

2026

ELECTRONICS — HONOURS

Paper : DSCC-8

(Electromagnetism)

Full Marks : 75

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Group - A

1. Answer **any ten** questions : 2×10
- (a) State Snell's Law for refraction.
 - (b) What is magnetic reluctance?
 - (c) Does the Poynting theorem apply to static fields? Explain.
 - (d) Write down electromagnetic field equations given by Faraday.
 - (e) State and explain Lenz's Law.
 - (f) Define Lorentz Gauge and Coulomb's Gauge.
 - (g) What is a polarization of charges and hence define polarization vector?
 - (h) What is an electric dipole? Define dipole moment.
 - (i) What is meant by polarization of Plane waves?
 - (j) Define wavelength and wave number.
 - (k) What is eddy current?
 - (l) State one difference between conduction and displacement current density.

Group - B

Answer **any three** questions.

2. (a) What is Lorentz force? 2+3
(b) Sketch the path of a charge particle moving under crossed electric and magnetic field.
3. What is skin effect? Define skin depth. Write down Maxwell's equation in conducting medium. 2+1+2
4. What is meant by electromagnetic dispersion? Hence explain normal and anomalous dispersion. 2+3

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5. Define displacement current. Consider a capacitor is connected to an ac source to form a closed circuit. Calculate the displacement current in the capacitor from electric flux density. 2+3
6. Derive the equation of continuity from Maxwell's equation and hence show that it follows the law of conservation of charge. 3+2

Group - C

Answer *any four* questions.

7. (a) What is motional emf and transformer emf?
 (b) Write the expression for the induced emf under the combined force of both the above emfs.
 (c) Derive the expression of emf for a practical transformer in terms of coupling coefficient. (2+2)+2+4
8. (a) Write the differential form and integral form of the basic postulates of electrostatic field.
 (b) Derive the expression for electric potential due to point charge and hence extend it for 'n' number of point charges. (2½+2½)+(3+2)
9. (a) An electromagnetic wave propagates downward from an aircraft into water. The wave is at a frequency of 10GHz. Assuming distilled water (no losses) with a relative permittivity of 81 and neglecting any effect at the interface between air and water, calculate :
 (i) phase velocity, wavelength and wave number in air.
 (ii) phase velocity, wavelength and wave number in water.
 Given $\epsilon_0 = 8.854 \times 10^{-12}$ F/m.
 (b) State Fresnel's equation. State Brewster's law. (3+3)+(2+2)
10. Derive the tangential and normal component of electric field and electric flux density at the interface between two dielectrics. 5+5
11. (a) Define magnetic flux and magnetic flux density.
 (b) Explain the physical significance of the Maxwell's equation, $\vec{\nabla} \cdot \vec{B} = 0$. Hence define magnetic vector potential.
 (c) Derive Ampere's circuital law from the Maxwell's equation, $\vec{\nabla} \times \vec{B} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$. (2+2)+2+4
12. (a) An electron is located at a point in space. Calculate the electric field intensity at a distance R from the electron. The charge of an electron is e .
 Find the force the electron exerts on dust particle, charged with a total charge of 3.2×10^{-19} C and located at a distance R from the electron.
 (b) Define linear, surface and volume charge densities. (2½+2½)+5