25

Ref. No.: PH/T/IA//2017(S)

BACHELOR OF ELECTRICAL ENGINEERING EXAMINATION, 2017

(1st Year, 1st Semester, Supplementary)

Physics-IA

Time: Three hours **Full Marks: 100**

Answer any *five* questions.

1. a) Find the value of $\vec{\nabla}\frac{1}{r^3}$ where $\vec{r} = r\hat{r}$ is the position vector.

   b) If $\vec{A} + \vec{B} + \vec{C} = 0$ show that $\vec{A} \times \vec{B} = \vec{B} \times \vec{C} = \vec{C} \times \vec{A}$

   c) Give the physical significance of the gradient of a scalar.

   d) Show that the gravitational field is conservative. **5+5+5+5=20**

2. a) Show that a circular motion can be considered as the superposition of two simple harmonic motions.

   b) Write down the differential equation of motion for a harmonic oscillator with a damping force proportional to velocity. Solve it for the case of small damping.

   c) What do you mean by phase velocity and group velocity?

   5+10+5=20

3. a) State Faraday's law of electromagnetic induction and express it in differential form.

   b) Find the expressions for the growth and the decay of charge on a capacitor connected in series with a resistor. What do you mean by the time constant of the circuit? When can the transient be said to practically die out?

   c) A capacitor of capacitance 0.5 μF and leakage resistance 10 MΩ is charged to a certain voltage and then insulated. Find the time the voltage will take to fall to half of its original value.

   5+12+3=20

4. a) Explain analytically the interference of light from the principle of superposition of waves.

   b) Calculate the spacing between the consecutive maxima in the interference pattern.

   c) Show graphically the intensity variation with phase difference between the interfering waves in an interference pattern.

   d) Two coherent sources are 0.18 mm apart and the fringes are observed on a screen 80 cm away. It was found that with a certain monochromatic source of light, the fourth bright fringe is situated at a distance of 10.8 mm from the central fringe. Calculate the wavelength of light.

   6+5+3+6=20

5. a) Distinguish between Fresnel and Fraunhofer classes of diffraction.

   b) Obtain an expression for intensity of Fraunhofer diffraction due to a transmission grating. Find the necessary condition for obtaining principal maxima of different orders in case of a grating.

   c) Monochromatic light (λ=6560 Å) falls normally on a 2 cm wide grating. If the first order spectrum is produced at an angle of 18°14' from the incident direction, find the total number of lines in the grating.

   3+12+5=20

6. a) State and explain 1st law of thermodynamics with its mathematical form.
   b) Compare isothermal and adiabatic processes. An ideal gas is compressed adiabatically to 1/3 of its volume. What will be the ratio of its initial and final pressure? (Take γ=1.4 for the gas).
   c) An ideal gas of volume V_i expands isothermally to volume V_f. Find out its work done with p-v diagram.

6+9+5=20

7. a) Describe Carnot's reversible cycle and deduce work done for each of its processes. Hence find out its efficiency in terms of source and sink temperature.
   b) A Carnot's engine has efficiency 1/3, and its source temperature is 60K. To get 50% efficiency what will be its source temperature?
   c) What is entropy? 20 gms of ice melts at 0°C to 20 gms of water. Find out the change of entropy. [Latent heat for melting of ice is 80 cal/gm]

12+4+4=20

8. a) Distinguish between stream-line motion and turbulent motion.
   b) Explain Bernoulli's principle.
   c) Define co-efficient of viscosity from Newton's law.
   d) From Poiseuille's equation, find the rate of flow of water through a capillary tube of 1 mm diameter and 1m length under a pressure of a column of water 20 cm in height. [g = 980 cm/s^2, η of water = 0.001 in cgs unit]

6+4+5+5=20