2024
B.A./B.Sc.
Second Semester
CORE – 3
PHYSICS
Course Code: PHC 2.11
(Electricity & Magnetism)

Total Mark: 70   *Pass Mark: 28*
Time: 3 hours

Answer <u>five</u> questions, taking <u>one</u> from each unit.

UNIT–I

1. (a) What are electric field lines? State four property of electric field lines.
        3
    (b) Using Gauss' law, find the electric field due to a uniformly charged solid sphere. 6
    (c) Prove that electrostatic potential due to a point charge lying at the origin is inversely proportional to distance from the point charge. 3
    (d) If $\vec{A} = xy\hat{i} + yz\hat{j} + zx\hat{k}$, calculate divergence of $\vec{A}$. 2

2. (a) Find the electrostatic potential due to an electric dipole. 6
    (b) Obtain the expression of electrostatic energy of a charged sphere. 4
    (c) Define conservative field and curl of a conservative field. 2
    (d) If $\vec{E} = (x + y)\hat{i} + (y - 2x)\hat{j} - 2z\hat{k}$. Find curl $\vec{E}$ and div $\vec{E}$. 2

UNIT–II

3. (a) In case of a point charge placed near an infinite conducting plane, use the method of electrical image to find
        (i) the electric potential
        (ii) electric field strength
        (iii) the total charge induced on the conducting plane. 11

(b) Two parallel plate air capacitors have their plate areas 100 and 500 cm² respectively. If they have the same charge and potential and the distance between the plates of the first capacitor is 0.5 mm, what is the distance between the plates of the second capacitor?   3

4. (a) Obtain the expression of capacitance of a parallel plate capacitor filled with composite dielectric. What will happen to capacitance when the parallel plate capacitor is partially filled with a single dielectric slab?   6

(b) Prove that $\vec{D} = \varepsilon_o \vec{E} + \vec{P}$, where the symbols have their usual meaning.   4

(c) What is linear charge density? Find the capacitance of a cylindrical capacitor filled with dielectric.   4

UNIT–III

5. (a) Derive the expression of magnetic field on the axis of a circular current loop.   5

(b) State and prove Ampere's circuital law. Express it in differential form.   5

(c) Find the relation between relative permeability and susceptibility.   2

(d) A 0.25 m long solenoid has 500 turns and has flux density of 2.52×10^{-3} T at its centre. What is the current in the solenoid?   2

6. (a) Explain in brief Lorentz force. Find the force on a current carrying conductor placed in a magnetic field.   4

(b) Use Ampere's circuital law to find the magnetic field due to a toroid.   3

(c) For a current loop placed in a uniform magnetic field, show that torque is equal to the cross product of magnetic dipole moment and magnetic field.   4

(d) State Biot Savart's law. A straight wire carries a current of 6 ampere, calculate the magnitude of the magnetic field 15 cm away from the wire.   3

UNIT–IV

7. (a) Explain how Maxwell modified Ampere's law. 3
   (b) Discuss decay of current in LR circuit. 4
   (c) In a parallel LCR circuit, obtain the expression of resonance frequency. 5
   (d) Calculate the coefficient of self induction, when current change from +2 A to –2 A in 0.05 second induces an e.m.f. of 8 volt in a coil. 2

8. (a) Discuss the growth of current in LCR circuit with direct current input. 12
   (b) If a current of 3 ampere in one coil causes the flux in another coil of 1000 turns to change by 10^{-4} Wb in each turn, then what is the mutual inductance? 2

UNIT–V

9. (a) What is ideal current source? Describe how matrix method is used in circuit analysis. 4
   (b) Show that for linear electrical networks, consisting of any combination of voltage sources, current sources, and resistors with two terminals, it is electrically equivalent to a single voltage source V and a single series resistor R. 5
   (c) State and prove Norton's theorem. 5

10. (a) Discuss the theory of ballistic galvanometer. 9
    (b) State and prove reciprocity theorem. 5

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