This question paper contains 2 printed pages. *Your Roll No. .....*

Sl. No. of Ques. Paper	: 557
Unique Paper Code	: 251506
Name of Paper	: ELHT-504 : Wave Propagation and Antenna
Name of Course	: B.Sc. (Hons.) Electronics
Semester	: V
Duration :	: 3 hours
Maximum Marks	: 75

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

Question No. 1 is compulsory. Attempt five questions in all. All questions carry equal marks.

1. (a) Write Maxwell's equations in point form. Give their physical significance.

   (b) A parallel-plate capacitor with plate area 5 cm^2 and plate separation of 3 mm has a voltage 50 sin 10^3t V applied to its plates. Calculate the displacement current assuming $\varepsilon=2\varepsilon_0$.

   (c) Explain how a quarter wave transformer can be used for matching the load to a transmission line.

   (d) How are the waveguide resonators different from the conventional LC circuits?

   (e) Define radiation pattern, directive gain and power gain of an antenna. 5×3

2. (a) Derive the transmission line equations. Also find expression for characteristic impedance of the line.

   (b) An air line has characteristic impedance of 70 Ω and phase constant of 3 rad/m at 100 MHz. Calculate the inductance per meter and capacitance per meter of the line.

   (c) Distinguish between distortionless line and lossless line. 8+5+2

3. (a) State and prove Poynting's theorem.

   (b) The electric field in free space is given by:

   $$E = 50 \cos(10^9 t+\beta x)a_y \text{ V/m}$$

   (i) Find the direction of wave propagation.

   (ii) Calculate β and the time taken to travel a distance of $\lambda/2$.

   (c) Define loss tangent and give its physical significance. 8+4+3

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4. (a) Define phase velocity and group velocity. Explain the pulse broadening in dispersive medium.

   (b) For a lossless transmission line, obtain an expression for average power transferred from the source to load.

   (c) Find the skin depth at a frequency of 1·6 MHz in aluminium, where $\mu_r=1$ and $\sigma=38{\cdot}2$ MS/m. Also find propagation constant and wave velocity. 4+7+4

5. (a) Obtain expressions for reflection and transmission coefficients for a plane wave incident normally on an interface between two different media.

   (b) Derive field expressions for TM modes in rectangular waveguides.

   (c) Explain why a rectangular waveguide cannot support TEM mode. 4+9+2

6. (a) Derive Fresnel's equations for a parallel polarized plane wave incident obliquely at interface of two different media.

   (b) Find the directive gain of the Hertzian dipole.

   (c) Define effective area of a receiving antenna. Find an expression for effective area of Hertzian dipole. 8+3+4

7. (a) Derive field expressions for a half wave dipole antenna.

   (b) Mention *two* applications of small loop antenna.

   (c) A magnetic field strength of 5 μA/m is required at a point on $\theta=\pi/2$, 2 km from an antenna in air. Neglecting ohmic losses, how much power must a Hertzian dipole of length $\lambda/25$ transmit? 7+2+6

Physical constants : $\mu_0=4\pi\times10^{-7}$ H/m; $\varepsilon_0=8{\cdot}85\times10^{-12}$ F/m, $c=3\times10^8$ m/s.