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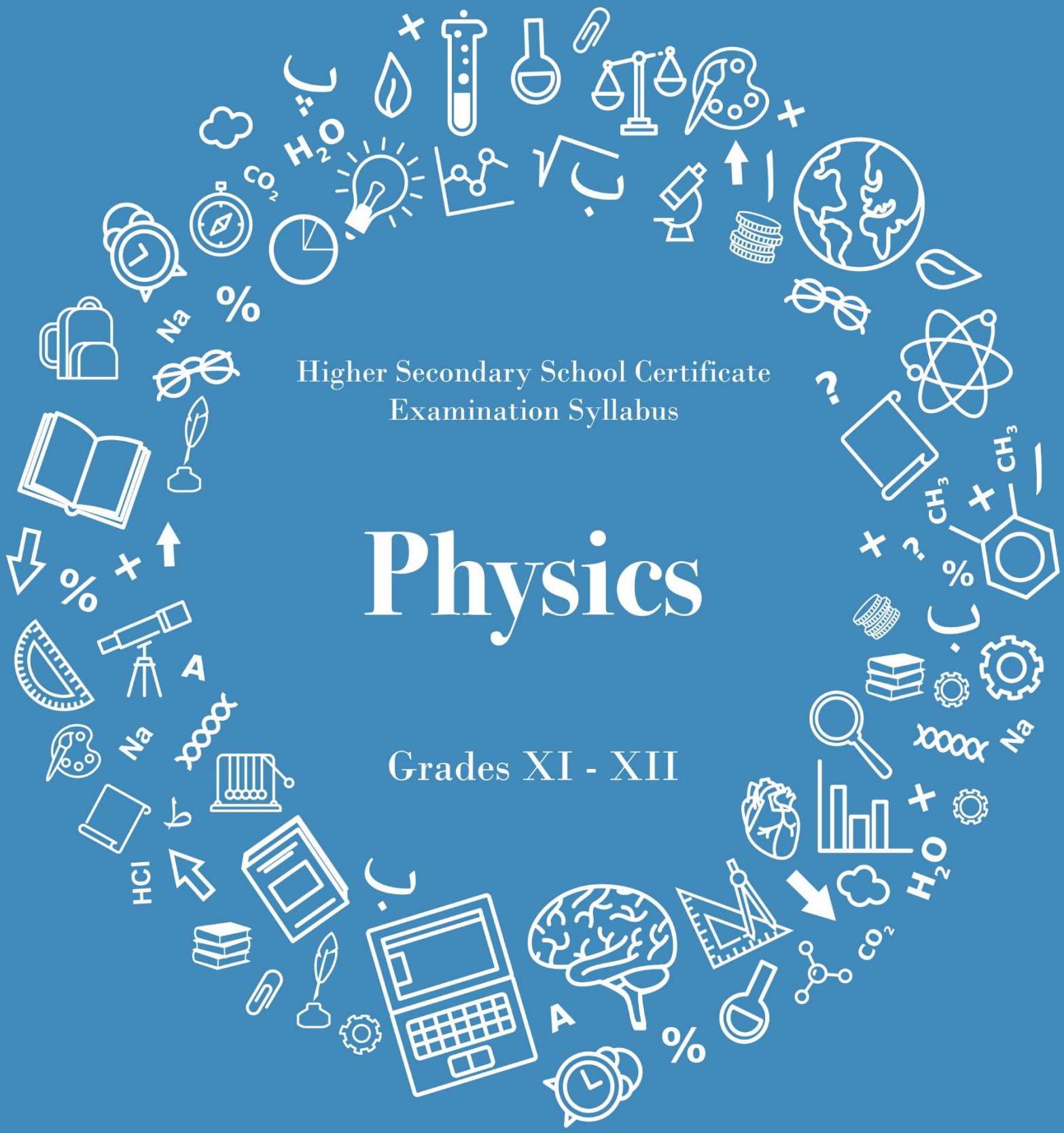

Higher Secondary School Certificate
Examination Syllabus

Physics

Grades XI - XII

(Based on New National Curriculum 2022-2023)

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Higher Secondary School Certificate Examination Syllabus

PHYSICS

GRADES XI-XII

This syllabus will be examined in both Annual and September Examination sessions from Annual Examinations 2026 for Grade XI and Annual Examinations 2027 for Grade XII

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Preface

Established in 2002 through the Pakistan government's ordinance, the Aga Khan University Examination Board (AKU-EB) is country's first private autonomous qualification awarding body Secondary School Certificate (SSC) and Higher Secondary School Certificate (HSSC). Its vision is to be a model of excellence and innovation in education in Pakistan and the developing world.

AKU-EB achieves its vision by developing examination syllabi which inculcate conceptual thinking and higher order learning and is aligned with the National Curriculum and mapped with provincial curricula and international standards. AKU-EB revises its syllabi periodically to support the needs of students, teachers and society.

The aims of the syllabus review of SSC and HSSC are to:

- Ensure continued compatibility with the goals of the National Curriculum of Pakistan.
- Review the content for inclusion of new knowledge and deletion of obsolete knowledge.
- Review the content for clarity and relevance as per the changing needs of students, teachers and society.
- Enhance and strengthen continuation and progression of content both within and across grades IX - XII (SSC and HSSC).
- Ensure the readiness of students for higher education.

During the syllabus review, the needs of all the stakeholders were identified through a needs-assessment survey. Students and teachers of AKU-EB affiliated schools from across Pakistan participated in the survey. Thereafter, a revision panel, which consisted of examiners, teachers of affiliated and non-affiliated schools, teacher trainers and university academicians, reviewed and revised the syllabus following a planned, meticulous and standardised syllabi review process.

The development of the revised syllabus has been made possible by the creativity and relentless hard work of Curriculum and Examination Development unit and the constant support provided by all the other units of AKU-EB. We are particularly thankful to our Principal Syllabus Reviewers, Syllabus Revision Panellists and all other reviewers for their contribution. We are also thankful to all the students and teachers who took part in the needs-assessment survey and to the principals of AKU-EB affiliated schools who made this endeavour possible by facilitating and encouraging their teachers and students to be a part of the survey and the syllabus revision panel.

With your support and collective hard work, AKU-EB has been able to take the necessary steps to ensure effective implementation of the National Curriculum of Pakistan through this syllabus. We are confident that this syllabus will continue to provide the support that is needed by students to progress to the next level of education and we wish the very best to our students and teachers in implementing this syllabus.

Dr Naveed Yousuf
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Understanding of AKU-EB Syllabi

1. The AKU-EB syllabi guide the students, teachers, parents and other stakeholders regarding the topics that will be taught and examined in each grade (IX, X, XI and XII). In each syllabus document, the content progresses from simple to complex, thereby, facilitating a gradual, conceptual learning of the content.

2. The topics of the syllabi are divided into sub-topics and **student learning outcomes** (**SLOs**). The SLOs define the depth and the breadth at which each topic or subtopic will be taught, learnt and examined. The syllabi also provide enabling SLOs where needed to scaffold student learning.

3. Each SLO starts with an achievable and assessable **command word** such as describe, relate, evaluate, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that the students are expected to undertake during their studies.

4. The SLOs are classified under the following cognitive levels of Bloom's Taxonomy: Remember (R), Understand (U), Apply and beyond [Apply (A), Analyse (An), Evaluate (E), Create (C)]. This is to facilitate effective planning for teaching, learning and assessment. In addition, some SLOs are identified as Formative Assessments (FA), where applicable.

