

June 2018

**APPLIED PHYSICS**

Time Allowed: 2 Hours

Full Marks: 35

**Answer to Question No.1 is compulsory and to be answered first.****This answer is to be made in separate loose script(s) provided for the purpose.****Maximum time allowed is 30 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided.****On early submission of answer scripts of Question No.1,  
a student will get the remaining script earlier.****Answer any five questions from Group-A & B, as directed.**

1. Choose the correct answer from the given alternatives: 10x1
- i) The retardation ( $f$ ) of a particle moving along a straight path varies with time ( $t$ ) as  $f = 4t$ . If the initial velocity of the particle be zero, find the time in which the velocity increases to  $32 \text{ ms}^{-1}$  – (a) 16 s, (b) 8 s, (c) 4 s, (d) 2 s.
  - ii) The recoil of a gun after firing a shell is due to the principle of conservation of – (a) mass, (b) linear momentum, (c) angular momentum, (d) kinetic energy.
  - iii) An electric fan is running at an angular speed of 120 rpm. The angular retardation developed after switching off the fan is  $\pi/2 \text{ rad s}^{-2}$ . Find the time in which the angular speed decreases to 30 rpm – (a) 57.3 s, (b) 6.0 s, (c) 3.0 s, (d) 0.96 s.
  - iv) The moment of inertia ( $I$ ) of a particle of mass  $m$  about an axis is given by ( $r$  = perpendicular distance of the particle from the axis) – (a)  $I = mr$ , (b)  $I = m/r$ , (c)  $I = m/r^2$ , (d)  $I = mr^2$ .
  - v) According to work-energy theorem, the work done by a force on a moving body is equal to – (a) change in kinetic energy of the body, (b) change in potential energy of the body, (c) rate of change of momentum of the body, (d) change in momentum of the body.
  - vi) The specific resistance of a conductor depends upon – (a) length of the conductor, (b) area of cross-section of the conductor, (c) temperature of the conductor, (d) none of these.
  - vii) An air-filled very long solenoid of length  $L$  and total number of turns  $N$  is carrying a current  $I$ . The magnetic field well inside the solenoid is ( $\mu_0$  = permeability of air) – (a)  $B = \mu_0 N I$ , (b)  $B = \mu_0 N I L$ , (c)  $B = (\mu_0 N I)/L$ , (d)  $B = (\mu_0 L I)/N$ .
  - viii) The SI unit of self-inductance is Henry which can also be expressed as – (a) volt s amp, (b) volt s  $\text{amp}^{-1}$ , (c) volt  $\text{s}^{-1} \text{ amp}^{-1}$ , (d) volt s  $\text{amp}^{-2}$ .
  - ix) The value of the energy band gap for germanium crystal is – (a) 1.1 eV, (b) 0.11 eV, (c) 0.068 eV, (d) 0.68 eV.
  - x) The penetrating power of X-rays produced by an X-ray tube can be increased by – (a) increasing the filament current, (b) increasing the tube voltage, (c) decreasing the filament current, (d) decreasing the tube voltage.

**Group-A**Answer any three questions.

2. a) Establish Newton's third law using second law and the principle of conservation of linear momentum.
- b) Define the term 'impulse of a force'. Write down its relation with momentum. 3+2

3.
  - a) Establish the relation between linear speed and angular speed of a particle executing circular motion.
  - b) A body is released from the top of a tower. It reaches the ground after 3 seconds. Calculate the height of the tower and the velocity of the body just before touching the ground. Also calculate the distance travelled by the body in the last second of its journey. ( $g = 10.0 \text{ m s}^{-2}$ ). 2+3
4.
  - a) State the principle of conservation of mechanical energy. Prove that the total mechanical energy of a freely falling body under gravity is conserved.
  - b) Express power in terms of force and velocity. Write down the expression of the potential energy stored in a spring of spring constant  $k$  when it is stretched (elongated) by small amount  $\delta x$ . 3+2
5.
  - a) Define temperature coefficient of resistance of a substance. What do you mean by the term 'critical temperature' in respect to the phenomenon of superconductivity?
  - b) The resistance of a coil at  $30^\circ\text{C}$  is 15 ohm. If the resistance of the coil at  $100^\circ\text{C}$  be 18 ohm, calculate the value of the temperature coefficient of resistance of the coil. 2+3
6.
  - a) What is Seebeck effect? Write down one importance of Seebeck series.
  - b) An electric bulb is rated 60 W at 220 V. Calculate the resistance of the bulb. If the bulb be connected across a 200 V supply calculate the current through the bulb and the electric energy consumed by the bulb in one hour. 2+3

#### **Group-B**

Answer any two questions.

7.
  - a) Two long parallel conductors carrying currents in the same direction (like currents) attract each other – explain.
  - b) Lenz's law in electromagnetic induction is consistent with the principle of conservation of energy – explain.
  - c) Define self-inductance of a coil in terms of magnetic flux. 2+2+1
8.
  - a) Briefly state the principle of generation of alternating current and name the basic components of an AC generator. 3+2
  - b) State Fleming's right hand rule.
9.
  - a) Explain full wave rectification by bridge rectifier (circuit diagram, input and output wave forms are essential). 3+2
  - b) Explain the term 'depletion region' in p-n junction.
10.
  - a) Write down the basic properties of LASER beam which make it different from ordinary light.
  - b) Draw the curve showing the variation of intensity with wavelength of X-rays obtained from X-ray tube and mark cut-off wavelength ( $\lambda_{\min}$ ), continuous & characteristic X-rays. 3+2