[This question paper contains 2 printed pages.]

Your Roll No. 17009558026

Sr. No. of Question Paper : 2175

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Unique Paper Code : 32517919-OC

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

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

Semester : VI

Duration : 3 Hrs 30 mins

Maximum Marks : 75

Instructions for Candidates

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

Q1. (a)Prove Snell's law for a plane wave at oblique incidence. (4)

(b)Derive the expression for Brewster's angle for oblique incidence with electric field intensity parallel to plane of incidence. (7)

(c) An electromagnetic wave travels in free space with the electric field component $E = 100\, exp^{j(0.866y+0.5z)} a_x\ V/m$, determine

(i) angular frequency and wavelength

(ii) The magnetic field component. (4)

P.T.O.

Q2. (a)What is Poynting Theorem. Derive an expression for the net power flowing out of a closed surface. (8)

(b)What is the difference between lossy dielectric medium and conducting medium.(3)

(c)In a nonmagnetic medium

$E = 4\sin(2\pi \times 10^7 t - 0.8x)\, a_z\ V/m$. Find

(*i*)Relative permittivity and intrinsic impedance of the medium.

(*ii*) The time-average power carried by the wave. (4)

Q3. (a)Find the expression for input impedance of a lossless transmission line of characteristic impedance Z_0 and load impedance Z_L. (8)

(b)Prove that maximum power is delivered to the load when reflection coefficient is zero. (4)

(c)Find the standing wave ratio of a transmission line with characteristic impedance 75Ω and load impedance 35 Ω. (3)

Q4. (a)Derive the electric and magnetic field expressions for dominant Transverse Magnetic mode in a rectangular waveguide. (7)

(b)In a rectangular waveguide for which a=1.5 cm, b=0.8 cm, σ=0, $\varepsilon_r = 4$.

$H_x = 2\sin\left(\frac{\pi x}{a}\right)\cos\left(\frac{3\pi y}{b}\right)\sin(\pi \times 10^{11} t - \beta z) A/m$. Determine the mode of operation, cut-off frequency, phase constant and intrinsic impedance. (4)

(c)An air-filled rectangular waveguide with dimension a=8.636 cm and b=4.318 cm is fed by a 4GHz carrier from a coaxial cable. Calculate the phase velocity and group velocity of the wave. (4)

Q5. (a)Why antenna is needed for efficient radiation of electromagnetic waves. Write the two types of antennas. (3)

(b)Show that the directive gain of the Hertzian dipole is $G_d(\theta, \Phi) = 1.5\sin^2(\theta)$? (4)

(c)What is waveguide resonator. Derive an expression for the resonant frequency of resonator for Transverse Magnetic mode. (8)

Q6. (a) Define the E-plane and H-plane pattern of an antenna. Draw the E-plane, H-plane and three-dimensional field pattern of the Hertzian dipole. (5)

(b) Define the term – electrostatic field, inductive field, and far field region of an antenna. (3)

(c)What is antenna array? Find the expression for an array factor of a two-element array. (7)

Q7. (a) Derive the Radar range equation. (8)

(b)A radar transmitting at 3 GHz radiates 200kW. Determine the signal power density at range 100 km if the effective area of the radar antenna is 10 m^2. (5)

(c) What are the two applications of small loop antenna? (2)

(100)