5. Where applicable, **Practical Activities** section is provided to elaborate the assessment in the Practical Examination.

6. The **Examination Specification** is provided which elucidates the weightage of each topic in the examinations determined based on the content as well as the relevance of the topic.

7. To implement this syllabus, students and teachers can take support from additional material provided by the board to its affiliated schools including **Learning Resource Guides**, **Pacing Guides** and **Model Papers**.

8. The AKU-EB syllabi for Secondary School Certificate (SSC) and Higher Secondary School Certificate (HSSC) are designed to foster not only conceptual understanding but also critical thinking and problem-solving skills. These syllabi ensure students develop the cognitive, affective and psychomotor skills essential for success at the university and beyond.

Subject Rationale of AKU-EB Physics

Why study Physics?

Physics is a fundamental science that explores the nature of matter, energy, and the universe. It provides answers to basic questions about how the world works. By studying physics at the SSC level, you will:

1. **Understand Natural Phenomena:** Learn how everyday occurrences, such as the motion of objects, electricity, magnetism, heat, and light, occur according to specific physical laws.

2. **Develop Critical Thinking Skills:** Physics encourages logical thinking and problem-solving. You will learn to analyse situations, identify solutions, and make decisions based on evidence.

3. **Lay the Foundation for Future Studies:** Physics is essential for students who want to pursue careers in engineering, medicine, environmental sciences, or technology. It provides a strong base for further studies in various scientific discipline.

4. **Improve Practical Skills:** Through experiments and activities, physics helps you develop observation, experimentation, and measurement skills, which are valuable in everyday life.

5. **Contribute to Technological Advancements:** Physics is the backbone of many technological innovations that we use every day, from smartphones to energy-efficient devices. Understanding physics enables you to contribute to and appreciate these advancements.

Physics is not just a subject but a way of understanding the world and solving real-world problems. Whether exploring the cosmos or understanding the smallest particles, physics will inspire curiosity and equip you with tools to make sense of the world.

What will you learn in AKU-EB Physics?

Physics is a fundamental branch of experimental sciences as it studies everything from the very smallest particles of matter, such as quarks and leptons, to the vast distances between millions and billions of galaxies and the Milky Ways. Through a systematic study of the smallest and the largest phenomena, and everything in between, physics uncovers what is currently known about regarding matter and energy, while also opening doors for explore the yet unknown realms.

As Physics is based on both theoretical and as well as a practical approaches, therefore, learners in this subject have the opportunity to design, construct, investigate, collect and interpret meaningful data, analyse their findings and communicate results. These investigations can take place both inside and outside the laboratory.

Physics combines content, methodology and cognitive skill which enhances the learner's abilities to think conceptually and critically, and to solve real-life problems.

Where will it take you?

After studying AKU-EB Physics, students will be able to pursue the following career fields:

- Electronic Engineering
- Civil Engineering
- Electrical Engineering
- Petroleum Engineering
- Renewable Energy
- Medical Physics
- Geophysics
- Astrophysics
- Mechanical Engineering
- Software Engineering
- Automobile Engineering
- Textile Engineering

And many other related fields.

How to approach the syllabus?

The AKU-EB syllabi is carefully designed with a reader-friendly approach to ensure that students and teachers can easily comprehend it, making it functional for teaching, learning and assessment purposes. The syllabus includes following parts:

Subject Rationale	It is an introductory document for students.
Student Learning Outcomes (SLOs)	These guides students about what must be achieved
Exam Specification	It guides regarding what is expected in the examination.
Practical Activities	These includes laboratory activities to be performed during an academic year.
Additional Resources:	
Pacing Guide	It ensures smooth transition and curricular continuity of a school's academic year. It also predicts the time and pace of syllabus implementation.
Resource Guide	It includes teaching and learning resources for students and teachers.
Model Paper	It guides regarding exam pattern, types of questions and marking scheme.
Command Word Guide	It clarifies expectations regarding the cognitive levels and skills that should be acquired by the students and which are assessed in its examinations.

Student Learning Outcomes of AKU-EB HSSC Physics Syllabus

Part I (Grade XI)

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level[1]		
				R	U	A and beyond
1.	**Physical Quantities and Measurement**	Students should be able to:				
	1.1 Physical Quantities	1.1.1	discuss that all physical quantities consist of a numerical magnitude and a unit;			E
		1.1.2	determine appropriate values of physical quantities;			A
		1.1.3	identify the SI base quantities and their units;		*	
		1.1.4	discuss derived units as products or quotients of the SI base units;			E
		1.1.5	use SI base units to check the homogeneity of physical equations;			A
	1.2 Dimensions	1.2.1	describe the concept of dimensions;		*	
		1.2.2	discuss various physical quantities in terms of their dimensions;			E
		1.2.3	show the homogeneity of physical equations by using dimensions;			A
		1.2.4	derive the formula for physical quantities by using dimensions;			A
	1.3 Precision and Accuracy	1.3.1	differentiate between precision and accuracy;		*	
		1.3.2	analyse the accuracy and precision of data collected using different measuring instruments;			An

[1]R = Remember, U = Understand, A = Apply and beyond [Apply (A), Analyse (An), Evaluate (E), Create (C)]

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
1.4	Significant Figures and Uncertainty	1.4.1	solve word problems related to uncertainty in derived quantity with correct number of significant figures;			A
		1.4.2	justify that all measurements contain uncertainty.			E

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
2.	**Scalars and Vectors**	Students should be able to:				
2.1	Introduction to Vectors	2.1.1	differentiate between scalar and vector quantities;		*	
2.2	Addition of Vectors by Rectangular Component Method	2.2.1 2.2.2 2.2.3	analyse a vector into its rectangular components; explain the sum of vectors using perpendicular components; calculate the resultant of two vectors by rectangular component method;		 * 	An A
2.3	Scalar Product of Two Vectors	2.3.1 2.3.2 2.3.3	define scalar product of two vectors; exemplify scalar product of two vectors in terms of angle between them; describe properties of scalar product of two vectors;	* 	 * *	
2.4	Vector Product of Two Vectors	2.4.1 2.4.2 2.4.3	define vector product of two vectors; exemplify vector product of two vectors in terms of angle between them; describe properties of vector product of two vectors.	* 	 * *	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
3.	**Motion in One Dimension**	Students should be able to:				
3.1	Equations of Motion	3.1.1	derive equations of motion for a body moving with a uniform acceleration in a straight line;			A
		3.1.2	solve word problems related to uniformly accelerated motion including free fall using appropriate equations;			A
3.2	Law of Conservation of Momentum	3.2.1	describe law of conservation of linear momentum;		*	
		3.2.2	exemplify the law of conservation of momentum in: a. karate chops to break a pile of bricks, b. car crashes, c. ball and bat, d. motion under thrust of a rocket in a straight line;		*	
		3.2.3	define elastic and inelastic collision;	*		
		3.2.4	apply law of conservation of momentum to study the special cases of elastic collision between two bodies in one dimension;			A
		3.2.5	apply law of conservation of momentum in one and two dimensions in solving word problems;			A
3.3	Work	3.3.1	describe work as the dot product of force and displacement;		*	
		3.3.2	deduce the work done from the force displacement graphs;			E
3.4	Conservative and Non-Conservative Fields	3.4.1	differentiate between conservative and non-conservative field;		*	
3.5	Work-Energy Theorem	3.5.1	deduce the work-energy theorem in non-resistive and resistive medium;			E
		3.5.2	solve word problems related to the work-energy theorem.			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
4. Motion in Two Dimensions		Students should be able to:				
4.1	Projectile	4.1.1	explain projectile motion;		*	
		4.1.2	derive the relation for: a. time of flight, b. maximum height, c. horizontal range of a projectile, d. maximum horizontal range of a projectile;			A
		4.1.3	solve word problems related to the given relations (a, b, c and d);			A
		4.1.4	predict qualitatively the effect of air resistance on the motion of a projectile;			E
4.2	Angular Motion	4.2.1	describe angular displacement, angular velocity and angular acceleration;		*	
		4.2.2	derive the relationship between linear and angular displacement, velocity and acceleration;			A
		4.2.3	solve word problems related to the rotational motion;			A
4.3	Centripetal Force and Centripetal Acceleration	4.3.1	define centripetal force and centripetal acceleration;	*		
		4.3.2	derive centripetal acceleration when speed is uniform;			A
		4.3.3	justify that a centrifuge is used to separate materials using centripetal force;			E
		4.3.4	explain that the objects in orbiting satellites appear to be weightless;		*	
		4.3.5	describe that artificial gravity is created to counter weightlessness;		*	

