

SEAL

I/LM/R-EXAM  
2020

700019

PHYSICS

Time : 3 hours ]

[ Full Marks : 100

- Notes :** (i) Answer the questions as directed.  
(ii) The figures in the right-hand margin indicate full marks for the questions.  
(iii) Group A is compulsory. Attempt any **Four** questions from Group B.

**GROUP—A**

( Compulsory Group )

1. Attempt any *ten* from the following:

2×10=20

- (a) If  $\phi(x,y) = x^2 - y^2$ , find  $\text{grad } \phi$ .
- (b) Write the conditions for producing standing waves.
- (c) What do you mean by adiabatic process? Write the equation of adiabatic process.
- (d) Electric potential in a region of space is given by  $V = 50x^2 - 75y$ . Find electric field at (1,1,0). ( $V$  is in volt and  $x, y$  in meter.)
- (e) State Ampere circuital law.
- (f) Define self-inductance and write its physical meaning.
- (g) What is polarization of light? Can sound be polarized? Justify your answer.
- (h) What is de Broglie wavelength of a bullet of mass 0.040 kg travelling at the speed of 1.0 km/sec ?
- (i) Draw the energy band diagram of  $n$ -type semiconductor.
- (j) State Moseley's law.

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- (k) What force is required to stretch a steel wire  $\frac{1}{2}$  sq.cm in cross-section to double its length? (Young's modulus =  $2 \times 10^{11} \text{Nm}^{-2}$ )
- (l) What is rms value of AC? What is its physical significance?

### GROUP—B

2. Attempt any *four* from the following :

5×4=20

- (a) State and explain parallel axis and perpendicular axis theorems with example.
- (b) Discuss the phenomena of beats mathematically. Mention two applications of beats.
- (c) Prove the relation  $C_p - C_v = R$  using 1st law of thermodynamics.
- (d) A charge of 8 mC is located at the origin. Calculate the work done in taking a small charge of  $-2 \times 10^{-9} \text{C}$  from a point  $P(0, 0, 3 \text{ cm})$  to a point  $Q(0, 4 \text{ cm}, 0)$  via a point  $R(0, 6 \text{ cm}, 9 \text{ cm})$ .
- (e) Derive the expression for impedance of  $L-R-C$  circuit from the phasor diagram.
- (f) Draw the ray diagram of a refracting telescope and calculate its magnification.

3. Attempt any *four* from the following:

5×4=20

- (a) State the radioactive disintegration law and derive the disintegration equation.
- (b) What is Zener diode? Discuss how a Zener diode is used as a voltage regulator.
- (c) In double-slit experiment, using light of wavelength 600 nm, the angular width of a fringe formed on a distant screen is  $0.1^\circ$ . What is the separation between two slits? Write the conditions to produce interference.
- (d) Derive the expression for magnetic field inside a long solenoid using Ampere's law.
- (e) What is damping? Write the differential equation of damped harmonic oscillation.

4. Attempt any *four* from the following:

5×4=20

- (a) State Kepler's laws of planetary motion. Prove Kepler's second law from the law of conservation of angular momentum.
- (b) What do you mean by velocity of efflux? Find its expression from Bernoulli's theorem.
- (c) What is transformer? The ratio of number of turns in primary to secondary is 1 : 20. It is connected to a supply of 200 volt a.c. Find the voltage across secondary and find the ratio of current in primary and secondary.
- (d) Derive the expression for work done in an adiabatic process.
- (e) Discuss the growth of charge when a condenser is charged through a resistance ( $R$ ). Derive the growth equation.
- (f) Derive the expression for focal length of a lens in terms of its refractive index and the radius of curvature of both sides.

5. Write the postulates of Bohr's theory and find out the energy of electron in hydrogen atom. Discuss how Bohr's theory could explain different series in hydrogen spectra.

20

6. (a) Draw the circuit diagram of common-emitter transistor to study its characteristics and discuss its input and output characteristics.

(b) How is a common-emitter transistor used as an amplifier?

10+10=20

7. Describe the working of a Carnot's engine. Find out the expression for efficiency of Carnot's engine.

20

8. (a) Derive a relation between torque and angular momentum.

(b) If earth will suddenly expand to 8 times of its present volume, then how will the duration of day be affected?

10+10=20