Physics

Part I (Grade XI)

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels[1]		
				K	U	A
1.	**Measurement**	Students should be able to:				
1.1	Scope of Physics	1.1.1	describe the importance of physics in space technology, nano-technology, aero-dynamics, medical physics, thermodynamics and solid state physics;		*	
1.2	International System (SI) Units	1.2.1	define the following: a. SI base units, b. derived units, c. supplementary units;	*		
		1.2.2	identify the components of SLO 1.2.1 (a, b and c) for the various measurements;		*	
		1.2.3	show the derived units as products or quotients of the base units;			*
1.3	Errors and Uncertainty	1.3.1	differentiate between systematic and random errors;		*	
		1.3.2	solve word problems related to the uncertainty in the derived quantity;			*
1.4	Precision and Accuracy	1.4.1	define precision and accuracy;	*		
		1.4.2	differentiate between precision and accuracy;		*	
1.5	Significant Figures	1.5.1	solve word problems using scientific notations and with correct number of significant figures;			*
		1.5.2	recognise that the least count (LC) of an instrument is the smallest measurable value of that instrument;		*	

[1] K = Knowledge, U = Understanding, A = Application and other higher-order cognitive skills

Physics

Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
1.6	Dimensions	1.6.1	describe the concept of dimensions using mass, length and time;		*	
		1.6.2	show the homogeneity of physical equations by using dimensions and basic units;			*
		1.6.3	derive formula for physical quantities by using dimensions.			*

Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
2.	**Vectors and Equilibrium**	Students 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 2.2.2 2.2.3	explain the sum of vectors using head to tail rule; define resultant, negative, unit, null, position and equal vectors; analyse a vector into its rectangular components;	 * 	* 	 *
2.3	Addition of Vectors by Rectangular Component Method	2.3.1	explain the sum of vectors using perpendicular components;		*	
2.4	Scalar Product of Two Vectors	2.4.1 2.4.2 2.4.3	define scalar product of two vectors; exemplify the scalar product of two vectors in terms of angle between them; describe properties of scalar product of two vectors;	* 	 * *	
2.5	Vector Product of Two Vectors	2.5.1 2.5.2 2.5.3	define vector product of two vectors; exemplify vector product of two vectors in terms of angle between them; describe properties of vector product;	*	 * *	
2.6	Torque	2.6.1 2.6.2	describe torque as a vector product of $\vec{r} \times \vec{F}$; discuss applications of torque;		* *	
2.7	Equilibrium of Forces	2.7.1 2.7.2	define equilibrium and its types; describe first and second conditions of equilibrium with the help of examples from daily life.	*	 *	

Physics

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
3.	**Motion and Force**	Students should be able to:				
3.1	Displacement	3.1.1	define displacement;	*		
3.2	Velocity	3.2.1	define velocity, average velocity and instantaneous velocity;	*		
		3.2.2	define acceleration, average acceleration and instantaneous acceleration;	*		
		3.2.3	interpret velocity-time graph for constant direction;			*
		3.2.4	calculate area under velocity-time graph;			*
		3.2.5	analyse the significance of area under velocity-time graph;			*
3.3	Acceleration	3.3.1	explain the equations of motion a. for uniformly accelerated bodies in a straight line, b. in uniform gravitational field in a non-resistive medium;		*	
3.4	Laws of Motion	3.4.1	describe Newton's laws of motion;		*	
3.5	Force, Momentum and Impulse	3.5.1	relate the rate of change of momentum with Newton's 2nd law of motion;		*	
		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 interaction of forces during rocket propulsion;		*	

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
3.6	Projectile	3.6.1	define the following: a. projectile, b. projectile motion, c. trajectory of projectile;	*		
		3.6.2	describe projectile motion in non-resistive medium;		*	
		3.6.3	derive the relation for a. time of flight, b. maximum height, c. horizontal range of a projectile;			*
		3.6.4	solve word problems related to the above relations (a, b and c);			*
		3.6.5	exemplify projectile motion through the motion of ballistic missiles.		*	

