

(This Question paper contains 2 printed page)

Roll No. _____

S.No. of Question Paper : 1973

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Unique Paper Code : 2513010015

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

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

Semester : VI

Duration : 3 Hours

Maximum Marks : 90

(Write your Roll No. on the top immediately on the receipt of this question paper)

Question No.-1 is compulsory, Attempt five questions in all.

All questions carry equal marks.

(Use of non-programmable scientific calculator is allowed)

- Q1.** (a) What are phase matching conditions for oblique incidence? (3)
(b) In free space $E(z, t) = 10 \sin(\omega t + \beta z) \hat{a}_y \text{ V/m}$. Find $H(z, t)$. (3)
(c) Show that the input impedance of shorted line with $\beta l < \pi/2$ acts as an inductor. (3)
(d) What is waveguide resonator? What is resonating frequency of resonator operating in transverse electric mode? (3)
(e) Explain how quarter-wave transformer is used for impedance matching. (3)
(f) Define the term- electrostatic field, inductive field and far field region of an antenna. (3)
- Q2.** (a) Derive the expressions for Fresnel's equations for oblique incidence with electric field intensity vector perpendicular to plane of incidence. (10)
(b) Prove Snell's law for a plane wave at oblique incidence. (8)
- Q3.** (a) What is difference between phase velocity and group velocity of a wave? (6)
(b) Find the input impedance and standing wave ratio of – shorted line, open circuited line and matched line. (8)
(c) Find the Standing wave ratio of a transmission line with characteristic impedance 75Ω and load impedance 35Ω . (4)
- Q4.** (a) Find the expression for input impedance of a lossless transmission line of characteristic impedance Z_0 and load impedance Z_L . (10)
(b) Prove that maximum power is delivered to the load when reflection coefficient is zero. (8)
- Q5.** (a) Derive the electric and magnetic field expressions for Transverse Magnetic mode in a rectangular waveguide. (10)
(b) Which type of mode is not supported by hollow rectangular waveguide and why. (3)
(c) A rectangular waveguide with dimension $a = 2.5 \text{ cm}$ and $b = 1 \text{ cm}$ is to operate below 10.5 GHz . How many TE and TM modes can the waveguide transmit if the guide is filled with a medium characterized by $\sigma = 0$, $\mu_r = 1$, $\epsilon_r = 4$. Calculate the cut-off frequencies of the modes. (5)

- Q6.** (a) Derive the expression for radiation resistance for Hertzian dipole antenna. (12)
 (b) Show that the directive gain of the Hertzian dipole is $G_d(\theta, \Phi) = 1.5\sin^2(\theta)$. (6)
- Q7.** (a) Derive the equation for the power radiated and the radiation resistance of a Half wave dipole antenna. Compare it with that for a quarter wave dipole antenna. (10)
 (b) An electric field strength of 10 mV/m is to be measured at an observation point $\theta = 5\pi/2$, 500 km from a half-wave (resonant) dipole antenna operating in air at 50 MHz
- i) What is the length of the dipole?
 - ii) Calculate the current that must be fed to the antenna.
 - iii) Find the average power radiated by the antenna.
 - iv) If a transmission line with $Z_0 = 75 \Omega$ is connected to the antenna, determine the standing wave ratio. (8)