آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

Higher Secondary School Certificate Examination Syllabus

PHYSICS

CLASSES XI-XII

(based on National Curriculum 2006)

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Higher Secondary School Certificate Examination Syllabus

PHYSICS

CLASSES XI-XII

This subject is examined in both May and September Examination sessions

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PREFACE

In pursuance of National Education Policy (1998-2010), the Curriculum Wing of the Federal Ministry of Education has begun a process of curriculum reform to improve the quality of education through curriculum revision and textbook development (Preface, National Curriculum documents 2000 and 2002).

AKU-EB was founded in August 2003 with the same aim of improving the quality of education nationwide. As befits an examination board it seeks to reinforce the National Curriculum revision through the development of appropriate examinations for the Secondary School Certificate (SSC) and Higher Secondary School Certificate (HSSC) based on the latest National Curriculum and subject syllabus guidance.

AKU-EB has a mandate by Ordinance CXIV of 2002 to offer such examination services to English and Urdu medium candidates for SSC and HSSC from private schools anywhere in Pakistan or abroad, and from government schools with the relevant permissions. It has been accorded this mandate to introduce a choice of examination and associated educational approach for schools, thus fulfilling a key objective of the National Curriculum of Pakistan: "Autonomy will be given to the Examination Boards and Research and Development cells will be established in each Board to improve the system" (ibid. para. 6.5.3 (ii)).

AKU-EB is committed to creating continuity of educational experience and the best possible opportunities for its students. In consequence it offered HSSC for the first time in September, 2007 to coincide with the arrival of its first SSC students in college or higher secondary school. Needless to say this is not an exclusive offer. Private candidates and students joining AKU-EB affiliated schools and colleges for HSSC Part 1 are eligible to register as AKU-EB candidates even though they have not hitherto been associated with AKU-EB.

This examination syllabus exemplifies AKU-EB's commitment to national educational goals.

- It is in large part a reproduction, with some elaboration, of the Class XI and XII National Curriculum of the subject.

- It makes the National Curriculum freely available to the general public.

- The syllabus recommends a range of suitable textbooks already in print for student purchase and additional texts for the school library.

- It identifies areas where teachers should work together to generate classroom activities and materials for their students as a step towards the introduction of multiple textbooks, another of the Ministry of Education's policy provisions for the improvement of higher secondary education (ibid. para. 6.3.4).

This examination syllabus brings together all those cognitive outcomes of the National Curriculum statement which can be reliably and validly assessed. While the focus is on the cognitive domain, particular emphasis is given to the application of knowledge and understanding, a fundamental activity in fostering "attitudes befitting useful and peaceful citizens and the skills for and commitment to lifelong learning which is the cornerstone of national economic development" (Preface to National Curriculum documents 2000 and 2002).

To achieve this end AKU-EB has brought together university academicians, teacher trainers, writers of learning materials and above all, experienced teachers, in regular workshops and subject panel meetings.

AKU-EB provides copies of the examination syllabus to subject teachers in affiliated schools to help them in planning their teaching. It is the syllabus, not the prescribed textbook which is the basis of AKU-EB examinations. In addition, the AKU-EB examination syllabus can be used to identify the training needs of subject teachers and to develop learning support materials for students. Involving classroom teachers in these activities is an important part of the AKU-EB strategy for improving the quality of learning in schools.

The Curriculum Wing of the Federal Ministry of Education has recently released new subject specifications and schemes of study to take effect in September, 2008. These documents are a major step forward towards a standards-related curriculum and have been welcomed by AKU-EB. Our current HSSC syllabuses have been revised to ensure conformity with the new National Curriculum 2006.

We stand committed to all students who have embarked upon the HSSC courses in facilitating their learning outcomes. Our examination syllabus document ensures all possible support.

Dr. Thomas Christie
Director,
Aga Khan University Examination Board
July 2009

1. Aims/Objectives of the National Curriculum (2006)[1]

Aims

The aims of physics at higher secondary level are to enable students to:

- Develop among the students the habit of scientific and rational thinking and an attitude to search for order and symmetry in diverse phenomena of nature and thereby to appreciate the supreme wisdom and creative powers of the creator.

- Become life-long learner, effective problem solver, responsible and productive citizens in a technological world.

- Strengthen the concepts developed at the secondary level to lay firm foundation for further learning of physics at the tertiary level, in engineering or in other physics dependent and vocational courses.

- Develop process skills and experimental observational, manipulative, decision making and investigatory skills in the students.

- Understand and interpret scientific information presented in verbal, mathematical or graphical form and to translate such information from one from to another.

- Understand and appreciate the inter-relationship and balance that exists in nature, the problems associated with the over exploitation of the environmental resources and disturbance because of the human activities in the ecological balance, thus taking care of the environment.

2. Rationale of the AKU-EB Examination Syllabus

2.1 General Rationale

2.1.1 In 2007, the Curriculum Wing of the Federal Ministry of Education (MoE) issued a revised part-wise Scheme of Studies. All subjects are to be taught and examined in both classes XI and XII. It is therefore important for teachers, students, parents and other stakeholders to know:

(a) that the AKU-EB Scheme of Studies for its HSSC examination (Annex A) derives directly from the 2007 Ministry of Education Scheme of Studies;
(b) which topics will be examined in Class XI and in Class XII;
(c) at which cognitive level or levels (Knowledge, Understanding, Application and other higher order skills) the topics and sub-topics will be taught and examined;

[1] Government of Pakistan (2006), *National Curriculum; Physics Classes XI-XII, Islamabad,* Ministry of Education (Curriculum Wing)

2.1.2 This AKU-EB examination syllabus addresses these concerns. Without such guidance teachers and students have little option other than following a single textbook to prepare for an external examination. The result is a culture of rote memorization as the preferred method of examination preparation. The pedagogically desirable objectives of the National Curriculum which encourage "observation, creativity and other higher order thinking [skills]" are generally ignored. AKU-EB recommends that teachers and students use multiple teaching-learning resources for achieving the specific objectives of the National Curriculum reproduced in the AKU-EB examination syllabuses.

2.1.3 The AKU-EB examination syllabuses use a uniform layout for all subjects to make them easier for teachers to follow. Blank sheets are provided in each syllabus for writing notes on potential lesson plans. It is expected that this arrangement will also be found helpful by teachers in developing classroom assessments as well as by question setters preparing material for the AKU-EB external examinations. The AKU-EB aims to enhance the quality of education through improved classroom practices and improved examinations.

2.1.4 The Student Learning Outcomes (SLOs) in Section 3 start with command words such as list, describe, relate, explain, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that candidates following the AKU-EB examination syllabuses are expected to undertake in the course of their subject studies. The examination questions will be framed using the same command words or the connotation of the command words to elicit evidence of these competencies in candidates' responses. The definitions of command words used in this syllabus are given in Section 7. It is hoped that teachers will find these definitions useful in planning their lessons and classroom assessments.

2.1.5 The AKU-EB has classified SLOs under the three cognitive levels, Knowledge (K), Understanding (U) and Application of knowledge and skills (A) in order to derive multiple choice questions and constructed response questions on a rational basis from the subject syllabuses ensuring that the intentions of the National Curriculum should be met in full. The weighting of marks to the Multiple Choice and Constructed Response Papers is also derived from the SLOs, command words and cognitive levels. In effect the SLOs derived from the National Curriculum determine the structure of the AKU-EB subject examination set out in Section 4 and 5.

2.2 Specific Rationale of the AKU-EB Physics Examination Syllabus

2.2.1 The National Education Policy (1998-2010) outlines the following objectives for higher secondary education:

a. To prepare the students well for the pursuit of professional and specialized education;

b. To make available such teaching and learning materials that will make learning rewarding and attractive.

c. To introduce a system of evaluation that emphasizes learning of concepts and discourages rote memorization.

2.2.2 In line with National Education Policy, the AKU-Examination Board syllabuses in science subject focus on the following:

a. Broadening student's conceptual understanding through opportunities for enhancing their scientific skills, inquiry and experimentation.

b. Allocating marks for each cognitive level of learning such as knowledge, understanding and application. The importance of content has been clearly elaborated as student learning outcomes.

c. Reducing overloading and repetition. There is a need to look at the syllabus critically with due consideration to the fundamental concepts of secondary level science.