Topics and Sub-Topics		Student Learning Outcomes	Cognitive level		
			R	U	A and beyond
4.4 Moment of Inertia	4.4.1	explain moment of inertia and its SI unit with dimension;		*	
	4.4.2	compare the moment of inertia in rod, ring, disc and sphere;		*	
	4.4.3	derive relationship between torque, moment of inertia and angular acceleration;			A
	4.4.4	solve word problems related to the given relationships;			A
4.5 Angular Momentum	4.5.1	explain angular momentum and its SI unit with dimension;		*	
	4.5.2	solve word problems related to angular momentum;			A
	4.5.3	explain the law of conservation of angular momentum;		*	
	4.5.4	illustrate the applications of conservation of angular momentum in: a. flywheels to store rotational energy, b. gyroscopes in navigation system, c. ice skaters to adjust their angular velocity.			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
5.	**Deformation in Solids**	Students should be able to:				
5.1	Types of Solids	5.1.1	distinguish between the structures of crystalline, amorphous and polymeric solids;		*	
5.2	Deformation in Solids	5.2.1	describe the deformation of solids in one dimension;		*	
5.3	Tensile and Plastic Deformation	5.3.1	describe terms elastic deformation, plastic deformation and elastic limit;		*	
5.4	Stress, Strain and Young Modulus	5.4.1 5.4.2 5.4.3 5.4.4	define stress, strain and Young modulus; interpret force extension graph for a deformed material; solve word problems related to Young modulus; use daily life objects to explain stress, strain and Young modulus;	*		E A FA[2]
5.5	Elastic Potential Energy of Materials	5.5.1	determine the elastic potential energy of a material by using $E = \frac{1}{2}Fx = \frac{1}{2}kx^2$.			A

[2]FA= Formative Assessment, not to be assessed under examination conditions

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
6.	**Fluids Dynamics**	Students should be able to:				
	6.1 Floating Objects	6.1.1	describe upthrust;		*	
		6.1.2	solve word problems using $Upthrust = \rho gV$;			A
		6.1.3	state the principle of floatation in terms of upthrust;	*		
		6.1.4	state Archimedes' principle of floatation;	*		
		6.1.5	justify that ships are engineered to float in the sea;			E
	6.2 Streamline and Turbulent Flow	6.2.1	define the following terms: a. streamline flow (laminar flow), b. turbulent flow, c. incompressible flow;	*		
		6.2.2	state the conditions required for turbulent flow;	*		
	6.3 Equation of Continuity	6.3.1	derive the equation of continuity;			A
		6.3.2	explain that squeezing one end of a rubber pipe results in increase in flow velocity at the other end;		*	
		6.3.3	solve word problems related to the equation of continuity;			A
	6.4 Bernoulli's Equation	6.4.1	derive Bernoulli's equation;			A
		6.4.2	justify that the difference in pressure can arise from different rates of flow of a fluid;			E
		6.4.3	explain Bernoulli effect in the following cases: a. atomizer, b. swing of ball, c. the lift of golf ball (the magnus effect), d. venturi duct;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
6.5	Viscous Fluids and Fluid Friction	6.5.1	define the following terms: a. viscous fluids, b. non-viscous fluids;	*		
		6.5.2	describe that viscous force in a fluid causes a retarding force on an object moving through it;		*	
		6.5.3	explain that real fluids are viscous fluids;		*	
		6.5.4	describe the following terms: a. fluid friction, b. super fluidity;		*	
		6.5.5	use different liquids in the surroundings to explain fluid friction and super fluidity.			FA

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
7.	**Oscillations**	Students should be able to:				
7.1	Simple Harmonic Motion (S.H.M.)	7.1.1	define periodic and non-periodic oscillation;	*		
		7.1.2	describe Simple Harmonic Motion (S.H.M.);		*	
7.2	Uniform Circular Motion and S.H.M.	7.2.1	define the following terms in the context of oscillations: a. displacement, b. amplitude, c. period, d. frequency, e. angular frequency, f. phase difference;	*		
		7.2.2	relate S.H.M. with uniform circular motion;		*	
		7.2.3	derive expression for instantaneous displacement, velocity and acceleration in terms of angular velocity (ω);			A
		7.2.4	solve word problems related to the SLO # 7.2.3;			A
		7.2.5	analyse graphical representations of the variations of displacement, velocity and acceleration with time for simple harmonic motion;			An
7.3	Mass-Spring System	7.3.1	explain that the motion of a body under elastic restoring force is S.H.M.;		*	
		7.3.2	derive an expression for the time period of a mass-spring system;			A
		7.3.3	solve word problems using the expression for the time period of a mass-spring system;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
7.4	Simple Pendulum	7.4.1 7.4.2 7.4.3	explain that the motion of a simple pendulum is S.H.M.; derive an expression for the time period of a simple pendulum; solve word problems using the expression for the time period of a simple pendulum;		* 	 A A
7.5	Energy Conservation in S.H.M.	7.5.1 7.5.2 7.5.3	derive an expression to show that energy is conserved in mass-spring system executing S.H.M.; solve word problems related to given expression; analyse the interchange between kinetic and potential energy during simple harmonic motion;			A A An
7.6	Free and Forced Oscillation	7.6.1	exemplify free and forced oscillation;		*	
7.7	Resonance	7.7.1 7.7.2	define resonance; describe applications and consequences of resonance in real life;	*	 *	
7.8	Damped Oscillations	7.8.1 7.8.2 7.8.3	explain damped oscillation; list different applications of damped oscillation; illustrate displacement-time graphs to show light, critical and heavy damping.	 *	*	 A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
8.	**Waves**	Students should be able to:				
8.1	Wave Motion	8.1.1	define progressive waves;	*		
		8.1.2	explain energy transfer through a progressive wave;		*	
		8.1.3	solve word problems using *intensity = power/ area* and *intensity* $\propto$ *(amplitude)*^{2} for a progressive wave;			A
		8.1.4	solve word problems using $V = f\lambda$;			FA
8.2	Transverse and Longitudinal Waves	8.2.1	differentiate between transverse and longitudinal waves;			FA
		8.2.2	analyse graphical representations of transverse and longitudinal waves;			FA
8.3	Superposition of Waves	8.3.1	state the principle of superposition of two waves;	*		
		8.3.2	describe the phenomenon of interference of sound waves;		*	
		8.3.3	calculate the phase difference between two waves;			A
		8.3.4	explain the formation of beats using diagrams;		*	
8.4	Stationary Waves	8.4.1	define the terms nodes and antinodes;	*		
		8.4.2	describe the formation of stationary waves in a string and air column;		*	
		8.4.3	solve word problems related to stationary waves;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
8.5	Doppler's Effect	8.5.1	describe Doppler's effect;		*	
		8.5.2	derive the relation between the original frequency of source of sound and the apparent frequency detected by the listener in following conditions: a. when the source is at rest and the listener is moving towards or away from the source, b. when the listener is at rest and the source is moving towards or away from the listener, c. when both source and listener are moving towards each other, d. when both source and listener are moving away from each other;			A
		8.5.3	solve word problems using the above relations mentioned in the SLO # 8.5.2;			A
		8.5.4	explain the application of Doppler's effect in electromagnetic waves;		*	
		8.5.5	apply Doppler's effect to understand the working of radar, sonar, satellites and red and blue shifts;			A
8.6	Waves in Modern World	8.6.1	use of waves in modern world for: a. medical purposes, b. digital transmission, c. storage of information, d. monitoring earthquake and tsunami.			FA

