SECTION 3: PHYSICS

3.1. Content List for Physics

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1	Force and motion
2	Work and energy
3	Rotational and circular motion
4	Waves
5	Thermodynamics
6	Electrostatics
7	Current Electricity
8	Electromagnetism
9	Electromagnetic Induction
10	Electronics
11	Dawn of modern Physics
12	Atomic spectra
13	Nuclear Physics

3.2. Subtopics & Learning Objectives

1- FORCE AND MOTION

SUBTOPICS

- Displacement
- Velocity
- Displacement-time graph
- Acceleration
- Uniform acceleration
- Variable acceleration
- Graphical representation of acceleration with velocity time graph
- Newton's laws of motion
- Newton's first law of motion
- Newton's second law of motion
- Newton's third law of motion
- Linear Momentum
- Law of conservation of momentum
- Collision
- Elastic collision
- Elastic collision in one dimension
- Elastic collision in one dimension under different cases
- Projectile motion
- Characteristics of projectile motion
- Time off light
- Maximum height
- Horizontal range

LEARNING OBJETIVES

1.1. Describe displacement.
1.2. Describe average velocity of objects.
1.3. Interpret displacement-time graph of objects moving along the same straight line.
1.4. Define uniform acceleration
1.5. Distinguish between uniform and variable acceleration.
1.6. Explain that projectile motion is two-dimensional motion in a vertical plane.
1.7. Communicate the ideas of a projectile in the absence of air resistance.
1.8. Explain Horizontal component (VH) of velocity is constant.
1.9. Acceleration is in the vertical direction and is the same as that of a vertically free-falling object.
1.10. Differentiate between the characteristics of horizontal motion and vertical motion
1.11. Evaluate, using equations of uniformly accelerated motion for a given initial velocity of frictionless projectile, the following issues:
    a. How much higher does it go?
    b. How far would it go along the level land?
    c. Where would it be after a given time?
    d. How long will it remain in air?
    e. Determine for a projectile launched from ground height
    f. Launch angle that results in the maximum range
    g. Relation between the launch angles that result in the same range.
1.12. Apply Newton’s laws to explain the motion of objects in a variety of context.
1.13. Describe the Newton’s second law of motion as rate of change of momentum.
1.14. Correlate Newton’s third law of motion and conservation of momentum.
1.15. Solve different problems of elastic and inelastic collisions between two bodies in one dimension by using law of conservation of momentum.
1.16. Describe that momentum is conservational situations.
1.17. Identify that for a perfectly elastic collision, the relative speed of approach is equal to the relative speed of separation.

2- WORK AND ENERGY	**SUBTOPICS** • Work • Energy • Kinetic energy • Potential energy • Gravitational potential energy • Power
	LEARNING OBJECTIVES 2.1. Describe the concept of work in terms of the product of force F and displacement d in the direction of force 2.2. Define energy 2.3. Explain kinetic energy 2.4. Explain the difference between potential energy and gravitational potential energy. 2.5. Describe that the gravitational potential energy is measured from a reference level and can be positive or negative, to denote the orientation from the reference levels. 2.6. Express power as scalar product of force and velocity. 2.7. Explain that work done against friction is dissipated as heat in the environment. 2.8. State the implications of energy losses in practical devices
3- ROTATIONAL AND CIRCULAR MOTION	**SUBTOPICS** • Angular displacement • Revolution • Degree • Radian • Angular velocity • Relation between linear and angular variables • Relation between linear and angular displacements • Relation between linear and angular velocities • Relation between linear and angular accelerations • Centripetal force • Forces causing centripetal acceleration
	LEARNING OBJECTIVES 3.1. Define angular displacement, express angular displacement in radians. 3.2. Define revolution, degree and radian 3.3. Define and Explain the term angular velocity 3.4. Find out the relationship between the following: a. Relation between linear and angular variables b. Relation between linear and angular displacements c. Relation between linear and angular velocities d. Relation between linear and angular accelerations

4- WAVES

SUBTOPICS

- Progressive waves
- Crest
- Trough
- Amplitude
- Wavelength
- Time period and frequency
- Types of progressive waves
- Transverse waves
- Longitudinal waves
- Periodic waves
- Transverse periodic waves
- Longitudinal periodic waves
- Speed of sound in air
- Principle of superposition/superposition of sound waves
- Stationary waves/standing waves
- Stationary waves in a stretched string/fundamental frequency and harmonics
- Doppler effect
- Observer is moving towards a stationary source
- Observer is moving away from a stationary source
- When the source is moving towards the stationary observer
- When the source is moving away from the stationary observer
- Simple harmonic motion (SHM)
- Characteristics of simple harmonic motion
- Instant aeneous displacement
- Amplitude
- Vibration
- Time period
- Frequency

LEARNING OBJETIVES

4.1. Describe the meaning of wave motion as illustrated by vibrations in ropes and springs.
4.2. Demonstrate that mechanical waves require a medium for their propagation while electromagnetic waves do not.
4.3. Define and apply the following terms to the wave model; medium, displacement, amplitude, period, compression, rarefaction, crest, trough, wavelength, velocity.
4.4. Solve problems using the equation: v=fl.
4.5. Describe that energy is transferred due to a progressive wave.
4.6. Compare transverse and longitudinal waves.
4.7. Explain that speed of sound depends on the properties of medium in which it propagates and describe Newton's formula of speed of waves.
4.8.Describe the Laplace correction in Newton's formula for speed of sound in air.
4.9. Identify the factors on which speed of sound in air depends.
4.10. Describe the principle of super position of two waves from coherent sources.
4.11. Describe the phenomenon of interference of sound waves.
4.12. Explain the formation of stationary waves using graphical method
4.13. Define the terms, node and antinodes.
4.14. Describe modes of vibration of strings.
4.15. Describe formation of stationary waves in vibrating air columns.
4.16. Explain the principle of Superposition
4.17. Explain S.H.M and explain the characteristics of S.H.M.