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
4.	**Work, Power and Energy**	Students should be able to:				
	4.1 Work	4.1.1	define work as the cross-product of force and displacement;	*		
		4.1.2	describe work when force and displacement are acting at an angle (θ);		*	
		4.1.3	list different units of work done;	*		
		4.1.4	distinguish between positive, negative and zero work done 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 as the rate of doing work;	*		
		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 word problems;			*
	4.4 Energy	4.4.1	define energy;	*		
		4.4.2	list different units of energy;	*		
		4.4.3	differentiate between potential and kinetic energy;		*	
	4.5 Work-Energy Relation	4.5.1	deduce the relationship between energy and work a. when friction is present, b. when friction is not present;			*
	4.6 Absolute Gravitational Energy	4.6.1	analyse the absolute gravitational energy;			*
		4.6.2	derive an expression for absolute potential energy (PE);			*

Physics

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
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 word problems;		* 	 * *
4.8	Conservation of Energy	4.8.1 4.8.2	explain the law of conservation of energy; derive potential energy and kinetic energy in a resistive medium;		* 	 *
4.9	Types of Energy Sources	4.9.1 4.9.2	list the types of conventional and non-conventional energy sources; describe the uses of energy in different fields.	*	 *	

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
5.	**Circular Motion**	Students should be able to:				
5.1	Angular Motion	5.1.1	define angular displacement, angular velocity and angular acceleration;	*		
		5.1.2	discuss the relation between linear and angular displacement, velocity and acceleration;		*	
5.2	Centripetal Force and Centripetal Acceleration	5.2.1	define centripetal force and centripetal acceleration;	*		
		5.2.2	derive centripetal acceleration when speed is uniform;			*
		5.2.3	relate centripetal acceleration with angular velocity;		*	
5.3	Moment of Inertia	5.3.1	define moment of inertia and state its SI unit with dimension;	*		
5.4	Angular Momentum	5.4.1	define angular momentum and state its SI unit with dimension;	*		
		5.4.2	explain the law of conservation of angular momentum;		*	
5.5	Rotational Kinetic Energy	5.5.1	define rotational kinetic energy;	*		
		5.5.2	derive an expression for rotational kinetic energy and use this expression for solving word problems;			*
5.6	Artificial Satellites and Weightlessness	5.6.1	describe reasons for weightlessness in artificial satellites;		*	
		5.6.2	relate free fall motion with orbital motion of satellites;		*	
		5.6.3	classify different types of satellites;		*	
		5.6.4	define geostationary orbits;	*		
		5.6.5	derive an expression for geostationary altitudes and solve problems based on this expression;			*
		5.6.6	explain how artificial gravity can be produced when a satellite revolves around the Earth;		*	
5.7	Orbital Velocity	5.7.1	define orbital velocity;	*		
		5.7.2	derive a relation for orbital velocity and use this relation for solving word problems.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
6.	**Fluid Dynamics**	Students should be able to:				
6.1	Streamline and Turbulent Flow	6.1.1	define the following terms: a. streamline flow, b. turbulent flow;	*		
		6.1.2	state the conditions required for turbulent flow;	*		
6.2	Equation of Continuity	6.2.1	derive the equation of continuity;			*
		6.2.2	describe the motion of a rocket using the equation of continuity;		*	
		6.2.3	solve word problems related to the equation of continuity;			*
6.3	Bernoulli's Equation	6.3.1	derive Bernoulli's equation;			*
		6.3.2	apply Bernoulli effect in the flow of air over an aerofoil, venturi meter and atomizers;			*
		6.3.3	solve word problems using Bernoulli's equation;			*
6.4	Viscous Fluids and Fluid Friction	6.4.1	define the following terms: a. viscous fluids, b. non-viscous fluids;	*		
		6.4.2	describe that viscous force in a fluid causes a retarding force on an object moving through it;		*	
		6.4.3	define fluid friction;	*		