3. Topics and Student Learning Outcomes of the Examination Syllabus

Part – I (Class XI)

Topics		Student Learning Outcomes		Cognitive levels[2]		
				K	U	A
1. Measurement		**Candidates should be able to:**				
1.1	Scope of Physics	1.1.1	describe the importance of physics in science, technology and society;		*	
1.2	S.I. Units	1.2.1 1.2.2	describe S.I base units, derived units and supplementary units for various measurements; show the derived units as products or quotients of the base units;		* *	
1.3	Errors and Uncertainty	1.3.1 1.3.2	differentiate between systematic and random errors; measure the uncertainty in the derived quantity;		*	 *
1.4	Precision and Accuracy	1.4.1	state differences between precision and accuracy;	*		
1.5	Significant Figures	1.5.1 1.5.2	calculate answers with correct scientific notations, number of significant figures in all numericals; show that the least count (L.C) of an instrument is the smallest increment measurable by it;		 *	*
1.6	Dimensions	1.6.1 1.6.2	measure the homogeneity of physical equations by using dimension and basic units; derive formula for physical quantities by using dimensions.		 *	*

[2] K = Knowledge, U = Understanding, A= Application (for explanation see Section 7: Definition of command words used in Student Learning Outcomes and in Examination Questions).

NOTES

				K	U	A
2.	**Vectors and Equilibrium**	**Candidates should be able to:**				
2.1	Cartesian Coordinate System	2.1.1	describe the Cartesian coordinate system in two and three dimension systems;		*	
2.2	Addition of Vectors by Head to Tail Rule	2.2.1	explain the sum of vectors using head to tail rule;		*	
		2.2.2	define resultant, negative, unit, null, position and equal vectors;	*		
		2.2.3	solve a vector into its rectangular components;			*
2.3	Addition of Vectors by Rectangular Component Method	2.3.1	determine the sum of vectors using perpendicular components;		*	
2.4	Scalar Product of Two Vectors	2.4.1	define scalar product of two vectors;	*		
		2.4.2	describe the scalar product of two vectors in terms of angle between them;		*	
		2.4.3	discuss properties of scalar product of two vectors;		*	
2.5	Vector Product of Two Vectors	2.5.1	define vector product of two vectors;	*		
		2.5.2	describe vector product of two vectors in terms of angle between them;		*	
		2.5.3	discuss properties of vector product;		*	
2.6	Torque	2.6.1	describe torque as a vector product of $\vec{\mathbf{r}} \times \vec{\mathbf{F}}$;		*	
		2.6.2	list applications of torque;	*		

NOTES

			K	U	A
2.7 Equilibrium of Forces	2.7.1	define equilibrium and its types;	*		
	2.7.2	describe first and second conditions of equilibrium with the help of examples from daily life.		*	
3. Motion and Force	**Candidates should be able to:**				
3.1 Displacement	3.1.1	define displacement with illustrations;	*		
3.2 Velocity	3.2.1	define velocity, average velocity and instantaneous velocity with illustrations;	*		
	3.2.2	define acceleration, average acceleration and instantaneous acceleration;	*		
	3.2.3	interpret velocity-time graph for constant direction and understand significance of area under velocity-time graph;			*
3.3 Acceleration	3.3.1	summarize the equations of motion for uniformly accelerated bodies in a straight line and in uniform gravitational field in a non-resistive medium;		*	
3.4 Laws of Motion	3.4.1	state Newton's laws of motion;	*		
3.5 Force, Momentum and Impulse	3.5.1	describe the relation between Newton's 2nd law of motion and the rate of change of momentum;		*	
	3.5.2	infer impulse as product of impulsive force and time;			*
	3.5.3	describe law of conservation of momentum;		*	
	3.5.4	apply law of conservation of momentum and study the special cases of elastic collision between two bodies in one dimension;			*
	3.5.5	describe the force produced due to flow of water;		*	
	3.5.6	apply the law of conservation of momentum to study explosive forces;			*
	3.5.7	explain forces applied on the process of rocket propulsion;		*	

NOTES

				K	U	A
3.6 Projectile		3.6.1	define projectile, projectile motion and trajectory of projectile;	*		
		3.6.2	describe projectile motion in non-resistive medium;		*	
		3.6.3	derive the relation for time of flight, maximum height and horizontal range of a projectile and use these relations in solving numericals;			*
		3.6.4	relate the motion of ballistic missiles with projectile motion.		*	
4. Work, Power and Energy		**Candidates should be able to:**				
4.1 Work		4.1.1	define work;	*		
		4.1.2	describe work when force and displacement are acting at an angle (θ);		*	
		4.1.3	list different units of work;	*		
		4.1.4	distinguish between positive, negative and zero work with examples;		*	
		4.1.5	describe work done by variable and constant forces;		*	
4.2 Work Done in a Gravitational Field		4.2.1	explain the work done in a gravitational field;		*	
4.3 Power		4.3.1	define power and give its dimension;	*		
		4.3.2	list different units of power;	*		
		4.3.3	derive the formula of power in terms of force and velocity and use it in solving numericals;			*
4.4 Energy		4.4.1	define energy;	*		
		4.4.2	differentiate between potential and kinetic energy;		*	
		4.4.3	list units of energy;	*		

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				K	U	A
4.5	Work-Energy Relation	4.5.1	deduce how energy is related with work (i) when friction is present (ii) when friction is not present;			*
4.6	Absolute Gravitational Energy	4.6.1 4.6.2	analyse the absolute gravitational energy; derive an expression for absolute P.E;		 *	*
4.7	Escape Velocity	4.7.1 4.7.2 4.7.3	describe the concept of escape velocity; derive the formula for escape velocity; calculate escape velocity for the moon and the earth when mass and radius of the bodies are given and use this formula for solving numerical;		* *	 *
4.8	Conservation of Energy	4.8.1 4.8.2	explain the law of conservation of energy; demonstrate potential energy and kinetic energy in a resistive medium;		* *	
4.9	Types of Energy Sources	4.9.1 4.9.2	list the conventional and non-conventional energies; describe the uses of energy.	*	 *	
5.	**Circular Motion**	**Candidates should be able to:**				
5.1	Angular Motion	5.1.1	define angular displacement, angular velocity and angular acceleration;	*		
		5.1.2	investigate the relation between linear and angular displacement, velocity and acceleration;		*	
5.2	Centripetal Force and Centripetal Acceleration	5.2.1 5.2.2 5.2.3	define centripetal force and centripetal acceleration; derive centripetal acceleration when velocity is uniform; relate centripetal acceleration with the angular velocity;	*	 * *	
5.3	Moment of Inertia	5.3.1	define moment of inertia and its formula;	*		

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				K	U	A
5.4	Angular Momentum	5.4.1 5.4.2	define angular momentum and state its S.I. unit with dimension; explain the law of conservation of angular momentum;	*	 *	
5.5	Rotational Kinetic Energy	5.5.1 5.5.2	define rotational kinetic energy; derive an expression for rotational kinetic energy and use this expression for solving numericals;	*		 *
5.6	Artificial Satellites and Weightlessness	5.6.1 5.6.2 5.6.3 5.6.4 5.6.5	define weightlessness in artificial satellites; classify different types of satellites; define geostationary orbits; derive expression for geostationary orbits altitudes; explain how artificial gravity can be produced when a satellite revolves around the earth;	* *	 * * *	
5.7	Orbital Velocity	5.7.1 5.7.2	define orbital velocity; derive a relation for orbital velocity and use this relation for solving numericals;	*		 *
6.	**Fluid Dynamics**	**Candidates should be able to:**				
6.1	Streamline and Turbulent Flow	6.1.1	define streamline and turbulent flow and state the conditions for turbulent flow;	*		
6.2	Equation of Continuity	6.2.1 6.2.2 6.2.3	derive the equation of continuity; describe the motion of a rocket on the basis of the equation of continuity; solve problems by using this equation;		* *	 *

