Sem V
E&TRX Engg : Electromagnetics 15/5/06

Con. 1704-06. (REVISED COURSE) TV-8286
(3 Hours) [Total Marks : 100

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) Vector notation should be used wherever **necessary**.
(5) Assumptions made should be **clearly** stated.
(6) Assume any **suitable** data whenever **required** but **justify** the **same**.

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1. Answer any **four** from the following :–
   (a) Prove that $\bar{\nabla}.\bar{D} = \rho_v$ and obtain Laplace's and Poisson's eqauation
   (b) Explain the significance of displacement current
   (c) What is skin effect ? Define skin depth and state how is it related to the attenuation constant
   (d) Briefly explain the concept of retarded potentials
   (e) Write a short note on Smith chart
   (f) What is uniform plane wave ? Explain what is meant by transverse electromagnetic wave. 12 8

2. (a) State Maxwell's equations for static fields. Explain how are they modified for time varying fields.
   (b) The field intensity $\bar{E} = 250 \sin 10^{10}t$ (V/m) for a field propagating in the medium whose $\sigma = 5$ s/m and $\epsilon_r = 1$. Calculate the displacement current density $\bar{J}_D$, the conduction current density $\bar{J}_C$ and the frequency at which $\bar{J}_C = \bar{J}_D$. 12 8

3. (a) State and explain Poynting vector using modified Ampere's law derive the Poynting theorem and describe the significance of each of its terms.
   (b) Consider a circular cylinder with radius of one meter and length 0·75 m in free space with its axis along the z direction. An EM wave is propagating in the positive z direction with its electric field

$$\bar{E} = \text{Cos}\left[2\pi f\left(t - \frac{z}{c}\right)\right]\bar{a}_x \text{ (V/m)}$$

   Where f = 100 MHz and c is the velocity of light. Determine (i) Poynting vector and (ii) Net power flow entering the cylinder. 12 8

4. (a) Derive the boundary conditions for electric and magentic field vectors at the boundary of two dielectric media.
   (b) An electromagnetic wave propagates in free space. Its fields are given by : 12
   $\bar{E} = 30\ \pi\ e^{j(10^8 t + \beta z)}\ \bar{a}_x$ (V/m)
   $\bar{H} = H_o\ e^{j(10^8 t + \beta z)}\ \bar{a}_y$ (A/m) 8
   Find H_o and β.

5. (a) Derive the expressions for the reflection coefficient and transmission coefficient for perpendicularly polorized plane wave incident obliquely on a perfect conductor. 12 8
   (b) A plane wave of 200 MHz travelling in free space impinges normally on a large block of material having $\epsilon_r = 4$, $\mu_r = 9$ and $\sigma = 0$. Determine η_1, η_2, β_1, β_2, T_T and T_R. 20

6. (a) Derive an expression for the characteristic impedance of a two wire transmission line.
   (b) A lossless 50 Ω transmission line is terminated in 25 + j 50 Ω. Find (a) voltage ref ection coefficient; (b) current reflection coefficient; (c) VSWR and (d) impedance at 0·3 λ distance from the load.

7. Explain briefly the radiation for a short dipole in free space. Show that the power radiated by the short dipole.
   $P = 80\ \pi^2\ I^2\ \text{rms}\ (dl/\lambda)^2$
   Hence obtain the expression for radiation resistance.