



**FEDERAL BOARD OF INTERMEDIATE  
AND SECONDARY EDUCATION  
H-8/4, ISLAMABAD**



No.1-10/FBISE/RES/652

30 August, 2024

**Subject: IMPLEMENTATION OF ASSESSMENT FRAMEWORKS AND MODEL QUESTION PAPERS DEVELOPED ON NATIONAL CURRICULUM OF PAKISTAN (NCP) 2022-2023**

In continuation to this office Notifications bearing No.1-10/FBISE/RES/383 dated 14 March 2024 and No.1-10/FBISE/RES/422 dated 19 March 2024 on the subject of Implementation of National Curriculum of Pakistan (NCP) 2022-23, Assessment Frameworks, Model Question Papers along with SLOs Alignment Charts and Tables of Specifications (ToS) at SSC-I and HSSC-I levels in the subjects of English Compulsory, Urdu Compulsory, Pakistan Studies (SSC-I), Islamiyat Compulsory (HSSC-I), Physics, Chemistry, Biology, Mathematics and Computer Science are hereby uploaded on FBISE Website [www.fbise.edu.pk](http://www.fbise.edu.pk). The Weblink is [https://fbise.edu.pk/curriculum\\_model\\_paper.php](https://fbise.edu.pk/curriculum_model_paper.php).

2. It is important to note that the Assessment Frameworks which contain all the SLOs of the curriculum 2022-23 will guide students, teachers and paper setters. Students will receive clear instructions on how to prepare for examinations. Teachers will use the Frameworks to understand what to teach in class and to prepare their students for the final examinations. Similarly, paper setters will use these documents for guidance in creating examination papers. It may be noted that the SLOs of Summative Assessment mentioned in the Assessment Frameworks will be included in the Final Board Examinations, whereas the SLOs of Formative Assessment will NOT be included in the Final Board Examinations; however, they will be part of teaching-learning activity in the class.

3. It is reiterated that the examinations of all the above mentioned subjects will be based on Student Learning Outcomes (SLOs) given in the respective curriculum (Assessment Frameworks) instead of textbooks. Educational institutions, students and teachers may consult the books of publishers reviewed by National Curriculum Council available on its Weblink <https://ncc.gov.pk/SiteImage/Misc/files/Annexures.pdf>. Moreover, the institutions are free to rely on any other valid and reliable instructional/reference material to fulfil the instructional requirements of the SLOs of these subjects.

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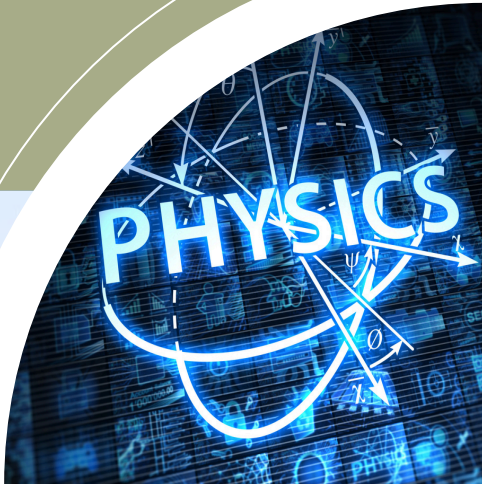
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ASSESSMENT FRAMEWORK AND MODEL QUESTION PAPER

# PHYSICS

Grade XI

NATIONAL CURRICULUM  
2022-23



FEDERAL BOARD OF  
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**H-8/4, ISLAMABAD**



**ASSESSMENT FRAMEWORK  
FOR  
PHYSICS GRADE-XI  
CURRICULUM 2022-23**

# ACKNOWLEDGEMENT

It is a great honour that we, at the Federal Board of Intermediate and Secondary Education, have developed the Assessment Framework (AF) for the subject of Physics for Grade-XI. The primary objective of the AF is to optimize the current curriculum 2022-23. This comprehensive framework has been crafted meticulously by subject matter and assessment experts who conducted an in-depth review of all learning outcomes for Grade-XI Physics curriculum. They evaluated these outcomes in terms of their scope, cognitive level, and progression across the grade.

This significant undertaking was the result of a series of extensive meetings and collaborative efforts of the subject and assessment experts. Their dedication and expertise have been instrumental in bringing this framework to fruition.

The Assessment Framework will serve as a guiding document for students, teachers and paper setters. Students will receive clear directions for preparing themselves for the annual examination. Similarly, teachers will use it as a guide to understand what to teach in class and to prepare students for the final examinations accordingly. Similarly paper setters will also seek guidance from this document.

Following subject as well as assessment experts/committee members remained constantly engaged in the development of the AF:

1. Mr. Muhammad Jahangir Mirza, HOD Physics, OPF College for Boys, H-8/4 Islamabad
2. Mr. Muhammad Imran Khaliq, Assistant Professor, Islamabad Model College for Boys, G-10/4, Islamabad
3. Mrs. Robina Ahmad, Assistant Professor, Islamabad Model College for Girls, I-8/4, Islamabad
4. Mr. Naeem Nazeer, SET Physics, Islamabad Model College for Boys, Street 17, I-10/1, Islamabad

The whole work was successfully accomplished under the able supervision and guidance of Syed Junaid Akhlaq, Chairman, FBISE and due to the hard work and dedication of the staff of Research Section of FBISE, in particular, Syed Zulfiqar Shah, Deputy Secretary, Research and Academics who played a pivotal and leading role in finalizing the AF.

**MIRZA ALI**  
Director (Research & Academics)  
FBISE, Islamabad

## **ASSESSMENT FRAMEWORK FOR PHYSICS GRADE-XI, CURRICULUM 2022-23**

To ensure clarity and precision in assessment, the learning outcomes have been categorized into two distinct groups: formative and summative. This classification helps in effectively measuring student progress and understanding. Each Student learning outcome (SLO) has been carefully marked as either formative or summative within the newly developed Assessment Framework. SLOs of Summative Assessment Format will be part of the Final Examination while SLOs of Formative Assessment will although be part of the teaching-learning activity but they will **NOT** be part of Final Examinations. Estimated cognitive levels i.e Knowledge (K), Understanding (U) and Application (A) of all the SLOs have also been indicated. It may be noted that all the higher cognitive levels have been collectively accumulated in the cognitive level of 'Application'. In subjects involving Practicals (Lab work), it has been mentioned categorically whether an SLO is summative for theory or summative for Practical Based Assessment (PBA). If an SLO is summative for PBA, it means that Laboratory work is required in the teaching-learning activity and it will be part of the Practical Examination/ Practical Based Assessment.

The Assessment Framework will act as a comprehensive guide for students, teachers and paper setters. Students will have clear instructions on how to prepare for the annual examinations. Teachers will use the framework to understand the curriculum and effectively prepare their students for the final examination. Additionally, paper setters will refer to this document for guidance in setting examination papers.

A model question paper has also been developed to provide a clear structure and format for upcoming examinations. The model question paper ensures consistency and fairness, offering students a comprehensive understanding of what to expect in their examinations. By aligning the paper with the Student Learning Outcomes (SLOs) of the curriculum, we ensured that the questions accurately reflect the skills and knowledge that students are expected to acquire.

