

MAY 2018**PHYSICS Paper-A****(Mechanics-II)****Time Allowed : 3 Hours****Max. Marks : 44**

Note : Attempt five questions in all, selecting at least two each from Unit-I and Unit-II. Unit-III is compulsory. Use of log tables and non-programmable calculator is allowed.

Unit - I

1. (a) What do you understand by fictitious force ? Show that the expression for \vec{F}_R in rotating frame is given by :

$$\vec{F}_R = \vec{F}_S - m\vec{\omega} \times (\vec{\omega} \times \vec{r}) - 2m(\vec{\omega} \times \vec{u}_R)$$

where the letters have their usual meanings. 6

- (b) Find the horizontal component of the Coriolis force acting on a body of mass 0.5 mg moving northward with a horizontal velocity of 100 m/s at 30° N latitude of earth. 3
2. (a) Describe Michelson-Morley experiment and explain physical significance of the results. 7
- (b) Calculate the time it will take the plane of oscillation of Foucault's pendulum to turn through 90° at a place where the latitude is 30° . 2
3. (a) Obtain Euler's equations for the motion of a rigid body about a fixed point. 6
- (b) What do you understand by precession and nutation in case of gyroscope ? 3

Unit – II

4. (a) Starting from Lorentz's transformations for space co-ordinates derive the equations for transformations of velocity. Under what conditions do these equations reduce to Galilean Transformations for velocity? 6
- (b) The half life of a particle at rest is 2.18×10^{-8} sec. What will be its half life in a beam moving with a speed of $0.8c$? 3
5. (a) Obtain the relativistic energy relation : 3
- $$E = \sqrt{p^2 c^2 + m_0^2 c^4}$$
- (b) Explain relativistic Doppler effect. 3
- (c) What do you mean by Minkowski space? Why the time co-ordinate is multiplied by c ? 2+1
6. (a) Derive an expression for the relativistic increase in the mass of a body. 7
- (b) Calculate the decrease in mass of 1gm of water at 0°C , when it turns into ice at 0°C . 2

Unit – III

7. Attempt any **eight** parts, **each** part carries **1** mark :

- (a) What is twin paradox?
- (b) Is earth an inertial frame of reference?
- (c) How the Coriolis force affects the weather?
- (d) At what latitude will the plane of vibration of Foucault's pendulum not rotate at all?
- (e) Give two postulates of special theory of relativity.
- (f) Why length contraction is not observed in daily life?
- (g) "Inertia tensor is symmetric". Explain.
- (h) What are Galilean transformations?
- (i) How the rotation of earth affects the value of 'g'?
- (j) What do you mean by asymmetric top? $8 \times 1 = 8$

PHYSICS Paper-B

(Vibrations, Waves and E.M. Theory-II)

Time Allowed : Three Hours

Maximum Marks : 44

- Note: (i) Attempt five questions in all, selecting two questions from each of section A and section B.
(ii) Section C is compulsory.
(iii) The use of non-programmable calculator is allowed.
(iv) Logarithmic tables may be asked if needed.
(v) After evaluation of answer books out of 44 marks, the marks will be given out of 22.

Section – A

1. (a) Derive expression for reflection and transmission coefficient at the boundary between two media. What will be their values when impedance of transmitted section is :
(i) Zero (ii) Infinity? 5
- (b) Two strings of linear densities 0.5g/cm and 1.5g/cm join together and stretched by certain force. Calculate :
(i) Ratio of wave speed in the two strings.
(ii) Reflection and transmission coefficient of energy. 4
2. (a) What do you mean by characteristic impedance of the string? Show that it is given by product of mass per unit length of string and wave velocity. 5
- (b) Prove that intensity of a progressive wave is proportional to square of amplitude. 4
3. (a) Obtain expression for energy of vibrating string. 5
- (b) Define the term wave velocity and group velocity. Find the relation between wave velocity and group velocity. Is group velocity always greater than wave velocity? Comment. 4