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
6.5	Fluid Friction and Terminal Velocity	6.5.1	define terminal velocity;	*		
		6.5.2	describe the factors on which terminal velocity depends;		*	
		6.5.3	state Stoke's law;	*		
		6.5.4	derive an expression for terminal velocity of spherical body falling through viscous fluids by using Stoke's law;			*
		6.5.5	apply dimensional analysis to confirm the form of the Stoke's law.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
7.	**Oscillations**	Students should be able to:				
7.1	Simple Harmonic Motion (SHM)	7.1.1	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 in uniform circular motion; derive expression for instantaneous displacement, velocity and acceleration in terms of (ω);		*	 *
7.3	Phase Angle	7.3.1	define phase angle;	*		
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 7.5.3	show the motion of a simple pendulum is SHM; 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;			* * *
7.6	Energy Conservation in SHM	7.6.1	relate potential energy (PE) and kinetic energy (KE) with total energy for a body oscillating with SHM;		*	
7.7	Free and Forced Oscillation	7.7.1	exemplify free and forced oscillation;		*	
7.8	Resonance	7.8.1	exemplify resonance;		*	
7.9	Damped Oscillations	7.9.1 7.9.2	explain damped oscillation; list different applications of damped oscillation.	 *	*	

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
8.	**Waves**	Students should be able to:				
	8.1 Wave Motion	8.1.1	describe periodic waves;		*	
		8.1.2	exemplify the propagation of waves;		*	
		8.1.3	define progressive waves;	*		
		8.1.4	explain energy transfer through a progressive wave;		*	
		8.1.5	differentiate between transverse and longitudinal waves;		*	
		8.1.6	solve word problems using $V = f\lambda$;			*
	8.2 Speed of Sound	8.2.1	relate the speed of sound with the properties of the medium in which it propagates;		*	
		8.2.2	describe Newton's formula for the speed of sound;		*	
		8.2.3	discuss Laplace's correction to Newton's formula;		*	
		8.2.4	explain 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	explain the formation of beats using diagrams;		*	
	8.4 Stationary Waves	8.4.1	describe the formation of stationary waves using graphs;		*	
		8.4.2	define the terms nodes and antinodes;	*		
		8.4.3	describe the formation of stationary waves in a string;		*	
		8.4.4	classify the harmonic overtones in a string;		*	
		8.4.5	identify the formation of stationary waves in a vibrating air column;		*	
		8.4.6	solve word problems using $L = n\lambda / 2$;			*

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
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;			*
		8.5.3	solve word problems using the above relations;			*
		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.			*

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
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;		*	
		9.1.2	discuss the concept of wave-front;		*	
		9.1.3	describe Huygen's principle;		*	
		9.1.4	relate linear superposition of light with Huygen's principle;		*	
	9.2 Interference of Light	9.2.1	describe coherent 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 and use the relation in solving word problems;			*
	9.3 Interference in Thin Films	9.3.1	describe basic concept of interference in thin films;		*	
	9.4 Newton's Ring	9.4.1	exemplify the formation of Newton's rings;		*	
	9.5 Michelson's Interferometer	9.5.1	describe the working and uses of Michelson's interferometer;		*	
	9.6 Diffraction of Light	9.6.1	define diffraction of light;	*		
		9.6.2	describe diffraction of light by diffraction grating;		*	
		9.6.3	describe diffraction in a narrow slit;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
9.7	Bragg's Law	9.7.1	define Bragg's law;	*		
		9.7.2	describe X-rays diffraction through crystals;		*	
		9.7.3	describe the applications of X-rays diffraction in medical physics;		*	
		9.7.4	derive the equation $2\,d\,\sin\theta = m\,\lambda$ and use this equation for solving word problems;			*
9.8	Polarisation	9.8.1	describe unpolarised and polarised light;		*	
		9.8.2	explain polarisation with reference to transverse waves;		*	
		9.8.3	explain the production of polarisation by a polaroid;		*	
		9.8.4	describe the applications of polarisation in daily life.		*	

