BIOLOGY 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 Biology

Biology is the study of life. The first organisms appeared on the planet over 3 billion years ago and, through reproduction and natural selection, have given rise to the 8 million or so different species alive today. Estimates vary, but over the course of evolution 4 billion species could have been produced. The word “biology” was coined by German naturalist Gottfried Reinhold in 1802 but our understanding of living organisms only started to grow rapidly with the advent of techniques and technologies developed in the 18th and 19th centuries, not least the invention of the microscope and the realization that natural selection is the process that has driven the evolution of life. Biologists attempt to understand the living world at all levels using many different approaches and techniques. At one end of the scale is the cell, its molecular construction and complex metabolic reactions. At the other end of the scale biologists investigate the interactions that make whole ecosystems function. Many areas of research in Biology are extremely challenging and many discoveries remain to be made. Biology is still a young science and great progress is expected in the 21st century. This progress is sorely needed at a time when the growing human population is placing ever greater pressure on food supplies and on the habitats of other species, and is threatening the very planet we occupy.

1.2. Aims

The aims of Biology courses at senior secondary level are to enable students to:

- appreciate scientific study and creativity within a global context through stimulating and challenging opportunities
- acquire a body of knowledge, methods and techniques that characterize science and technology
- 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
- 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 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 industrial and technological applications.

1.3. Objectives of Biology Education

The objectives of Biology 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 Biology 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. Biology as a subject

2.1. Content areas in BIOLOGY

2.1.1 DIVERSITY & BIOLOGICAL CLASSIFICATION

Biological classification is the process by which scientists group living organisms. Organisms are classified based on how similar they are. Historically, similarity was determined by examining the physical characteristics of an organism, but modern classification uses a variety of techniques including genetic analysis. The science of naming and classifying organisms is called taxonomy. Scientists use an internationally accepted system for classifying and naming organisms. Taxonomy uses hierarchical classification to help scientists understand and organize the diversity of life on our planet.

2.1.2 MORPHOLOGY OF PLANTS

The study of Plant Morphology is important in Biology, as it helps in studying the external features of plants. The study of Morphology also helps us to determine the evolutionary relationships between organisms. This is usually considered distinct from plant anatomy, which is the study of the internal structure of plants, especially at the microscopic level. Plant morphology is useful in the visual identification of plants.

2.1.3 ANATOMY OF PLANTS

Plant anatomy focuses on the structural or body parts and systems that make up a plant. A typical plant body consists of three major vegetative organs: the root, the stem, and the leaf, as well as a set of reproductive parts that include flowers, fruits, and seeds.

The study of plant anatomy helps us to understand the structural adaptations of plants with respect to diverse environmental conditions. It also helps us to distinguish between monocots, dicots, and gymnosperms.

2.1.4 PLANT PHYSIOLOGY

Plant physiology is a branch of study in Botany dealing with the physiological processes or functions of plants like mineral nutrition photosynthesis, respiration , opening of stomata, plant growth & development etc. Precisely, it is a descriptive study of variation and structure of plants at the molecular and cellular level, resulting in ecological, physiological and biochemistry related aspects of plant exploration.

2.1.5 HUMAN PHYSIOLOGY

Human physiology deals specifically with the physiological attributes of the human body at various levels of organization, i.e. from cellular to tissue and ultimately, physiology at the biological system level. Human physiology is important because it imparts an in-depth understanding of the vital processes that the body does so as to attain the utmost goal of maintaining homeostasis. Basic physiological functions are digestion, respiration , circulation of body fluids , excretion , body movements and neural control & coordination .

2.1.6 STRUCTURAL ORGANISATION IN ORGANISMS

Cell, in biology, the basic membrane-bound unit that contains the fundamental molecules of life and of which all living things are composed. Cells provide structure and function for all living things, from microorganisms to humans. Scientists consider them the smallest form of life. Cells house the

biological machinery that makes the proteins, chemicals, and signals responsible for everything that happens inside our bodies. Cell biologists rely on an array of tools to peer into the body and examine cells. Imaging techniques magnify organelles and track cells as they divide, grow, interact, and carry out other vital tasks.

2.1.7 REPRODUCTION

Reproduction is a biological process by which an parent organism reproduces an offspring that is biologically similar to the parent organism. Reproduction enables and ensures the continuity of species, generation after generation. It is the main feature of life on earth. Humans reproduce sexually by the uniting of the female and male sex cells. Although the reproductive systems of the male and female are different, they are structured to function together to achieve internal fertilization. It is very important for an adult and adolescent to be aware of sexual health, reproduction, contraceptives, STDs. This will help in maintaining good reproductive health, physically as well as mentally. People can protect themselves from sexually transmitted infections only if they are well informed about the same.