A detailed Table of Specifications (ToS) has been created to ensure equitable coverage of cognitive levels and content domains in order to generate a balanced question paper. The ToS serves as drawing scale and action plan for the question paper, ensuring that all important areas of the curriculum are adequately and proportionately assessed.

## **FORMATIVE ASSESSMENT: AN ESSENTIAL COMPONENT OF EFFECTIVE LEARNING**

Formative assessment is a pivotal element in the educational process, distinguished by its role in providing ongoing feedback to both students and educators. Unlike summative assessments, which evaluate student learning at the end of an instructional period, formative assessments are integrated into the learning process to monitor student understanding and guide instructional decisions.

The primary objective of formative assessment is to identify learning gaps and misunderstandings as they occur, enabling timely interventions. This dynamic approach allows teachers to adjust their teaching strategies to better meet the needs of their students. For instance, if a teacher notices through a quick quiz or class discussion that a significant portion of the class struggles with a particular concept, they can revisit that topic, providing additional explanations or alternative methods of instruction. This adaptability is crucial for fostering a deeper understanding of the material.

Formative assessments come in various forms, ranging from informal methods like classroom discussions, observations, and questioning, to more structured approaches such as quizzes, peer assessments, and self-reflections. These methods are not limited to paper-and-pencil tasks but can include digital tools that provide instant feedback. The versatility of formative assessments allows educators to cater to diverse learning styles and preferences, ensuring that all students are engaged and supported in their learning journey.

Formative assessment plays a significant role in creating a supportive classroom environment. It shifts the focus from merely achieving grades to understanding the learning process. This approach reduces the pressure on students, as they perceive assessments not as a final judgment of their abilities but as a part of their learning journey. Consequently, formative assessment can lead to increased student motivation and engagement.

In conclusion, formative assessment is a powerful tool that, when effectively implemented, can significantly enhance the learning experience. It provides invaluable insights for both teachers and students, promotes a growth-oriented learning environment, and supports the continuous development of essential skills. As education evolves, the role of formative assessment will undoubtedly continue to be central in fostering successful and meaningful learning experiences.

## **SUMMATIVE ASSESSMENT: EVALUATING LEARNING OUTCOMES IN THE FORM OF TERMINAL/FINAL EXAMINATION**

Summative assessment is a fundamental component of the educational process, designed to evaluate student learning at the conclusion of an instructional period. Unlike formative assessment, which provides ongoing feedback during the learning process, summative assessment serves as a final measure of what students have learned. Typically administered at the end of a unit, course, or academic year. Summative assessment aims to determine the extent to which educational objectives have been achieved.

The primary purpose of summative assessment is to assess the overall effectiveness of instruction and learning. It provides a conclusive evaluation of student performance, often in the form of tests, final projects, or standardized exams. These assessments generate grades or scores that reflect a student's achievement in a given subject area over a specific period or time duration.

Summative assessment is often used to make critical decisions regarding student progression, certification, or placement in subsequent educational levels. Additionally, summative assessments provide valuable data that inform curriculum development and instructional strategies. By analyzing summative assessment results, educators can identify trends, strengths, and weaknesses within their instructional approaches, allowing for improvements in future teaching.

In conclusion, summative assessment plays a critical role in the educational process by providing a final evaluation of student learning. While it differs from formative assessment in its focus and application, it is an essential tool for measuring academic achievement. When balanced with formative assessments, summative assessments contribute to a well-rounded and effective approach to evaluating and supporting student learning.



**National Curriculum of Pakistan 2022-2023**  
**Assessment Framework Physics Grade-XI (HSSC-I)**  
**Details of Content Areas/ SLOs**