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				K	U	A
6.3	Bernoulli's Equation	6.3.1 6.3.2 6.3.3	derive Bernoulli's equation; interpret and apply Bernoulli effect in the flow of air over an aerofoil, venturi meter and atomizers; solve problems by the help of Bernoulli's equation;		* 	 * *
6.4	Viscous Fluids	6.4.1 6.4.2	define viscous and non-viscous fluids; describe that viscous force in a fluid causes a retarding force on an object moving through it;	* 	 *	
6.5	Fluid Friction	6.5.1 6.5.2 6.5.3	define fluid friction; apply dimensional analysis to confirm the form of the Stoke's law; apply Stoke's law to derive an expression for terminal velocity of spherical body falling through viscous fluids;	* 	 	 * *
6.6	Terminal Velocity	6.6.1 6.6.2	define terminal velocity; describe the factors on which it depends.	* 	 *	
7.	**Oscillations**	**Candidates should be able to:**				
7.1	Simple Harmonic Motion (SHM)	7.1.1 7.1.2 7.1.3 7.1.4	define the terms, oscillatory motion, periodic motion, time period, frequency and amplitude; state Hook's law; derive Hook's law; derive an expression for acceleration of a body vibrating under elastic restoring force;	* * 	 * *	
7.2	Uniform Circular Motion and SHM	7.2.1 7.2.2	discuss SHM on the basis of uniform circular motion; derive expression for displacement, instantaneous velocity and acceleration in terms of (ω);		* *	

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				K	U	A
7.3	Phase	7.3.1 7.3.2	define phase angle; derive an expression for the displacement "x";	* 	 *	
7.4	A Horizontal Mass-Spring System	7.4.1	derive an expression for instantaneous velocity in case of horizontal mass-spring system;		*	
7.5	Simple Pendulum	7.5.1 7.5.2	show that the motion of a simple pendulum is SHM; derive an expression for the time period of simple pendulum and use this expression for solving numericals;		*	 *
7.6	Energy Conservation in SHM	7.6.1	relate between P.E, K.E and total energy for a body oscillating with SHM;		*	
7.7	Free and Forced Oscillation	7.7.1	explain free and forced oscillation with examples;		*	
7.8	Resonance	7.8.1	explain the phenomenon of resonance with examples;		*	
7.9	Damped Oscillations	7.9.1	define damped oscillation and list down its different applications.	*		
8. Waves		**Candidates should be able to:**				
8.1	Wave Motion	8.1.1 8.1.2 8.1.3 8.1.4 8.1.5 8.1.6 8.1.7	define wave motion with the help of examples; define periodic waves; describe the propagation of waves with an example; define progressive waves; explain how energy is transferred through a progressive wave; differentiate between transverse and longitudinal waves; derive the relation $V = \upsilon \lambda$ and use it in solving numericals;	* * * 	 * * * 	 *

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				K	U	A
8.2	Speed of Sound	8.2.1	show that the speed of sound depends on the properties of medium in which it propagates;		*	
		8.2.2	describe Newton's formula for speed of sound;		*	
		8.2.3	discuss Laplace's correction in Newton's formula;		*	
		8.2.4	demonstrate the effects of pressure, density and temperature on the speed of sound in air;		*	
		8.2.5	show the expression $V = V_o + 0.61\ t$;		*	
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	classify the formation of beats giving an illustration;		*	
8.4	Stationary Waves	8.4.1	define stationary waves;	*		
		8.4.2	describe the formation stationary waves using graphical approach;		*	
		8.4.3	define the terms nodes and antinodes;	*		
		8.4.4	classify with illustration the formation of stationary waves in a string;		*	
		8.4.5	recognize the formation of stationary waves in a vibrating air column;	*		
		8.4.6	describe modes of vibration in a string and explain them by using $L = n\ \lambda / 2$;		*	
8.5	Doppler's Effect	8.5.1	define 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 four different conditions and use these relations for solving numericals;			*
		8.5.3	explain the application of Doppler's effect in electromagnetic waves;		*	

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			K	U	A
	8.5.4	apply Doppler's effect to understand the working of radar, sonar and satellites.			*
9. Physical Optics	**Candidates should be able to:**				
9.1 Nature of Light	9.1.1 9.1.2 9.1.3	discuss different points of view about nature of light; discuss the concept of wave-front; describe Hygen's principle and use it to explain linear superposition of light;		* * *	
9.2 Interference of Light	9.2.1 9.2.2 9.2.3	define interference of light and state conditions necessary for it; explain Young's double slit experiment; derive relation for fringe spacing and use the relation in solving numericals;	*	 *	 *
9.3 Interference in Thin Films	9.3.1	state basic concept of interference in thin films;	*		
9.4 Newton's Ring	9.4.1	explain the phenomenon of formation of Newton's rings with examples;		*	
9.5 Michelson's Interferometer	9.5.1	describe the working and use of Michelson's interferometer;		*	
9.6 Diffraction of Light	9.6.1 9.6.2 9.6.3 9.6.4	define diffraction of light; describe diffraction of light by diffraction gratting; describe diffraction in a narrow slit; describe X-rays diffraction through crystals;	*	 * * *	
9.7 Bragg's Law	9.7.1 9.7.2	define Bragg's law; derive the equation 2 d sin θ = m λ and use this equation for solving numericals;	*		*

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				K	U	A
9.8	Polarization	9.8.1 9.8.2 9.8.3 9.8.4	define polarization; evaluate polarization as a phenomenon associated with transverse waves; express that polarization is a product by a polaroid; identify uses of polarization.	* *	 * 	 *
10.	**Thermodynamics**	**Candidates should be able to:**				
10.1	Kinetic Theory of Gases	10.1.1 10.1.2 10.1.3	state basic postulates of kinetic theory of gases; calculate pressure on a gas molecule inside a gas container; interpret temperature in terms of kinetic energy;	*	 	 * *
10.2	Gas Laws	10.2.1	derive Boyle's and Charle's law with the help of kinetic theory;		*	
10.3	Internal Energy	10.3.1	explain that internal energy is function of 'state' and is independent of paths;		*	
10.4	Work and Heat	10.4.1 10.4.2 10.4.3	describe that heat flow and work are two forms of energy transfer between systems; calculate the heat being transferred; express work in terms of change in volume;		* * 	 *
10.5	Thermodynamics	10.5.1 10.5.2 10.5.3 10.5.4	define thermodynamics and thermal equilibrium; explain the 1st law of thermodynamics; apply the 1st law of thermodynamics in (i) isothermal, (ii) adiabatic, (iii) isobaric, (iv) isochoric; calculate the 1st law of thermodynamics in terms of change in internal energy, work done on the system and work done by the system;	*	 * 	 * *

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			K	U	A
	10.5.5	explain the 1st law of thermodynamics in terms of conservation of energy;		*	
10.6 Specific and Molar Specific Heat of Gases	10.6.1 10.6.2	define the terms specific heat and molar specific heat; show that $C_p - C_v = R$ and also explain $C_p > C_v$ by using 1st law of thermodynamics;	*	 *	
10.7 Reversible and Irreversible Process	10.7.1	define reversible and irreversible process;	*		
10.8 Second Law of Thermodynamics	10.8.1	explain the 2nd law of thermodynamics with the help of schematic diagram;		*	
10.9 Carnot Engine	10.9.1 10.9.2 10.9.3	define heat engine in terms of the 2nd law of thermodynamics; explain the working principle of Carnot engine with its four processes with PV diagram; derive the formula for efficiency of Carnot engine and use it in solving numericals;	*	 *	 *
10.10 Refrigerator	10.10.1 10.10.2	describe refrigerator as it is a reverse of heat engine; derive expression for its efficiency;		*	 *
10.11 Entropy	10.11.1 10.11.2 10.11.3 10.11.4	explain the term entropy; describe positive and negative entropy; explain that increase in entropy is an evidence of increase in temperature of a system; outline environmental crisis as an entropy crisis.	 *	* * *	

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Part-II (Class XII)

Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
11. Electrostatics		**Candidates should be able to:**				
11.1	Electrostatics	11.1.1	define charge and types of charge;	*		
11.2	Coulomb's Law	11.2.1	explain Coulomb's law for static charges;		*	
		11.2.2	describe the effect of medium on Coulomb's force;		*	
		11.2.3	apply the principle of electrostatic phenomenon on ink-jet printer and photocopier;			*
11.3	Electric Field and Electric Intensity	11.3.1	define electric intensity;	*		
		11.3.2	derive an expression for the magnitude of electric field of a distance or from a point charge "q" and use the expression in solving numericals;			*
		11.3.3	draw electric field lines due to (i) same charges and (ii) opposite charges;		*	
		11.3.4	describe the concept of electric dipole;		*	
		11.4.1	explain electric flux;		*	
11.4	Electric Flux	11.4.1	explain electric flux;		*	
11.5	Gauss's Law with its Applications	11.5.1	explain Gauss's law;		*	
		11.5.2	apply Gauss's law to find field due to a hollow charged spherical			*

