

This question paper contains 7 printed pages]

**CODE : FRO-2017**

**PHYSICS**

*Roll No.* .....

*Time : 3 Hours*

*Maximum Marks : 200*

- Note* :— (i) Question paper consists of *two* parts viz. Part I and Part II. Each part contains four questions. The paper as a whole carries eight questions. Question Nos. 1 and 5 are compulsory. The candidates are required to attempt *three* more questions out of the remaining six questions taking at least *one* question from each part i.e. this is in addition to the compulsory question of each part. Attempt *five* questions in all. All questions carry equal marks. The parts of a question are to be attempted at one place in continuation. Answers should be brief and to the point.
- (ii) Parts of same question must be attempted together and not to be attempted in between the answers to other questions.
- (iii) Non-programmable calculator and log tables can be used.

P.T.O.

## Part I

1. (a) A stone is allowed to fall under gravity from the top of a  $h$  meter high tower at the equator. Find the horizontal displacement of the stone due to earth's rotation. 20
- (b) Establish the equivalence of Kelvin-Planck and Clausius statements of second law of thermodynamics. 10
- (c) Obtain Fresnel's equations when incident wave is polarized with its  $\vec{E}$  vector normal to the plane of incidence. 10
2. (a) Obtain an expression for the time period of a torsional pendulum. How, the modulus of rigidity of the wire of a material can be determined using torsional pendulum ? 20

- (b) What will be work done in spraying a drop of water of one mm radius into a million droplets of equal size, if the surface tension of water is  $7.2 \times 10^{-2}$  N/m ? 10
- (c) If two capillary tubes of lengths  $l_1$  and  $l_2$  and radii  $r_1$  and  $r_2$  are connected co-axially, in series, find the rate of liquid flow through combination, if the coefficient of viscosity of the liquid is  $\mu$ . 10
3. (a) What is magnetocaloric effect ? Calculate the cooling produced by adiabatic demagnetisation of a paramagnetic salt placed in a magnetic field of 10,000 Gauss at 3 K as the field is reduced to zero. The curie constant per gram is 0.06 C.G.S. units. The specific heat at constant field,  $C_H$  is constant equal to  $0.10 \text{ cal gm}^{-1} \text{ deg}^{-1}$ . 20

- (b) Using Maxwell-Boltzmann distribution of speeds, find an expression for the most probable speed of gas molecules. 10
- (c) What were assumptions made during the derivation of Planck's radiation formula ? Taking Planck's radiation formula show that it respectively leads to Wien's and Rayleigh Jeans formula in smaller and longer wavelength region. 10
4. (a) Write the equation of motion of forced oscillator. Derive an expression for amplitude of forced oscillator. Explain its dependence on the frequency of the applied force. 20
- (b) How, ratio and difference between wavelengths of sodium D lines can be measured using Michelson interferometer ? Derive relevant expressions. 10



- (c) Plane polarized light is incident on a piece of quartz cut parallel to the axis. Find the least thickness for which the ordinary and extraordinary rays combine to form plane polarized light given that : 10

$$\mu_o = 1.5442, \mu_E = 1.5533, \lambda = 5 \times 10^{-5} \text{ cm.}$$

### Part II

5. (a) Using Laplace equation, find electric potential at any point between the plates of a parallel plate condenser. 20
- (b) Explain why in Compton scattering, X-ray photons give modified as well as original line,  $\gamma$ -ray photons give only modified line and visible light photons give original line only. 10
- (c) Describe the basic principle of imaging using an electron microscope. 10

6. (a) Deduce an expression for dipolar polarizability of polar dielectrics. 20
- (b) An electron and a proton are accelerated through a potential difference of 1 GV. Find their wavelengths using relativistic and non-relativistic expressions. 10
- (c) Using concepts of anomalous Zeeman effect, obtain an expression for Lande g-factor. 10
7. (a) Describe the working and principle of a Bainbridge's mass spectrograph. 20
- (b) The half-life of radon is 3.80 days. Calculate the number of days in which a given radon sample will decay such that only 1/20th of its original amount remains. 10
- (c) On the basis of mass-energy relation, explain the phenomenon of pair production and pair annihilation. 10

8. (a) A transistor having  $\alpha = 0.99$  is used in a common-base amplifier. If the load resistance is  $4.5 \text{ K}\Omega$  and the dynamic resistance of the emitter junction is  $50\Omega$ , find the voltage gain and power gain. 10
- (b) Derive an expression for rectification efficiency and ripple factor for a full-wave rectifier. 20
- (c) Calculate the power developed by an AM wave in a load of  $100 \Omega$  when the peak voltage of carrier wave is 100 volt and the modulation index is 0.4. 10