Section – B

4. (a) Using Maxwell equations, derive the wave equation of e.m. waves in the medium having finite permeability and permittivity but no conductivity ($\sigma = 0$). 5
- (b) Calculate the amplitudes of electric and magnetic field vector at the surface of earth. Assuming the solar radiations reaches the earth as plane wave and average power received by earth is $1.24 \times 10^3\text{Wm}^{-2}$. 3
- (c) Define skin depth. 1

5. (a) What is the Poynting vector ? State and prove Poynting theorem. 5

(b) Derive the expression for impedance of conducting medium to the e.m. waves and hence show that phase difference between electric field and magnetic field of e.m. wave in the conductor is $\pi/4$. 4

6. (a) Discuss propagation of plane e.m. waves incident normally at the boundary separating two media of different impedances and show that a perfect conductor is a perfect reflector of e.m. waves. 5

(b) Show that in the conducting medium, the displacement current leads the conduction current by $\pi/2$ radian. 2

(c) A plane radio wave has $E_0 = 10^{-4} \text{ Vm}^{-1}$. Calculate :

(i) B_0 and (ii) Intensity S_{av} of the wave. 2

Section – C

7. Attempt any eight parts :

(a) The sinusoidal wave is $y = 0.1 \sin 2\pi (0.01x - 100t)$ where x, y are in meter and t in second. Calculate the speed of the wave.

(b) Show that $y = x^2 + c^2t^2$ the solution of one dimensional wave equation.

(c) Can a sinusoidal wave be used for transmission of a signal ? Explain.

(d) Give the examples of normal and anomalous dispersion mediums.

(e) What are the nodes and antinodes in stationary waves?

(f) If the first medium is air and second medium has refractive index 2.

Calculate the reflection and transmission coefficient of energy.

(g) What is the value of impedance of dielectric to e.m. waves in vacuum?

(h) Write down the dimension of $\vec{E} \times \vec{H}$.

(i) High frequency e.m. waves propagate only small distance in a conductor. Comment.

(j) What is the impedance matching ? Give its applications. $8 \times 1 = 8$

PHYSICS Paper-C

(Electricity and Magnetism-II)

Time : 3 Hours

Max. Marks : 22

Note: Attempt five questions in all by selecting two questions from each of Unit I and II, Unit III is compulsory. Use of non-programmable calculator is allowed.

Unit - I

1. Explain the significance of invariance of charge ? Show that the surface integral of electric field is independent of the frame of reference. 4
2. (a) What is ferromagnetism ? Explain ferromagnetism on the basis of domain theory. 2.5
(b) A current in a solenoid produces a magnetising field of 167 A/m. What is the magnetic induction in rod it when it has (a) air core
(b) Iron core of magnetic susceptibility 5000. 1.5
3. (a) Distinguish between para, ferro and diamagnetic substances. 2
(b) An electric field in the laboratory frame is given by $\vec{E} = (4\hat{i} + 6\hat{j})$ Vm⁻¹. Calculate this field as measured in a moving frame with a velocity $\vec{V} = (8\hat{i} + 6\hat{j}) \times 10^7$ m sec⁻¹. 2

Unit - II

4. (a) State and explain Biot Savart's law. Derive an expression for the magnetic field at a point on the axis of a circular coil carrying current. 2.5
(b) Calculate the magnetic field at the ends of a 20cm long solenoid having 300 turns and carrying current of 2A. 1.5
5. State and prove reciprocity theorem of mutual Induction. 4
6. (a) An A.C. Circuit having an inductor and a resistance in series draws a power of 560W from an a.c. some marked 210V, 60Hz. If the power factor of circuit is 8 calculate : 2
(i) The impedance of circuit
(ii) The impedance of inductor used.
(b) What is Hall effect ? How does it help in deciding that the current in a metallic conductor is due to motion of electrons. 2