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
9.	**Physical Optics**	Students should be able to:				
9.1	Nature of Light	9.1.1	discuss different points of view about nature of light;			E
		9.1.2	discuss the concept of wave-front;			E
		9.1.3	describe Huygen's principle;		*	
9.2	Interference of Light	9.2.1	define coherent and monochromatic sources of light;	*		
		9.2.2	define interference of light;	*		
		9.2.3	state conditions necessary for the interference of light;	*		
		9.2.4	explain Young's double slit experiment;		*	
		9.2.5	derive relation for fringe spacing;			A
		9.2.6	solve word problems related to the fringe spacing;			A
9.3	Michelson's Interferometer	9.3.1	describe the construction and working of Michelson's interferometer;		*	
		9.3.2	describe qualitatively about gravitational waves;		*	
		9.3.3	state that a gravitational wave passes a body of mass creates a distortion in spacetime;	*		
		9.3.4	describe the use of interferometers in detecting gravitational waves;		*	
9.4	Diffraction of Light	9.4.1	define diffraction of light;	*		
		9.4.2	describe diffraction of light by diffraction grating;		*	
		9.4.3	describe diffraction in a narrow slit;		*	
		9.4.4	solve word problems related to diffraction of light;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
9.5	Bragg's Law	9.5.1	state Bragg's law;	*		
		9.5.2	describe diffraction of X-rays through crystals;		*	
		9.5.3	derive the equation $2\ d\ sin\ \theta = m\ \lambda$;			A
		9.5.4	solve word problems related to the given equation;			A
9.6	Polarisation	9.6.1	describe unpolarised and polarised light;		*	
		9.6.2	explain polarisation with reference to transverse waves;		*	
		9.6.3	explain polarisation by reflection;		*	
		9.6.4	explain polarisation by a polaroid;		*	
		9.6.5	state Malus's law;	*		
		9.6.6	solve word problems related to the Malus's law;			A
		9.6.7	describe the applications of polarisation in daily life.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
10. Thermodynamics		Students should be able to:				
10.1	Heat and Temperature	10.1.1	distinguish between heat and temperature;		*	
		10.1.2	describe heat as a form of transit energy;		*	
		10.1.3	identify that regions of equal temperature are in thermal equilibrium;		*	
		10.1.4	investigate to provide evidence for the transfer of thermal energy between two bodies at different temperatures in a closed system;			FA
10.2	Fundamentals of the Ideal Gas	10.2.1	state Boyle's law and Charles's law;	*		
		10.2.2	describe that a gas obeying $PV \propto T$ is an ideal gas;		*	
10.3	Kinetic Molecular Theory of Gases	10.3.1	state basic postulates of kinetic molecular theory of gases;	*		
		10.3.2	derive relation $PV = \frac{1}{3} Nm < v^2 >$;			A
		10.3.3	calculate the root-mean-square speed of an ideal gas;			A
		10.3.4	derive the formula for the average translational kinetic energy of a gas;			A
		10.3.5	solve word problems related to given average translational kinetic energy of a gas;			A
10.4	Internal Energy and Work	10.4.1	describe internal energy of an ideal gas as the sum of their kinetic energy of molecules only;		*	
		10.4.2	explain that internal energy is function of 'state' and is independent of paths;		*	
		10.4.3	explain work done in thermodynamics;		*	
		10.4.4	differentiate between the work done by a gas and the work done on a gas;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
10.5	First Law of Thermodynamics	10.5.1	explain the first law of thermodynamics;		*	
		10.5.2	apply the first law of thermodynamics in: a. isothermal, b. adiabatic, c. isobaric, d. isochoric processes;			A
		10.5.3	calculate the following on the basis of the first law of thermodynamics: a. change in internal energy, b. work done, c. change in heat;			A
10.6	Molar Specific Heat of Gases	10.6.1	define the terms: a. specific heat, b. molar specific heat;	*		
		10.6.2	explain $C_p > C_v$;		*	
		10.6.3	show that $C_p - C_v = R$ by using first law of thermodynamics;			A
10.7	Reversible and Irreversible Process	10.7.1	describe the concept of reversible and irreversible processes;		*	
10.8	Second Law of Thermodynamics	10.8.1	explain the second law of thermodynamics using schematic diagram;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
10.9	Carnot Engine	10.9.1	describe heat engine with reference to the second law of thermodynamics;		*	
		10.9.2	explain the working principle of Carnot engine and its four processes with pressure-volume (PV) diagram;		*	
		10.9.3	derive the formula for efficiency of Carnot engine;			A
		10.9.4	solve word problems related to efficiency of Carnot engine;			A
		10.9.5	design an energy efficient device for daily life use;			FA
10.10	Refrigerator	10.10.1	describe refrigerator as a reverse of heat engine;		*	
		10.10.2	derive expression for the coefficient of performance of a refrigerator;			A
10.11	Entropy	10.11.1	explain 'entropy';		*	
		10.11.2	describe positive and negative entropy;		*	
		10.11.3	explain that increase in entropy is the evidence of increase in temperature of a system;		*	
		10.11.4	explain that energy is degraded during all natural processes;		*	
		10.11.5	discuss environmental crisis as an entropy crisis.			E

Part II (Grade XII)

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level[1]		
				R	U	A and beyond
11. Gravitation		Students should be able to:				
11.1	Newton's Law of Gravitation	11.1.1 11.1.2	explain Newton's law of gravitation; solve word problems using Newton's law of gravitation;		*	 A
11.2	Gravitational Field Strength	11.2.1 11.2.2	define gravitational field strength; solve word problems using the relation $g = GM/r^2$;	*		 A
11.3	Gravitational Force and Motion of Satellite	11.3.1 11.3.2 11.3.3	analyse circular orbits in gravitational fields; define geo-stationary satellite; analyse the motion of geo-stationary satellites;	 *		An An
11.4	Variation in value of 'g'	11.4.1 11.4.2	derive the relation for the variation of gravitational field strength with height and depth; analyse that 'g' is approximately constant for small changes in height near the Earth's surface;			A An
11.5	Gravitational Potential	11.5.1 11.5.2	calculate gravitational potential; justify that the concept of gravitational potential leads to the gravitational potential energy of two-point masses.			A E

[1]R = Remember, U = Understand, A = Apply and beyond [Apply (A), Analyse (An), Evaluate (E), Create (C)]

