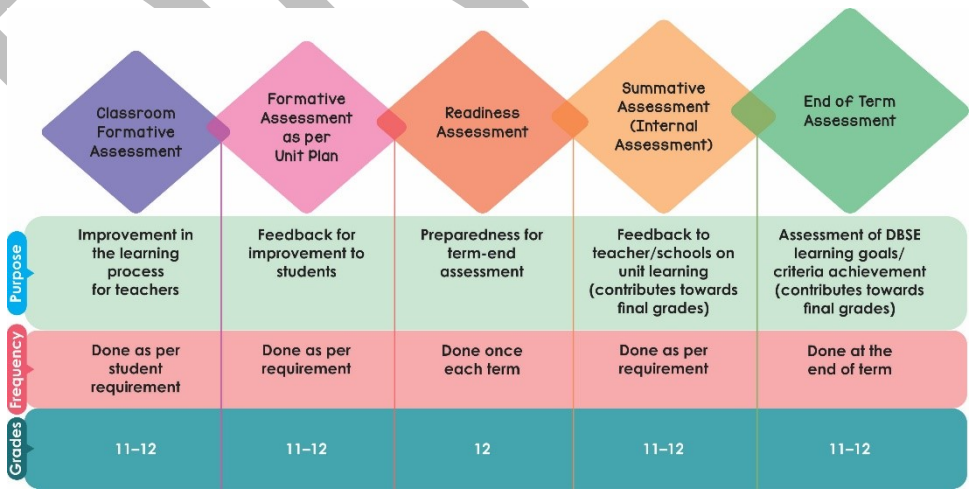
The assessment tasks and methods used in internal assessments provide opportunities for students to show their academic achievements in multiple ways and provide feedback for further enhancement of learning. Term-end assessment tasks are based on curriculum objectives defined for Physics.

DBSE assessments used for reporting for grades 11 & 12 can be School-led and/or Board-led. School-led assessments are based on an item pool provided by DBSE and Board-led assessments are developed and administered by DBSE. In grade 12, DBSE monitors internal assessments and readiness assessments. Term-end assessments are conducted by DBSE.

4.1. Assessment structure

Global best practices suggest a multifaceted assessment structure. That is, students should be assessed in multiple ways and at multiple times without increasing the workload of teachers or students, to the extent possible. A schematic representation of the DBSE assessment structure is presented below:

Figure 1: Assessments in DBSE



4.2. Assessment calendar

The assessment calendar for internal and external assessments for academic year 2022- 23 grade 11 and 12 assessments is given below.

Table 3: Grade XI assessment calendar

Chapter	Duration		Assessment	Criteria Assessed	Assessment Strategies
1	04 Jul 2022	16 Jul 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
2	18 Jul 2022	30 Jul 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
3	1 Aug 2022	6 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
4	8 Aug 2022	18 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
5	22 Aug 2022	3 Sep 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
6	5 Sep 2022	30 Sep 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based assessment**
7	1 Nov 2022	19 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz

9	21 Nov 2022	26 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Competency based test
10	28 Nov 2022	17 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
11	19 Dec 2022	28 Jan 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
12	30 Jan 2023	4 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
13	6 Feb 2023	10 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Applying C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
14	13 Feb 2023	24 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
1 - 20 March 2023			**Term-end 2**	**All 4 Criteria**	**Competency based assessment**

Table 4: Grade XII Assessment calendar

Chapter	Duration		Assessment	Criteria Assessed	Assessment Strategies
1	04 Apr 2022	7 May 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
2	9 May 2022	27 May 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Applying C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
3	4 Jul 2022	6 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
4	8 Aug 2022	31 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
5	16 Aug 2022	23 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
6	1 Sep 2022	10 Sep 2022	Internal Assessment	A. Criteria A – Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
			Readiness Assessment	**All 4 Criteria**	Competency based assessment
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based assessment**
7	01 Nov 2022	12 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
8	14 Nov 2022	19 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding	

				B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
9	21 Nov 2022	16 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
10	12 Dec 2022	17 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
11	19 Dec 2022	31 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
12	16 Jan 2023	28 Jan 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
13	30 Jan 2023	10 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	•
			Readiness Assessment	All 4 Criteria	Competency based assessment
1 - 20 March 2023			**Term-end 2**	**All 4 Criteria**	**Competency based assessment**

4.3. Assessment levels and grades

The assessment criteria directly relate to the objectives of the Physics curriculum and carry equal weightage. The student achievement levels will be reported as a number grade as described in the grade descriptions.