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
<b>Domain: A Measurements</b>				
[SLO: P-11-A-01] Make reasonable estimates of physical quantities [of those quantities that are discussed in the topics of this grade]	Formative	Understanding	Question will not be asked in final examination	07 periods
[SLO: P-11-A-02] Express derived units as products or quotients of the SI base units	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-A-03] Analyze the homogeneity of physical equations [Through dimensional analysis]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-A-04] Derive formulae in simple cases [Through using dimensional analysis]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-A-05] Analyze and critique the accuracy and precision of data collected by measuring instruments	Summative	Application	Question(s) will be asked in final examination.	05 periods
[SLO: P-11-A-06] Assess the uncertainty in a derived quantity [By simple addition of absolute, fractional or percentage uncertainties]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-A-07] Justify why all measurements contain some uncertainty	Summative	Understanding + Application	Question(s) will be asked in final examination.	
<b>Domain: B Mechanics</b>				
[SLO: P-11-B-01] Represent a vector in 2-D as two perpendicular components	Summative	Understanding + Application	Question(s) will be asked in final examination.	10 periods
[SLO: P-11-B-02] Describe the product of two vectors (dot and cross-product) along with their properties.	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-03] Derive the equations of motion [For uniform acceleration cases only. Derive from the definitions of velocity and acceleration as well as graphically].	Formative	Understanding	Question will not be asked in final examination	
[SLO: P-11-B-04] Solve problems using the equations of motion [For the cases of	Summative	Application	Question(s) will be asked in	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
uniformly accelerated motion in a straight line, including the motion of bodies falling in a uniform gravitational field without air resistance. This also includes situations where the equations of motion need to be resolved into vertical and horizontal components for 2-D motion]			final examination.	
[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance [This includes solving problems making use of the below facts: (i) Horizontal component ( $V_H$ ) of velocity is constant. (i) Acceleration is in the vertical direction and is the same as that of a vertically free falling object. (ii) The horizontal motion and vertical motion are independent of each other. Situations may require students to determine for projectiles: - How high does it go? - How far would it go along the level land? - Where would it be after a given time? - How long will it remain in flight? Situations may also require students to calculate for Ja projectile launched from ground height the - launch angle that results in the maximum range. - relation between the launch angles that result in the same range.] [SLO: P-11-B-06] Predict qualitatively how air resistance affects projectile motion [This includes analysis of both the horizontal component and vertical component of velocity and hence predicting qualitatively the range of the projectile.]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-06] Predict qualitatively how air resistance affects projectile motion [This includes analysis of both the horizontal component and vertical component of velocity and hence predicting qualitatively the range of the projectile.]	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-07] Express angles in radians	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	05 periods
[SLO: P-11-B-08] Define and calculate angular displacement, angular velocity and angular acceleration [This involves use of $S = r\theta$ , $v = r\omega$ , $\omega = 2\pi/T$ , $a = r\omega^2$ and $a = v^2/r$ to solve problems].	Summative	Knowledge+ Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-09] Use equations of angular motion to solve problems involving rotational motions.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-10] Analyze qualitatively motion in a curved path due to a perpendicular force.	Summative	Understanding + Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
[SLO: P-11-B-11] Apply the principle of conservation of momentum to solve simple problems [Including elastic and inelastic interactions between objects in both one and two dimensions. Knowledge of the concept of coefficient of restitution is not required. Examples of applications include: - karate chops to break a pile of bricks - car crashes - ball & bat - the motion under thrust of a rocket in a straight line considering short thrusts during which the mass remains constant]	Formative	Application	Question will not be asked in final examination.	05 periods
[SLO: P-11-B-12] Predict and analyze motion for elastic collisions [This include making use of the fact that for an elastic collision, total kinetic energy is conserved and the relative speed of approach is equal to the relative speed of separation]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-13] Justify why though the momentum of a closed system is always conserved, some change in kinetic energy may take place	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-14] Define and calculate centripetal force [Use $F = mr\omega^2$ , $F = mv^2 / r$ ]	Summative	Knowledge+ Application	Question(s) will be asked in final examination.	15 periods
[SLO: P-11-B-15] Analyze situations involving circular motion in terms of centripetal force [e.g. situations in which centripetal acceleration is caused by a tension force, a frictional force, a gravitational force, or a normal force.]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-16] Explain why the objects in orbiting satellites appear to be weightless.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-17] Describe how artificial gravity is created to counter weightlessness.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-18] Define and calculate moment of inertia of a body and angular momentum.	Summative	Knowledge+ Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-19] Derive and apply the relation between torque, moment of inertia and angular acceleration.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-20] State and apply the law of conservation of angular momentum. Illustrate the applications of conservation of angular momentum in real life [Such as by flywheels to store rotational energy, by gyroscopes in navigation systems, by ice skaters to adjust their angular velocity].	Summative	Knowledge+ Understanding + Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
[SLO: P-11-B-21] Justify how a centrifuge is used to separate materials using centripetal force	Summative	Application	Question(s) will be asked in final examination.	32 periods
[SLO: P-11-B-22] Distinguish between the structures of crystalline, glassy, amorphous, and polymeric solids.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-23] Describe that deformation of solids in one dimension [that it is caused by a force and that in one dimension, the deformation can be tensile or compressive].	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-24] Define and use the terms stress, strain and the Young modulus	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-25] Describe an experiment to determine the Young modulus of a metal wire.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-26] Describe and use the terms elastic deformation, plastic deformation and elastic limit	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-27] Justify why and apply the fact that the area under the force–extension graph represents the work done	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-28] Determine the elastic potential energy of a material [that is deformed within its limit of proportionality from the area under the force-extension graph. Also state and use $E_p = \frac{1}{2}Fx = \frac{1}{2}kx^2$ for a material deformed within its limit of proportionality].	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-29] Derive the formula for kinetic Energy [using the equations of motion]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-30] Deduce the work done from force-displacement graph	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-31] Differentiate between conservative and non-conservative forces	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-32] Utilize the work – energy theorem in a resistive medium to solve problems.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-33] Justify and use Archimedes’ principle of flotation	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-34] Justify how ships are engineered to float in the sea	Summative	Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
[SLO: P-11-B-35] Define and apply the terms: steady (streamline or laminar) flow, incompressible flow and non-viscous flow as applied to the motion of an ideal fluid	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-36] Use equation of continuity to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-37] Explain that squeezing the end of a rubber pipe results in increase in flow velocity	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-38] Justify that the continuity is a form of the principle of conservation of mass.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-39] Justify that the pressure difference can arise from different rates of flow of a fluid [Bernoulli effect].	Formative	Application	Question(s) will not be asked in final examination.	
[SLO: P-11-B-40] Explain and apply Bernoulli's equation for horizontal and vertical fluid flow	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-B-41] Explain why real fluids are viscous fluids.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-42] Describe how viscous forces in a fluid cause a retarding force on an object moving through it.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-43] Describe super fluidity [As the state in which a liquid will experience zero viscosity. Students should know the implications of this state e.g. this allows for super fluids to creep over the walls of containers to 'empty' themselves. It also implies that if you stir a superfluid, the vortices will keep spinning indefinitely.]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-B-44] Analyze the real world applications of the Bernoulli effect [For example, atomisers in perfume bottles, the swinging trajectory of a spinning cricket ball and the lift of a spinning golf ball (the magnus effect), the use of Venturi ducts in filter pumps and car engines to adjust the flow of fluid, etc]	Summative	Application	Question(s) will be asked in final examination.	
<b>Domain C: Heat and Thermodynamics</b>				30 periods
[SLO: P-12-C-01] State that regions of equal temperature are in thermal equilibrium	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-C-02] Relate a rise in temperature of an object to an increase in its internal energy	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-03] Apply the equation of state for an ideal gas [expressed as $pV = nRT$ , where $n$ = amount of substance (number of moles) and as $pV = NkT$ , where	Summative	Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
N = number of molecules]				
[SLO: P-11-C-04] State that the Boltzmann constant k is given by $k=R/N_A$	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-C-05] Describe the basic assumptions of the kinetic theory of gases [Including understanding the temperature, pressure and density conditions under which an ideal gas is a good approximation of a real gas.]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-06] Use $W = p\Delta V$ for the work done when the volume of a gas changes at constant pressure.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-07] Describe the difference between the work done by a gas and the work done on a gas.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-08] Define and use the first law of thermodynamics [ $Q = \Delta U + W$ expressed in terms of the increase in internal energy, the heating of the system (energy transferred to the system by heating) and the work done on the system]	Summative	Knowledge + Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-09] Explain qualitatively, in terms of particles, the relationship between the pressure, temperature and volume of a gas [Specifically the below case: (a) pressure and temperature at constant volume. (b) volume and temperature at constant pressure (c) pressure and volume at a constant temperature]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-10] Use the equation, including a graphical representation of the relationship between pressure and volume for a gas at constant temperature.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-11] Justify how the first law of thermodynamics expresses the conservation of energy.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-C-12] Relate a rise in temperature of a body to an increase in its internal energy.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-13] State the working principle of a heat engine.	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-C-14] Describe the concept of reversible and irreversible processes.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-15] State and explain the second law of thermodynamics.	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
[SLO: P-11-C-16] State the working principle of Carnot's engine	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-17] Describe that refrigerator is a heat engine operating in reverse as that of an ideal heat engine.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-18] Explain that an increase in temperature increases the disorder of the system.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-19] Explain that increase in entropy means degradation of energy.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-20] Explain that energy is degraded during all natural processes.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-21] Identifying that system tends to become less orderly over time.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-22] Explain that Entropy, S, is a thermodynamic quantity that relates to the degree of disorder of the particles in a system.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-C-23] State that the Carnot cycle sets a limit for the efficiency of a heat engine at the temperatures of its heat reservoirs given by Efficiency=1-T(cold reservoir)/T(hot reservoir)	Summative	Knowledge	Question(s) will be asked in final examination.	
<b>Domain D: Waves</b>				
[SLO: P-11-D-01] Use intensity = power/area to solve problems. Use Intensity $\propto$ (amplitude) <sup>2</sup> for a progressive wave to solve problems	Summative	Application	Question(s) will be asked in final examination.	26 periods
[SLO: P-11-D-02] Explain that when a source of sound waves moves relative to a stationary observer, the observed frequency is different from the source frequency [describing of the Doppler effect for a stationary source and a moving observer is not required]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-03] Use the expression $f_o = (f_s \cdot v) / (v \pm v_s)$ for the observed frequency when a source of sound waves moves relative to a stationary observer.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-D-04] Explain the applications of the Doppler effect [such as radar, sonar, astronomy, satellite, radar speed traps and studying cardiac problems in	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
humans]				
[SLO: P-11-D-05] Explain that polarization is a phenomenon associated with transverse waves	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-06] Define and apply Malus's law [ $I = I_0 \cos^2\theta$ to calculate the intensity of a plane-polarized electromagnetic wave after transmission through a polarizing filter or a series of polarizing filters. (calculation of the effect of a polarizing filter on the intensity of an unpolarized wave is not required).]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-07] Use the principle of superposition of waves to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-D-08] Differentiate between constructive and destructive interference.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-09] Apply the principle of superposition to explain the working of noise canceling headphones.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-10] Illustrate experiments that demonstrate stationary waves [using microwaves, stretched strings and air columns (it will be assumed that end corrections are negligible; knowledge of the concept of end corrections is not required)]	Formative	Application	Question(s) will not be asked in final examination.	
[SLO: P-11-D-11] Explain the formation of a stationary wave using graphical representation	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-12] Explain the formation of harmonics in stationary waves.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-13] Analyze experiments that demonstrate diffraction [including the qualitative effect of the gap width relative to the wavelength of the wave; for example diffraction of water waves in a ripple tank]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-14] Explain the term coherence.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-15] Explain beats [as the pulsation caused by two waves of slightly different frequencies interfering with each other]	Summative	Knowledge + Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-16] Illustrate examples of how beats are generated in musical	Summative	Understanding	Question(s) will be asked in	



NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
instruments		+ Application	final examination.	
[SLO: P-11-D-17] Explain the use of polaroids in sky photography and stress analysis of materials	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-18] Describe qualitatively gravitational waves [as waves of the intensity of gravity generated by the accelerated masses of an orbital binary system that propagate as waves outward from their source at the speed of light]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-D-19] State that as a gravitational wave passes a body with mass the distortion in space-time can cause the body to stretch and compress periodically	Formative	Knowledge	Question(s) will not be asked in final examination.	
[SLO: P-11-D-20] State that gravitational waves pass through the Earth due to far off celestial events, but they are very minute amplitude	Formative	Knowledge	Question(s) will not be asked in final examination.	
[SLO: P-11-D-21] Describe the use of interferometers in detecting gravitational waves [Interferometers are very sensitive detection devices that make use of the interference of laser beams (working and set up details are not required) and were used to first detect the existence of gravitational waves]	Formative	Understanding	Question(s) will not be asked in final examination.	
<b>Domain E: Electricity and Magnetism</b>				32 periods
[SLO: P-11-E-01] State that an electric field is an example of a field of force	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-E-02] Define and calculate electric field strength [Use $F = qE$ for the force on a charge in an electric field. Use $E = \frac{\Delta V}{\Delta d}$ to calculate the field strength of the uniform field between charged parallel plates]	Summative	Knowledge+ Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-11-E-03] Represent an electric field by means of field lines	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-E-04] Describe the effect of a uniform electric field on the motion of charged particles	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-E-05] State that, for a point outside a spherical conductor, the charge on the sphere may be considered to be a point charge at its center	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-E-06] Explain how a Faraday cage works [by inducing internal electric fields that work to shield the inside from the influence of external electric fields]	Summative	Understanding	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
SLO: P-11-E-07] State and apply Coulomb's law [ $F = k \frac{Q_1 Q_2}{r^2}$ for the force between two point charges in free space, where $k = \frac{1}{4\pi\epsilon_0}$ ]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-11-E-08] Use $E = k \frac{Q}{r^2}$ for the electric field strength due to a point charge in free space.	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-09] Describe how Ferro fluids work [they make use of temporary soft magnetic materials suspended in liquids to develop fluids that react to the poles of a magnet and have many applications in fields such as electronics]	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-09-E-10] Use, for a current-carrying conductor, the expression $I = Anvq$ [where n is the number of charge carriers per unit volume.]	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-11] State and use $V = W/Q$	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-12] State and use $P = IV$ , $P = I^2 R$ and $P = V^2/R$	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-13] State and use $R = \rho L/A$	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-14] State that the resistance of a light-dependent resistor (LDR) decreases as the light intensity increases	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-15] Define and use the electromotive force (e.m.f.) [of a source as energy transferred per unit charge in driving charge around a complete circuit]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-16] Distinguish between e.m.f. and potential difference (p.d.) in terms of energy considerations	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-17] Explain the effects of the internal resistance of a source of e.m.f. on the terminal potential difference	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-18] State Kirchhoff's first law and describe that it is a consequence	Summative	Knowledge	Question(s) will be asked in	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
of conservation of charge			final examination.	
[SLO: P-09-E-19] State Kirchhoff's second law and describe that it is a consequence of conservation of Energy	Summative	Knowledge + Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-20] Derive, using Kirchhoff's laws, a formula for the combined resistance of two or more resistors in series	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-21] Derive and apply a formula for the combined resistance of two or more resistors in parallel	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-22] Use Kirchhoff's laws to solve simple circuit problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-23] State and use the principle of the potentiometer as a means of comparing potential differences	Summative	Understanding + Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-24] Explain the use of a galvanometer in null methods	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-25] Explain the use of thermistors and light- dependent resistors in potential dividers [to provide a potential difference that is dependent on temperature and light intensity]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-26] Explain the internal resistance of sources and its consequences for external circuits	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-27] Explain how inspectors can easily check the reliability of a concrete bridge with carbon fibers as the fibers conduct electricity	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-28] Define and explain magnetic fields	Summative	Knowledge	Question(s) will be asked in final examination.	18 periods
[SLO: P-09-E-29] State that a force might act on a current- carrying conductor placed in a magnetic field	Summative	Knowledge + Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-30] Use the equation $F=BIL \sin(\theta)$ [ with directions as interpreted by Fleming's left-hand rule to solve problems]	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-31] Define magnetic flux density [as the force acting per unit current per unit length on a wire placed at right angles to the magnetic field]	Summative	Knowledge	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
[SLO: P-09-E-32] Use $F=BqV \sin(\theta)$ to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-33] Describe the motion of a charged particle moving in a uniform magnetic field perpendicular to the direction of motion of the particle	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-34] Explain how electric and magnetic fields can be used in velocity selection	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-35] Sketch magnetic field patterns due to the currents in a long straight wire, a flat circular coil and a long solenoid	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-36] State that the magnetic field due to the current in a solenoid is increased by a ferrous core.	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-09-E-37] Explain the origin of the forces between current-carrying conductors and determine the direction of the forces.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-38] Define magnetic flux [as the product of the magnetic flux density and the cross-sectional area perpendicular to the direction of the magnetic flux density]	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-09-E-39] Use $\Phi=BA$ to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-40] Use the concept of magnetic flux linkage	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-41] Explain experiments that demonstrate Faraday's and Lenz's laws [(a) that a changing magnetic flux can induce an e.m.f. in a circuit, (b) that the induced e.m.f. is in such a direction as to oppose the change producing it, (c) the factors affecting the magnitude of the induced e.m.f.]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-09-E-42] Use Faraday's and Lenz's laws of electromagnetic induction to solve problems	Summative	Application	Question(s) will be asked in final examination.	
[SLO: P-09-E-43] Explain how seismometers make use of electromagnetic induction to the earthquake detection [specifically in terms of: (i) any movement or vibration of the rock on which the seismometer rests (buried in a protective case) results in relative motion between the magnet and the coil (suspended by a spring from the frame.) (ii) the emf induced in the coil is directly proportional	Summative	Understanding + Application	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
to the displacement associated]				
<b>Domain F: Modern Physics</b>				08 periods
[SLO: P-11-F-01] Distinguish between inertial and non-inertial frames of reference.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-02] Describe the significance of Einstein's assumption of the constancy of the speed of light.	Summative	Understanding	Question(s) will be asked in final examination.	
SLO: P-11-F-03] Describe that if c is constant then space and time become relative.	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-04] State the postulates of Special relativity	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity [Specifically in the case of: a— the relativity of simultaneity. b— the equivalence between mass and energy. c— length contraction. d— time dilation. e— mass increase]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-06] State that space-time is a mathematical model in relativity that treats time as a fourth dimension of the traditional three dimensions of space (It can be thought of as a metaphorical sheet of paper that can bend, and when it bends it can cause effects such as stretching and compression seen when gravitational waves pass through objects.)	Formative	Knowledge	Question(s) will not be asked in final examination.	
[SLO: P-11-F-07] State that nucleon number and charge are conserved in nuclear processes	Summative	Knowledge	Question(s) will be asked in final examination.	26 periods
[SLO: P-11-F-08] Describe the composition, mass and charge of $\alpha$ , $\beta$ and $\gamma$ radiations [both $B^-$ (electrons) and $B^+$ (positrons) are included]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-09] Explain that an antiparticle has the same mass but opposite charge to the corresponding particle [give the example that a positron is the antiparticle of an electron]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-10] State that (electron) antineutrinos are produced during $\beta^-$ -decay and (electron) neutrinos are produced during $\beta^+$ -decay	Summative	Knowledge	Question(s) will be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
[SLO: P-11-F-11] Explain that $\alpha$ -particles have discrete energies but that $\beta$ -particles have a continuous range of energies because (anti)neutrinos are emitted in $\beta$ -decay	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-12] Describe quarks and antiquarks (as a fundamental) [including that there are six flavors (types) of quark: up, down, strange, charm, top and bottom]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-13] Describe protons and neutrons in terms of their quark composition	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-14] State that a hadron may be either a baryon (consisting of three quarks) or a meson (consisting of one quark and an antiquark)	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-F-15] Describe the changes to quark composition that take place during $\beta^-$ and $\beta^+$ decay	Summative	Knowledge	Question(s) will be asked in final examination.	
[SLO: P-11-F-16] State that electrons and neutrinos are fundamental particles called leptons	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-18] State the Higgs Boson as a fundamental particle which is responsible for the particle's mass.	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-19] Explain that every subatomic particle has a corresponding antiparticle [that has the same mass as a given particle but opposite electric or magnetic properties according to the Standard Model of Particle Physics]	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-20] Describe protons and neutrons in terms of their quark composition	Summative	Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-21] State that a hadron may be either a baryon (consisting of three quarks) or a meson (consisting of one quark and an antiquark)	Summative	Knowledge+ Understanding	Question(s) will be asked in final examination.	
[SLO: P-11-F-22] Explain that there are various contending theories about what 'mass' and 'force' are generated from [e.g. that these are generated from quantum fields when they are energized, or from multidimensional 'strings' that	Formative	Understanding	Question(s) will not be asked in final examination.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
vibrate in higher dimensions to give rise to particles (no further technical knowledge beyond these simple descriptions is expected at this level)]				
[SLO: P-11-F-23] Explain the working principle of particle accelerators and also their uses.	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-24] Explain that antimatter is the counterpart of matter [e.g. a positron is the antimatter counterpart to an electron]	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-25] Illustrate that antiparticles usually have the same weight, but opposite charge, compared to their matter counterparts	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-26] State that most of the matter in the observable universe is matter	Formative	Knowledge	Question(s) will not be asked in final examination.	
[SLO: P-11-F-27] Describe the asymmetry of matter and antimatter in the universe as an unsolved mystery	Formative	Understanding	Question(s) will not be asked in final examination.	
[SLO: P-11-F-28] Describe annihilation reactions [a particle meets its corresponding antiparticle, they undergo annihilation reactions in which either all the mass is converted to heat and light energy, or some mass is left over in the form of new subatomic particles.]	Summative	Understanding	Question(s) will be asked in final examination.	
<b>Domain N: Experimentation Skills</b>				28 periods
[SLO: P-11-N-01] - test that the lab equipment is functioning properly, without any potential risk of injury, before conducting an experiment	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it	
[SLO: P-11-N-02] - ensure that work space for conducting the experiment is not too crowded with apparatus as to be hazardous	<b>Formative for PBA</b>	Application	will be part of Lab work.	
[SLO: P-11-N-03] - ensure that safe distance is kept at all times from other investigators who may be handling lab apparatus	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it	
[SLO: P-11-N-04] - suggest broadly what potential bodily harm could occur from physical, chemical, biological and safety hazards in the context of the experiment being conducted	<b>Formative for PBA</b>	Application	will be part of Lab work.	
[SLO: P-11-N-05] - State that it is always better to ask for help from the lab instructor when unsure of how to use new apparatus	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it	
[SLO: P-11-N-06] Set up apparatus correctly without assistance from a supervisor	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
			will be part of Lab work.	
[SLO: P-11-N-07] Follow instructions given in the form of written instructions and diagrams (including circuit diagrams)	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-08] Use apparatus to collect an appropriate quantity of data	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-09] Repeat readings where appropriate	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-10] Make measurements that span the largest possible range of values within the limits either of the equipment provided or of the instructions given.	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-11] Use a false origin where appropriate while plotting graphs	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-12] Estimate the absolute uncertainty in Measurements	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-13] Express the uncertainty in a measurement as an absolute or percentage uncertainty, and translate between these forms	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-14] Express the absolute uncertainty in a repeated measurement as half the range of the repeated readings, where this is appropriate.	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-15] Draw straight lines of best fit or curves to show the trend of a graph	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-16] Draw tangents to curved trend lines and determine the gradient of a straight-line graph or of a tangent to a curve	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it	



NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
			will be part of Lab work.	
[SLO: P-11-N-17] Relate straight-line graphs to equations of the form $y = mx + c$ , and derive expressions that equate to the gradient and/or the y-intercept of their graphs	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-110-N-18] Read the coordinates of points on the trendline of a graph	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-19]-----				
[SLO: P-11-N-20] determine the y-intercept of a straight-line graph or of a tangent to a curve, including where these are on graphs with a false origin.	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-21] draw conclusions from an experiment, including determining the values of constants	<b>Formative for PBA</b>	Application	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-22] Explain whether experimental data supports a given hypothesis and make predictions based on the data	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-23] Determine whether a relationship containing a constant is supported by experimental data	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-24] For results of an experiment: Calculate the percentage difference between values of the constant Compare this percentage difference with a pre-given percentage uncertainty Give a conclusion based on this comparison.	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-25] Identify and describe the limitations in an experimental procedure	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-26] Identify the most significant sources of uncertainty in an experiment.	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	

NCP SLOs Description	Form of Assessment	Cognitive Level	Remarks	Number of Periods Required (1 period=40 minutes)
[SLO: P-11-N-27] An experimental arrangement that will improve the accuracy of the experiment or to extend the investigation to answer a new question	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	
[SLO: P-11-N-28] Describe these modifications clearly in words or diagrams.	<b>Formative for PBA</b>	Understanding	Question will not be asked in final examination, however, it will be part of Lab work.	