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
12. Electrostatics		Students should be able to:				
12.1	Charge	12.1.1	define charge and its types;	*		
		12.1.2	calculate the total charge on a body as integral multiple of elementary charge (electron);			A
12.2	Coulomb's Law	12.2.1	state Coulomb's law for static charges;	*		
		12.2.2	derive a relation for electrostatic force;			A
		12.2.3	solve word problems related to the electrostatic force;			A
		12.2.4	describe the effect of medium on Coulomb's force;		*	
		12.2.5	explain the concept of electrostatic shielding;		*	
		12.2.6	describe working of faraday cage;		*	
12.3	Electric Field and Electric Field Intensity	12.3.1	describe electric field and electric field intensity around an isolated point charge;		*	
		12.3.2	compare the formation of electric field lines when: a. same charges are brought together, b. opposite charges are brought together;		*	
		12.3.3	derive an expression for the magnitude of electric field intensity of a point charge at a distance;			A
		12.3.4	solve word problems using the relation $E = \frac{kq}{r^2}$;			A
		12.3.5	illustrate electric field intensity as a function of position;			A
12.4	Electric Flux	12.4.1	explain electric flux as a dot product of electric field intensity and area vector;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
12.5	Gauss's Law	12.5.1	explain Gauss's law;		*	
		12.5.2	apply Gauss's law to find the electric field intensity produced between two oppositely charged parallel plates due to: a. a hollow charged spherical surface, b. an infinite sheet of charges;			A
12.6	Electric Potential	12.6.1	describe electric potential at a point as the work done in bringing a unit charge from infinity to that point;		*	
		12.6.2	state unit of electric potential;	*		
		12.6.3	describe electric field as potential gradient;		*	
		12.6.4	derive an expression for electric potential at a point due to a point charge;			A
		12.6.5	illustrate electric potential as a function of position;			A
		12.6.6	define electron volt (eV);	*		
12.7	Capacitor	12.7.1	derive capacitance of a parallel plate capacitor in terms of area, distance and permittivity of free space;			A
		12.7.2	calculate equivalent capacitance of different capacitors connected in series and parallel combinations;			A
		12.7.3	analyse graphs of potential difference, charge and current with reference to time for a capacitor charging and discharging through a resistor;			An
		12.7.4	describe time constant, show that the product of RC has the same unit as time;		*	
		12.7.5	use equations of the form $x = x_0\, e^{-(\frac{t}{RC})}$ where x could represent current, charge or potential difference for a capacitor discharging through resistor;			A

Topics and Sub-Topics		Student Learning Outcomes	Cognitive level		
			R	U	A and beyond
12.8 Energy Stored in a Capacitor	12.8.1	list the use of capacitors in various household appliances;	*		
	12.8.2	explain polarisation of dielectric of a capacitor;		*	
	12.8.3	show that energy stored in a capacitor is $W = ½ QV$ and $W = ½ CV^2$;			A
	12.8.4	determine the electric potential energy stored in a capacitor from the area under the potential-charge graph.			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
13. Electric Current		Students should be able to:				
	13.1 Current Electricity	13.1.1	define electric current;	*		
		13.1.2	describe the flow of current in a conductor;		*	
		13.1.3	solve word problems using the expression $I = Anvq$;			A
	13.2 Resistance and Resistivity	13.2.1	define resistance and resistivity;	*		
		13.2.2	derive a relation between resistance and resistivity;			A
		13.2.3	solve word problems using the relation $R = \frac{\rho l}{A}$;			A
		13.2.4	describe the relationship between temperature and resistance of a conductor;		*	
		13.2.5	state that the resistance of a light-dependent resistor (LDR) decreases as the light intensity increases;	*		
		13.2.6	calculate the value of carbon resistance by using the following colour codes includes: a. 3 band colour code, b. 4 band colour code, c. 5 band colour code, d. 6 band colour code;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
13.3	Electromotive Force (e.m.f.) and Potential Difference	13.3.1	state Ohm's law;	*		
		13.3.2	illustrate the I-V characteristics of a metallic conductor at constant temperature, a semiconductor diode, thermistor and a filament lamp;			A
		13.3.3	define electromotive force (e.m.f.) and internal resistance;	*		
		13.3.4	compare electromotive force with terminal potential difference;		*	
		13.3.5	derive a relation to understand the effects of the internal resistance of a source of e.m.f. on the terminal potential difference;			A
13.4	Electric Power	13.4.1	define electric power;	*		
		13.4.2	derive relations for electric power in terms of current (I), voltage (V) and resistance (R);			A
		13.4.3	calculate the power dissipation due to the internal resistance of a circuit;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
13.5	Kirchoff's Laws	13.5.1	explain Kirchoff's laws;		*	
		13.5.2	explain conservation of charge in a circuit with the help of Kirchoff's first law;		*	
		13.5.3	explain conservation of energy in a circuit with the help of Kirchoff's second law;		*	
		13.5.4	derive a formula for equivalent resistance of two or more resistors using Kirchhoff's law in: a. series, b. parallel;			A
		13.5.5	solve problems using Kirchhoff's laws;			A
13.6	Potential Divider	13.6.1	explain the principle and working of a potential divider circuit;		*	
		13.6.2	explain the use of thermistors and light-dependent resistors in potential dividers;		*	
		13.6.3	describe the potentiometer with the help of a diagram;		*	
13.7	D.C. Circuits	13.7.1	describe the Wheatstone bridge circuit with the help of a diagram;		*	
		13.7.2	calculate the unknown resistance by using a Whetstone bridge;			A
		13.7.3	find (e.m.f.) of cell using null method;			A
		13.7.4	compare the (e.m.f.) of two cells by using a potentiometer.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
14. Electromagnetism		Students should be able to:				
	14.1 Magnetic Field by a Current Carrying Conductor	14.1.1	describe magnetic field due to current in a straight wire and solenoid;		*	
		14.1.2	describe the direction of magnetic field produced by a current carrying conductor;		*	
		14.1.3	describe Biot-Savart's law;		*	
		14.1.4	describe magnetic flux and magnetic flux density;		*	
		14.1.5	solve word problems using $\phi = \vec{B}.\vec{A}$;			A
		14.1.6	explain Ampere's law;		*	
		14.1.7	discuss applications of Ampere's law in: a. solenoid, b. toroid;			E
	14.2 Magnetic Force	14.2.1	explain that force act on a current-carrying conductor placed in a magnetic field with directions as interpreted by Fleming's left-hand rule;		*	
		14.2.2	derive an expression for force, i.e. $F = ILB \sin\theta$;			A
		14.2.3	solve word problems using $F = ILB \sin\theta$;			A
		14.2.4	derive an equation for force on a moving charge in a uniform magnetic field and beam of particles;			A
		14.2.5	solve word problems using an equation for force on a moving charge in a uniform magnetic field and beam of particles;			A
	14.3 Magnetic Torque	14.3.1	derive an expression of torque due to a couple acting on a coil;			A
		14.3.2	solve word problems using an expression of torque due to a couple acting on a coil;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
14.4	Practical Application of Electromagnetism	14.4.1	list the essential steps to convert a galvanometer into voltmeter and ammeter;	*		
		14.4.2	describe Hall effect;		*	
		14.4.3	derive the expression $V_H = BI/(ntq)$;			A
		14.4.4	solve word problems related to $V_H = BI/(ntq)$;			A
		14.4.5	explain that electric and magnetic fields can be used in velocity selection in fields like mass spectrometry, charged particle accelerators and plasma physics.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
15.	**Electromagnetic Induction and Alternating Current**	Students should be able to:				
15.1	Law of Electromagnetic Induction	15.1.1	describe electromagnetic induction;		*	
		15.1.2	explain Faraday's law of electromagnetic induction;		*	
		15.1.3	determine the direction of induced e.m.f. using Lenz's law;			A
		15.1.4	solve word problems using the Faraday's and Lenz's laws of electromagnetic induction;			A
15.2	Seismometer	15.2.1	describe the components and working mechanism of electromagnetic seismometer;		*	
		15.2.2	explain that electromagnetic induction is applied in seismometer to detect earthquakes;		*	
15.3	Inductance	15.3.1	explain self and mutual induction with formulae and units;		*	
		15.3.2	identify inductors as important components of A.C. circuits termed as chokes;		*	
15.4	Alternating Current (A.C.) as Sinusoidal Wave	15.4.1	define sinusoidal waves;	*		
		15.4.2	define alternating current and alternating voltage;	*		
		15.4.3	define the following terms: a. time period, b. frequency, c. peak value, d. peak to peak value;	*		
		15.4.4	calculate a sinusoidal alternating current or voltage using equation $x = x_0 \sin(\omega t)$;			A
		15.4.5	calculate the root mean square (r.m.s.) value of alternate current and alternate voltage;			A
		15.4.6	explain that the mean power in a resistive load is half of the maximum power of a sinusoidal alternating current;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
15.5	A.C. Circuits	15.5.1	explain the flow of A.C. through resistor, capacitor and inductor;		*	
		15.5.2	define reactance of capacitor and inductor;	*		
		15.5.3	explain the factors that affect reactance in A.C. circuits;		*	
		15.5.4	explain 'phase lag' and 'phase lead' in a circuit through graphs/ vector diagram;		*	
		15.5.5	derive the expression of impedance as vector summation of resistance in series (R-C and R-L) circuits;			A
		15.5.6	solve word problems using the expression of impedance;			A
15.6	Semiconductor Devices	15.6.1	describe intrinsic and extrinsic semiconductor materials;		*	
		15.6.2	compare P-type and N-type semiconductor;		*	
		15.6.3	describe formation of p-n junction in diode with labelled diagram;		*	
		15.6.4	describe forward and reverse bias;		*	
15.7	Rectification and Smoothing	15.7.1	define rectification;	*		
		15.7.2	compare Half wave and Full wave rectification;		*	
		15.7.3	explain the use of four diodes (bridge rectifier) for the full wave rectification of an alternating current;		*	
		15.7.4	analyse the effect of a single capacitor in smoothing the output of a rectifier circuit, including the impact of capacitance values and load resistance on ripple voltage and waveform characteristics.			An