Women should be aware of their fitment for pregnancy. They must have access to proper medical services when they are pregnant, have a safe delivery and deliver a healthy baby.

2.1.8 GENETICS & EVOLUTION

Genetics is the scientific study of genes and heredity—of how certain qualities or traits are passed from parents to offspring as a result of changes in DNA sequence. **genetics**, study of heredity in general and of genes in particular. Genetics forms one of the central pillars of biology and overlaps with many other areas, such as agriculture, medicine, and biotechnology. Through the process of reproduction, genes are transferred to successive generations. In some cases, mutations occur which causes a significant change in the gene, altering the way in which a gene is expressed. These variations are also transferred during the process of reproduction. Gene mutations cause the evolution we observe. It causes a change either in the organization or amount of genetic material in a cell. Such a mutation if occurred in a gamete can be easily inherited by the emerging gamete. New alleles of genes are produced as a result of mutations and hence the variations between entities. Therefore, genes and genetic mutations play a significant role in the process of evolution.

2.1.9 BIOLOGY IN HUMAN WELFARE

Biology and human welfare are interrelated which gives us an opportunity to explore future possibilities of making our lives easier and comfortable. Human welfare from biology is demonstrated by the process of cheese and curd, alcohol brewing, settlement of plants and animals, processing of food, methods of agriculture, medical diagnostics, and many more. Health is affected by factors such as the lifestyle of an individual, infections caused by bacteria, and genetic disorders. The ability to protect the body from diseases is known as immunity. Innate immunity and adaptive immunity are the two types of immunity. It is important to bring improvement in food resources to meet the ever-increasing demand of the population. This includes the improvement of food resources not only in terms of quantity but also in quality, i.e. increase in yield as well as improvement in crop variety.

We need sustainable practices in agriculture and animal husbandry to achieve this without compromising the environment and natural balance.

2.1.10 BIOTECHNOLOGY

Biotechnology is "the integration of natural sciences and engineering sciences in order to achieve the application of organisms, cells, parts thereof and molecular analogues for products and services "Biotech improves crop insect resistance, enhances crop herbicide tolerance and facilitates the use of more environmentally sustainable farming practices. Biotechnology is vital for more than just helping

our bread rise and our adult beverages ferment. It has applications that stretch far beyond the laboratory. Scientists and engineers can use this field to help create bio-based fuels, improve sustainable food production or move us closer to a zero-waste future that will help us reduce our impact on the planet. We could even find ways to use the carbon dioxide that is changing the climate as a raw material for fuel or as an energy source.

2.1.8 ECOLOGY

Ecology is the study of how organisms and the environment interact with one another and how those interactions affect the abundance and distribution of various species. Studying ecology allows scientists to understand how different living and nonliving things impact one another and clarifies how human activity affects the natural world.

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			
CHAPTER	**Content**	**Duration**	**Resources**
LIVING WORLD	What is living? Biodiversity; Need for classification; three domains of life; taxonomy and systematics; concept of species and taxonomical hierarchy; binomial nomenclature; tools for study of taxonomy museums, zoological parks, herbaria, botanical gardens.	1 week	NCERT Books
BIOLOGICAL CLASSIFICATION	Five kingdom classification; Salient features and classification of Monera, Protista and Fungi into major groups: Lichens, Viruses and Viroids.	2 weeks	NCERT Books
PLANT KINGDOM	Salient features and classification of plants into major groups – Algae, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae (three to five salient and distinguishing features and at least two examples of each category); Angiosperms – classification upto class, characteristic features and examples.	3 weeks	NCERT Books
MORPHOLOGY OF FLOWERING PLANTS	Morphology and modifications: Internal Morphology of different parts of flowering plants: root, stem, leaf, inflorescence, flower, fruit and seed (to be dealt along with the relevant experiment of the Practical Syllabus).	3 weeks	NCERT Books
ANATOMY OF FLOWERING PLANTS	Anatomy and functions of different tissues.	1 week	NCERT BOOKS
TRANSPORT IN PLANTS	Movement of water, gases and nutrients; cell to cell transport, diffusion, facilitated diffusion, active transport; plant-water relations, imbibition, water potential, osmosis, plasmolysis; long distance transport of water – Absorption, apoplast, symplast, transpiration pull, root pressure and guttation; transpiration, opening and closing of stomata; Uptake and translocation of mineral nutrients – Transport	1 week	NCERT BOOKS