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			K	U	A
11.6 Electric Potential	11.6.1	describe electric potential at a point in terms of work done in bringing a unit charge from infinity to that point;		*	
	11.6.2	define unit of electric potential;	*		
	11.6.3	describe electric field as potential gradient;		*	
	11.6.4	derive an expression for electric potential at a point due to a point charge;		*	
	11.6.5	define electron volt (eV);	*		
	11.6.6	explain Millikan's method to find charge on an electron;		*	
11.7 Capacitor	11.7.1	define capacitance of a capacitor and its S.I unit;	*		
	11.7.2	describe functions of capacitors in simple circuit by drawing a labelled diagram;		*	
	11.7.3	calculate capacitance of different capacitors in series and in parallel using formulae;			*
	11.7.4	explain polarization of dielectric of a capacitor;		*	
11.8 Energy Stored in a Capacitor	11.8.1	prove that energy stored in a capacitor is $W = ½ QV$ and $W = ½ CV^2$;			*
	11.8.2	explain charging and discharging of a capacitor.		*	
12. Current Electricity	**Candidates should be able to:**				
12.1 Current Electricity	12.1.1	define current;	*		
	12.1.2	describe the flow of current in a conductor;		*	
	12.1.3	distinguish between conventional and non-conventional current;		*	

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			K	U	A
12.2 Resistance	12.2.1	define resistance and conductance;	*		
	12.2.2	define voltage;	*		
	12.2.3	state Ohm's law and give an example of a conductor which obeys Ohm's law;	*		
	12.2.4	explain factors on which resistance depends;		*	
	12.2.5	explain non-ohmic relationship between current and voltage for semi-conductor diode and a filament lamp;		*	
12.3 Resistivity and Conductivity	12.3.1	define resistivity;	*		
	12.3.2	define conductivity;	*		
	12.3.3	differentiate between resistivity and conductivity;		*	
	12.3.4	derive a relation between resistance and resistivity;		*	
	12.3.5	show a relation between temperature and resistance;		*	
	12.3.6	calculate the value of carbon resistance by using colour code;			*
12.4 Internal Resistance	12.4.1	define emf;	*		
	12.4.2	derive a relation between emf and P.D with the help of formula;		*	
	12.4.3	discuss examples of effect of internal resistance on external circuit in terms of current and voltage;		*	
	12.4.4	define power;	*		
	12.4.5	calculate the formula of power in terms of I, V and R;			*
	12.4.6	calculate the power dissipation due to the internal resistance of a circuit;			*
12.5 Kirchoff's Laws	12.5.1	explain Kirchoff's laws;		*	
	12.5.2	show conservation of charge in a circuit with the help of Kirchoff's 1st law;		*	
	12.5.3	show conservation of energy in a circuit with the help of Kirchoff's 2nd law;		*	

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			K	U	A
12.6 Potential Divider	12.6.1	define potential divider with examples;	*		
	12.6.2	explain the construction and working of a rheostat with the help of a diagram;		*	
	12.6.3	explain the functions of a rheostat as a potential divider;		*	
12.7 Balanced Potential	12.7.1	define Wheatstone bridge with the help of a diagram;	*		
	12.7.2	calculate the unknown resistance by using a Whetstone bridge;			*
	12.7.3	define potentiometer with the help of diagram;	*		
	12.7.4	demonstrate the measurement and comparison of emfs by using potentiometer;		*	
	12.7.5	show that potentiometer is the most accurate device for emf's measurement and comparison.		*	
13. Electromagnetisms	**Candidates should be able to:**				
13.1 Current Carrying Conductor in a Magnetic Field	13.1.1	define domain theory;	*		
	13.1.2	compare strong and weak magnetic fields;		*	
	13.1.3	derive an expression for force i.e. F = ILB $\sin\theta$ and use this equation for solving numericals;			*
	13.1.4	differentiate between magnetic flux and magnetic flux density;		*	
	13.1.5	describe factors governing field produced by long straight wire;		*	
	13.1.6	derive the equation for flux $\phi = \vec{\mathbf{B}}.\vec{\mathbf{A}}$ and use this equation for solving numericals;			*
	13.1.7	explain Biot-Savart's law and its applications;		*	
	13.1.8	explain Ampere's current law and its use to find the magnetic flux density inside a solenoid;		*	
	13.1.9	give applications of Ampere's law;	*		

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				K	U	A
13.2	Force on a Moving Charged Particle	13.2.1 13.2.2	derive an equation for force on a moving charge in a uniform magnetic field and beam of particles and use this equation for solving numericals; calculate e/m value by using beam of charged particles in a uniform magnetic field;			* *
13.3	Cathode Rays Oscilloscope (CRO)	13.3.1	describe basic principle and uses of CRO;		*	
13.4	Current Carrying Rectangular Coils in a Uniform Magnetic Field	13.4.1 13.4.2	derive an expression of torque due to a couple acting on a coil and use this expression for solving numericals; define sensitivity of galvanometer;	 *		*
13.5	Electrical Instruments	13.5.1 13.5.2 13.5.3	explain the principle, construction and working of galvanometer, voltmeter, ammeter, AVO meter analogue and digital multimetre (DMM); explain different types of galvanometer; list the important steps to change G.M into voltmeter and ammeter.	 *	* *	
14.	**Electromagnetic Induction**	**Candidates should be able to:**				
14.1	Law of Electromagnetic Induction	14.1.1 14.1.2 14.1.3	describe electromagnetic induction; explain Faraday's law of electromagnetic induction; apply Lenz's law to determine the direction of induced emf;		* *	 *
14.2	Inductance	14.2.1 14.2.2	distinguish between inductance and induction; explain self and mutual induction with formula and units;		* *	

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				K	U	A
14.3	Energy Stored in an Inductor	14.3.1	evaluate the formula $E = \frac{1}{2} L I^2$;			*
		14.3.2	show that the energy is stored in an inductor;		*	
14.4	Simple AC Generator, DC Generator and DC Motor	14.4.1	describe principle, construction and working of an AC and DC generator;		*	
		14.4.2	differentiate between AC and DC generators;		*	
		14.4.3	discuss back emf in motor and back motor effect in generator;		*	
14.5	Transformer	14.5.1	describe the principle, construction and working of a transformer;		*	
		14.5.2	differentiate between step up and step down transformer;		*	
		14.5.3	give the uses of step up and step down transformers in daily life;	*		
		14.5.4	derive $\frac{N_s}{N_p} = \frac{V_s}{V_p}$ and $V_s I_s = V_p I_p$ for an ideal transformer and use it for solving numericals;			*
		14.5.5	describe the simple energy losses due to eddy current and hysteresis.		*	
15.	**Alternating Current**	**Candidates should be able to:**				
15.1	Root Mean Square Value (rms)	15.1.1	define alternating current;	*		
		15.1.2	describe time period, frequency, peak and rms value of alternate current and alternate voltage;		*	
		15.1.3	describe sinusoidal waves;		*	
15.2	AC Circuits	15.2.1	explain flow of AC through resister, capacitor and inductor;		*	
		15.2.2	show 'phase lag lead' in a circuit through a vector diagram;		*	

