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NCC-003-1152002 Seat No. _____

M. Sc. (Electronics) (Sem. II) (CBCS) Examination

April / May – 2017

Advance Electromagnetics : Paper-VI

[Department of Electronics]

Faculty Code : 003

Subject Code : 1152002

Time : Hours] [Total Marks : **70**

1 Answer any seven from the following : **14**

(1) Prove that the wave equations in free space are given by

$$\nabla^2 E = \mu_0 \in_0 \ddot{E}$$

$$\nabla^2 H = \mu_0 \in_0 \ddot{H}$$

(2) Prove that E and H are perpendicular to each other in EM wave.

(3) Prove that the wave equations in phasor form are given as

$$\nabla^2 E = \gamma^2 E$$

$$\nabla^2 H = \gamma^2 H$$

Where $\gamma = \sqrt{-\omega^2 \mu \in + j\omega\mu\sigma}$.

(4) Prove that $\delta = \frac{1}{\alpha}$ where δ is depth of penetration and α is attenuation constant.

(5) Briefly write on direction consines of a vector field.

(6) Prove that $\Gamma_E = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1}$.

(7) Explain the terms phase velocity and group velocity.

(8) Show that TEM wave does not exist in hollow waveguides.

(9) Write four different definitions of propagation constant of transmission line.

(10) Define an antenna. What is radiation intensity ?

2 Answer any two from the following :

(1) Prove that a uniform plane wave propagating in x-direction has no x-components of E and H, i.e., $E_x = 0$ and $H_x = 0$. **7**

(2) Prove that $\frac{E}{H} = 120\pi\ \Omega$. **7**

(3) Prove that for conducting medium **7**

$$\alpha = \omega \sqrt{\frac{\mu \in}{2}\left[1 + \frac{\sigma^2}{\omega^2 \in^2} - 1\right]}$$

$$\beta = \omega \sqrt{\frac{\mu \in}{2}\left[\sqrt{1 + \frac{\sigma^2}{\omega^2 \in^2}} + 1\right]}$$

3 Answer the following :

(1) For a normal incidence of EM wave on a perfect conducting surface show that **7**

$$\tilde{E}_R(z, t) = 2E_i \sin\beta z \sin\omega t$$

$$\tilde{H}_R = 2H_i \cos\beta z \cos\omega t$$

(2) Assuming oblique incidence of EM wave on perfect conductor prove for the case of parallel polarization that 7

$$H_T = 2H_i \cos(\beta y \cos\theta) e^{-j\beta x \sin\theta},$$

$$E_{Tx} = 2j\eta \cos\theta H_i \sin\beta_y y e^{-j\beta_x x}$$

$$E_{Ty} = 2\eta \sin\theta H_i \cos\beta_y y e^{-j\beta_x x}$$

OR

3 Answer the following :

(1) A vessel under sea water requires a minimum signal level of $20\mu V/m$. What is the depth in the sea that can be reached by 4.0 MHz plane wave from an airplane ? The wave has an electric field intensity of 100 V/m. The propagation is vertical into the sea. For sea water, $\sigma = 4.0$ mho/m, $\mu_r = 1$, $\in_r = 81$. 7

(2) Solve the following. 7

When a wave of 6 GHz propagates in parallel conducting plates separated by 3 cm, find the phase and group velocity for dominant wave. Find the modes that will propagate through this guide if the separation distance is 6 cm.

4 Answer the following :

(1) Derive the expressions for the field components H_x, H_y, E_x, E_y for EM wave travelling between two perfectly conducting plates. 7

(2) Obtain the expressions for the field components H_x, H_y, E_x, E_y for EM wave travelling in the rectangular hollow waveguide with perfectly conducting walls. 7

5 Answer any two from the following :

(1) Discuss the transmission line with proper equations and show that 7

$$Z_i = \frac{V_L \cosh \gamma l + Z_0 I_L \sinh \gamma l}{I_L \cosh \gamma l + \left(\frac{V_L}{Z_0}\right) \sinh \gamma l}$$

Point out the special cases of Z_i when load is open or short circuited.

(2) Write a detailed note on Smith chart with proper derivation of r-circle and x-circle equations. 7

(3) Discuss radiation from half-wave dipole antennal with detail mathematical steps and show that 7

$$P_T = 73.0\, I_{ef\,f}^2 \quad R_r = 73\,\Omega.$$

(4) Find the directivity of current element, Idl. 7