This question paper contains 3 printed pages]

Roll No. ☐☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : **1381**

Unique Paper Code : **2221502**   **F-7**

Name of the Paper . : **Electromagnetic Theory**

Name of the Course : **B.Sc. (Hons.) Physics (Erstwhile FYUP)**

Semester : **V**

Duration : **3 Hours**   Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

All questions carry equal marks.

Question No. **1** is compulsory.

1. Attempt any *five* of the following : $5 \times 3 = 15$

   (*a*) Discuss and compare Lorentz and Coulomb gauges.

   (*b*) If the earth receives 1400 Joules m^{-2} sec^{-1} solar energy, what are the amplitudes of the electric and magnetic fields of radiation.

   (*c*) Calculate the skin depth for radio waves of wavelength 4000 m for penetrating into sea water of conductivity $\sigma = 4$ mho/m.

   (*d*) Discuss the significance of plasma frequency in the transmission of radio waves through ionosphere.

P.T.O.

(e) An electromagnetic wave polarized parallel to plane of incidence is incident from air on to distilled water with $\mu_r = 1$ and $\varepsilon_r = 81$, find the brewsters angle.

(f) Show that good conductors are good reflectors.

(g) Show that E.B is relativestically invariant.

2. (a) Discuss how Maxwell's modified Ampere's law to make it consistent with the equation of continuity. Explain the significance of displacement current.

(b) The conduction current density in a dielectric is given by $J = 0.02 \sin(10^9 t)$ Amp/m^2. Find the displacement current density, if $\sigma = 10^3$ mho/m and $\varepsilon_r = 6.5$.   10,5

3. (a) Derive Fresnel's relation for reflection and transmission of electromagnetic waves having electric field component normal to the plane of incidence at the boundary of two dielectrics.

(b) Derive the boundary conditions satisfied by the electric and magnetic field vectors at the boundary of two dielectrics.   11,4

4. (a) Starting with the Maxwell's equations obtain the wave equation for the propagation of electromagnetic wave in a symmetric planar wave guide. Derive the appropriate eigen value equations.

(b) Show that there exists only one symmetric TE mode for $0 < V < \pi$. V being the dimensionless wave guide parameter.   12,3

5. (a) Explain how to produce and analyze plane and circularly polarized light from a beam of polarized light.

(b) What is the SOP of electromagnetic wave having electric field vector : 12,3

$$\overline{E} = 2 \sin (\omega t - kz)\hat{i} + 3\sin (\omega t - kz - \frac{\pi}{2})\hat{j}.$$

6. (a) Deduce expressions for electric and magnetic fields of an oscillating electric dipole.

(b) Suppose that in one inertial system B = 0 but E ≠ 0 (at some point P). Is it possible to find another system in which the electric field is zero at P. Give reason. 12,3

7. (a) Derive the transformation laws for the electric and magnetic fields in the case of parallel plate capacitor.

(b) Show that $(E^2 - C^2B^2)$ is relativistically invariant. 12,3