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			K	U	A
15.3 Impedance	15.3.1	describe impedance as vector summation of resistance in series (R-C and R-L) circuits;		*	
15.4 Three Phase AC supply	15.4.1	describe three phase AC supply;		*	
15.5 Electromagnetic Waves	15.5.1	explain electromagnetic waves and spectrum (ranging from radio waves to gamma rays);		*	
	15.5.2	describe production, transmission and receptions of EM waves;		*	
	15.5.3	describe the amplitude modulation (A.M) and frequency modulation (F.M).		*	
16. Physics of Solids	**Candidates should be able to:**				
16.1 Classification of Solids	16.1.1	distinguish among the structure of crystalline, amorphous and polymeric solids;		*	
	16.1.2	define lattice and unit cell;	*		
16.2 Mechanical Properties of Solids	16.2.1	differentiate between elastic and plastic deformations in solids;		*	
	16.2.2	define tensile compression stress;	*		
	16.2.3	define Young's modulus, shear modulus and bulk modulus;	*		
	16.2.4	derive the formulae of Young's modulus, shear modulus and bulk modulus;		*	
	16.2.5	define elastic limit and yield strength;	*		
	16.2.6	deduce the strain energy in a deform material from the area under the force extension graph;			*

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			K	U	A
16.3 Electric Properties of Solids	16.3.1	define conductors, insulators and semi-conductors;	*		
	16.3.2	describe energy bands in solids;		*	
	16.3.3	define energy gaps in insulators, intrinsic and extrinsic semi-conductors;	*		
16.4 Super Conductors	16.4.1	describe the behaviour of super conductors and their potential uses;		*	
16.5 Magnetic Properties of Solids	16.5.1	describe dia, para and ferro magnetic solids;		*	
	16.5.2	describe ferro magnets as a special case of para-magnets, magnetic dipoles and domains;		*	
	16.5.3	define curie point, paramagnetic substances, dia-magnet substances, ferro- magnetic substances, soft and hard magnetic substances.	*		
17. Electronics		**Candidates should be able to:**			
17.1 Electronics	17.1.1	define electronics;	*		
17.2 Semi-conductor Devices	17.2.1	differentiate between conductors and insulators;		*	
	17.2.2	explain semi-conductors;		*	
	17.2.3	differentiate p-type and n-type semi-conductors with the help of diagrams;		*	
	17.2.4	describe p-n junction and p-n junction diode with labelled diagrams;		*	
	17.2.5	define forward and reverse bias;	*		
	17.2.6	explain direct current;		*	
	17.2.7	define rectification;	*		
	17.2.8	define half and full wave rectification;	*		

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			K	U	A
	17.2.9	describe the function and uses of LEDs and photodiode;		*	
	17.2.10	define transistor;	*		
	17.2.11	distinguish between PNP and NPN transistor;		*	
	17.2.12	deduce current equation and its application;			*
17.3 Operational Amplifier	17.3.1	explain the uses of transistor as a switch and as an amplifier;		*	
17.4 Digital System	17.4.1	differentiate between analogue and digital system;		*	
	17.4.2	describe logic gates and show their function with the help of truth table with two inputs;		*	
	17.4.3	explain and relate different logic gates and their control function.		*	
18. Dawn of Modern Physics	**Candidates should be able to:**				
18.1 Special Theory of Relativity	18.1.1	distinguish between inertial and non-inertial frames of reference;		*	
	18.1.2	explain postulates of special theory of relativity;		*	
	18.1.3	conceptualize that if (C) is constant then space and time become relative;		*	
	18.1.4	show the consequences of special theory of relativity;		*	
	18.1.5	explain the amplification of mass increase, time dilation and length contraction for speed travel;		*	
18.2 Quantum Theory	18.2.1	discuss the black body radiations with the help of wavelength-energy graph;		*	
	18.2.2	describe laws governing black body radiations with their drawbacks;		*	
	18.2.3	explain Plank's hypothesis for black body;		*	

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			K	U	A
	18.2.4	show that the radiations emitted and absorbed by black body is quantized;		*	
	18.2.5	discuss photon as an electromagnetic radiation;		*	
18.3 Photoelectric Effect	18.3.1	describe the phenomenon of photoelectric effect;		*	
	18.3.2	explain different features of photoelectric effect with the help of a graph;		*	
	18.3.3	derive Einstein's photoelectric equation;		*	
	18.3.4	define a photocell;	*		
	18.3.5	give the uses of a photocell;	*		
18.4 Compton's Effect	18.4.1	describe the Compton's effect;		*	
	18.4.2	compare the phenomenon of pair production and pair annihilation;		*	
	18.4.3	describe particle nature of light;		*	
	18.4.4	describe the wave nature of light;		*	
	18.4.5	state de-Broglie's hypothesis;	*		
	18.4.6	explain de-Broglie's hypothesis to show that every particle has wave nature as well as particle nature;		*	
	18.4.7	describe Davison and Germer experiment;		*	
	18.4.8	state the uncertainty principle;	*		
	18.4.9	explain the uncertainty principle with the help of an experiment.		*	

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				K	U	A
19. Atomic Spectra		**Candidates should be able to:**				
19.1	Atomic Spectra, Spectrum of Hydrogen, Bohr's model of Hydrogen atom	19.1.1 19.1.2 19.1.3 19.1.4 19.1.5 19.1.6	describe the origin of different types of optical spectra; analyse the experimental facts of hydrogen spectrum; describe Bohr's postulate of atomic model of hydrogen atom; explain hydrogen spectrum in terms of energy levels; derive an expression for quantized radii; prove $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$ and use this for solving numericals;		* * * * 	 * *
19.2	Emission of Spectral Lines	19.2.1	deduce spectral lines through discrete electron energy level;			*
19.3	Excitation and Ionization Potential	19.3.1 19.3.2	define excitation potential and ionization potential; determine ion energy and various excitation energy of an atom using an energy level diagram;	*	 *	
19.4	Inner Shell Transition and Characteristics	19.4.1 19.4.2 19.4.3	describe inner shell transitions; explain production and characteristics of X-rays by understanding inner shell transition; explain the production, properties and uses of X-rays;		* * *	
19.5	Lasers	19.5.1 19.5.2	describe the terms, 'spontaneous emission', 'stimulated emission', 'meta-stable state', 'population inversion' and 'laser action'; describe the structure and purpose of main components of He-Ne laser gas.		* *	

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				K	U	A
20.	**Nuclear Physics**	**Candidates should be able to:**				
20.1	Composition of Atomic Model	20.1.1	describe a simple model of an atom to include electrons, protons and neutrons;		*	
20.2	Atomic Number, Mass Number, Isotopes and Isobars	20.2.1	define atomic number, mass number, isotopes and isobars;	*		
		20.2.2	determine number of protons, neutrons and nucleons for the specification of nucleus in the form ${}^{A}_{Z}X$;		*	
20.3	Mass Spectrograph	20.3.1	describe the principle, construction and working of mass spectrograph;		*	
20.4	Mass Defect and Binding Energy	20.4.1	define the terms, mass defect, binding energy;	*		
		20.4.2	show (graphically) variation of binding energy per nucleon with the help of mass number;		*	
20.5	Radioactivity	20.5.1	define radioactivity and list the properties of α, β *and* γ radiations;	*		
20.6	Law of Radioactive Decay	20.6.1	explain the phenomenon of radioactive decay and describe α, β *and* γ decay with balance equations;		*	
		20.6.2	define half-life of a radioactive element;	*		
		20.6.3	derive an equation for two half-life from the decay of radioactive element;		*	

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				K	U	A
20.7	Detection of Ionizing Radiation	20.7.1 20.7.2	describe the interaction between α, β particles and γ rays with matter; analyse the nature of radiations emitted from a radioactive particle by using Wilson cloud chamber, G.M counter and Solid state detector;		* 	 *
20.8	Nuclear Fission and Fusion	20.8.1	describe the phenomena of nuclear fission and fusion;		*	
20.9	Nuclear Reactor	20.9.1 20.9.2	explain the working principle of a nuclear reactor; list the various types of nuclear reactor;	 *	*	
20.10	Nuclear Radiations and Exposure	20.10.1	discuss the awareness about nuclear radiation exposure and biological effects of radiations;		*	
20.11	Medical Physics	20.11.1 20.11.2	describe in simple terms the uses of radiations for medical diagnosis and therapy; describe importance of limiting exposure to ionizing radiations;		* *	
20.12	Basic Forces of Nature	20.12.1	describe basic forces of nature;		*	
20.13	Building Blocks of Nature	20.13.1	describe the modern view of the building blocks of matter based on hadrons, leptons and quarks.		*	