Note: In the Assessment Framework, summative SLOs for PBA are not identified. Therefore, a separate list of practicals for summative assessment (for PBA) will be shared along with the model question paper of the PBA.

**Note: PBA STANDS FOR “PRACTICAL BASED ASSESSMENT”**



# Federal Board HSSC-I Examination

## Physics Model Question Paper

(Curriculum 2022-2023)

### Section - A (Marks 17)

Time Allowed: 25 minutes

**Section – A is compulsory. All parts of this section are to be answered on this page and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.**

ROLL NUMBER					

Version No.			

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1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9

Candidate Sign. \_\_\_\_\_

Invigilator Sign. \_\_\_\_\_

**Q1. Fill the relevant bubble against each question according to curriculum. Each part carries one mark.**

S #	Question	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)
1.	Which of the following quantities are dimensionally similar?	Torque and work	Stress and spring constant	Angle and length	Strain and pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	Maximum work is obtained by the process called:	Isochoric	Isothermal	Isobaric	Adiabatic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	Projectile motion is two-dimensional motion under constant acceleration due to	Air resistance	Gravity	Horizontal distance	Velocity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	A turtle travel 45cm in 20 minutes, its average velocity will be:	2.25cm/h	90cm/h	135cm/h	15cm/h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	A stationary wave is formed by waves of frequency 512Hz. The speed of the wave is 65m/s, the distance between two consecutive antinodes is:	0.126m	0.06m	0.03m	0.024	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	A wire is stretched to double of its original length, its strain is	0.5	1	zero	2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	Cyclotron frequency of a charged particle moving in a magnetic field B is independent of:	Magnetic flux density	Charge on a particle	Velocity of particle	Mass of particle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	The best instrument for accurate measurement of emf of a cell is:	Voltmeter	Potentiometer	Ammeter	Ohmmeter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9.	The percentage uncertainty in mass and velocity of an object is 2% and 3% respectively. Which of the following is the maximum uncertainty in the measurement of its kinetic energy?	5%	8%	1%	7%	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
10.	Theory of relativity was formulated by.	Isaac Newton	Rutherford	Plank	Albert Einstein	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
11.	The radius at two ends of a pipe is in the ratio of 2:3, then the speed of liquid at the two ends is in the ratio of:	2:3	3:2	4:9	9:4	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
12.	Lepton number for muon particle is:	-1	+1	+1/2	0	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
13.	Which of the following moving particle is not deflected by magnetic field?	Neutron	Proton	Electron	Positron	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
14.	The force that acts on the body but it does no work is called:	Frictional force	Gravitational force	Centripetal force	Elastic force	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
15.	The region around a charge in which a test charge can feel an electric force is called	Electric intensity	Electric Potential	Electric Field	Electric Energy	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
16.	Moment of inertia of a spinning body about its axis does not depend on the:	Angular velocity of body	Mass of body	Orientation of the axis	Distribution of the mass around axis	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
17.	When $F_x = 3 \text{ N}$ and $F = 5 \text{ N}$ then $F_y =$	6N	8N	2N	4N	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>



# Federal Board HSSC-I Examination

## Physics Model Question Paper

(Curriculum 2022-23)

**Time allowed: 2.45 hour**

**Total Marks Sections B and C: 68**

Note: Answer all parts from Section 'B' and all questions from Section 'C' on the **E-sheet**. Write your answers on the allotted/given spaces.

### SECTION – B (Marks 42)

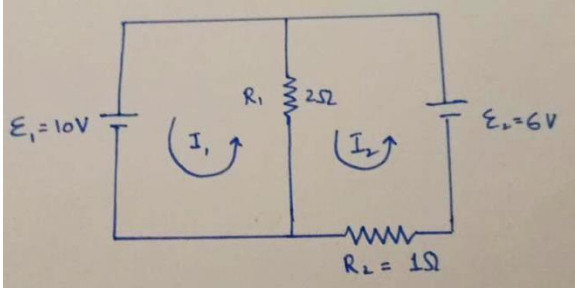
**Q. 2 Answers the following questions briefly.**

**(14x3 = 42)**

(i)	An equation is dimensionally correct. Does it mean that equation is necessary correct?	03	<b>OR</b>	Find cross product of two unit vectors at $0^\circ$ and $90^\circ$ .	03
(ii)	Define crystalline and amorphous solid.	03	<b>OR</b>	What are the differences between gluons and photons.	03
(iii)	Write the characteristics of scalar product.	03	<b>OR</b>	Define the principle used in seismometer.	03
(iv)	Differentiate between conservative and non-conservative forces.	03	<b>OR</b>	How a steady flow is different from turbulent flow?	03
(v)	What is effect of radius of cross section of conductor on its resistance?	03	<b>OR</b>	Radius of sphere is measured with a screw gauge and is substituted in the formulae of its surface area ( $A=4\pi r^2$ ) and volume ( $V=4/3\pi r^3$ ). Which of the two results will be more accurate?	03
(vi)	Explain the stress strain curve for ductile material.	03	<b>OR</b>	Describe the limitation of first law of thermodynamics.	03
(vii)	Find the angle of projection of a projectile for which the maximum height and corresponding range are equal?	03	<b>OR</b>	An ideal liquid is flowing through a pipe of variable diameter as shown in figure. Where is pressure high (at position A or at B). Justify your answer.  <div style="text-align: center;"> </div>	03
(viii)	By using concept of dot product, how can you describe that magnetic flux is scalar product of magnetic flux density ( <b>B</b> ) and vector area ( <b>A</b> )?	03	<b>OR</b>	Is there any transfer of energy through a medium when stationary waves are produced in it? Explain.	03
(ix)	Two tuning forks of frequencies 456 Hz and 452 Hz are sounded together. How many beats are produced over a period of 10 second?	03	<b>OR</b>	A 40 kg mass is supported by 5 m long aluminium wire ( $Y_A=7\times 10^{10}$ Pa). To have same elongation in a copper wire of the same length under the same weight, find the diameter of copper wire. ( $Y_C=12\times 10^{10}$ Pa)	03
(x)	Why does the resistance of LDR decrease with increase in intensity of light on it?	03	<b>OR</b>	Define (a) radian (b) angular acceleration	03
(xi)	If 280 J of work is done in carrying a charge from a place where potential is -12V to another place where potential is V volt. Calculate the value of V.	03	<b>OR</b>	Write the characteristics of an ideal fluid.	03
(xii)	Two spheres A and B are of the same masses but the radius of A is greater than that of B. Which one will require more torque applied on it to bring into rotation about their axes of rotation?	03	<b>OR</b>	Hydrogen has three isotopes. How can you use magnetic field to separate them?	03
(xiii)	Define constructive and destructive interference.	03	<b>OR</b>	State the process in which the internal energy of the system remains constant?	03
(xiv)	How can you polarize ordinary light using polarizers?	03	<b>OR</b>	Why does smoke rise faster in a chimney on a windy day?	03