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
10. Thermodynamics		Students should be able to:				
10.1	Kinetic Theory of Gases	10.1.1	state basic postulates of kinetic theory of gases;	*		
		10.1.2	calculate pressure on a gas molecule inside a gas container;			*
		10.1.3	interpret temperature in terms of kinetic energy;			*
10.2	Gas Laws	10.2.1	derive Boyle's and Charles's law with the help of kinetic theory of gases;			*
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	describe the forms of energy transfer between systems, i.e. heat flow and work done;		*	
		10.4.2	explain work in terms of change in volume;		*	
		10.4.3	solve word problems related to the work done in thermodynamics system during a volume change;			*
10.5	Thermodynamics	10.5.1	define the 'thermodynamics' and 'thermal equilibrium';	*		
		10.5.2	explain the 1st law of thermodynamics;		*	
		10.5.3	apply the 1st law of thermodynamics in (a) isothermal, (b) adiabatic, (c) isobaric, (d) isochoric processes;			*
		10.5.4	calculate on the basis of the 1st law of thermodynamics a. change in internal energy, b. work done on the system, c. work done by the system;			*
		10.5.5	explain the 1st law of thermodynamics in terms of conservation of energy;		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
10.6	Specific and Molar Specific Heat of Gases	10.6.1 10.6.2 10.6.3	define the terms specific heat and molar specific heat; explain $C_p > C_v$ show that $C_p - C_v = R$ by using 1st law of thermodynamics;	*	*	*
10.7	Reversible and Irreversible Process	10.7.1	compare reversible and irreversible reactions;		*	
10.8	Second Law of Thermodynamics	10.8.1	explain the 2nd law of thermodynamics using schematic diagram;		*	
10.9	Carnot Engine	10.9.1 10.9.2 10.9.3	describe heat engine with reference to 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 word problems;		* *	*
10.10	Refrigerator	10.10.1 10.10.2	describe refrigerator as a reverse of heat engine; derive expression for the coefficient of performance of a refrigerator;		*	*
10.11	Entropy	10.11.1 10.11.2 10.11.3 10.11.4	explain 'entropy'; describe positive and negative entropy; explain that increase in entropy is an evidence of increase in temperature of a system; discuss environmental crisis as an entropy crisis.		* * * *	

Physics

Part II (Grade XII)

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
11. Electrostatics		Students should be able to:				
11.1	Electrostatics	11.1.1	describe charge and types of charge;		*	
11.2	Coulomb's Law	11.2.1 11.2.2 11.2.3	explain Coulomb's law for static charges; describe the effect of medium on Coulomb's force; discuss the working of ink-jet printer and photocopier with reference to electrostatic;		* * *	
11.3	Electric Field and Electric Intensity	11.3.1 11.3.2 11.3.3 11.3.4	define electric intensity; derive an expression for the magnitude of electric field of a distance or from a point charge "q" and use the expression in solving word problems; compare electric field lines formed when a. same charges are brought together, b. opposite charges are brought together; describe the concept of electric dipole;	* 	 * *	 *
11.4	Electric Flux	11.4.1	explain electric flux;		*	
11.5	Gauss's Law with its Applications	11.5.1 11.5.2	explain Gauss's law; apply Gauss's law to find the electric field intensity produced a. due to a hollow charged spherical, b. due to an infinite sheet of charge, c. between two opposite charged parallel plates;		*	 *

Topics and Sub-topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
11.6	Electric Potential	11.6.1	describe electric potential at a point as work done in bringing a unit charge from infinity to that point;		*	
		11.6.2	state 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 measure the charge on an electron;		*	
11.7	Capacitor	11.7.1	evaluate capacitance of parallel plate capacitors in terms of area, distance and permittivity of free space;			*
		11.7.2	calculate capacitance of different capacitors in series and in parallel using formulae;			*
		11.7.3	describe the effects of resistance in charging and discharging of capacitors with the help of *q-t* graph;		*	
		11.7.4	describe time constant;		*	
		11.7.5	describe that the product of *RC* has the same unit as time $\tau = RC$;		*	
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 polarisation of dielectric of a capacitor.		*	