	of food, phloem transport, massflow hypothesis.		
MINERAL NUTRITION	Essential minerals, macro- and micronutrients and their role; deficiency symptoms; mineral toxicity; elementary idea of hydroponics as a method to study mineral nutrition; nitrogen metabolism, nitrogen cycle, biological nitrogen fixation.	2 weeks	NCERT BOOKS
Term 2			
PHOTOSYNTHESIS IN HIGHER PLANTS	Photosynthesis as a means of autotrophic nutrition; site of photosynthesis, pigments involved in photosynthesis (elementary idea); photochemical and biosynthetic phases of photosynthesis; cyclic and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C3 and C4 pathways; factors affecting photosynthesis.	2 weeks	NCERT Books
RESPIRATION IN PLANTS	Exchange of gases; cellular respiration – glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations – number of ATP molecules generated; amphibolic pathways; respiratory quotient.	1 week	NCERT Books
PLANT – GROWTH AND DEVELOPMENT	Seed germination; phases of plant growth and plant growth rate; conditions of growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a plant cell; growth regulators – auxin, gibberellin, cytokinin, ethylene, ABA; seed dormancy; vernalisation; photoperiodism.	1 week	NCERT BOOKS
STRUCTURAL ORGANISATION IN ANIMALS	Animal tissues; Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach). (a brief account only)	1 week	NCERT BOOKS
ANIMAL KINGDOM	Salient features and classification of animals non-chordates up to phyla level and chordates up to class level (three to five salient features and at least two examples of each category). (No live animals or specimen should be displayed.)	1 week	NCERT BOOKS
CELL-THE UNIT OF LIFE	Cell theory and cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; cell envelope; cell membrane, cell wall; cell organelles – structure and function; endomembrane system, endoplasmic reticulum, golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, microbodies;	1 week	NCERT BOOKS

	cytoskeleton, cilia, flagella, centrioles (ultrastructure and function); nucleus.		
BIOMOLECULES	Chemical constituents of living cells: biomolecules, structure and function of proteins, carbohydrates, lipids, nucleic acids; Enzymes- types, properties, enzyme action.	1 week	NCERT BOOKS
CELL CYCLE AND CELL DIVISION	Cell cycle, mitosis, meiosis and their significance	1 week	NCERT BOOKS
DIGESTION AND ABSORPTION	Alimentary canal and digestive glands, role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; calorific values of proteins, carbohydrates and fats; egestion; nutritional and digestive disorders – PEM, indigestion, constipation, vomiting, jaundice, diarrhoea.	1 week	NCERT BOOKS

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**
SEXUAL REPRODUCTION IN FLOWERING PLANTS	Flower structure; development of male and female gametophytes; pollination – types, agencies and examples; outbreeding devices; pollen-pistil interaction; double fertilization; post fertilization events – development of endosperm and embryo, development of seed and formation of fruit; special modes apomixis, parthenocarpy, polyembryony; Significance of seed dispersal and fruit formation.	2 weeks	NCERT Books
PRINCIPLES OF INHERITANCE AND VARIATION	**Heredity and variation:** Mendelian inheritance; deviations from Mendelism – incomplete dominance, codominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosome theory of inheritance; chromosomes and genes; Sex determination – in humans, birds and honey bee; linkage and crossing over; sex linked inheritance – haemophilia, colour blindness; Mendelian disorders in humans – thalassemia; chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.	3 weeks	NCERT Books
MOLECULAR BASIS OF INHERITANCE	Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; transcription, genetic code, translation; gene expression and regulation – lac operon; genome and human and rice genome projects; DNA fingerprinting.	4 weeks	NCERT Books
STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION	Improvement in food production: Plant breeding, tissue culture, single cell protein, Biofortification, Apiculture and Animal husbandry.	2 weeks	NCERT Books
BIOTECHNOLOGY – PRINCIPLES AND PROCESSES	Genetic Engineering (Recombinant DNA Technology)	1 week	NCERT Books
BIOTECHNOLOGY AND ITS APPLICATION	Application of biotechnology in health and agriculture: Human insulin and vaccine production, stem cell technology, gene therapy; genetically modified organisms – Bt crops; transgenic animals; biosafety issues, bio piracy and patents	1 week	NCERT Books