### SECTION – C (Marks 26)

**Note:** Attempt all questions. Marks of each question are given along with each question.

<p><b>Q.3</b></p>	<p>Explain elastic collision in one dimension and prove that for two bodies colliding elastically, relative speed of approach before collision is equal to relative speed of separation after collision.</p>	<p>02+ 05</p>	<p><b>OR</b></p>	<p>Explain Carnot cycle. Derive the relation for the efficiency of Carnot engine.</p>	<p>04+ 03</p>
<p><b>Q.4</b></p>	<p>State law of conservation of angular momentum. Show that <math>\Delta L/\Delta t = 0</math> and angular momentum <math>L</math> is conserved for an isolated system.</p>	<p>01+ 03+ 02</p>	<p><b>OR</b></p>	<p>Show that electric field intensity is equal to negative of potential gradient. Prove that Volt/meter = Newton / Coulomb</p>	<p>04 + 02</p>
<p><b>Q.5</b></p>	<p>What is meant by quark? Explain the quark family of particle.</p>	<p>02+ 05</p>	<p><b>OR</b></p>	<p>What is special theory of relativity? Describe the following consequences of special theory of relativity A: Mass variation B: Length contraction C: Time dilation</p>	<p>01+ 02+ 02+ 02</p>
<p><b>Q.6</b></p>	<p>Find current flowing through each resistor, using Kirchoff's law in the given circuit.</p> 	<p>06</p>	<p><b>OR</b></p>	<p>In an experiment a 3kg water rocket is launched from ground. The rocket total energy at the top of its flight is 2352J. a. What was the rocket launching speed? b. What height did the rocket reach? c. What is the kinetic energy and potential energy of the rocket after 2.5s of its launch?</p>	<p>02+ 02+ 02</p>

**FBISE HSSC-I Examination**  
**Physics Model Question Paper**  
(Curriculum 2023)

**Alignment of Questions with Curriculum**  
**Student Learning Outcomes**

Sr No	Section: Q. No. (Part no.)	Domain Title/ Content Area	Student Learning Outcomes	Cognitive Domain *	Allocated Marks in Model Paper
1	A: Q1(1)	Domain A	[SLO: P-11-A-03] Analyze the homogeneity of physical equations	U	1
2	A: Q1(2)	Domain C	[SLO: P-11-C-08] Define and use the first law of thermodynamics	U	1
3	A: Q1(3)	Domain B	[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance	K	1
4	A: Q1(4)	Domain B	[SLO: P-11-B-04] Solve problems using the equations of motion	A	1
5	A: Q1(5)	Domain D	[SLO: P-11-D-10] Illustrate experiments that demonstrate stationary waves [SLO: P-11-D-11] Explain the formation of a stationary wave using graphical representation	A	1
6	A: Q1(6)	Domain B	[SLO: P-11-B-24] Define and use the terms stress, strain and the Young modulus	U	1
7	A: Q1(7)	Domain E	[SLO: P-09-E-33] Describe the motion of a charged particle moving in a uniform magnetic field perpendicular to the direction of motion of the particle	U	1
8	A: Q1(8)	Domain E	[SLO: P-09-E-23] State and use the principle of the potentiometer as a means of comparing potential differences	K	1
9	A: Q1(9)	Domain A	[SLO: P-11-A-06] Assess the uncertainty in a derived quantity	A	1
10	A: Q1(10)	Domain F	[SLO: P-11-F-04] State the postulates of Special relativity [SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity	K	1
11	A: Q1(11)	Domain B	[SLO: P-11-B-38] Justify that the continuity is a form of the principle of conservation of mass[SLO: P-11-B-36] Use equation of continuity to solve problems.	U	1
12	A: Q1(12)	Domain F	[SLO: P-11-F-16] State that electrons and neutrinos are fundamental particles called leptons	K	1
13	A: Q1(13)	Domain E	[SLO: P-09-E-33] Describe the motion of a charged particle moving in a uniform magnetic field perpendicular to the direction of motion of the particle	K	1
14	A: Q1(14)	Domain B	[SLO: P-11-B-14] Define and calculate centripetal force [SLO: P-11-B-15] Analyze situations involving circular motion in terms of centripetal force	U	1
15	A: Q1(15)	Domain E	[SLO: P-11-E-02] Define and calculate electric field strength	K	1
16	A: Q1(16)	Domain B	[SLO: P-11-B-18] Define and calculate moment of inertia of a body and angular momentum. [SLO: P-11-B-19] Derive and apply the relation between torque, moment of inertia and angular acceleration.	U	1
17	A: Q1(17)	Domain B	[SLO: P-11-B-01] Represent a vector in 2-D as two perpendicular components	A	1

18	B: Q2(i)	Domain A  Domain B (Vectors)	[SLO: P-11-A-03] Analyse the homogeneity of physical equations [through dimension analysis] OR [SLO: P-11-B-02] Describe the product of two vectors (dot and cross-product) along with their properties	A	3
19	B: Q2(ii)	Domain A (Measurement)  Domain F (Particle Physics)	[SLO: P-11-B-22] Distinguish between the structures of crystalline, glassy, amorphous, and polymeric solids. OR [SLO: P-11-F-17] State, W, Z, gluon, and photons as fundamental particles called exchange particles or force carriers	K  U	3
20	B: Q2(iii)	Domain B (Vectors)  Domain E (Magnetisms)	[SLO: P-11-B-02] Describe the product of two vectors (dot and cross-product) along with their properties OR [SLO: P-09-E-43] Explain how seismometers make use of electromagnetic induction to the earthquake detection [specifically in terms of: (i) any movement or vibration of the rock on which the seismometer rests (buried in a protective case) results in relative motion between the magnet and the coil (suspended by a spring from the frame.) (i) the emf induced in the coil is directly proportional to the displacement associated]	K  K	3
21	B: Q2(iv)	Domain B (Work And K.E)  Domain B (Fluid Dynamics)	[SLO: P-11-B-31] Differentiate between conservative and non-conservative forces OR [SLO: P-11-B-35] Define and apply the terms: steady (streamline or laminar) flow, incompressible flow and non-viscous flow as applied to the motion of an ideal fluid	U	3
22	B: Q2(v)	Domain E (Electricity) Domain A (Measurement)	[SLO: P-09-E-13] State and use $R=\rho L/A$ OR [SLO: P-11-A-05] Analyze and critique the accuracy and precision of data collected by measuring instruments	U	3
23	B: Q2(vi)	Domain B (Deformation of solid) Domain C (Heat and Thermodynamics)	[SLO: P-11-B-26] Describe and use the terms elastic deformation, plastic deformation and elastic limit OR [SLO: P-11-C-08] Define and use the first law of thermodynamics	U	3
24	B: Q2(vii)	Domain B (Translatory motion)  Domain B (Fluid Dynamics)	[SLO: P-11-B-05] Evaluate and analyze projectile motion in the absence of air resistance [SLO: P-11-B-06] Predict qualitatively how air resistance affects projectile motion OR [SLO: P-11-B-40] Explain and apply Bernoulli's equation for horizontal and vertical fluid flow	A  U	3
25	B: Q2(viii)	Domain E (Magnetism)  Domain D (Waves)	[SLO: P-09-E-38] Define magnetic flux [SLO: P-11-B-02] Describe the product of two vectors (dot and cross-product) along with their properties OR [SLO: P-11-D-10] Illustrate experiments that demonstrate stationary waves [SLO: P-11-D-11] Explain the formation of a stationary wave using graphical representation	U	3
26	B: Q2(ix)	Domain D (Waves) Domain B (Deformation of solid)	[SLO: P-11-D-16] Illustrate examples of how beats are generated in musical instruments OR [SLO: P-11-B-24] Define and use the terms stress, strain and the Young modulus	A	3
27	B: Q2(x)	Domain E (Electricity)	[SLO: P-09-E-14] State that resistance of a light dependent resistor (LDR) decreases as the light intensity increases. OR	U	3



