First Year Examination of the Three Year

Degree Course, 2001

(Faculty of Science)

PHYSICS

Paper III

(Electromagnetics)

Time - Three Hours

Maximum Marks - 50

Attempt **Five** question in all,

selecting **ONE** question from each unit.

All questions carry equal marks.

UNIT I

1. (a) Establish the equation of 'motion' of the coil of a moving coil ballistic galvanometer and solve it for different levels of damping.Find the expression for time period when the motion is oscillatory. **2+4+2**

   (b) The charge sensitivity of a B.G. is 2×10^{-9} Coul./mm, and the time period of its coil is π sec. What is the value of its current sensitivity? **2**

2. (a) Describe the method for measuring magnetic field by using a search coil and a Ballistic Galvanometer. Derive the formula used. **3+3**

   (b) A condenser of capaicty 0.2 μf is charged to 2 volts and is discharged through a Ballistic Galvanometer. The B.G. shows a throw of 12.5 cm in the beginning. When condenser is replaced by another condenser, the reading in B.G. is found to reduce by 2.5 cm. What is the capacity of the second condenser? **4**

UNIT II

3. (a) Derive an expression for potential at a point due to an arbitrary charge distribution and hence define monopole, dipole and quadrupole moments **3+2**

   (b) What is the charge density on the surface of a conducting sphere of radius 0.15 m whose potential is 200 volt? ($E_0 = 8.85 \times 10^{-12}$ MKS units). **5**

4. (a) Define Polarisation vector and electric displacement, and establish Gauss' laww in its general form. **2+2**

(b) Two identical capacitors of capacity C each are joined in series and this combination is connected to a battery of emf E. Calculate charge, potential and energy stored in each capacitor. The space between the plates of one of the condensers is filled by a dielectric material of dielectric constant K.Calculate new values of all these quantitities. **1.5+1.5+3**

UNIT III

5. (a) A point charge q is placed near an infinite conducting plane plate. Calculate the surface density of charge induced on the plate. Hence prove that the total induced charge on the plate is -q. **3+2**

(b) Write the Poisson equaition in Cartesian and spherical Polar coordinates explaining meaning of each symbol. Draw a diagram showing coordinates of a point in two coordinate system. **3+2**

6. (a) State Uniqueness Theorem, explaining meaning of each term. Use it to prove that the electric field inside a hollow conductor is zero. **2+3**

(b) Two equal and similar charges, distant 3a/2 apart are placeed at a distance a from a grounded infinite plane conducting plate. Calculate the angle which the resultant force acting on either charge makes with the normal to the surface **5**

UNIT IV

7. (a) State Ampere's Circuital law. Prove that

$$\text{div. } B = 0.$$ **1+2**

(b) Deduce an expression for Torque acting on a current carrying loop placed in a uniform magnetic field. **4**

(c) A uniform magnetic field of 1.5 Webers/m^2 is acting from south to north. A 5.0 MeV proton (mass 1.7×10^{-27} kg.) is moving in it vertically downwards. Find the magnitude and direction of force experenced by it. **3**

8. (a) Define Magnetisation vector and surface current. Establish a relation between them. **2+2**

(b) Define 'Susceptibility' State 'Curie Wiess Law' and define Curie temperature'. **3**

(c) An iron rod 20 cm. long, I cm in diameter and of permeability 1000 is placed inside a solenoid 1 meter long having 600 turns. A current of 0.5 Amp.Is passed through the solenoid. Find the magnetic moment of the rod ($\mu o=4 \pi \times 10^{-7}$ MKS units). **3**

UNIT V

9. Define Self and Mutual Inductance. Describe Rayleigh's method of measuring self inductance of a coil. Derive the necessary formula used. State Lenz's law **2+4+3+1**

10. A constant e.m.f. source is connected to a series LCR combitnation. Discuss the process of charging of the condenser when it.

(i) increases exponentially,

(ii) oscillates before reaching a constant value.

Find the expression for the requency of these oscillations. **4+1+3+2**