[This question paper contains 5 printed pages.]

5096   **B**

B.Sc./B.Sc. (Hons.)/I
PH-101—PHYSICS

Time : *3 Hours*   *Maximum Marks* : *75*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *Five* questions in all including
Question No. 1 which is compulsory.

1. Attempt any *five* of the following :   5×3=15

    (*a*) Calculate the period of an artificial satellite of
          the earth in circular orbit at a height of 300 km
          above the surface of earth. Radius of
          earth = 6,371 km., Mass of earth = 6×10^{24} kg.,
          $G = 6.67 \times 10^{-11}$ Nm^2 kg^{-2}.

    (*b*) Calculate the percentage contraction in the length
          of a rod moving with a velocity of 0.8C in a direction
          inclined at 60° to its length.

    (*c*) What are massless particles ? If photons have
          speed C in one reference frame, can they be found
          at rest in any other frame. Give reason for your
          answer.

    (*d*) A particle is executing simple harmonic motion with
          time period T. Calculate the time taken by the
   particle to go from the extreme position to mean
          position.

(e) What features of laser make it suitable for medical applications ?

(f) Give the truth table of full adder and give its logic circuit.

(g) Calculate the rate at which water flows through a capillary tube of length 0.5 m with internal diameter of 1 mm. Coefficient of viscosity is 1.3×10^{-3} kg/m-sec. The pressure head is 20 cm. of water.

(h) What is Action Potential ? How does it travel down the Axon of a neuron ?

2. (a) Distinguish between inertial and non-inertial frame of reference.   2

(b) What is meant by Galilean transformations and Galilean invariance ? Show that while length and acceleration are invarient under Galilean transformations, velocity is not.   8

(c) State and prove Work-Energy theorem. Is this theorem valid for all kinds of forces ?   5

3. (a) Establish the relativistic formula for velocity addition. What is the relative speed of two photons approaching each other ?   8

(b) Derive the relation $= E^2 = p^2C^2 + m_0^2C^4$ where terms have their usual meaning. Start from

$$m = m_0 \left[1 - \frac{v^2}{c^2} \right]^{-1/2}$$

7

4. (a) Find the expression for torque required to twist a wire of length l, radius r, and modulus of rigidity η through an angle ϕ. Use this expression to determine the time period of a tortional pendulum having moment of inertia I.   10

   (b) What is the velocity of π meson whose proper mean life is 2.5×10^{-8} sec. and observed mean life is 2.5×10^{-7} sec.   5

5. (a) Two identical pendulums of length l and mass m are connected by a spring of force constant K as shown. Find the two normal mode frequencies. 8
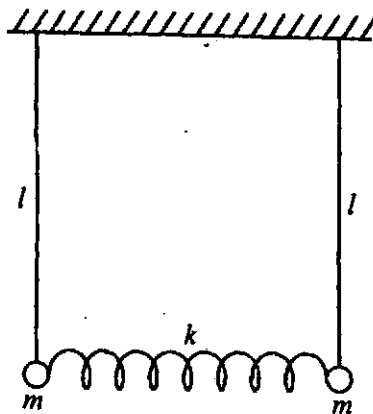
(b) Motion of a lightly damped harmonic oscillator of mass m is given by

$$x(t) = A_0 e^{-\lambda t} \sin (\omega t + \phi)$$

where A_0 and ϕ are constants, λ is the damping constant and $\omega = \sqrt{\omega_0^2 - \lambda^2}$, with ω_0 being the undamped angular frequency.

Show that the average energy decreases exponentially with time. 7

6. (a) Derive an expression for the fringe width in a Young's double slit experiment. Suppose this experiment is performed with white light. What is the colour of the central fringe. What is the colour of the fringe nearest to the central maxima ? 10

(b) A completely unpolarized light of intensity I_0 passes through a polariser and then through an analyser, which makes 30° angle with the polariser. What is the final intensity of light ? 5

7. (a) Explain the working of a monostable multivibrator using IC 555 Timer. Derive the expression for frequency and duty cycle of output. 8

(b) What is an R-S flip flop ? Give its truth table and circuit diagram using NAND gates. 4

(c) Explain the working of an LED. 3

8. (a) Discuss the principle of measurement of blood pressure with a sphygmo monometer.   4

    (b) Define the coefficient of viscosity. Show that the velocity of a streamline flow in a cylinder is given by

    $$V(r) = \frac{(p_1 - p_2)}{4\eta L}(R^2 - r^2)$$

    Where p_1 and p_2 are pressures at the two ends, L is its length, R its radius and η is coefficient of viscosity of liquid.   8

    (c) Realise .
         gates.