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
16. Quantum Mechanics		Students should be able to:				
16.1	Einstein Special Theory of Relativity	16.1.1	distinguish between inertial and non-inertial frames of reference;		*	
		16.1.2	explain postulates of special theory of relativity;		*	
		16.1.3	describe qualitatively and quantitatively the consequences of special theory of relativity;		*	
		16.1.4	describe that if the speed of light (c) becomes constant, then the space and time become relative;		*	
		16.1.5	describe that spacetime is a mathematical model in relativity that treats time as a fourth dimension of the traditional three dimensions of space;		*	
16.2	Quantum Theory	16.2.1	explain Planck's quantum theory of electromagnetic wave;		*	
		16.2.2	discuss the extension of Planck's theory given by Einstein;			E
		16.2.3	solve word problems using the relations: a. $E = pc$, b. $p = \frac{hf}{c}$;			A
16.3	Photoelectric Effect	16.3.1	define the following terms: a. threshold frequency, b. cutoff wavelength, c. work function, d. stopping potential;	*		
		16.3.2	describe photoelectric effect;		*	
		16.3.3	explain different features of photoelectric effect using graphs;		*	
		16.3.4	derive Einstein's photoelectric equation;			A
		16.3.5	solve word problems using photoelectric equation;			A

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
16.4	Compton's Effect	16.4.1	describe Compton's effect;		*	
		16.4.2	solve word problems using $\Delta\lambda = \frac{h}{m_o c}(1-\cos\theta)$;			A
16.5	Wave-Particle Duality	16.5.1	compare wave nature and particle nature of light;		*	
		16.5.2	state de-Broglie's hypothesis;	*		
		16.5.3	explain the wave nature of particles with reference to de-Broglie's hypothesis;		*	
		16.5.4	discuss the results of Davison and Germer experiment;			E
		16.5.5	solve word problems using the relations $\lambda = \frac{h}{mv}$ and $\lambda = \frac{h}{\sqrt{2mVe}}$;			A
		16.5.6	compare the phenomenon of pair production and pair annihilation;		*	
16.6	Atomic Structure and Heisenberg's Uncertainty Principle	16.6.1	describe Bohr's atomic model of hydrogen atom;		*	
		16.6.2	explain hydrogen spectrum in terms of energy levels;		*	
		16.6.3	derive relation for the wavelength of radiation emitted out by an electron using $1/\lambda = R_H\left[\frac{1}{p^2}-\frac{1}{n^2}\right]$;			A
		16.6.4	solve word problems using $1/\lambda = R_H\left[\frac{1}{p^2}-\frac{1}{n^2}\right]$;			A
		16.6.5	explain the formation and significance of emission and absorption line spectra;		*	
		16.6.6	explain Heisenberg's Uncertainty Principle;		*	
		16.6.7	explain that Heisenberg's Uncertainty Principle demonstrates the inaccuracies of Bohr atomic model.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
17. Nuclear Physics		Students should be able to:				
17.1	Structure of Nucleus	17.1.1	describe the composition and structure of the atomic nucleus;		*	
		17.1.2	discuss the forces that hold the nucleus together and the role of mesons in mediating these forces;			E
17.2	Mass Defect and Binding Energy	17.2.1	define the following terms, a. mass defect, b. binding energy;	*		
		17.2.2	identify (graphically) variation of binding energy per nucleon using mass number;		*	
		17.2.3	show simple nuclear reactions by nuclear equations;			A
		17.2.4	calculate mass defect and binding energy;			A
17.3	Radioactivity	17.3.1	define the term 'radioactivity';	*		
		17.3.2	list the properties of α, β and γ radiations;	*		
		17.3.3	describe that nucleon number and charge number are conserved in nuclear processes;		*	
		17.3.4	explain α, β and γ decay with balanced equations;		*	
		17.3.5	state that antineutrinos (electron) are produced during β^- decay and neutrinos (electron) are produced during β^+ decay;	*		
		17.3.6	explain that α-particles have discrete energies but that β-particles have a continuous range of energies because (anti)neutrinos are emitted in β-decay;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
17.4	Radioactive Decay Law	17.4.1	state the law of radioactive decay;	*		
		17.4.2	define activity and decay constant;	*		
		17.4.3	explain that radioactive decay is both spontaneous and random;		*	
		17.4.4	illustrate the exponential nature of radioactive decay;			A
		17.4.5	solve word problems using the relation $A = \lambda N$ and $N = N_0 e^{-\lambda t}$;			A
		17.4.6	define half-life of a radioactive element;	*		
		17.4.7	derive relation for half-life of a radioactive element;			A
		17.4.8	solve word problems using the relation for the half-life of a radioactive element;			A
17.5	Nuclear Reactions	17.5.1	differentiate between nuclear fission and fusion;		*	
		17.5.2	explain the role of neutrons in fission chain reaction;		*	
17.6	Nuclear Reactor	17.6.1	explain the working principle of a nuclear reactor;		*	
		17.6.2	describe the function of the principal components of a water moderated nuclear reactor;		*	
		17.6.3	discuss the significance of nuclear reactions in space.			FA[2]