The grade descriptions are based on assessment criteria levels. The level descriptors of an assessment criterion depict clear progression of improvement of skills and competencies for a learning period.

All the assessment tasks used to report students' achievements are based on task specific, hierarchical, and qualitatively defined rubrics. The categories used in rubrics represent increasing quality or sophistication of response to a task. They provide a basis for evaluating and recording students' responses to an assessment task. A rubric makes assessment expectations transparent.

In order to show the degree of competence in each criterion, fine grained descriptions of various levels are used. These descriptions indicate the progression of achievement in each criterion.

Criterion A: Knowing and understanding

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. state/recall the basic facts/concept ii. state/recall laws and theories iii. apply knowledge and understanding to suggest solutions to numerical problems
3-4	The student is able to: i. describe the major facts/concepts ii. describe laws and theories iii. apply knowledge and understanding to solve numerical problems
5-6	The student is able to: i. explain the major facts/concepts related to the domain ii. explain laws and theories of physics iii. apply knowledge and understanding to solve numerical problems set in familiar situations and suggest solutions to problems set in unfamiliar situations
7-8	The student is able to: i. demonstrate in-depth and systematic understanding of knowledge of facts and concepts ii. work with theoretical / research-based knowledge and has a comprehensive understanding of laws and theories of physics iii. apply knowledge and understanding to solve numerical problems set in familiar and unfamiliar situations

Criterion B: Applying

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. identify scientific ideas and concepts in familiar context ii. recognize or identify explanations of simple scientific phenomenon related to physics iii. use basic or everyday scientific knowledge to recognize aspects of familiar or simple phenomenon
3-4	The student is able to: i. use scientific ideas and concepts in familiar and unfamiliar context ii. state hypothesis of simple scientific phenomenon related to physics iii. draw on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation
5-6	The student is able to: i. use interrelated scientific ideas and concepts in variety of context ii. describe hypotheses of scientific phenomena, events and processes related to physics iii. draw upon moderately complex content knowledge to identify or construct explanations of familiar phenomena
7-8	The student is able to: i. use a range of interrelated scientific ideas and concepts in variety of context ii. explain hypotheses of novel scientific phenomena, events and processes related to physics iii. use more complex or more abstract content knowledge, to construct explanations of complex events and processes

Criterion C: Higher Order Thinking Skills

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. analyse given information with guidance using given parameters ii. collect and categorise simple ideas and information in a predictable and standard format iii. distinguish between scientific and non-scientific issues and identify the evidence supporting a scientific claim
3-4	The student is able to: i. analyse a range of information with minimum guidance using given parameters and can compare alternative methods and techniques for obtaining information ii. collect and categorise complex ideas and information appropriately developing the required formats iii. evaluate the reliability and relevance of information using limited guidance.
5-6	The student is able to: i. analyse new and/or abstract information and situations without guidance, using a range of techniques appropriate to the subject ii. collect and categorise complex ideas and information aligning with a purpose iii. evaluate the reliability and relevance of information using very limited guidance and can identify contradictory information
7-8	The student is able to: i. critically analyse complex, incomplete or contradictory information and communicate the outcome effectively ii. transform and present abstract ideas and information in a format appropriate for the audience and purpose iii. evaluate the reliability and relevance of information independently and can investigate and resolve contradictory information

Criterion D: Observations and investigation

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student: i. replicate a simple experiment in a constrained context ii. draw simple inferences from experiment data iii. identifies questions that can be investigated scientifically iv. investigations demonstrate an ability to undertake basic investigative v. approaches investigations in an ethical manner, but shows very limited awareness of environmental impact and safety vi. work requiring considerable guidance and instruction, and attempts at conclusions that are largely irrelevant
3-4	The student: i. can conduct experiment involving two or more independent variables in a constrained context ii. interpret data drawn from a moderately complex data set or less familiar context iii. states question that can be investigated scientifically iv. investigations demonstrate an ability to complete fairly routine practical work v. generally, approaches investigations in an ethical manner, with some awareness of environmental impact and safety vi. work requiring limited guidance and instruction, and draw appropriate conclusions
5-6	The student: i. can conduct experiments competently ii. interpret data drawn from a complex data set or unfamiliar context iii. can evaluate ways of exploring a given question scientifically iv. investigations demonstrate some innovative thinking and independence v. approaches to investigations in an ethical manner, paying significant attention to environmental impact and safety where applicable. vi. work independently and can draw reasonable conclusions to resolve authentic problems and identify limitations in interpretations of data sets including sources and the effects of uncertainty in scientific data.
7-8	The student: i. can conduct experiments competently ii. interpret data drawn from a complex data set and identify limitations in interpretations of data sets including sources and the effects of uncertainty in scientific data iii. can distinguish between arguments that are based on scientific evidence and theory and those based on other considerations iv. investigations demonstrate insight and independence to design and complete innovative practical work v. approaches to investigations in an ethical manner, paying full attention to environmental impact and safety where applicable. vi. work independently and can draw reasonable conclusions to resolve authentic problems

