

ET506M - Electromagnetic Waves

P. Pages : 2

Time : Three Hours



GUG/S/23/13927

Max. Marks : 80

- Notes :
1. All questions carry as indicated marks.
 2. Assume suitable data wherever necessary.
 3. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) What is a transmission line? Draw equivalent circuit representation of transmission line. **4**
- b) Derive the expression for power transfer on a transmission line. **6**
- c) For a transmission line the per unit length parameter are $0.1\Omega/\text{m}$, $0.2\mu\text{H}/\text{m}$ and $0.025/\text{m}$ Find the complex propagation constant at
i) 1MHz ii) 1GHz **6**

OR

2. a) Explain loss-less and low loss transmission line. **8**
- b) A loss-less transmission line has 75Ω characteristic impedance. The line is terminated in a load impedance of $50 - j100\Omega$, The maximum voltage measured on the line is 100V. Find the maximum and minimum current and the minimum voltage on the line. At what distance from the load the voltage and current are maximum. **8**
3. a) State and prove gauss law and explain application of gauss law. **8**
- b) A triangle is defined by three point A(2, -5,1) B(-3, 2, 4) and C(0, 3,1). Find $\mathbf{R}_{BC} \times \mathbf{R}_{BA}$; The A(ΔABC) and unit vector perpendicular to the plane of triangle located. **8**

OR

4. a) Define and explain coulombs law. **6**
- b) Explain poisons equation. **6**
- c) A 2mc positive charge is located in vacuum at P1 (3, -2, -4) and a $5\mu\text{C}$ negative charge is at P₂(1, -4, 2) . Find the vector force on the negative charge. **4**
5. a) Define and explain biot-savart law. **8**
- b) A single phase 150KVA transformer is required to stepdown the voltage from 1000V to 500V at 50Hz. The cross sectional area of the core is 625 sq cm and the maximum value of flux density is 1.25 WB/sqm. Determine
i) The number of HV and LV turns
ii) The emf per turn
iii) The primary and secondary full load current. **8**

OR

6. a) Write short note on: 8
 i) Faraday law
 ii) Amperes circuit law
- b) Derive the expression for transformer emf. 8
7. a) Write short note on: 8
 i) Circular polarization
 ii) Linear polarization.
- b) Derive wave equation for E & H in free space. 8

OR

8. a) Derive the expression for the attenuation constant, phase constant and intrinsic impedance for a uniform plane wave in a good conductor 8
- b) The magnetic field at the surface of a good conductor is 2A/m. the frequency of the field is 600MHz. If the conductivity of the conductor is $10^7 \text{ } \Omega / \text{m}$. Find the skin depth, surface impedance and the power loss per unit area of the conductor. 8
9. a) Compare Transmission line and wave guide. 6
- b) Calculate the cut-off wavelength of a rectangular wave guide whose inner dimension are $a = 2.3\text{cm}$, and $b = 1.03\text{cm}$ operating in TE_{10} mode. 4
- c) Write short note on guided wave between parallel plane. 6

OR

- 10 a) A parallel plane wave guide has 0.05m height and is filled with material having relative permittivity 2.4. What is the frequency ranges over which there is single mode propagation? If the magnetic field for the mode is 0.1A/m. Find the electric field inside the waveguide. 8
- b) Consider the TE_{10} mode wave operating at 10 GHz frequency and propagating in between the parallel plates separated by a distance of 3cm in air. Find guide wavelength, group velocity, phase velocity & wave impedance. 8
