Department of Physics

B.Sc General Model Questions

Course Title- Electromagnetic Theory

Semester – IV

1. Discuss about the important properties of displacement current.
2. Write down the modified Ampere's circuital law.
3. Write down the Maxwell's equations for dielectric and conducting medium.
4. What do you mean by electromagnetic wave?
5. Write down the properties of EM wave.
6. Mathematically prove that EM wave is transverse in nature.
7. Explain how the displacement current maintains the continuity of current in a circuit containing a capacitor.
8. Explain the inconsistency of Ampere's Circuital Law and explain how it can be removed. What is displacement current?
9. Write down the wave equations for the electric and magnetic field vectors in case of a dielectric medium and find the expression for the velocity of EM wave in the medium.
10. Prove that EM waves are transverse in nature.
11. Write down the boundary conditions for **E, D, B** and **H** at the interface between two dielectrics.
12. Write down the Fresnel's relations for reflection and transmission of a plane EM wave incident normally at a plane interface separating the two dielectrics.

13. For a plane EM wave propagating in vacuum with electric field amplitude E_0. Find the expression for the momentum density.
14. An EM wave polarized parallel to plane of incidence is incident from air to distilled water with $\mu_r = 1$ and $\varepsilon_r = 81$. Find the Brewster angle.
15. What are EM vector and scalar potential? Show that although these potentials are not unique in themselves but they define the fields **E** and **B** uniquely.
16. Calculate the characteristic impedance of free space for propagation of plane EM wave through it. Can any material medium possess characteristic impedance greater than this value?
17. If Earth receives 1400 J/m^2/sec solar energy, then what are the amplitudes of the electric and magnetic fields of radiation?
18. The magnitude of magnetic field vector **H** of a plane EM wave in vacuum is 1.5 A/m. Find the magnitude of the electric field vector **E** of the wave.
19. What is Plasma? State in brief the conditions for its existence. Derive an expression for the refractive index of collision-free plasma.
20. Show that in plasma, electron current lags the electric field by $\pi/2$.
21. The average density of electron (Ne) in an ionosphere is $9x10^{10}$ electrons/m^3. Calculate the plasma frequency (f_p) and the phase velocity of a plane EM wave of frequency (f) 200 MHz propagating through the ionosphere.
22. Starting from appropriate Fresnel's relations for the case of the electric field vector **E** of an EM wave polarized parallel to the plane of incidence, show that for a particular angle of incidence there is not reflected wave. Hence obtain an expression for the same.

23. In what respect does an electrically anisotropic medium differ from an isotropic medium?
24. Show that in an anisotropic medium the direction of energy flow is different from wave propagation.
25. Describe the concept of Laurent's half shade device used in a polarimeter. What are its advantages?
26. Show that the superposition of a left-handed and right-handed circularly polarized light produces a plane polarized light.
27. Describe how Nicol prism can be used for the production and analysis of plane polarized light.
28. Determine skin depth of graphite at 10 GHz. Given that $\sigma = 10^5$ mho/m.
29. Calculate the minimum thickness of a calcite plate that would convert a plane polarized light of wavelength 5890 A^o into circularly polarized light. Given that $\mu_0 = 1.658$ and $\mu_e = 1.486$.
30. Show that about 4% of the light incident normally on an air-glass interface will be reflected back. Given r.i of glass is 1.5.
31. Calculate the polarizing angle θ_p for external incidence on a plate of crown glass in air. Given r.i of crown glass is 1.52.
32. Calculate the strength of electric field at a distance of 10m from a 60W lamp.
33. State the Pointing theorem and define Pointing vector. What is the physical significance of Pointing vector?
34. Define the skin depth.
35. Define intrinsic impedance or characteristic impedance.
36. Describe the linear, circular and elliptical polarization.

37. What is an optical fibre? Describe its working principle.
38. What do you mean by ‘cross-talk’ in case of optical fibre?
39. Define the numerical aperture (NA).
40. Define the step and graded indices.
41. A step index fibre has a core of refractive index 1.55 and a cladding of refractive index 1.53. Determine its numerical aperture and acceptance angle.
42. A step index fibre has a core of refractive index 1.50 and a cladding of refractive index 1.40. If the fibre is used in water environment finds its numerical aperture and the acceptance angle. Given r.i of water is 1.33.
43. What is wave guide? State the condition of continuity of wave guide at interface.

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