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
12.	**Current Electricity**	Students should be able to:				
12.1	Current Electricity	12.1.1	define electric current;	*		
		12.1.2	describe the flow of current in a conductor;		*	
		12.1.3	distinguish between conventional and non-conventional current;		*	
12.2	Resistance	12.2.1	define resistance and conductance;	*		
		12.2.2	define voltage;	*		
		12.2.3	state Ohm's law;	*		
		12.2.4	explain factors affecting resistance;		*	
		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	describe the relationship between temperature and resistance;		*	
		12.3.6	calculate the value of carbon resistance by using colour codes;			*
12.4	Internal Resistance	12.4.1	define electromotive force (e.m.f.);	*		
		12.4.2	derive a relationship between e.m.f. and potential difference (PD) 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 electric power;	*		
		12.4.5	calculate the formula of power in terms of current (I), voltage (V) and resistance (R);			*

Physics

Topics and Sub-Topics	Student Learning Outcomes		Cognitive levels		
			K	U	A
	Students should be able to:				
	12.4.6	calculate the power dissipation due to the internal resistance of a circuit;			*
12.5 Kirchoff's Laws	12.5.1 12.5.2 12.5.3	explain Kirchoff's laws; explain conservation of charge in a circuit with the help of Kirchoff's 1st law; explain conservation of energy in a circuit with the help of Kirchoff's 2nd law;		* * *	
12.6 Potential Divider	12.6.1 12.6.2 12.6.3	exemplify potential divider; explain the construction and working of a rheostat with the help of a diagram; explain the functions of a rheostat as a potential divider;		* * *	
12.7 Balanced Potential	12.7.1 12.7.2 12.7.3 12.7.4 12.7.5	describe Wheatstone bridge with the help of a diagram; calculate the unknown resistance by using a Whetstone bridge; describe potentiometre with the help of diagram; describe the measurement and comparison of e.m.f. by using potentiometre; explain the accuracy of potentiometre for e.m.f.'s measurement and comparison.		* * * *	 *

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
13.	**Electromagnetism**	Students should be able to:				
	13.1 Current Carrying Conductor in a Magnetic Field	13.1.1	describe magnetic field due to current in a straight wire;		*	
		13.1.2	describe the direction of magnetic field produced by a current carrying conductor;		*	
		13.1.3	compare strong and weak magnetic fields;		*	
		13.1.4	derive an expression for force, i.e. $F = ILB\sin\theta$ and use this equation for solving word problems;			*
		13.1.5	describe magnetic flux and magnetic flux density and solve problems using $\phi = \vec{B}.\vec{A}$;		*	
		13.1.6	describe factors governing field produced by long straight wire;		*	
		13.1.7	explain Ampere's law;		*	
		13.1.8	discuss applications of Ampere's law in a. straight current carrying wire, b. solenoid;		*	
	13.2 Force on a Moving Charged Particle	13.2.1	derive an equation for force on a moving charge in a uniform magnetic field and beam of particles and use this equation for solving word problems;			*
		13.2.2	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;		*	

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
13.4	Current Carrying Rectangular Coils in a Uniform Magnetic Field	13.4.1	derive an expression of torque due to a couple acting on a coil and use this expression for solving word problems;			*
		13.4.2	define sensitivity of a galvanometre;	*		
13.5	Electrical Instruments	13.5.1	explain the principle, construction and working of a. galvanometer, b. voltmeter, c. ammeter, d. AVO meter, e. analogue digital multimetre (DMM);		*	
		13.5.2	explain different types of galvanometer;		*	
		13.5.3	list the important steps to change a galvanometre into voltmetre and ammetre.	*		
		13.5.4	differentiate between analogue and digital multimetre.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
14.	**Electromagnetic Induction**	Students should be able to:				
	14.1 Law of Electromagnetic Induction	14.1.1	describe electromagnetic induction;		*	
		14.1.2	explain Faraday's law of electromagnetic induction;		*	
		14.1.3	apply Lenz's law to determine the direction of induced e.m.f.;			*
	14.2 Inductance	14.2.1	distinguish between inductance and induction;		*	
		14.2.2	explain self and mutual induction with formula and units;		*	
	14.3 Energy Stored in an Inductor	14.3.1	derive the formula $E = \frac{1}{2} L I^2$;			*
		14.3.2	show that the energy is stored in an inductor;			*
	14.4 Simple Alternating Current (AC) Generator, Direct Current (DC) Generator and Direct Current (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 the effects of back e.m.f. in motor and back motor effects 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	list 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 word problems;			*
		14.5.5	describe the simple energy losses due to eddy current and hysteresis.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
15.	**Alternating Current**	Students should be able to:				
	15.1 Root Mean Square Value (rms)	15.1.1	describe sinusoidal waves;		*	
		15.1.2	define alternating current and alternating voltage;	*		
		15.1.3	describe the following terms: a. time period, b. frequency, c. peak value;		*	
		15.1.4	calculate the rms value of alternate current and alternate voltage;			*
	15.2 Alternating Current (AC) Circuits	15.2.1	explain the flow of AC through resister, capacitor and inductor;		*	
		15.2.2	explain 'phase lag' and 'phase lead' in a circuit through a vector diagram;		*	
	15.3 Impedance	15.3.1	derive the expression of 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 electromagnetic (EM) waves;		*	
		15.5.3	describe the amplitude modulation (AM) and frequency modulation (FM).		*	