NOTES

4. Scheme of Assessment

Class XI

Table 1: Number of Student Learning Outcomes by Cognitive level

Topic No.	Topics	No. of Sub-Topics	SLOs			Total
			K	U	A	
1	Measurement	6	1	6	3	10
2	Vectors and Equilibrium	7	4	10	1	15
3	Force and Motion	6	5	6	6	17
4	Work and Energy	9	7	10	4	21
5	Circular Motion	7	7	7	2	16
6	Fluid Dynamics	6	3	2	6	11
7	Oscillations	9	5	10	1	16
8	Waves	5	8	14	3	25
9	Physical Optics	8	6	10	3	19
10	Thermodynamics	11	6	13	7	26
	Total	**75**	**54**	**87**	**35**	**176**
	Percentage		**31**	**49**	**20**	

Table 2: Allocation of Marks for the Multiple Choice Questions (MCQs), Constructed Response Questions (CRQs) and Extended Response Questions (ERQs)

Topic No.	Topics	No. of Sub-Topics	Marks			Total
			Multiple Choice Questions	Constructed Response Questions	Extended Response Questions	
1	Measurement	6	2	5	0	7
2	Vectors and Equilibrium	7	3	5	0	8
3	Force and Motion	6	2	4	0	6
4	Work and Energy	9	4	3	5	12
5	Circular Motion	7	3	4	0	7
6	Fluid Dynamics	6	2	4	0	6
7	Oscillations	9	4	5	0	9
8	Waves	5	2	3	5	10
9	Physical Optics	8	3	4	0	7
10	Thermodynamics	11	5	3	5	13
	Total	**75**	**30**	**40**	**15**	**85**
	Practicals					15
	Total					**100**

Table 3: Paper Specifications

Topic No.	Topics	Marks Distribution			Total Marks
1.	Measurement	MCQs 2 @ 1 Mark CRQ 1 @ 2 Marks CRQ 1 @ 3 Marks			07
2.	Vectors and Equilibrium	MCQs 3 @ 1 Mark CRQ 1 @ 2 Marks CRQ 1 @ 3 Marks			08
3.	Force and Motion	MCQs 2 @ 1 Mark CRQ 1 @ 4 Marks			06
4.	Work and Energy	MCQs 4 @ 1 Mark CRQ 1 @ 3 Marks *ERQ 1 @ 5 Marks Choose any ONE from TWO			12
5.	Circular Motion	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			07
6.	Fluid Dynamics	MCQs 2 @ 1 Mark CRQ 1 @ 4 Marks			06
7.	Oscillations	MCQs 4 @ 1 Mark CRQ 1 @ 2 Marks CRQ 1 @ 3 Marks			09
8.	Waves	MCQs 2 @ 1 Mark CRQ 1 @ 3 Marks ERQ 1 @ 5 Marks Choose any ONE from TWO			10
9.	Physical Optics	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			07
10.	Thermodynamics	MCQs 5 @ 1 Mark CRQ 1 @ 3 Marks ERQ 1 @ 5 Marks Choose any ONE from TWO			13
	Total	**MCQs 30**	**CRQs 40**	**ERQs 15**	**85**
	Practical				15
	Total				**100**

* Extended response questions (ERQs) will require answers in more descriptive form. The answers will be in a paragraph rather than a word or a single sentence.

Class XII

Table 4: Number of Student Learning Outcomes by Cognitive level

Topic No.	Topics	No. of Sub- Topics	SLOs			Total
			K	U	A	
11	Electrostatic	8	5	13	5	23
12	Current Electricity	7	11	16	4	31
13	Electromagnetism	5	4	8	5	17
14	Electromagnetic Induction	5	1	11	3	15
15	Alternating Current	5	1	9	0	10
16	Physics of Solids	5	7	7	1	15
17	Electronics	4	5	11	1	17
18	Dawn of the Modern Physics	4	4	20	0	24
19	Atomic Spectra	5	1	10	3	14
20	Nuclear Physics	13	5	14	1	20
	Total	**61**	**44**	**119**	**23**	**186**
	Percentage		**24**	**64**	**12**	

Table 5: Allocation of Marks for the Multiple Choice Questions (MCQs), Constructed Response Questions (CRQs) and Extended Response Questions (ERQs)

Topic No.	Topics	No. of Sub-Topics	Marks			Total
			Multiple Choice Questions	Constructed Response Questions	Extended Response Questions	
11	Electrostatic	8	4	3	5	12
12	Current Electricity	7	3	4	0	7
13	Electromagnetic	5	3	5	0	8
14	Electromagnetic Induction	5	3	5	5	13
15	Alternating Current	5	3	5	0	8
16	Physics of Solids	5	2	3	0	5
17	Electronics	4	3	3	0	6
18	Dawn of the Modern Physics	4	3	3	5	11
19	Atomic Spectra	5	3	4	0	7
20	Nuclear Physics	13	3	5	0	8
	Total	**61**	**30**	**40**	**15**	**85**
	Practicals					15
	Total					**100**

Table 6: Paper specifications

Topic No.	Topics	Marks Distribution			Total Marks
11.	Electrostatic	MCQs 4 @ 1 Mark CRQ 1 @ 3 Marks *ERQ 1 @ 5 Marks Choose any ONE from TWO			12
12.	Current Electricity	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			07
13.	Electromagnetic	MCQs 3 @ 1 Mark CRQ 1 @ 2 Marks CRQ 1 @ 3 Marks			08
14.	Electromagnetic Induction	MCQs 3 @ 1 Mark CRQ 1 @ 2 Marks CRQ 1 @ 3 Marks ERQ 1 @ 5 Marks Choose any ONE from TWO			13
15.	Alternating Current	MCQs 3 @ 1 Mark CRQ 1 @ 2 Marks CRQ 1 @ 3 Marks			08
16.	Physics of Solids	MCQs 2 @ 1 Mark CRQ 1 @ 3 Marks			05
17.	Electronics	MCQs 3 @ 1 Mark CRQ 1 @ 3 Marks			06
18.	Dawn of the Modern Physics	MCQs 3 @ 1 Mark CRQ 1 @ 3 Marks ERQ 1 @ 5 Marks Choose any ONE from TWO			11
19.	Atomic Spectra	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			07
20.	Nuclear Physics	MCQs 3 @ 1 Mark CRQ 1 @ 2 Marks CRQ 1 @ 3 Marks			08
	Total	**MCQs 30**	**CRQs 40**	**ERQs 15**	**85**
	Practical				15
	Total				**100**

* Extended response questions (ERQs) will require answers in more descriptive form. The answers will be in a paragraph rather than a word or a single sentence.

4.1 Tables 1 and 4 summarize the number and nature of SLOs in each topic in classes XI and XII. This will serve as a guide in the construction of the examination paper. It also indicates that more emphasis has been given to Understanding (49% and 64%), Application and higher order skills (20% and 12%) to discourage rote memorization. Tables 1 and 4 however do not translate directly into marks.

4.2 There will be two examinations, one at the end of Class XI and one at the end of Class XII.

4.3 In each class, the theory paper will be in two parts: paper I and paper II. Both papers will be of duration of 3 hours.

4.4 Paper I theory will consist of 30 compulsory, multiple choice items. These questions will involve four response options.

4.5 Paper II theory will carry 55 marks and consist of a number of compulsory, structured questions and a number of extended response questions. Each extended response question will be presented in an either/or form.

4.6 Practical examination will be conducted separate from the theory paper. It will be based on the list of practical activities listed in the examination syllabus.

4.7 All constructed response questions will be in a booklet which will also serve as an answer script.

4.8 Practical exams to assess performance skills will carry 15 marks in class XI and 15 marks in class XII.

4.9 It is essential for each school to equip its laboratories with chemicals, instruments, apparatus, specimens etc. according to the requirements of the practicals. Each school will be responsible to make sure that each student is provided the opportunity to do the practicals.

List of practicals is attached as annex B.

5. Teaching-Learning Approaches and Classroom Activities

- Teaching in the class room should be very interactive with complete involvement of all students.
- Teacher should encourage question/answer sessions in the classroom during or after completing lecture.
- Use of board, videos, projector and multimedia should become a common habit by the teacher.
- Teacher should try to get as much a practical approach whenever delivering a complicated topic.
- Students should able to demonstrate independently in the lab, the practical application of what they have learnt in the classroom.
- On a weekly basis different projects should be assigned to the students individually or in groups.
- Teacher should try to relate as much as possible the different topics from the syllabus to the daily life.
- Creativeness among students should remain the main target by the teacher.