[2]FA= Formative Assessment, not to be assessed under examination conditions

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				R	U	A and beyond
18. Particle Physics		Students should be able to:				
18.1	Basic Forces of Nature	18.1.1	describe basic forces of nature;		*	
18.2	Fundamental Particles	18.2.1	state the two fundamental building blocks of matter (fermions and bosons);	*		
		18.2.2	state Higgs Boson as a fundamental particle which is responsible for the particle's mass;	*		
		18.2.3	state W-boson, Z-boson, gluon, and photons as fundamental particles called exchange particles or force carriers;	*		
		18.2.4	state that fermions are further divided into leptons and quarks;	*		
		18.2.5	state that electrons and neutrinos are fundamental particles called leptons;	*		
18.3	Quarks and Anti-Quarks	18.3.1	describe quarks and anti-quarks;		*	
		18.3.2	list the six types/ flavours of quarks and anti-quarks;	*		
		18.3.3	state that a hadron may be either a baryon (consisting of three quarks) or a meson (consisting of one quark and an antiquark);	*		
		18.3.4	describe protons and neutrons in terms of their quark composition;		*	
		18.3.5	describe the changes to quark composition that take place during β– and β+ decay;		*	
		18.3.6	construct a block diagram of standard model of particle physics;			C
18.4	Particle Accelerator	18.4.1	explain the working principle of particle accelerators and its uses.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
19. Medical and Space Physics		Students should be able to:				
	19.1 Production and Use of Ultrasound	19.1.1	describe the piezo-electric effect;		*	
		19.1.2	explain the generation and detection of ultrasound by piezo-electric transducer;		*	
		19.1.3	describe the specific acoustic impedance of a medium as $Z = \rho c$, where c is the speed of sound in the medium;		*	
		19.1.4	define coupling medium;	*		
		19.1.5	solve word problems using $\frac{I_r}{I_0} = \frac{(Z_1 - Z_2)^2}{(Z_1 + Z_2)^2}$;			A
		19.1.6	explain the working principle of ultrasound in diagnosing problems in internal structures;		*	
		19.1.7	calculate the attenuation of ultrasound in matter using $I = I_0 e^{-\mu x}$;			A
	19.2 Production and Use of X-rays	19.2.1	describe inner shell transitions;		*	
		19.2.2	explain production of X-rays and their properties;		*	
		19.2.3	explain the use of X-rays in imaging internal body structures;		*	
		19.2.4	explain the working of computed tomography (CT) scans;		*	
	19.3 PET Scanning	19.3.1	discuss the use of medical tracer use in positron emission tomography (PET) scanning;			E
		19.3.2	explain PET scanning including the use of β+ decay tracers, the concept of annihilation in tissue and the production of gamma-ray photons;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
19.4	Luminosity and Inverse Square Law	19.4.1	define the term ‘luminosity’;	*		
		19.4.2	describe inverse square law for radiant flux intensity (F) in terms of the luminosity (L) of the source $F = \frac{L}{4\pi d^2}$;		*	
		19.4.3	describe standard candle;		*	
		19.4.4	calculate the distances of galaxies using the standard candle;			A
19.5	Stellar Radii	19.5.1	explain Wein’s displacement law;		*	
		19.5.2	calculate the surface temperature of a star using Wein’s displacement law;			A
		19.5.3	state Stefan–Boltzmann’s law;	*		
		19.5.4	calculate the radius of a star using relation $L = 4\pi\sigma r^2 T^4$;			A
19.6	Hubble Law	19.6.1	explain the increased wavelength in the emission and absorption spectra lines from distant objects;		*	
		19.6.2	explain redshift leads to the idea that the Universe is expanding;		*	
		19.6.3	explain Hubble’s law and its relation to the Big Bang theory.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive level		
				R	U	A and beyond
20. Nature of Science		Students should be able to:				
	20.1 Debates about Aesthetic in Physics	20.1.1	discuss inherent mathematical beauty in the natural world by means of: a. elegance of simplicity, b. symmetry;			E
		20.1.2	explain counterargument with examples to the claim that physical truths must inherent mathematical elegance or display;		*	
		20.1.3	discuss the pros and cons in the debate over whether humans should research: a. on the existence of aliens/ extraterrestrial life, b. research into subatomic particles should continue, given the existence of nuclear weapons;			E
	20.2 Thought Experiments	20.2.1	explain the thought experiments along with examples;		*	
		20.2.2	explain that thought experiments have conveyed key concepts that would have been difficult to investigate through empirical methods, e.g. Newton's cannonball.		*	

Practical Activities of AKU-EB HSSC Physics Syllabus

Topics

Content Covered	Actions Performed	Attitude Developed
• Mechanics • Waves Motion • Modern Physics • Thermodynamics • Solid State Physics • Electricity and Magnetism	• Follow the safety precautions provided in the Lab guidelines. • Collect the required apparatus for the experiments. • Handle the apparatus/ equipment appropriately. • Perform the experiments with the help of given method/ steps. • Modify the steps to perform a similar experiment in the real-life settings. • Take readings with precision.	• Ensure safety of yourself, others around you and your surroundings. • Demonstrate a scientific mindset by asking questions and planning further investigations. • Display ethical dealings and practices while performing experiments. • Show willingness to solve problems and challenges. • Show self-reliance and cooperation when working independently and in a group setting respectively. • Revise judgements and change behaviour considering new evidence.

Topic Wise Practical Activities

Part I (Grade XI)

S. No.	Topic-Wise Practical Activities	Apparatus
	Topic 1: Physical Quantities and Measurement	
1	Determine the capacity and thickness of a test tube by using Vernier callipers.	Vernier callipers, test tube.
2	Measure the diameter of few ball bearings of different sizes using screw gauge and estimate their volumes.	Screw gauges, steel ball bearings.
3	Determine the radius of curvature of any spherical surface by using a spherometer.	Spherometer, convex or concave lens/ mirror.
	Topic 2: Scalars and Vectors	
4	Determine the weight of a body by vector addition of forces. (Parallelogram Method)	Gravesend's apparatus, slotted weights, thread nos., plane mirror strip.
	Topic 3: Motion in One Dimension	
5	Measure the free fall time of a ball using a ticker-timer and hence, calculate the value of 'g'.	Ticker-tape vibrator, roll of ticker-tape, steel ball, transformer, sellotape.
6	Investigate the value of acceleration due to gravity 'g' by free fall method using electronic timer.	Free fall apparatus, steel ball, electronic timer with power supply, plumb line, meter rod.
	Topic 7: Oscillations	
7	Verify that the time period of the simple pendulum is directly proportional to the square root of its length and hence, find the value of acceleration due to gravity 'g' from the graph.	Simple pendulum, stopwatch, stand with clamp, thread, cork, Vernier callipers.

S. No.	Topic-Wise Practical Activities	Apparatus
	Topic 8: Waves	
8	Determine the frequency of AC by Melde's apparatus/ electric sonometer.	AC vibrator, step-down transformer (6V), connecting wires, thread, pulley, scale plan.
9	Investigate the laws of vibration of stretched strings by sonometer or electromagnetic method. (Use copper wire instead of iron wire)	Sonometer, tuning forks of different frequencies, hanger, ½ kg weights, wires of different diameter, physical/ digital/ spring balance, weight box, meter rod.
10	Determine the wavelength of sound in air using stationary waves and calculate the speed of sound using resonance tube.	Resonance apparatus, different tuning forks of known frequencies, thermometer, Vernier callipers, rubber pad, two set squares, beaker.
	Topic 10: Thermodynamics	
11	Determine the specific heat capacity of solid using method of mixture (Regnaults Method).	Regnaults apparatus for specific heat, thermometer, solid ball, calorimeter.
12	Determine the specific heat capacity of water by electrical method.	Electrical calorimeter, 1/5^{o}C thermometer, battery, rheostat, key, ammeter, voltmeter, connecting wires, stopwatch, physical/ digital/ spring balance, weight box.