Term 2			
Ecosystem	Ecosystems: Patterns, components; productivity and decomposition; energy flow; pyramids of number, biomass, energy; nutrient cycles (carbon and phosphorous); ecological succession; ecological services – carbon fixation, pollination, seed dispersal, oxygen release (in brief).	1 week	NCERT Books
Biodiversity and its Conservation	Biodiversity-Concept, patterns, importance; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, national parks, sanctuaries and Ramsar sites.	1 week	NCERT Books
Reproduction in Organisms	Reproduction, a characteristic feature of all organisms for continuation of species; modes of reproduction – asexual and sexual reproduction; asexual reproduction – binary fission, sporulation, budding, gemmule formation, fragmentation; vegetative propagation in plants.	1 week	NCERT Books
Human Reproduction	Male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis – spermatogenesis and oogenesis; menstrual cycle; fertilisation, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).	2 weeks	NCERT Books
Reproductive Health	Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs); birth control – need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (elementary idea for general awareness).	1 week	NCERT Books
Evolution	Origin of life; biological evolution and evidences for biological evolution (paleontology, comparative anatomy, embryology and molecular evidences); Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution – variation (mutation and recombination) and natural selection with examples, types of natural selection; Gene flow and genetic drift; Hardy – Weinberg's principle; adaptive radiation; human evolution.	2 weeks	NCERT Books
Human Health and Diseases	Pathogens; parasites causing human diseases (malaria, dengue, chickengunia, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ring worm) and their control; Basic concepts of immunology – vaccines; cancer, HIV and AIDS; Adolescence – drug and alcohol abuse.	1 week	NCERT Books

Strategies for Enhancement in Food Production	Improvement in food production: Plant breeding, tissue culture, single cell protein, Biofortification, Apiculture and Animal husbandry.	2 weeks	NCERT Books
Microbes in Human Welfare	In household food processing, industrial production, sewage treatment, energy generation and microbes as biocontrol agents and biofertilizers. Antibiotics; production and judicious use.	1 week	NCERT Books

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 Biology Education are:

1. Criterion A – Knowledge and understanding
2. Criterion B – Application
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%)

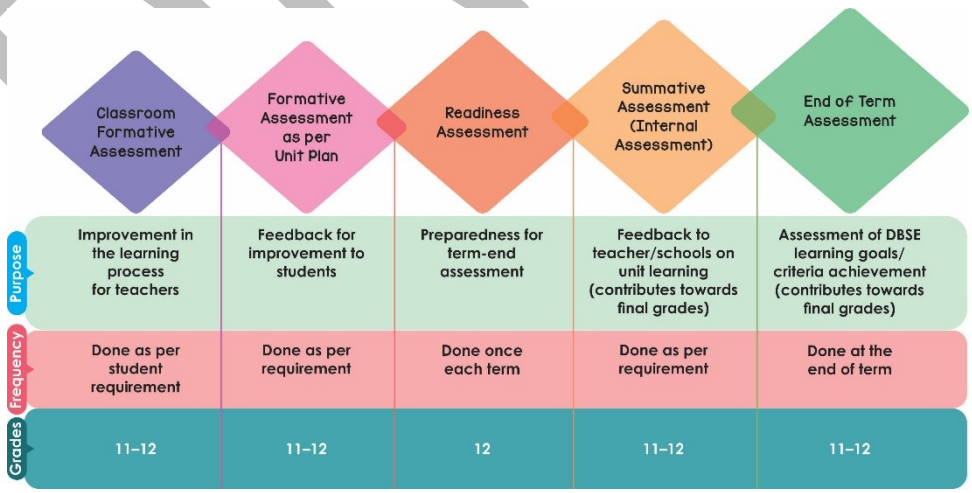
The assessment tasks and methods used in internal assessments provide opportunities for students to show their academic achievements in multiple ways and provide feedback for further enhancement of learning. Term-end assessment tasks are based on curriculum objectives defined for Biology.

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 monitor 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	9 Jul 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
2	11 Jul 2022	23 Jul 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
3	25 Jul 2022	13 Aug 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
4	16 Aug 2022	3 Sep 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
5	16 Aug 2022	3 Sep 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
6	5 Sep 2022	10 Sep 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
7	12 Sep 2022	17 Sep 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
8	19 Sep 2022	30 Sep 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application	

				C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based assessment**
9	01 Nov 2022	12Nov 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
10	14 Nov 2022	19 Nov 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
11	21 Nov 2022	3 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
12	5 Dec 2022	10 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
13	12 Dec 2022	17 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
14	19 Dec 2022	24 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
15	26 Dec 2022	31 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
16	16 Jan 2023	21 Jan 2023	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills	