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
16.	**Physics of Solids**	Students should be able to:				
	16.1 Classification of Solids	16.1.1	define lattice and unit cell of crystalline solids;	*		
		16.1.2	distinguish among the structures of crystalline, amorphous and polymeric solids;		*	
	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 deformed material from an area under the force and extension graph;			*
	16.3 Electric Properties of Solids	16.3.1	define conductors, insulators and semiconductors;	*		
		16.3.2	describe energy bands in solids;		*	
		16.3.3	describe energy gaps in insulators and, intrinsic and extrinsic semiconductors;		*	
	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	state domain theory of magnetism;	*		
		16.5.2	describe diamagnetic, paramagnetic and ferromagnetic solids;		*	
		16.5.3	describe ferromagnets as a special case of paramagnets, magnetic dipoles and domains;		*	
		16.5.4	define the following terms: a. curie point, b. soft and hard magnetic substances.	*		

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
17. Electronics		Students should be able to:				
17.1	Electronics	17.1.1	define electronics;	*		
17.2	Semiconductor Devices	17.2.1	differentiate between conductors and insulators;		*	
		17.2.2	describe semiconductors materials;		*	
		17.2.3	differentiate between p-type and n-type semiconductors with the help of diagrams;		*	
		17.2.4	describe p-n junction and p-n junction diode with labelled diagrams;		*	
		17.2.5	describe forward and reverse bias;		*	
		17.2.6	describe direct current;		*	
		17.2.7	define rectification;	*		
		17.2.8	describe half and full wave rectification;		*	
		17.2.9	describe the function and uses of light-emitting diodes (LEDs) and photodiodes;		*	
		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	define operational amplifier;	*		
		17.3.2	describe operational amplifier as an inverting and non-inverting amplifier;		*	
		17.3.3	explain the uses of transistor as a switch and as an amplifier;		*	
17.4	Digital System	17.4.1	describe logic gates;		*	
		17.4.2	explain functions of logic gates with the help of truth table with two inputs;		*	
		17.4.3	relate different logic gates and their control function.		*	

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
18.	**Dawn of Modern Physics**	Students 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	describe if the speed of light (c) is constant then space and time become relative;		*	
		18.1.4	describe the consequences of special theory of relativity;		*	
		18.1.5	explain the amplification of a. mass increase, b. time dilation, c. length contraction for speed travel;		*	
	18.2 Quantum Theory	18.2.1	discuss the blackbody radiations using wavelength-energy graph;		*	
		18.2.2	describe laws governing blackbody radiations and their drawbacks;		*	
		18.2.3	explain Planck's assumption for the existence of blackbody;		*	
		18.2.4	describe that the radiations emitted and absorbed by blackbody is quantised;		*	
		18.2.5	discuss photon as an electromagnetic radiation;		*	
	18.3 Photoelectric Effect	18.3.1	describe photoelectric effect;		*	
		18.3.2	explain different features of photoelectric effect using a graph;		*	
		18.3.3	derive Einstein's photoelectric equation;			*
		18.3.4	define a photocell;	*		
		18.3.5	list the uses of photocell;	*		

