[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5630 **J**

Unique Paper Code : 2513010015

Name of the Paper : Transmission Lines, Antenna and Wave Propagation (DSE)

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

Semester : VI

Duration : 3 Hours Maximum Marks : 90

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) The electric field in free space is given by $E = 50 \cos(10^8 t + \beta x)\ \hat{a}_y V/m$. Calculate the phase constant and the time it takes to travel a distance of half wavelength. (3)

   (b) For a transmission line which is terminated in a normalized impedance z_n, VSWR = 2. Find the normalized impedance magnitude. (3)

   (c) Find the input impedance of a shorted and open circuited transmission line? (3)

   (d) Explain why rectangular waveguide cannot support TEM mode. Find the broad wall dimension of a rectangular waveguide when the cut-off frequency for TE_{10} mode is 3 GHz. (3)

   (e) Why antenna is needed for efficient radiation of electromagnetic waves? (3)

   (f) Why half wave dipole is capable of delivering greater amount of power to space than the Hertzian dipole? (3)

2. (a) Derive the expression for Brewster's angle for oblique incidence with electric field intensity vector parallel to plane of incidence. (10)

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(b) Prove Snell's law for a plane wave at oblique incidence. (8)

3. (a) What is dispersion. Derive the expressions for group velocity in dispersive medium. (9)

(b) What is distortionless transmission line. Derive the expression for propagation constant and characteristic impedance of distortionless line. (9)

4. (a) Derive the expressions for propagation constant and characteristic impedance in terms of lumped parameters of a transmission line. (10)

(b) Determine the propagation constant and characteristic impedance of a lossless transmission lines. (4)

(c) An air-line has a characteristic impedance of 70 ohms and a phase constant of 3 rad/m at 100 MHz. Calculate the inductance per meter and capacitance per meter of the line. (4)

5. (a) Derive the electric and magnetic field expressions for Transverse Electric mode in a rectangular waveguide. (10)

(b) What is difference between Transverse Electromagnetic mode and Hybrid mode. (3)

(c) A rectangular waveguide with dimension a = 2.5 cm and b = 1 cm is to operate below 10.5GHz. How many TE and TM modes can the waveguide transmit if the guide is filled with a medium characterized by $\sigma = 0$, $\mu_r = 1$, $\varepsilon_r = 4$. Calculate the cut-off frequencies of the modes. (5)

6. (a) Derive the expression for radiation resistance for Hertzian dipole antenna. (10)

(b) Why are lumped parameter elements connected by wires are not useful as resonant circuits at microwave frequencies? (4)

(c) An air-filled resonant cavity with dimensions a=5 cm and b=4 cm and c=10 cm is made of copper $\sigma = 5.8 \times 10^7$S/m. Find the two lowest-order modes. (4)

7. (a) Derive the Friis transmission relation for two antennas separated by distance 'r'. (10)

(b) Find the maximum effective area of a $\lambda/2$ wire dipole operating at 30 MHz. How much power is received with an incident plane wave of strength 2 mV/m? (8)

(200)