6. Recommended Text and Reference Material

Recommended Books

1. Punjab Textbook Board (First edition). *Textbook for Physics XI*. Lahore: Punjab Textbook Board
2. Punjab Textbook Board (First edition). *Textbook for Physics XII.* Lahore: Punjab Textbook Board.
3. Abbas, Ghayyur. (2005). *Physics Practical Notebook for Class XI*: New Star Book Depot.
4. Abbas, Ghayyur. (2003). *Physics Practical Notebook for Class XII*: New Star Book Depot.

Reference Books

1. Sindh Textbook Board*. Fundamentals of Physics for Class XI.* Jamshoro: Sindh Textbook Board.
2. Sindh Textbook Board. *A textbook of Physics for Class XII.* Jamshoro: Sindh Textbook Board.
3. Khan, Nikhat. (2005). *Physics for Class XI.* Karachi: Oxford University Press.
4. Khan, Nikhat. (2007). *Physics for Class XII.* Karachi: Oxford University Press.
5. Sears Zamansky and Young Addison, *College Physics*. New York: Wesley Publication Co.
6. Nelkon and Parker. (Seventh edition). *Principles of Physics.* Heinemann: Collins Int'l Textbooks.
7. Gibbs, Keith. (Ninth edition). *Physics 1.* Dubai: Cambridge University Press.
8. Frederick J. Bueche, *Principles of Physics*. New York: McGraw Hill Inc.
9. Halliday and Resnick, *Fundamentals of Physics*: Walker Wiley India Pvt. Ltd.

Recommended Websites

1. www.learningsupport.akueb.edu.pk
2. www.extremescience.com
3. www.wyp-ptm.org
4. www.particleadventure.org
5. www.physorg.com
6. www.explorelearning.com
7. www.fearofphysics.com
8. www.aip.org/success/
9. www.scienceworld.wdfram.com
10. www.iaps.info/index.php
11. www.gravitycontrol.org
12. www.strategian.com
13. www.opticsnotes.com
14. www.interq.or.jp/japan/se-inoue/e_menu.htm
15. www.iit.edu/~smile/ph9115.html
16. www.explorescience.com
17. www.practicalphysics.org
18. www.physics2005.org
19. www.amasci.com/ele-projs.html
20. www.tpt.org/newtons/
21. www.junkscience.com
22. www.physlink.com
23. www.amasci.com/amateur/answers1.html
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7. Definition of Cognitive Levels and Command Words

7.1. Definitions of Cognitive Levels

Knowledge

This requires knowing and remembering facts and figures, vocabulary and contexts, and the ability to recall key ideas, concepts, trends, sequences, categories, etc. It can be taught and evaluated through questions based on: who, when, where, what, list, define, describe, identify, label, tabulate, quote, name, state, etc.

Understanding

This requires understanding information, grasping meaning, interpreting facts, comparing, contrasting, grouping, inferring causes/reasons, seeing patterns, organizing parts, making links, summarizing, solving, identifying motives, finding evidence, etc. It can be taught and evaluated through questions based on: why, how, show, demonstrate, paraphrase, interpret, summarize, explain, prove, identify the main idea/theme, predict, compare, differentiate, discuss, chart the course/direction, report, solve, etc.

Application

This requires using information or concepts in new situations, solving problems, organizing information and ideas, using old ideas to create new ones, generalizing from given facts, analyzing relationships, relating knowledge from several areas, drawing conclusions, evaluating worth, etc. It can be taught and evaluated through questions based on: differentiate, analyse, show relationship, propose an alternative, prioritize, give reasons for, categorize, illustrate, corroborate, compare and contrast, create, design, formulate, integrate, rearrange, reconstruct/recreate, reorganize, predict consequences etc.

7.2 Definition of Command Words

Knowledge

Define:	Only a formal statement or equivalent paraphrase is required. No examples need to be given.
Give:	Convey or reveal information.
Identify:	Describe with specific examples of how a given term or concept is applied in daily life.
List:	Requires a number of points, generally each of one word, with no elaboration. Where a given number of points are specified, this should not be exceeded.

Outline: Implies brevity, i.e. restricting the answer to giving essentials.

Recognize: Involves looking at a given example and stating what it most probably is.

State: Implies concise answer with little or no supporting argument, for example a numerical answer that can be obtained by inspection.

Write: To construct full sentence of continuous prose, not abbreviated text.

Understanding

Classify: To state a basis for categorization of a set of related entities and assign examples to categories.

Compare: List the main characteristics of two entities clearly identifying similarities (and differences)

Conceptualize: To form or prove a concept through observation, experience, facts or given data.

Demonstrate: Implies that the candidate is expected to show how is one thing related to another, usually it is a reference to theory but sometimes it is by physical manipulation or experiment.

Derive: To come up with a formula for a physical quantity unit by using the required quantities

Describe: To state in words (Using diagrams where appropriate) the main points of the topic. It is often used with reference wither to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

Determine: Often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into standard formula, for e.g. relative molecular mass.

Differentiate: To identify those characteristics which are always or sometimes distinguish between two categories.

Discuss: To give a critical account of the point involved in the topic.

Distinguish: To identify those characteristics which always or sometimes distinguish between two categories.

Draw:	Implies a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.
Explain:	May imply reasoning or some reference to theory, depending on the context.
Express:	Use appropriate vocabulary, language structure and intonation to communicate thoughts and feeling.
Investigate:	Thoroughly and systematically consider a given problem or a statement in order to find out the result or rule applied.
Relate:	Describe how things depend upon, follow from or are part of another.
Show:	Demonstrate with evidence.
Summarize:	Identify/review the main points, relevant factors and/or arguments so that these are explained in a clear and concise manner.

Application

Analyse:	To go beyond using the information for relating different characteristics of the components in given material and for drawing conclusions on the basis of common characteristics.
Apply:	To use the available information in different context to relate and draw conclusions.
Calculate:	Is used when numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
Deduce:	By recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answer extracted in an early part of the question.
Evaluate:	To judge or assess on the basis of facts, argument or other evidence to come to conclusion.
Infer:	To conclude by reasoning with the help of evidence.
Interpret:	Clarify both the explicit meaning and the implications of given information.
Measure:	To determine extent, quantity, amount or degree of something as determine by measurement or calculation.
Prove:	Establish the validity of a theory or a principle.
Solve:	To work out systematically the answer of a given problem.

Annex A

HSSC Scheme of Studies[3]

AKU-EB as a national board offers SSC and HSSC qualifications for both English and Urdu medium schools. The revised HSSC Scheme of Studies issued by the Curriculum Wing was implemented from September 2007. The marks allocated to subjects in the revised National Scheme of Studies have been followed.

HSSC I-II (Classes XI-XII) subjects on offer for examination

HSSC Part-I (Class XI) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Biology-I	85	15	100	English
Total:	**455**	**45**	**500**	

HSSC Part-II (Class XII) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Biology-II	85	15	100	English
Total:	**555**	**45**	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

[3] Government of Pakistan September 2007. *Scheme of Studies for SSC and HSSC (Classes IX-XII).* Islamabad: Ministry of Education, Curriculum Wing.