				D. Criterion D – Observation and Investigation Skills	
17	23 Jan 2023	28 Jan 2023	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
18	31 Jan 2023	4 Feb 2023	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
19	5 Feb 2023	11 Feb 2023	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
20	13 Feb 2023	18 Feb 2023	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation 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	20 Apr 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
2	22 Apr 2022	28 May 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
3	4 Jul 2022	30 Jul 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
4	1 Aug 2022	13 Aug 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
5	16 Aug 2022	27 Aug 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
6	29 Aug 2022	3 Sep 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
7	5 Sep 2022	10 Sep 2022		E.	
			Readiness Assessment	**All 4 Criteria**	Competency based assessment
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based**

					assessment
8	01 Nov 2022	5 Nov 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
9	7 Nov 2022	11 Nov 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
10	14 Nov 2022	19 Nov 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	
11	21 Nov 2022	3 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher order Thinking Skills D. Criterion D – Observation and Investigation Skills	
12	5 Dec 2022	10 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
13	12 Dec 2022	24 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	•
14	26 Dec 2022	31 Dec 2022	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	•

15	16 Jan 2023	28 Jan 2023	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation Skills	•
16	31 Jan 2023	4 Feb 2023	Internal Assessment	A. Criterion A – Knowledge and understanding B. Criterion B – Application C. Criterion C – Higher Order Thinking Skills D. Criterion D – Observation and Investigation 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 mathematics 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 of physics iii. apply knowledge and understanding to suggest solutions to numerical problems involving phenomena related to physics using one or two variables
3-4	The student is able to: i. describe the major physics facts/concepts ii. describe laws and theories of physics iii. apply knowledge and understanding to solve numerical problems involving physical phenomena using one or two variables

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 vii. and identify limitations in interpretations of data sets including viii. 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	Demonstrates a thorough knowledge and comprehensive understanding of the syllabus; successfully constructs and applies mathematical arguments at a sophisticated level in a wide variety of contexts; successfully uses problem solving techniques in challenging situations; recognizes patterns and structures, makes generalizations and justifies conclusions; understands and explains the significance and validity of results, and draws full and relevant conclusions; communicates mathematics in a clear, effective and concise manner, using correct techniques, notation and terminology; demonstrates the ability to integrate knowledge, understanding and skills from different areas of the course; uses technology correctly in challenging situations—makes efficient use of calculator's functionality when required.
6	Demonstrates a broad knowledge and comprehensive understanding of the syllabus; successfully constructs and applies mathematical arguments in a variety of contexts; uses problem solving techniques in challenging situations; recognizes patterns and structures, and makes some generalizations; understands and explains the significance and validity of results, and draws relevant conclusions; communicates mathematics in a clear and effective manner, using correct techniques, notation and terminology; demonstrates some ability to integrate knowledge, understanding and skills from different areas of the course; uses technology correctly in routine situations—makes efficient use of calculator's functionality when required
5	Demonstrates a broad knowledge and good understanding of the syllabus; applies mathematical arguments in performing routine tasks; successfully uses problem solving techniques in routine situations; successfully carries out mathematical processes in a variety of contexts, and recognizes patterns and structures; understands the significance of results and draws some conclusions; communicates mathematics effectively, using appropriate techniques, notation and terminology; demonstrates an awareness of the links between different areas of the course; makes use of calculator's functionality when required (this use may occasionally be inefficient).
4	Demonstrates a satisfactory knowledge of the syllabus; applies mathematical arguments in performing some routine tasks; uses problem solving techniques in routine situations; successfully carries out mathematical processes in straightforward contexts; shows some ability to recognize patterns and structures; has limited understanding of the significance of results and attempts to draw some conclusions; communicates mathematics adequately, using some appropriate techniques, notation and terminology; makes some use of calculator's functionality, but perhaps not always when required (this use may occasionally be inefficient).
3	Demonstrates partial knowledge of the syllabus and limited understanding of mathematical arguments in performing some routine tasks; attempts to carry out mathematical processes in straightforward contexts; makes an attempt to use problem solving techniques in routine situations; communicates some appropriate techniques, notation or terminology; occasionally uses calculator's functionality, but often inefficiently—does not always use it when required and may use an inefficient analytic approach.

2	Demonstrates limited knowledge of the syllabus; attempts to carry out mathematical processes at a basic level; communicates some mathematics, but often uses inappropriate techniques, notation or terminology; unable to use calculator correctly when required—questions exclusively requiring the use of the GDC are generally not attempted.
1	Demonstrates minimal knowledge of the syllabus; demonstrates little or no ability to use mathematical processes, even when attempting routine tasks; communicates only minimal mathematics and consistently uses inappropriate techniques, notation or terminology; is unable to make effective use of technology.