The student has to concentrate on..

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IPE Overall Strategy:

The total syllabus of 1st year can be divided into 3 parts.

Part-I	Part-II	Part-III
✓Physical world	✓Oscillations	✓Thermal properties of matter
✓Units and measurements	✓Gravitation	✓Thermodynamics
✓Motion in a straight line	✓Mechanical properties of solids	✓Kinetic theory
✓Motion in a plane	✓Mechanical properties of fluids	
✓Laws of motion		
✓Work, energy and power		
✓System of particles and rotational motion		

- First, the student has to concentrate on Long Answer Questions (LAQ) i.e. Section-C of question paper. We can expect one question from each part of above 3 parts.
- From part 1, the important questions may be like..
  - i) State and prove conservation of energy
  - ii) Newton's laws and their applications
  - iii) Conservation of Angular momentum and linear momentum.
- From part 2, the important questions may be like..
  - i) Time period simple pendulum derivation
  - ii) Gravitational potential energy, variation of g, determination of universal gravitational constant G
  - iii) Determination of Young's modulus, Bernoulli's theorem, Viscosity.
- From part 3,
  - i) Newton's laws of cooling
  - ii) Carnot Engine & refrigerator
  - iii) Pressure of an ideal gas.

IMPORTANT LONG ANSWER QUESTIONS

Part-I

- a) State newton's second law of motion. Hence derive the equation of motion F = ma from it.
  b) A body is moving along a circular path such that its speed always remains constant. Should there be a force acting on the body?
- Define angle of friction and angle of repose. Show that angle of friction is equal to angle of repose for a rough inclined plane. A block of repose for a rough inclined plane. A block of mass 4 kg is resting on a rough horizontal plane and is about to move when a horizontal force of 30 N is applied on it. If g = 10 ms^{-2}. Find the total contact force exerted by the plane on the block.
- Develop the notions of work and kinetic energy and show that it leads to work-energy theorem.
- What are collisions? Explain the possible types of collisions? Develop the theory of one dimensional elastic collision.
- State the law of conservation of energy and verify it in case of a freely falling body. What are the conditions under which the law of conservation of energy is applicable?
- a) State and prove parallel axes theorem.
  b) For a thin flat circular disk, the radius of gyration about a diameter as axis is k. If the disk is cut along a diameter AB as shown in to two equal pieces, then find the radius of gyration of each piece about AB.
- a) State and prove perpendicular axes theorem.
  b) If a thin circular ring and a thin flat circular disk of same mass have same moment of inertia about their respective diameters as axes. Then find the ratio of their radii.

- State and prove the principle of conservation of angular momentum. Explain the principle of conservation of angular momentum with examples.

Part-II

- Define simple harmonic motion. Show that the motion of (point) projection of a particle performing uniform circular motion, on any diameter, is simple harmonic.
- Show that the motion of a simple pendulum is simple harmonic and hence derive an equation for its time period. What is seconds pendulum?
- State Bernoulli's principle. From conservation of energy in a fluid flow through a tube, arrive at Bernoulli's equation. Give an application of Bernoulli's theorem.
- Define coefficient of viscosity. Explain Stoke's law and explain the conditions under which a rain drop attains terminal velocity 'v_1'. Give the expression for 'v_1'.

Part-III

- State Boyle's law and Charle's law. Hence, derive ideal gas equation. Which of the two laws is better for the purpose of thermometry and why?
- Explain thermal conductivity and coefficient of thermal conductivity. A copper bar of thermal conductivity 401 W/mK has one end at 104°C and the other end at 24°C. The length of the bar is 0.10 m and the cross-sectional area is 1.0×10^{-6} m^2. What is the rate of heat conduction, along the bar?
- State and explain Newton's law of cooling. State the conditions under which Newton's law of cooling is applicable. A body cools down from 60°C to 50°C in 5 minutes and to 40°C in another 8 minutes. Find the temperature of the surroundings.

- Explain reversible and irreversible processes. Describe the working of Cornot engine. Obtain an expression for the efficiency.
- State second law of thermodynamics. How is heat engine different from a refrigerator?
- Derive an expression for the pressure of an ideal gas in a container from Kinetic Theory and hence give Kinetic Interpretation of Temperature.

