B.Sc. PART–I, SECOND SEMESTER, (P.U.)

MAY 2015

PHYSICS Paper-A

(Mechanics-II)

Time Allowed : 3 Hours Maximum Marks : 45

Note: (*i*) Attempt **five** questions in all, selecting at least **two** questions each from UNIT-I and UNIT-II. Question No. 7 of UNIT–III is compulsory.

(*ii*) Use of non-programmable calculator is allowed.

UNIT–I

1. (*a*) Derive Euler's equations for rotation of a rigid body about a fixed axis. 6

(*b*) Three particles each of mass 'm' are placed at the points $(2a, a, 0)$; $(0, 2a, a)$ and $(a, 0, 2a)$. Find the principal moment of inertia of the system about z-axis. 3

2. (*a*) Derive an expression for the angular momentum of a rigid body about the Principal Axes (Lx, Ly, Lz) and hence define Inertia Tensor. 6

(*b*) A solid sphere of mass 50 g and radius 1 cm has a pivot pin of negligible dimensions fixed normally to its surface, when it spins like a top, it makes 14 revolutions/sec. Find out its precessional Angular-Velocity. 3

3. Discuss Michelson Morley experiment fully. What efforts were made to explain null results ? 9

UNIT–II

4. (*a*) On the basis of Lorentz transformations, discuss :

(*i*) Length contraction (*ii*) Time dilation. 6

(*b*) Obtain the relation; $E^2 = c^2 (p^2 + m_0^2 c^2)$, where symbols have their usual meanings. 3

5. Derive formula for relativistic variation of mass with velocity and dis... the result.

6. (*a*) What do you mean by relativistic Doppler effect and de... expression for longitudinal Doppler effect ?

(*b*) Find the volume of a cube moving with a speed of 0.8 C paralle... one of its edges.

UNIT–III

7. Attempt any **six** parts :

(*i*) How instantaneous velocity and instantaneous position ve... of a particle are related when a rigid body rotates about a poin...

(*ii*) What is a Gyroscope ? Give one example.

(*iii*) What do you mean by a Symmetric and an Asymmetric top ?

(*iv*) Explain space cone and body cone with the help of diagram.

(*v*) What are simultaneous events ?

(*vi*) How are relativistically moving square appears to an observe... rest ?

(*vii*) What is the energy liberated when 1 kg of mass is comple... converted into energy ?

$6 \times 1\frac{1}{2}$

PHYSICS Paper-B

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

Time Allowed : 3 Hours **Maximum Marks:**

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

(*ii*) UNIT–III is compulsory.

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

(*iv*) Logarithmic tables may be asked for if needed.

UNIT–I

1. (*a*) Two LC circuits are coupled by mutual inductance. Discuss ... behaviour of coupled system and find the frequency of oscilla... for the system. Also describe what do you mean by loose and t... coupling.

(*b*) Define normal coordinates and normal modes of an oscilla... system. Does energy exchange occur in normal modes.

2. (*a*) Define wave velocity and group velocity. Find a relation connec... the two. Is group velocity always greater than wave veloci... Comment.

(b) A wave of frequency 400 Hz is travelling with a velocity 340 ms^{-1}. How far are two points situated whose displacement differs in phase by $\pi/2$. 3

(a) Derive an expression for characteristic impedance of a string in terms of linear density and wave velocity. 5

(b) Discuss the use of anti-reflecting coatings on our lenses for use in our telescopes and microscopes. 2

(c) What do you mean by inertia controlled and stiffness controlled oscillators ? 2

UNIT–II

4. (a) Find out the equation of em wave in a medium having finite permittivity ϵ and permeability μ but with conductivity $\sigma = 0$. 8

(b) The light is generally characterised by electric field vector E, although it possesses magnetic field B also, explain why ? 1

5. (a) Find characteristic impedance of a medium for an em wave. Calculate its value for a dielectric medium. 7

(b) Calculate skin depth for a medium with $\mu = 4\pi \times 10^{-7}$ Hm^{-1} and $\sigma = 2 \times 10^{7}$ Sm^{-1} for an em wave with frequency 10^{10} Hz passing through it. 2

6. Find reflection and transmission coefficients of an em wave incident normally on a plane between media of impedances Z_1 and Z_2. 9

UNIT–III

7. Attempt any six parts, each part carries 1½ marks :

(a) Name and write the law which indicates the absence of monopoles.

(b) Calculate the maximum value of magnetic field of em wave that has maximum electric field of 1000 V m^{-1}.

(c) Give the characteristics of em wave.

(d) What is dispersion ? Does refractive index of medium depend upon wave frequency ?

(e) Distinguish between em wave and mechanical wave.

(f) Give the physical significance of Poynting vector.

(g) Define coupled oscillator. Give two examples.

PHYSICS Paper-C

(Electricity and Magnetism-II)

Time Allowed : 3 Hours **Maximum Marks : 45**

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

(ii) Unit III is compulsory.

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

UNIT–I

1. (*i*) Drive the equation of Continuity $\vec{\nabla} \cdot \vec{J} + \frac{\partial \rho}{\partial t} = 0$ where p and $\vec{J}$ are charge and current densities respectively. What form will it take for steady currents ?

   (*ii*) Calculate the average time between collisions for an electron of electron gas colliding with positive ion of Copper wire having $10^{...}$ electrons m^{-3}. Given resistivity of Copper is 1.7×10^{-8} ohm m. 5,4

2. Derive an expression for the electric field of a point charge moving with constant velocity. How does it differ from the field due to a stationary charge ? Illustrate with diagrams.

3. (*i*) Explain Langevin Theory of Diamagnetism.

   (*ii*) Find the percent increase in magnetic induction when the space with a current carrying toroid is filled with magnesium.

   Given that the susceptibility of Magnesium is 1.2×10^{-5}. 6,

UNIT–II

4. (*i*) State and prove the reciprocity theorem of Mutual Induction.

   (*ii*) What is Hall Effect ? Show that the Hall coefficient $R_H = 1/ne$. 6,

5. (*i*) Drive Gauss's Law in Magnetism.

   (*ii*) Explain the term surface current density. Give its application.

   (*iii*) Show that the magnetic field at a point inside the toroid varies inversely as its distance from the centre. 3,3

6. (*i*) Define vector potential and derive and expression for it.

   (*ii*) Show that the energy stored per unit volume in the magnetic field 'B' set up in a solenoid is $B^2/2\mu_0$. 5

UNIT–III

7. Attempt any **six** parts :

   (*i*) In a certain material the drift velocity is a quadratic function of electric field. Will the material be on ohmic or non-ohmic ?

   (*ii*) Can a free electron show diamagnetic effect ? Explain.

   (*iii*) Is the electric field due to a moving charge conservative ?

   (*iv*) Show that the magnetic scalar potential satisfies Laplace's equation.