T. E. (Electronics) (Sem IV) (Rev) 20/11/06

Engineering Electromagnetics

4011-Oct-06-EX-INK 92

Con. 4601-06. YM-6685

(REVISED COURSE)

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six**.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assumptions made should be **clearly stated**.
(5) Vector notation should be used whenever **necessary**.
(6) Use of **'Smith Chart'** is **allowed**.

1. (a) Derive Maxwell's equations for 'Time Varying Field' in differential and integral forms. Using this result write equations for medium as 'Good Conductor' and 'Good dielectric' in differential and integral forms. **12**

(b) Find the displacement current density next to your FM radio, in air, where the local FM station provides a carrier having. **4**

$$\vec{H} = 0{\cdot}2 \cdot \cos\left[2{\cdot}10\left(3 \times 10^8\, t - x\right)\right] \hat{a}_z \ \frac{V}{m}$$

(c) Given $\vec{E} = E_m \sin(wt - \beta z)\, \hat{a}y \ \frac{Amp}{m}$ in free space, find $\vec{D}$, $\vec{B}$, $\vec{H}$. **4**

2. (a) Obtain the boundary conditions for the normal and tangential components of electric and magnetic fields using Maxwell's equations. **8**

(b) State 'Poynting Theorem' and derive the expression of 'Instantaneous Poynting Vector'. **8**

(c) Write short note on 'Polarization'. **4**

3. (a) Obtain the expression for the field components of a transverse electric wave propagating through rectangular waveguide. **12**

(b) An air filled rectangular waveguide of inside dimension 7 × 3·5 cm operates in the TE_{10} mode. **8**
(i) Find cut-off frequency
(ii) Determine guide phase constant of the wave in waveguide at operating frequency of 3·5 GHz.
(iii) Determine guide wavelength at the same operating frequency.
(iv) Find 'Phase Velocity' of the EM wave.

4. (a) Derive Helmholtz Equation for the EM wave propagating in the conducting media. Using this result obtain the expression for attenuation and phase constant. **12**

(b) Calculate the ocean depths at which 1 micro Volts/meter field will be obtain with E at the surface equal to 1 Volts/meter at frequencies 1 KHz, 10 KHz, 100 KHz, 1000 KHz. What is the most suitable frequency for communication with submerged submarines ? **8**

Assume :— $\sigma = 4$ S/m, $\epsilon_r = 80$.

5. (a) For Free Space, prove that the value of 'Intrinsic Impedance' is equal to 377 Ohm. **8**

(b) Derive the expressions for reflection and transmission co-efficients in the case of 'wave reflection by a perfect dielectric—Normal Incidance'. **6**

(c) Determine the amplitudes of reflected and transmitted $\vec{E}$ and $\vec{H}$ at interface of two regions at $z = 0$. **6**

Given :— Incident $E_i = 1{\cdot}5 \times 10^{-3}$ Volts/m
$\epsilon_{r1} = 8{\cdot}5$, $\mu_{r1} = 1$, $\sigma_1 = 0$.
Region '2' is a free space.

6. (a) Derive an expression for the 'characteristic impedance' of the two wire transmission line 8

(b) Using Smith Chart find the input impedance to transmission line at a point (0·625 λ) from the load impedance $z_{load} = (75 - j25)\ \Omega$ and characteristic impedance, $z_0 = 50\ \Omega$. 8

(c) A transmission line has :— 4

R = 2 Ohm/meter,
L = 8 nano Henry/m,
G = 0·5 mili mho/m,
C = 0·23 pico Farad/m
Operating frequency is 1 GHz.
Calculate (i) Characteristic Impedance
(ii) Propagation Constant.

7. Explain briefly radiation from a short dipole in free space. 20
Show that the power radiated by the short dipole is :

$$P_T = 80\ \pi^2\ I_{rms}^2 \left(\frac{dl}{\lambda}\right)^2.$$