[This question paper contains 2 printed pages.]

Sr. No. of Question Paper : 6463 **D** **Your Roll No.....**

Unique Paper Code : 251506

Name of the Course : **B.Sc. (H) Electronics**

Name of the Paper : ELHT-504 : Wave Propagation and Antenna

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is compulsory.
3. Attempt **five** questions in all.
4. **All** questions carry equal marks.
5. Use of scientific calculator is allowed.

1. (a) A distortion less transmission line has $Z_0 = 60\Omega$, $\alpha = 20$ mNp/m, wave velocity = 1.8×10^8 m/s. Find the line parameters L and C.

   (b) In a material for which $\sigma = 10$S/m and $\varepsilon_r = 2$ the electric field intensity is $E = 250 \sin(10^{10}t)$V/m. Find the conduction and displacement current densities.

   (c) What is the difference between phase and group velocity.

   (d) What is the dominant mode in a rectangular waveguide for TE mode and draw its field configuration.

   (e) Determine the electric field intensity at a distance of 5 km from an antenna having a directive gain of 10 dB and radiating a total power of 30 kW. (3×5)

2. (a) Find an expression for input impedance of a lossless transmission line of characteristics impedance Z_0 and load impedance Z_L.

   (b) Show that quarter wave transmission line is used for impedance matching.

   (c) Define voltage standing wave ratio (VSWR). Find reflection coefficient and hence the VSWR of a transmission line having characteristic impedance 75Ω and load impedance 30Ω. (7+4+4)

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3. (a) For an electromagnetic wave propagating in conducting media, find the expressions for propagation constant, wave velocity and intrinsic impedance.

   (b) Prove that attenuation and phase constants have equal magnitude for good conductors.

   (c) A uniform plane wave propagating in a medium has $\vec{E} = 2e^{-\alpha z}\sin(10^8 t - \beta z)\,\hat{j}$ V/m. If medium is characterized by $\varepsilon_r = 1$, $\mu_r = 20$ and $\sigma = 3$ mho/m. Find α, β and **H**. (6+3+6)

4. (a) Discuss the reflection of a plane wave at normal incidence.

   (b) Prove snell's law for a plane wave at oblique incidence.

   (c) A uniform plane wave in air with $\vec{E} = 8\cos(\omega t - 4x - 3z)\,\hat{j}$ V/m is incident on a dielectric slab ($z \geq 0$) with $\varepsilon_r = 2.5$, $\mu_r = 1$. Find polarisation of the wave and angle of incidence. (6+5+4)

5. (a) Prove Poynting theorem for flow of energy in electromagnetic field and give its significance.

   (b) Discuss open circuited, short circuited and matched transmission lines.

   (c) A copper conductor which is characterized by $\sigma = 5.8 \times 10^7$ mho/m, $\varepsilon_r = 1$, $\mu_r = 1$ supports a uniform plane wave of frequency 60 Hz. Find attenuation constant, phase constant, propagation constant, intrinsic impedance and phase velocity of the wave. (4+6+5)

6. (a) Derive an expression for cut-off frequency in a rectangular waveguide for TM mode.

   (b) What is waveguide resonator ?

   (c) A rectangular wave guide of dimensions 3 cm × 2 cm operates at 10 GHz. Find cutoff frequency, cutoff wavelength, free space wavelength, guided wavelength, guided phase constant and phase velocity of TE_{10}. (6+3+6)

7. (a) What is dipole antenna ? Derive an expression of radiation resistance for half wave dipole antenna.

   (b) What are the various applications of small loop antenna ?

   (c) Find the maximum effective area of a half wave dipole antenna operating at 30 MHz. How much power is received with an incident plane wave of strength 2 mV/m. Given that maximum directive gain is 1.64. (7+3+5)