B.Sc. PART–I, SECOND SEMESTER, (P.U.)

MAY 2017

PHYSICS Paper-A

(Mechanics-II)

Time : 3 Hours **Max. Marks : 22**

Note : (i) Attempt *five* questions in all, selecting at least *two* from each Unit I and II . Unit III is compulsory.

(ii) All questions carry equal marks.

(iii) Use of non-programmable calculator is allowed.

Unit–I

$4\frac{1}{2} \times 2 = 9$

1. (a) Wha is Coriolis force? Discuss its effect on freely falling body.
   (b) A person drops an apple while in an elevator which is accelerating upwards at 4 m/s^2. Find the acceleration of apple relative to elevator and the time taken by the apple to fall on the floor if it was dropped at a point 3 metres above the floor.
2. (a) What is a Gyroscope? Give examples.
   (b) Obtain Euler's equations for the motion of a rigid body in principal axes.
3. What was the need of introducing the ether concept? Discuss Michelson Morley's experiment and conclusions drawn from it.

$4\frac{1}{2} \times 2 = 9$

Unit–II

4. (a) Derive an expression for relativistic law of addition of velocities in two inertial frames.
   (b) The real length of the red is 100 metres. If this rod length is measured by an observer moving parallel to its length is 51 metres, find the speed of the observer.
5. (a) Establish Einstein's mass energy equivalence relation.
   (b) Prove that proper time is Lorentz invariant.

6. (a) Give postulates of special theory of relativity. What are its consequences?
   (b) What is a twin paradox? How is it resolved?
   (c) What are simultaneous events?

Unit–III

7. Attempt any *eight* parts, each part carries 1/2 mark. $1/2 \times 8 = 4$
   (a) A circle and square are moving along x-axis. How will they appear to a stationary observer?
   (b) With what velocity should a particle move so that relativistic rest mass is equal to 25% of its rest mass.
   (c) Is Newton's second law of motion $\vec{F} = m\vec{a}$ always valid in special theory of relativity.
   (d) What is Minkowski space?
   (e) No cyclone are set up at equator. Explain.
   (f) What do you understand by centre of mass?
   (g) How many co-ordinates are required to specify the configuration of a rigid body?
   (h) When is the rigid body said to be undergoing pure translation?
   (i) How Galilean transformations are special case of Lorentz transformation?
   (j) What is Length contraction?

PHYSICS Paper-B

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

Time : 3 Hours **Max. Marks: 44**

Note : (i) Attempt *five* questions in all, selecting *two* questions from each of the 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 the wave equation for transverse wave in a string.
   (b) Prove that total energy and intensity of progressive wave are independent of x and t.
   (c) Two strings of linear densities 0.5 g cm^{-1} and 2.0 g cm^{-3} are joined together and stretched by certain force. Calculate ratio of wave speed in two strings.

2. (a) Prove that for wave propagating from one medium to another, the sum of the reflection and transmission coefficient of energy is unity.

(b) Differentiate between wave velocity and group velocity. Obtain relation between them and discuss it for normal, anomalous and no dispersion.

(c) Obtain expression for standing wave on a string of fixed length. Determine the location of nodes and antinodes. 3,3,3

3. (a) Derive an expression for characteristics impedance of a string.

(b) Two sinusoidal waves :

$$y_1 = 5 \sin (8t - 10x)\, m$$
$$y_2 = 5 \sin (3t - 5x)\, m$$

are superimposed. Calculate the group velocity. 6,3

Section – B

4. (a) Prove that electromagnetic waves are transverse in nature.

(b) Show that in the electromagnetic wave the electrostatic energy density is equal to magnetic energy density.

(c) Define Poynting vector. Write its unit. 5,3,1

5. (a) Prove that the amplitude of electromagnetic wave decreases exponentially with the distance of penetration.

(b) Calculate the coefficients of reflection and transmission of energy of the normally incident electomagnetic wave on the surface of medium having refractive index is 5.

(c) Derive an expression for the impedance of dielectric to the electromagnetic waves. 3,3,3

6. (a) Define skin depth. Show that it is inversely proportional to square root of conductivity of medium and frequency of electromagnetic waves.

(b) Show that for electromagnetic wave in free space, the electric field vector at any instant is 377 times the value of magnetic field vector.

(c) Derive an expression for average value of Poynting vector of electromagnetic wave in a conductor. 3,2,4

Section – C

7. Attempt any *eight* questions :

(a) Find the path difference between the two points having phase difference in $\pi/4$, for a wave having wavelength 2m.

(b) Define skin effect.

(c) Define refractive index.

(d) What are the uses of impedance matching?

(e) Differentiate between progressive and stationery waves.

(f) What is the significance of Gauss's law of magnetism ?

(g) Find the value of skin depth for a perfect conductor.

(h) Calculate the value of Poynting vector for 50 watt lamp at a distance of 1m from it.

(i) Write differential form of first and second Maxwell equation in free space.

(j) Electric and magnetic fields are closely related to each other. Explain. $8\times1=8$

PHYSICS Paper-C

(Electricity and Magnetism-II)

Time : 3 Hours **Max. Marks : 22**

Note : (i) Attempt *five* questions in all by selecting *two* questions from each of Units I and II .

(ii) Unit III is compulsory.

(iii) Use of non-programmable calculator is allowed.

Unit – I

1. Show that transformation equations of electric field from one frame at rest to other moving frame with constant velocity are given by

$E_{X'} = E_X$, $E_{Y'} = \gamma E_Y$ and $E_{Z'} = \gamma E_Z$ where, $E_{X'}$, $E_{Y'}$ and $E_{Z'}$ are the components of electric field in moving frame that is moving along X-axis. 4

2. (a) Derive the relation $\mu = h_0(1+x_m)$; where the symbol have their usual meaning.

(b) In a lab system, an electric field $\vec{E} = (2\hat{i} + 4\hat{j})$ V/*m*. Calculate electric field as measured in a frame of reference moving with velocity of $4(3\hat{i}+4\hat{j})\times10^7$ m/sec. 22

3. (a) Derive the differential and integral form of Ampere's law in magnetism.

(b) A magnetic field of 1.6×10^3 Tesla produces a flux of 2.4×10^{-5} wb. in a bar of iron of cross-section 0.2 cm^2. Derive the permeability and susceptibility of specimen. 22

Unit – II

4. (a) State Biot and Savart's law and derive the magnetic field due to a straight conductor carrying current.

(b) What is the singnificance of $\vec{\nabla} \cdot \vec{B} = 0$ and $\vec{\nabla} \times \vec{B} = 0$. $2^1/_2, 1^1/_2$

5. (a) By using Ampere's law, derive the relation for magnetic field due to a toroid.

(b) Calculate the mutual inductance between two coils, when a current of 4.0 A changes to 8.0 A in 0.5 sec. and induces an e.m.f. of 50 mV in the secondary coil. 2,2

6. State and prove reciprocity theorem in mutual induction. 4

Unit – III

7. Attempt any *six* :

(i) What are Ohmic and non-Ohmic conductors?

(ii) Differentiate between microscopic and macroscopic currents.

(iii) Why ferromagnetism is not found in liquids and gases?

(iv) Why an ordinary iron piece does not behave as a magnet?

(v) State the Gauss's law in magnetism.

(vi) Is the source of magnetic field is analogous to the source of electric field?

(vii) State the condition under which the equation $\vec{\Delta} \times \vec{B} = \mu_0 \vec{J}$ is valid. 1×6=6