

Mid-West University
Examinations Management Office
Final Examinations -2081

Level: Bachelor level/B.Sc./4th Semester

F. M: 60

Time: 3hrs.

P. M: 30

Subject: Electromagnetism (PHY 341/441)

Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.

Group – A

Attempt all long questions

[4x6 = 24]

1. Define divergence of a vector field with its physical meaning. Derive an expression for divergence of a vector of a vector field in Cartesian co-ordinates.
2. Define Displacement current and derive Maxwell's equation in final form. The electric field in air is given by,

$$\vec{E} = \rho t e^{-\rho-t} a_{\phi} \text{ V/m.} \quad \text{Find } \vec{B} \text{ \& } \vec{J}$$

OR

Explain the phenomenon of electromagnetic wave propagating in lossy dielectric medium and find the relation for intrinsic impedance in lossless dielectric medium and in free space.

3. What is relaxation time? Show that, $\rho_V = \rho_{V_0} e^{-t/\tau}$, Where symbol have usual meaning.
4. Show that the general expression for input impedance at any point on transmission line is,

$$Z_{in} = Z_0 \left[\frac{Z_L + Z_0 \tanh \gamma l}{Z_0 + Z_L \tanh \gamma l} \right], \text{ Where symbol have usual meaning.}$$

Group – B

Attempt all numerical questions.

[6x4= 24]

5. If $\vec{A} = 2x^2z^2\hat{a}_x - 2xy^2\hat{a}_y + 2x^2y^2\hat{a}_z$. Find the value of curl \vec{A} at point (1,1,1).
6. A spherical charge distribution is given by,

$$\rho = \rho_0 \left(1 - \frac{r^2}{a^2}\right) \quad r \leq a \text{ and } \rho = 0, r > a.$$

- a. Find the total amount of charge.
 - b. Calculate the electric field inside and outside the charge distribution.
7. If $\vec{J} = \frac{1}{r^3} (2\cos\theta\hat{a}_r + \sin\theta\hat{a}_{\theta}) \text{ A/m}^2$. Calculate the current passing through

- a. A hemispherical shell of radius 20cm, $0 < \theta < \pi/2$, $0 < \phi < 2\pi$.
 - b. A spherical shell of radius 10 cm.
8. Two straight wires are kept in air 2m apart carrying currents 80 A and 30 A in the same direction. Calculate the force between them and specify its nature.
 9. The magnetic vector potential is given by $\vec{A} = -\frac{\rho^2}{4} \hat{a}_z$ wb/m. Calculate the total magnetic flux crossing the surface $= \pi/2 \leq \rho \leq 2m$, $0 \leq z \leq 5m$.

OR

- A long solenoid of length 1m and radius of cross-section 1.5cm has a five layers of windings of 850 turns each. If solenoid carries a current of 5A. Calculate the value of;
- a. Magnetic induction and
 - b. Magnetic flux for a cross-section of the solenoid at the centre of the solenoid.
10. A Find the magnetic field due to a circular coil of radius 0.1m and having 200 turns at the centre of the coil when circulating current is 500 mA.

Group-C

Answer in brief any Six questions.

[6x2= 12]

11. If $\phi(x, y, z) = 3x^2 - yz^2$. Find grad ϕ at point (1,2,-1).
12. Define electric dipole with its importance.
13. A dielectric is placed in the field of a point charge. Will there be polarization volume charge density?
14. State Biot-savart law and write its vector form.
15. Explain about different energy losses in a transformer.
16. What is transmission line?
17. Differentiate between self-inductance and mutual Inductance.
18. Explain about Smith Chart.

THE END