Mid-West University

Examinations Management Office

Final Examinations-2080

Bachelor level/ B. Sc. /4th Semester — Full Marks: 60

Time: 3 hours — Pass Marks:30

Subject: Electromagnetism (PHY341/PHY441)

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. [5x6 = 30]

1. Define divergence of a vector function and derive the expression for divergence of vector $\vec{A}$. If $\vec{A}=x^2y\hat{a}_x + y^2z\,\hat{a}_y + (x-y)\hat{a}_z$; calculate div $\vec{A}$ at the point $(1,-1,1)$.
2. Write Maxwell's equation in final form. Solve Maxwell's equation for wave propagating in a lossy dielectric medium.
3. Define relaxation time? Show that, $\rho_V = \rho_{V_0} e^{-t/\tau}$, Where symbol have usual meaning. The relaxation time for good conductor is very short, what does it mean?
4. Define Transmission line and obtain the transmission line equations.

   OR

   Show that the average power of transmission line for real part is P_{av} (real) $= \frac{(V_0^+)^2(1-|\Gamma|^2)}{2z_o}$ where, symbols have their usual meanings.
5. Define electric dipole. Derive the expression for electric potential and electric field due dipole. Write the factor on which dipole moment is depends?

Group – B

Attempt all numerical questions. [5x4= 20]

6. A solenoid has length 2m and mean diameter of 0.05m. It has 4 layers of 1000 turns each. Calculate the flux density at its centre when a current of 2.5 amperes flows through it.
7. The magnetic vector potential is given by $\vec{A} = -\frac{\rho^2}{4}\hat{a}_z \frac{wb}{m}$. Calculate the total magnetic flux crossing the surface $= \frac{\pi}{2} \le \rho \le 2m$, $0 \le z \le 5m$.
8. If $\vec{J} = \frac{1}{r^3}(2\cos\theta\hat{a}_r + \sin\theta\hat{a}_\theta) A/m^2$. Calculate the current passing through
   i. A hemispherical shell of radius 20cm, $0 < \theta < \pi/2$, $0 < \phi < 2\pi$.
   ii. A spherical shell of radius 10 cm.
9. A spherical charge distribution is given by,

   $\rho = \rho_0(1 - \frac{r^2}{a^2})$ $r \le a$ and $\rho = 0$, $r > a$.

   a. Find the total amount of charge.
   b. Calculate the electric field (i) inside and outside the charge distribution.
   c. Find the value of r for which E is maximum.

10. A solenoid has a length of 50cm and a radius of 1cm. If the number of turns in the solenoid is 500, relative permeability of the material on which the turns are wound is 800, calculate the coefficient of self-inductance.

OR

A field of 0.02 Tesla acts at right angles to a coil of area 0.01 square meter with 50 turns. The coil is removed from the field in $1/10^{th}$ of a second. Find the average emf produced in it.

Group-C

Answer in brief any Five questions. [5x2= 10]

11. Write the physical significance of curl of a vector field.

12. Write the effects of temperature on the dielectric constant of a substance containing molecules of permanent dipole moment.

13. A current is sent through a hanging coiled spring. What changes do you expect and why?

14. Differentiate permittivity and permeability.

15. Explain about different energy losses in a transformer.

16. Explain about distortion less line.

17. What do you understand about Smith Chart?

The End