Assignment

FYUGP 3rd Semester

Subject: Physics

Topic: Maxwell's equations in Electromagnetism

Last date of submission: 18/09/2026

Name: _____

Roll No.(Class & GU): _____

Semester: _____

Department: _____

Date of Submission: _____

1. State Maxwell's equations in differential form. Explain their physical significance briefly.
2. Explain the importance of displacement current. Calculate the displacement current when the electric flux through a surface changes at a rate of 3×10^8 V m/s.
3. Show that electric and magnetic fields are invariant under gauge transformation.
4. Derive the expression for electric and magnetic fields in terms of scalar and vector potentials.
5. State the Coulomb Gauge and Lorenz Gauge conditions. Explain their physical significance briefly.
6. What is an interface? State the boundary conditions in terms of *E* and *B* at the interface of two insulating dielectric media having permittivity and permeability (ε_1, μ_1) and (ε_2, μ_2), respectively.
7. State and derive the Poynting theorem. Discuss the physical significance of each term in the theorem.
8. What is a plane electromagnetic wave? If both ***E*** and ***H*** are reversed simultaneously, does the direction of the Poynting vector change?

9. Why does a standing electromagnetic wave have zero Poynting vector over a complete cycle?
10. A plane electromagnetic wave in vacuum has an electric-field amplitude of $E_0 = 100\,\mathrm{V/m}$. Calculate its average intensity.
11. An electromagnetic wave has an average intensity of $600\,\mathrm{W/m^2}$. Calculate its average electromagnetic energy density in vacuum.
12. A plane EM wave in vacuum has an electric-field amplitude of $300\,\mathrm{V/m}$. Find the magnetic-field amplitude.
13. Find the conduction current density and displacement current density in a material having conductivity of 10^{-3} S/m and $\varepsilon_r = 2.5$. If the electric field in the material is $E = 5.0 \times 10^{-6}\, Sin\,(9.0 \times 10^{9}t)V/m$
14. An electromagnetic wave travels through a non-magnetic dielectric medium of refractive index $n = 1.5$. If the electric-field amplitude is $450\,\mathrm{V/m}$, calculate the magnetic-field amplitude.
15. Given $E = 10Cos(10^{6}t - ßx)\hat{j}$ at a point in air. Find H and the Poynting vector at that point.