Part II (Grade XII)

S. No.	Topic-Wise Practical Activities	Apparatus
	Topic 12: Electrostatics	
1	Determine the relation between current and capacitance when different capacitors are used in AC circuit using different series and parallel combinations of capacitors.	AC milliammeter, AC voltmeter, capacitors of different capacitances, step-down transformer, sand paper, connecting wires.
2	Determine time constant by charging and discharging a capacitor through a resistor.	Galvanometer, power supply, large value capacitor, key, stopwatch.
	Topic 13: Electric Current	
3	Investigate the relationship between current passing through a tungsten filament lamp and the potential applied across it.	36 W, 12 V car bulb, bulb holder, 12 V battery, high resistance rheostat, voltmeter, ammeter, key, sandpaper, connecting wires.
4	Determine resistance of voltmeter by drawing graph between (R) and (I/V).	Voltmeter, resistance box, two keys, sandpaper, connecting wires, graph paper.
5	Determine resistance of wire by slide wire bridge.	Slide wire bridge, resistance box, unknown resistance, galvanometer, rheostat, cell, tapping key, connecting wires, sandpaper.
6	Determine internal resistance of a cell using potentiometer.	Potentiometer, battery, ammeter, resistance box, rheostat, two keys, galvanometer, cell, shunt wire, sandpaper, connecting wires.
7	Determine electromotive force (e.m.f.) of a cell using potentiometer.	Potentiometer, battery, two-way key, rheostat, ammeter, key, shunt, wire, galvanometer, sandpaper, connecting wires.
	Topic 14: Electromagnetism	
8	Variation of magnetic field due to current flowing in a solenoid.	Circular coil of insulated copper fitted in a board, white paper plain sheet (A-4 size), scissors, compass needle, battery, ammeter, key plug, rheostat, connecting wires.
9	Convert galvanometer into voltmeter of range 0.3 V.	Galvanometer, voltmeter (0-3 V), battery, two resistance box, one-way key, rheostat, connecting wires and sand paper.

S. No.	Topic-Wise Practical Activities	Apparatus
	Topic 15: Electromagnetic Induction and Alternating Current	
10	Study the relationship between current and capacitive reactance in an A.C. circuit and calculate capacitive reactance.	AC milliammeter, AC voltmeter, capacitors of different, capacitances, step-down transformer, sandpaper, connecting wires.
11	Draw characteristics of semiconductor diode and calculate forward and reverse current resistances.	Semi-conductor diode, voltmeter, milliammeter, micro-ammeter, 500 Ω rheostat, 1 kΩ resistor, 3 V battery, sandpaper, connecting wires.
	Topic 16: Quantum Mechanics	
12	Study of the variation of electric current with intensity of light using a photocell.	Photocell, galvanometer, battery, rheostat, key, electric bulb with case, connecting wires.

Scheme of Assessment

Grade XI

Table 1: Exam Specifications

Topic No.	Topics	Marks Distribution			Total Marks
		MCQs	CRQs	ERQs	
1.	Physical Quantities and Measurement	2	Total 2 Marks (1 CRQ)		4
2.	Scalars and Vectors	2	Total 2 Marks (1 CRQ)		4
3.	Motion in One Dimension	6	Total 2 Marks (1 CRQ)	5 Marks Choose any ONE from TWO	13
4.	Motion in two Dimensions	7	Total 3 Marks (1 CRQ)		15
5.	Deformation in Solids	1	Total 2 Marks (1 CRQ)		3
6.	Fluids Dynamics	4	Total 2 Marks (1 CRQ)		6
7.	Oscillations	7	Total 3 Marks (1 CRQ)		10
8.	Waves	7	Total 3 Marks (1 CRQ)	5 Marks Choose any ONE from TWO	15
9.	Physical Optics	7	Total 3 Marks (1 CRQ)		15
10.	Thermodynamics	7	Total 3 Marks (1 CRQ)		10
	Total	**50**	**25**	**10**	**85**
	Practical*				**15**
	Total				**100**

Note: The cognitive distribution of marks for Physics HSSC are as follows
Remember: 0 to 15%
Understand: 45 to 60%
Apply and beyond: 25 to 40%

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Grade XII

Table 2: Exam Specifications

Topic No.	Topics	Marks Distribution			Total Marks
		MCQs	CRQs	ERQs	
11.	Gravitation	2	Total 3 Marks (1 CRQ)		5
12.	Electrostatics	8	Total 3 Marks (1 CRQ)	5 Marks Choose any ONE from TWO	16
13.	Electric Current	8	Total 3 Marks (1 CRQ)		16
14.	Electromagnetism	4	Total 4 Marks (1 CRQ)		8
15.	Electromagnetic Induction and Alternating Current	7	Total 2 Marks (1 CRQ)	5 Marks Choose any ONE from TWO	14
16.	Quantum Mechanics	7	Total 2 Marks (1 CRQ)		14
17.	Nuclear Physics	3	Total 3 Marks (1 CRQ)		6
18.	Particle Physics	2	Total 2 Marks (1 CRQ)		4
19.	Medical and Space Physics	7	Total 3 Marks (1 CRQ)		10
20.	Nature of Science	2			2
	Total	**50**	**25**	**10**	**85**
	Practical*				**15**
	Total				**100**

Note: The cognitive distribution of marks for Physics HSSC are as follows
Remember: 0 to 15%
Understand: 45 to 60%
Apply and beyond: 25 to 40%

Examination Structure and Practical Requirements for Grades XI and XII

Theory:

- Multiple Choice Question (MCQ) requires candidates to choose one best/ correct answer from four options for each question. Each MCQ carries ONE mark.
- Constructed Response Question (CRQ) requires students to respond with a short text (few phrases/ sentences), calculations or diagrams.
- Extended Response Question (ERQ) requires students to answer in a more descriptive form. The answer should be in paragraph form, with diagrams where needed, and address all parts of the question.
- Table 1 and 2 contains the mark distribution for each topic.
- There will be two examinations, one at the end of grade XI and one at the end of grade XII.
- In each grade, the theory paper will be of 3 hours and will consist of two parts: paper I and paper II.
- Paper I theory will consist of 50 compulsory, multiple choice items. These questions will involve four responses options. The answer sheet for paper I will be provided separately.
- Paper II theory will carry 35 marks and consist of Constructed Response Questions (CRQs) and Extended Response Questions (ERQs). Each extended response question will be presented in an either/ or form.
- The booklet for paper II will serve as an answer script.

Practical:

- In each grade, practical examination (Paper III) will be conducted separate from the theory paper and will consist of 15 marks.
- Practical examination (Paper III) will be based on the list of practical activities given in the examination syllabus. Schools may design their own practical manuals based on these activities for teaching and learning purpose.
- Practical journal/ portfolio should be developed by students and endorsed by a figure of authority, such as a teacher or principal, and submitted at the time of the practical examination (Paper III).
- It is essential for each school to equip its laboratories with chemicals, instruments, apparatus, specimens etc. according to the requirements of the practical activities. Each school will be responsible to make sure that each student is provided the opportunity to do the practical activities.

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