Table 9: Description of Grade points

Grade	Grade Description
7	Displays comprehensive subject knowledge and a thorough command of concepts and principles. Selects and applies relevant information, concepts and principles in a wide variety of contexts. Analyses and evaluates quantitative and qualitative data thoroughly. Constructs detailed explanations of complex phenomena and makes appropriate predictions. Evidences great proficiency in solving problems, including those that are challenging or unfamiliar. Communicates logically and concisely using appropriate terminology and conventions. Shows insight or originality. Approaches investigations in an ethical manner, paying full attention to environmental impact and safety where applicable. Investigations demonstrate insight and independence to design and complete innovative practical work with highly competent investigative and analytical techniques, and with innovative and effective conclusions to resolve authentic problems.
6	Displays very broad subject knowledge and a thorough understanding of concepts and principles. Selects and applies relevant information, concepts and principles in most contexts. Analyses and evaluates quantitative and qualitative data with a high level of competence. Constructs explanations of complex phenomena and makes appropriate predictions. Solves basic or routine problems and evidences competency in solving those that are challenging or unfamiliar. Communicates effectively using appropriate terminology and conventions. Shows occasional insight or originality. Approaches to investigations in an ethical manner, paying significant attention to environmental impact and safety where applicable. Investigations demonstrate some innovative thinking and independence to design and complete practical work with competent investigative and analytical techniques, and with highly competent and reasonable conclusions to resolve authentic problems.
5	Displays broad subject knowledge and shows sound understanding of most concepts and principles and applies them in some contexts. Analyses and evaluates quantitative and qualitative data competently. Constructs explanations of simple phenomena. Solves most basic or familiar problems and some new or difficult quantitative and/or qualitative problems. Communicates clearly with little or no irrelevant material. Approaches investigations in an ethical manner, paying attention to environmental impact and safety where applicable. Investigations demonstrate appropriate investigative and analytical techniques with relevant and pertinent conclusions to resolving authentic problems.
4	Displays reasonable subject knowledge (though possibly with some gaps) and shows adequate understanding of most basic concepts and principles, but with limited ability to apply them. Demonstrates some analysis or evaluation of quantitative or qualitative data. Solves some basic or routine problems but shows limited ability to solve challenging or unfamiliar problems. Communicates adequately, although responses may lack clarity and include some repetitive or irrelevant material. Generally approaches investigations in an ethical manner, with some attention to environmental impact and safety where applicable. Investigations demonstrate an ability to complete fairly routine practical work with some appropriate investigative and analytical techniques, and with some conclusions relevant to the

	problem under study.
3	Displays limited subject knowledge and shows a partial understanding of basic concepts and principles, and weak ability to apply them. Shows some ability to manipulate data and solve basic or routine problems. Communicates with a lack of clarity and some repetitive or irrelevant material. Sometimes approaches investigations in an ethical manner, with some attention to environmental impact and safety where applicable. Investigations demonstrate an ability to complete a basic investigation with simple analytical techniques, and with some partial conclusions of some relevance to study
2	Displays little subject knowledge and shows weak understanding of basic concepts and principles, and little evidence of application. Exhibits minimal ability to manipulate data and little or no ability to solve problems. Offers responses which are often incomplete or irrelevant. Occasionally approaches investigations in an ethical manner but shows very limited awareness of environmental impact and safety. Investigations demonstrate an ability to undertake basic investigative work requiring considerable guidance and instruction, and attempts at conclusions that are largely incorrect/irrelevant.
1	Fragmentary subject knowledge and shows very little understanding of any concepts or principles. Rarely demonstrates personal skills, perseverance or responsibility in investigative activities. Rarely approaches investigations in an ethical manner or shows an awareness of environmental impact and safety. Investigations demonstrate an ability to undertake very basic practical work with complete dependence on supervised instruction, with attempts at conclusions are either absent or completely incorrect/irrelevant.