		Domain B (Rotational and circular motion)	[SLO: P-11-B-07] Express angles in radians [SLO: P-11-B-08] Define and calculate angular displacement, angular velocity and angular acceleration [This involves use of $S = r\theta$ , $v = r\omega$ , $\omega = 2\pi/T$ , $a = r\omega^2$ and $a = v^2/r$ to solve problems].	K	
28	B: Q2(xi)	Domain E (Electricity)  Domain B (Fluid Dynamics)	[SLO: P-09-E-11] State and use $V=W/Q$ OR [SLO: P-11-B-35] Define and apply the terms: steady (streamline or laminar) flow, incompressible flow and non-viscous flow as applied to the motion of an ideal fluid	A  K	3
29	B: Q2(xii)	Domain B (Rotation and circular motion)  Domain E (Magnetism)	[SLO: P-11-B-18] Define and calculate moment of inertia of a body and angular momentum. [SLO: P-11-B-19] Derive and apply the relation between torque, moment of inertia and angular acceleration. OR [SLO: P-09-E-32] Use $F=BqV \sin(\theta)$ to solve problems [SLO: P-09-E-33] Describe the motion of a charged particle moving in a uniform magnetic field perpendicular to the direction of motion of the particle	U	3
30	B: Q2(xiii)	Domain D (Waves)  Domain C (Heat and thermodynamics)	[SLO: P-11-D-08] Differentiate between constructive and destructive interference. OR [SLO: P-11-C-08] Define and use the first law of thermodynamics  SLO: P-11-C-02] Relate a rise in temperature of an object to an increase in its internal energy	K	3
31	B: Q2(xiv)	Domain D (Waves)  Domain B (Fluid Dynamics)	[SLO: P-11-D-17] Explain the use of polaroid's in sky photography and stress analysis of materials OR [SLO: P-11-B-44] Analyze the real-world applications of the Bernoulli effect	U	3
32	C: Q3	Domain B (Translatory motion ) Domain D (Waves)	[SLO: P-11-B-12] Predict and analyze motion for elastic collisions OR [SLO: P-11-C-16] State the working principle of Carnot's engine	U	7
33	C: Q4	Domain B (Rotation and circular motion)  Domain E (Electrostatics)	[SLO: P-11-B-20] State and apply the law of conservation of angular momentum. Illustrate the applications of conservation of angular momentum in real life. OR [SLO: P-11-E-02] Define and calculate electric field strength	U	6
34	C: Q5	Domain F (Particle Physics)  Domain F (Relativity)	[SLO: P-11-F-12] Describe quarks and antiquarks (as a fundamental [SLO: P-11-F-13] Describe protons and neutrons in terms of their quark composition OR [SLO: P-11-F-05] Explain qualitatively and quantitatively the consequences of special relativity	K	7
35	C: Q6	Domain E (Electricity)  Domain B (work and energy)	[SLO: P-09-E-20] Derive, using Kirchhoff's laws, a formula for the combined resistance of two or more resistors in series OR [SLO: P-11-B-29] Derive the formula for kinetic [using the equations of motion]	A	6

\*Cognitive Level

K: Knowledge

U: Understanding

A: Application

## Table of Specification Model Paper Physics – Grade XI

Domain	Measurements A	Mechanics B						Heat and Thermodynamics C	Waves D	Electricity and Magnetism E			Modern Physics F		Total Marks	Percentage
		Vectors (B1-B2)	Translatory motion (B3-B6) (B11-B13)	Rotational and circular motion (B7-B10) (B14-B21)	Work and Kinetic energy (B29-B32)	Fluid Dynamic (B33-B44)	Deformation of solid (B22-B28)			Heat and Thermodynamics (C1-C23)	Waves (D1-D21)	Electrostatics (E1-E9)	Electricity (E10-E27)	Magnetism (E28-E43)		
<b>Assessment Objectives</b>	Measurements (A1-A7)	Vectors (B1-B2)	Translatory motion (B3-B6) (B11-B13)	Rotational and circular motion (B7-B10) (B14-B21)	Work and Kinetic energy (B29-B32)	Fluid Dynamic (B33-B44)	Deformation of solid (B22-B28)	Heat and Thermodynamics (C1-C23)	Waves (D1-D21)	Electrostatics (E1-E9)	Electricity (E10-E27)	Magnetism (E28-E43)	Relativity (F1-F8)	Particle Physics (F9-F28)	Total Marks	Percentage
<b>K Knowledge</b>		2(iii/f)3	Q#1(iii) 1	Q2(x/s)3		Q2(xi/s)3	Q2(ii/f)3	Q2(xiii/s)3	Q2(xiii/f)3	Q1(xv)1	Q1(viii)1	Q1(xiii)1 Q2(iii/s)3	Q5(s)7 Q1(x)1	Q1(xii)1 Q5(f)7	41	27 %
<b>U Understanding</b>	Q#1(i)1		Q3(f)7	Q#1(xvi)1 Q2(xii/f)3 Q4(f)6	Q#1(xiv)1 Q2(iv/f)3	Q#1(xi)1 Q2(iv/s)3 Q2(xiv/s)3 Q2(vii/s)3	Q#1(vi)1 Q2(v/s)3 Q2(vi/f)3	Q#1(ii)1 Q2(vi/s)3 Q3(s)7	Q2(viii/s)3 Q2(xiv/f)3	Q4(s)6	Q2(x/f)3 Q2(v/f)3	Q1(vii)1 Q2(viii/f)3 Q2(xii/s)3		Q2(ii/s)3	78	51 %
<b>Application A</b>	Q#1(ix)1 Q2(i/f)3	Q#1(xvii)1 Q2(i/s)3	Q#1(iv)1 Q2(vii/f)3		Q6(s)6		Q2(ix/s)3		Q#1(v)1 Q2(ix/f)3	Q2(xi/f)3	Q6(f)6				34	22 %
<b>Total Marks</b>	5	7	12	13	10	13	13	14	13	10	13	11	8	11	153	-
Total Percentages	3%	5%	8%	8.5%	6.5%	8.5%	8.5%	9%	8.5%	7%	8.5%	7%	5%	7%	-	100 %

**Note:**

- 1 This ToS does not reflect policy, but it is particular to this model question paper.
- 2 Proportionate / equitable representation of the content areas as per the defined ranges may be ensured.
- 3 The percentage of cognitive domain is 30%, 50%, and 20% for knowledge, understanding, and application, respectively with  $\pm 5\%$  variation.
- 4 While selecting alternative questions for Short Response Questions (SRQs) and Extended Response Questions (ERQs), it must be kept in mind that:
  - Difficulty levels of both questions should also be same
  - SLOs of both the alternative questions must be different

**Key:** Question Number (part/ first choice) marks      example: Q2 ( i / f ) 2 , Question Number (part/ second choice) marks      Q2 ( i / s ) 2



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