Physics

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
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;		*	
18.5	Dual Nature of Light	18.5.1	describe particle nature of light;		*	
		18.5.2	discuss the wave nature of light;		*	
		18.5.3	state de-Broglie's hypothesis;	*		
		18.5.4	explain that every particle has wave nature as well as particle nature with the reference to de-Broglie's hypothesis;		*	
		18.5.5	describe Davison and Germer experiment;		*	
		18.5.6	state the uncertainty principle;	*		
		18.5.7	explain the uncertainty principle with the help of an experiment.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
19.	**Atomic Spectra**	Students should be able to:				
	19.1 Atomic Spectra, Spectrum of Hydrogen, Bohr's model of Hydrogen Atom	19.1.1	describe the origin of different types of optical spectra;		*	
		19.1.2	analyse the experimental facts of hydrogen spectrum;			*
		19.1.3	describe Bohr's atomic model of hydrogen atom;		*	
		19.1.4	explain hydrogen spectrum in terms of energy levels;		*	
		19.1.5	derive an expression for quantized radii;			*
		19.1.6	prove $1/\lambda = R_H\left[\frac{1}{p^2}-\frac{1}{n^2}\right]$;			*
		19.1.7	solve word problems related to the SLO 19.1.6;			*
	19.2 Emission Spectrum	19.2.1	deduce spectral lines through discrete electron energy level;			*
	19.3 Excitation and Ionization Potential	19.3.1	define excitation potential and ionisation potential;	*		
		19.3.2	determine ion energy and excitation energy levels of an atom using an energy level diagram;			*
	19.4 Inner Shell Transition and Characteristics	19.4.1	describe inner shell transitions;		*	
		19.4.2	explain production and characteristics of X-rays based on inner shell transition;		*	
		19.4.3	explain the production, properties and uses of X-rays;		*	
	19.5 Lasers	19.5.1	describe the following terms: a. spontaneous emission, b. stimulated emission, c. meta-stable state, d. population inversion,` e. laser action;		*	
		19.5.2	describe the structure and functions of main components of He-Ne laser gas.		*	

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
20.	**Nuclear Physics**	Students 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 the following terms: a. atomic number, b. mass number, c. isotopes, d. 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 following terms: a. mass defect, b. binding energy;	*		
		20.4.2	identify (graphically) variation of binding energy per nucleon using mass number;		*	
	20.5 Radioactivity	20.5.1	define the term 'radioactivity';	*		
		20.5.2	list the properties of α, β and γ radiations;	*		
	20.6 Law of Radioactive Decay	20.6.1	explain the process of radioactive decay;		*	
		20.6.2	describe α, β and γ decay with balanced equations;		*	
		20.6.3	define half-life of a radioactive element;	*		
		20.6.4	derive an equation for first and second half-life from the decay of radioactive element;			*

Topics and Sub-Topics		Student Learning Outcomes		Cognitive levels		
				K	U	A
		Students should be able to:				
20.7	Detection of Ionizing Radiation	20.7.1	describe the effect of α, β particles and γ rays on matter;		*	
		20.7.2	analyse the nature of radiations emitted from a radioactive particle by using Wilson cloud chamber, Geiger-Muller (G.M.) counter and solid state detector;			*
20.8	Nuclear Fission and Fusion	20.8.1	differentiate between nuclear fission and fusion;		*	
20.9	Nuclear Reactor	20.9.1	explain the working principle of a nuclear reactor;		*	
		20.9.2	list the various types of nuclear reactor;	*		
20.10	Nuclear Radiations and Exposure	20.10.1	discuss the biological effects due to exposure of nuclear radiations;		*	
20.11	Medical Physics	20.11.1	describe uses of radiations for medical diagnosis and therapy;		*	
		20.11.2	describe importance of limiting exposure to ionising 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.		*	

Blank Page