IMPORTANT SHORT ANSWER QUESTIONS

Part-I

- A parachutist flying in an aeroplane jumps when it is at a height of 3 km above ground. He opens his parachute when he is about 1 km above ground. Describe his motion.
- A bird holds a fruit in its beak and flied parallel to the ground. It lets go of the fruit at some height. Describe the trajectory of the fruit as it falls to the ground as seen by (a) the bird (b) a person on the ground.
- Show that the maximum height reached by a projectile launched at an angle of 45° is one quarter of its range.
- State parallelogram law of vectors. Derive an expression for the magnitude and direction of the resultant.
- What is relative motion? Explain it.
- Show that a boat must move at an angle of 90° with respect to river water in order to cross the river in a minimum time?
- Define unit vector, null vector and position vector.
- If $|\vec{a}+\vec{b}|=|\vec{a}-\vec{b}|$, prove that the angle between $\vec{a}$ and $\vec{b}$ is 90°.
- Show that the trajectory of an object thrown at certain angle with the horizontal is a parabola.
- Explain the terms the average velocity and instantaneous velocity. When are they equal?
- Show that the maximum height and range of a projectile are $\frac{U^2Sin^2\theta}{2g}$ and $\frac{U^2Sin^2 2\theta}{g}$ respectively where the terms have their regular meanings.
- A stone of mass 0.1 kg is thrown vertically upwards. Give the magnitude and direction of the net force on the stone (a) during its upward motion ,(b) during the downward motion, (c) at the highest point where it momentarily comes to rest.
- Define the terms momentum and impulse. State and explain the law of conservation of linear momentum. Give examples.
- Why are shock absorbers used in motor cycles and cars?
- Explain the terms limiting friction, dynamic friction and rolling friction.
- Explain advantages and disadvantages of friction.
- Mention the methods used to decrease friction.
- State the laws of rolling friction.
- Why is pulling the lawn roller preferred to pushing it?
- What is potential energy? Derive an expression for the gravitational potential energy.
- A lorry and a car moving with the same momentum are brought to rest by the application of brakes which provide equal retarding forces. Which of them will come to rest in shorter time? Which will come to rest in less distance?
- Distinguish between conservative and non-conservative forces with one example each.
- Show that in the case of one dimensional elastic collision, the relative velocity of approach of two colliding bodies before collision is equal to the relative velocity of separation after collision.
- Distinguish between centre of mass and centre of gravity.
- Explain about the centre of mass of Earth-Moon system and its rotation around the sun.
- Define vector product. Explain the properties of a vector product with two examples.
- Define angular velocity (ω). Derive $v = r\omega$.
- Define angular acceleration and torque. Establish the relation between angular acceleration and torque.

Part-II

- Define simple harmonic motion? Give two examples.
- What is Phase? Discuss the phase relations between displacement velocity and acceleration in simple harmonic motion.
- Obtain an equation for the frequency of oscillation of spring of force constant k to which a mass m, is attached.
- Derive the expressions for displacement, velocity and acceleration of a particle executing SHM.
- State Kepler's laws of planetary motion.
- Derive the relation between acceleration due to gravity (g) at the surface of a planet and gravitational constant (G).
- How does the acceleration due to gravity 'g' change for the same values of height (h) and depth (d).
- What is Orbital velocity ? Obtain an Expression for it.
- What is escape velocity ? Obtain an expression for it.
- What is a Geostationary satellite? State its uses.
- Define Hooke's law of elasticity, proportionality limit, permanent set and breaking stress.
- Define modulus of elasticity, stress, strain and Poisson's ratio.
- Describe the behaviour of a wire under gradually increasing load.
- What is atmospheric pressure and how is it determined using Barometer?
- What is gauge pressure and how is a manometer used for measuring pressure differences?
- State Pascal's law and verify it with the help of an experiment.
- Explain hydraulic lift and hydraulic brakes.
- What is Hydrostatic paradox?
- Explain how pressure varies with depth.
- What is Torricelli's law? Explain how the speed of efflux is determined with an experiment.
- What is Venturi-meter? Explain how it is used.
- What is Reynold's number? What is it's significance?
- Explain dynamic lift with examples.
- Explain Surface Tension and Surface energy.
- Explain how surface tension can be measured experimentally.

Part-III

- Explain Celsius and Fahrenheit scales of temperature. Obtain the relation between Celsius and Fahrenheit scales of temperature.
- Pendulum clocks generally go fast in winter and slow in summer. Why?
- In what way is the anomalous behaviour of water advantageous to aquatic animals?
- Explain conduction, convection and radiation with examples.
- Write a short notes on triple point of water.
- Explain how C_p of a gas is greater than C_v?
- State and explain first law of thermo dynamics.
- Define two principal specific heats of a gas Which is greater and why?
- Derive the relation between the two specific heat capacities of a gas on the basis of first law of thermodynamics.
- Obtain an expression for the work done by and ideal gas during isothermal change.
- Obtain an expression for the work done by an ideal gas during adiabatic change and explain.
- Compare isothermal and an adiabatic processes.
- How specific heat capacity of mono atomic, diatomic and poly atomic gases can be explained on the basis of Law of equipartition of energy?

The student must prepare all VSAQs of all chapters to get full marks.