

2023
B.A./B.Sc.
Second Semester
CORE – 3
PHYSICS
Course Code: PHC 2.11
(Electricity & Magnetism)

Total Mark: 70
Time: 3 hours

Pass Mark: 28

Answer five questions, taking one from each unit.

UNIT-I

1. (a) State and prove Gauss's law. 4
- (b) Using Gauss's law, find the electric field due to a hollow cylinder. 4
- (c) State Gauss's divergence theorem and obtain the differential form of Gauss's law. 3
- (d) A charge of 100 Coulomb is located at the point (3, 4, 0) m. Find the electric field intensity at the origin. 3
2. (a) What is an electric dipole? Define electric dipole moment. 2
- (b) Find the electric field due to an electric dipole. 6
- (c) Obtain Poisson's and Laplace's equation. 3
- (d) If $\vec{P} = x^3z\hat{i} + 3y^2z^2\hat{j} - 4xyz^2\hat{k}$, find $\text{div } \vec{P}$ at the point (4, -2, 2). 3

UNIT-II

3. (a) Using the method of electrical image, find the electric potential, electric field strength, surface charge density of induced charge on the sphere. Also find force between the sphere and the point charge placed near a conducting sphere. 12
- (b) Calculate the capacitance of a spherical capacitor, if the diameter of inner sphere is 0.2 m and that of outer sphere is 0.3 m, the space between them being filled with a liquid of dielectric constant 20. 2

4. (a) Define capacitance. Prove that for an isolated conducting sphere, the surface charge density will be larger in regions of higher curvature. 1+3=4
- (b) Find the capacitance of a cylindrical capacitor filled with dielectric. 3
- (c) Obtain the integral and differential form of Gauss's law in dielectrics. 5
- (d) Calculate the area of the plates of a parallel plate capacitor of capacitance 2 F, if the distance of separation between the plates is 0.5 cm. 2

UNIT-III

5. (a) Derive the expression of magnetic field due to a straight wire using Biot-Savart's law. 5
- (b) Explain how current loop behave as a magnetic dipole. Obtain the associated magnetic dipole moment. 2+2=4
- (c) Describe briefly, the theory of ferromagnetism. 3
- (d) Find the magnetic field due to a circular coil of radius 0.1 m having 200 turns, at the centre of the coil when circulating current is 500 mA. 2
6. (a) Using-Biot Savart's, discuss the concept of magnetic vector potential. 5
- (b) Explain hysteresis with the help of B-H curve. 4
- (c) State six properties of ferromagnetic substances. 3
- (d) The magnetic susceptibility of a medium is 948×10^{-11} henry/metre. Calculate its absolute permeability and relative permeability. 2

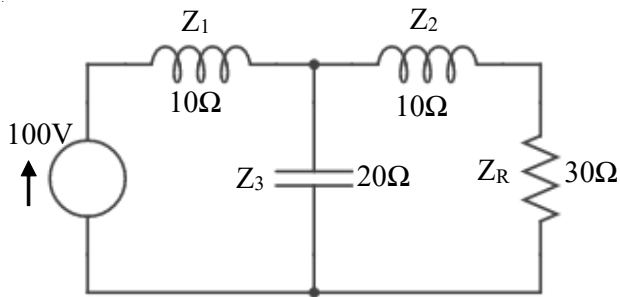
UNIT-IV

7. (a) Derive the reciprocity theorem of mutual induction. 6
- (b) Discuss growth of current in CR circuit. 6
- (c) In a coil, an emf of 6 V is induced when the current in the coil change by 100 A in 1 s. Find the coefficient of self inductance in the coil. 2
8. (a) What is wattless current? What is the condition for current to be wattless? 1+1=2

- (b) Discuss sharpness of resonance in LCR series circuit and obtain the Q-factor for the same. 9
- (c) In a parallel LCR circuit, a resistor of resistance $200\ \Omega$, an inductor of inductance $10\ \text{mH}$ and a capacitor of capacitance $0.1\ \mu\text{F}$ are connected. Find the resonant frequency. 3

UNIT-V

9. (a) What is an electric network? State the laws that are used to calculate current in an electric network. 1+2=3
- (b) Describe the use of mesh current method in circuit analysis. 3
- (c) State and prove superposition theorem. 1+4=5
- (d) For the network shown in the circuit, calculate the current through the load impedance Z_R . 3



10. (a) State and prove maximum power transfer theorem. 1+4=5
- (b) Explain how damping is corrected in a moving coil ballistic galvanometer. State the conditions for a moving coil galvanometer to be ballistic. 5+1=6
- (c) For the network shown in the figure, calculate the maximum power. 3