HSSC Part-I (Class XI) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Mathematics-I	100	-	100	English
Total:	**470**	**30**	**500**	

HSSC Part-II (Class XII) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Mathematics –II	100	-	100	English
Total:	**570**	**30**	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

HSSC Part-I (Class XI) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I Pakistan Culture-I [a]	100	-	100	Urdu English
Any one subject combinations of the following:				
Physics-I Mathematics-I *Statistics-I	85 100 85	15 - 15	300	English English English
Economics-I Mathematics-I *Statistics-I	100 100 85	- - 15	300	English / Urdu English English
Economics-I Mathematics-I Computer Science-I	100 100 75	- - 25	300	English / Urdu English English
Physics-I Mathematics-I Computer Science-I	85 100 75	15 - 25	300	English English English
Mathematics-I *Statistics-I Computer Science-I	100 85 75	- 15 25	300	English English English
Total:			**500**	

HSSC Part-II (Class XII) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Any one subject combinations of the following:				
Physics-II Mathematics-II *Statistics-II	85 100 85	15 - 15	300	English English English
Economics-II Mathematics-II *Statistics-II	100 100 85	- - 15	300	English / Urdu English English
Economics-II Mathematics-II Computer Science-II	100 100 75	- - 25	300	English / Urdu English English
Physics-II Mathematics-II Computer Science-II	85 100 75	15 - 25	300	English English English
Mathematics-II *Statistics-II Computer Science-II	100 85 75	- 15 25	300	English English English
Total:			**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.

b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***These subject is offered <u>ONLY</u> in the May examination.**

HSSC Part-I (Class XI) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Principles of Accounting-I	100	-	100	English
Principles of Economics	75	-	75	English
Principles of Commerce	75	-	75	English
Business Mathematics	50	-	50	English
Total:	**500**	**-**	**500**	

HSSC Part-II (Class XII) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Principles of Accounting-II	100	-	100	English
Commercial Geography	75		75	English
*Computer Studies **OR** Banking	60 **OR** 75	15 -	75	English
Business Statistics	50	-	50	English
Total:	**600**		**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***This subjects are offered <u>ONLY</u> in the May examination.**

HSSC Part-I (Class XI) Humanities Group

Subjects	Marks	Medium
English Compulsory-I	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	Urdu English
Any three of the following Elective Subjects	300	
1. Civics-I	(100	English / Urdu
2. Computer Science-I (75+25 practical)	each)	English
3. Economics-I		English / Urdu
4. *Education-I		English / Urdu
5. *Geography-I (85+15 practical)		English / Urdu
6. *Islamic Studies-I		English / Urdu
7. *Islamic History-I		English / Urdu
8. Literature in English-I		English
9. Mathematics-I		English
10. *Psychology-I (85+15 practical)		English / Urdu
11. *Statistics-I (85+15 practical)		English
12. *Sociology-I		English / Urdu
13. Urdu Literature-I		Urdu
14. *Fine Arts-I		English
Total:	**500**	

HSSC Part-II (Class XII) Humanities Group

Subjects	Marks	Medium
English Compulsory-II	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	Urdu English
Islamiyat **OR** Ethics [b]	50	English / Urdu
Pakistan Studies	50	English / Urdu
Any three of the following Elective Subjects	300	
1. Civics-II	(100	English / Urdu
2. Computer Science-II (75+25 practical)	each)	English
3. Economics-II		English / Urdu
4. *Education-II		English / Urdu
5. *Geography-II (85+15 practical)		English / Urdu
6. *Islamic Studies-II		English / Urdu
7. *Islamic History-II		English / Urdu
8. Literature in English-II		English
9. Mathematics-II		English
10. *Psychology-II (85+15 practical)		English / Urdu
11. *Statistics-II (85+15 practical)		English
12. *Sociology-II		English / Urdu
13. Urdu Literature-II		Urdu
14. *Fine Arts-II		English
Total:	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***These subjects are offered <u>ONLY</u> in the May examination.**

Annex B

List of Practicals Activities

Class XI

S. No.	SLO No.	OBJECTIVE	APPARATUS
Topic 1: Measurement			
1.	1.5.2	Determine the capacity and thickness of a test tube by using Vernier callipers.	Vernier callipers, test tube.
2.	1.5.2	Measure the diameter of few ball bearings of different sizes using screw gauge and estimate their volumes.	Screw gauges, steel ball bearings.
3.	1.5.2	Determine the radius of curvature of any spherical surface by using a spherometer.	Spherometer, convex or concave lens/mirror.
Topic 2: Vectors and Equilibrium			
4.	2.3.1	Determine the weight of a body by vector addition of forces. (Parallelogram Method)	Gravesand's apparatus, slotted weights, thread nos., plane mirror strip.
5.	2.7.2	Verify the two conditions of equilibrium using a suspended meter rod.	Meter scales, hangers, slotted weights, stand.
Topic 3: Motion and Force			
6.	3.3.1	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.
7.	3.3.1	Investigate the value of 'g' by free fall method using electronic timer.	Free fall apparatus, steel ball, electronic timer with power supply, plumb line, meter rod.

S. No.	SLO No.	OBJECTIVE	APPARATUS
Topic 7: Oscillations			
8.	7.5.2	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 'g' from the graph.	Simple pendulum, stopwatch, stand with clamp, thread, cork, Vernier callipers.
Topic 8: Waves			
9.	8.4.4	Determine the frequency of A.C by Melde's apparatus / electric sonometer.	AC vibrator, step-down transformer (6V), connecting wire, thread, pulley, scale plan.
10.	8.4.4	Investigate the laws of vibration of stretched strings by sonometer or electromagnetic method. (Instead of using iron wire use copper wire)	Sonometer, tuning forks of different frequencies, hanger, ½ kg weights, wires of different diameter, physical /digit/spring balance, weight box, meter rod.
11.	8.4.5	Determine the wavelength of sound in air using stationary waves and to calculate the speed of sound using resonance tube.	Resonance apparatus. two tuning forks of known frequencies, thermometer, plumb line, Vernier callipers, rubber pad, two set squares, beaker.

S. No.	SLO No.	OBJECTIVE	APPARATUS
Topic 10: Thermodynamics			
12.	10.6.1	Measure the mechanical equivalent of heat by electric method.	Electrical calorimeter, 1/5 ^{o}C thermometer, battery, rheostat, key, ammeter, voltmeter, connecting wires, stopwatch, physical/digit/spring balance, weight box.
13.	10.6.1	Determine the specific heat of water by electrical method.	Electrical calorimeter, 1/5 ^{o}C thermometer, battery, rheostat, key, ammeter, voltmeter, connecting wires, stopwatch, physical/digit/spring balance, weight box.

Class XII

S. No.	SLO No.	OBJECTIVE	APPARATUS
Topic 11: Electrostatics			
1.	11.7.3	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.	11.8.2	Determine time constant by charging and discharging a capacitor through a resistor.	Galvanometer, power supply, large value capacitor, key, stopwatch.
Topic 12: Current Electricity			
3.	12.2.5	Determine resistance of voltmeter by drawing graph between (R) and (I/V).	Voltmeter, resistance box, two keys, sand paper, connecting wires, graph paper.
4.	12.3.5	Investigate the relationship between current passing through a tungsten filament lamp and the potential applied across it.	36W, 12 Volt car bulb, bulb holder, 12 volt battery, high resistance rheostat, voltmeter, ammeter, key, sand paper, connecting wires.
5.	12.7.2	Determine resistance of wire by slide wire bridge.	Slide wire bridge, resistance box, unknown resistance, galvanometer, rheostat, cell, tapping key, connecting wires, sand paper.
6.	12.7.4	Determine internal resistance of a cell using potentiometer.	Potentiometer, battery, ammeter, resistance box, rheostat, two keys, galvanometer, cell, shunt wire, sand paper, connecting wires.

S. No.	SLO No.	OBJECTIVE	APPARATUS
7.	12.7.5	Determine emf of a cell using potentiometer.	Potentiometer, battery, two way key, rheostat, ammeter, key, shunt, wire, galvanometer, sand paper, connecting wires.
Topic 17: Electronics			
8.	17.2.5	Draw characteristics of semiconductor diode and calculate forward and reverse current resistances.	Semi-conductor diode, voltmeter, milliammeter, micro ammeter, 500Ω rheostat, 1kΩ resistor, 3V battery, sand paper, connecting wires.
9.	17.2.11	Study the characteristics of an NPN transistor.	NPN transistor, DC power supplies, microammeter, variable resistance of 500Ω, 50Ω & 10Ω, 2.2kΩ, milliammeter, high resistance voltmeter.
10.	17.4.2	Verify truth table for logic gates.	DC power supply, OR, AND, NOR, NAND, NOT gates, LED indicator module, two key plugs, connecting wires.
11.	17.4.3	Make burglar alarm using NAND gate.	Two NAND gates, two resistance of 100kΩ, electronic bell, connecting wires, power supply 5V DC, key plugs.
12.	17.4.3	Make a fire alarm using gates.	AND, OR gates, smoke sensor, heat sensor, alarm, connecting wires, power supply, alarm bell.
Topic 18: Dawn of Modern Physic			
13.	18.3.5	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.