5- THERMODYNAMICS	**SUBTOPICS** • First law of thermodynamics • Specific heat and Molar specific heat/specific heat capacity
	LEARNING OBJECTIVES 5.1. Describe that thermal energies transferred from a region of higher temperature to a region of lower temperature. 5.2. Differentiate between specific heat and molar specific heat. 5.3. Calculate work done by a thermodynamic system during a volume change. 5.4. Describe the first law of thermodynamics expressed in terms of the change in internal energy, the heating of the system and work done on the system. 5.5. Explain that first law of thermodynamics expresses the conservation of energy. 5.6. Define the terms, specific heat and molar specific heats of a gas. 5.7. Apply first law of thermodynamics to derive Cp–Cv= R.
6- ELECTROSTATICS	**SUBTOPICS** • Coulomb's law • Coulomb's law in material media • Electric field and its intensity • Electric field intensity due to an infinite sheet of charge • Electric field intensity between two oppositely charged parallel plates • Electric potential • Capacitor • Capacitance of a capacitor and its unit • Capacitance of a parallel plate capacitor • Energy Stored in a Capacitor • Charging and Discharging a Capacitor
	LEARNING OBJECTIVES 6.1. State Coulomb's law and explain that force between two-point charges is reduced in a medium other than free space using Coulomb's law 6.2. Describe the concept of an electric field as an example of a field of force 6.3. Calculate the magnitude and direction of the electric field at a point due to two charges with the same or opposite signs 6.4. Sketch the electric field lines for two-point charges of equal magnitude with same or opposite signs 6.5. Describe and draw the electric field due to an infinite size conducting plate of positive or negative charge 6.6 Define electric potential at a point in terms of the work done in bringing unit positive charge from infinity to that point 6.7. Define the unit of potential 6.8. Derive an expression for electric potential at a point due to a point charge 6.9. Demonstrate charging and discharging of a capacitor through a resistance

7- CURRENT ELECTRICITY	**SUBTOPICS** • Ohm's Law • Electrical resistance • Specific resistance or resistivity • Effect of temperature on resistance • Temperature coefficient of resistance • Variation of resistivity with temperature • Internal resistance of a supply • Electric power • Unit of electric power • Kilowatt-hours
	LEARNING OBJECTIVES 7.1. Describe the concept of steady current. 7.2. State Ohm's law. 7.3. Define resistivity and explain its dependence upon temperature. 7.4. Explain the internal resistance of sources and its consequences for external circuits. 7.5. Describe the conditions for maximum power transfer.
8- ELECTROMAGNETISM	**SUBTOPICS** • Magnetic field • Magnetic Flux • Magnetic Flux Density
	LEARNING OBJECTIVES 8.1. Define magnetic flux density and its units. 8.2. Describe the concept of magnetic flux(Ø) as scalar product of magnetic field(B) and area(A)using the relation ØB=B⊥A=B.A. 8.3. Describe quantitatively the path followed by a charged particle hot into a magnetic field in a direction perpendicular to the field. 8.4. Explain that a force may act on a charged particle in a uniform magnetic field.
9- ELECTROMAGNETIC INDUCTION	**SUBTOPICS** • Electromagnetic induction • Faraday's Law • Lenz's Law • Lenz's Law and conservation of energy • Generating electricity-Alternating Current Generator • Transformers
	LEARNING OBJECTIVES 9.1. State Faraday's law of electromagnetic induction. 9.2. Account for Lenz's law to predict the direction of an induced current and relate to the principle of conservation of energy. 9.3. Describe the construction of a transformer and explain how it works. 9.4. Describe how set-up and step-down transformers can be used to ensure efficient transfer of electricity along cables.

10- ELECTRONICS	**SUBTOPICS** • Rectification
	LEARNING OBJECTIVES 10.1. Define rectification and describe the use of diodes for half and full wave rectifications.
11- DAWN OF MODERN PHYSICS	**SUBTOPICS** • The particle model of light
	LEARNING OBJECTIVES 11.1. Explain the particle model of light in terms of photons with particular energy
12- SPECTRA SPECTRA	**SUBTOPICS** • Atomic spectra/ line spectrum
	LEARNING OBJECTIVES 12.1. Describe and explain Atomic spectra/ line spectrum
13- NUCLEAR PHYSICS	**SUBTOPICS** • Spontaneous and random nuclear decay/the law of radioactive decay • Half Life and rate of decay • Biological effects of radiation • Biological and medical uses of radiation
	LEARNING OBJECTIVES 13.1. Describe as impel model for the atom to include protons, neutrons and electrons. 13.2. Identify the spontaneous and random nature of nuclear decay. 13.3. Describe the term half-life and solve problems using the equation 13.4. Describe biological effects of radiation state and explain the different medical uses of radiation.