

B.E. Electronics & Communication/Telecommunication Engineering (Model Curriculum) Sem-V  
**ET506M : Electromagnetic Waves**

P. Pages : 2

Time : Three Hours



**GUG/W/22/13927**

Max. Marks : 80

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

1. a) What is transmission line? Draw equivalent circuit representation of Transmission line. **4**
- b) i) Derive equation governing voltage & current on a transmission line. **8**
- ii) For a transmission line the per unit length parameters are  $0.1\Omega/\text{m}$ ,  $0.2\mu\text{H}/\text{m}$  and  $0.02\text{S}/\text{m}$ . Find the complex propagation constant at (a) 1 MHz (b) 1 GHz **4**

**OR**

2. a) i) Differentiate between AC & DC transmission line. **4**
- ii) Explain the term Propagation constant & Characteristics impedance. **6**
- b) A  $50\Omega$  lossless transmission line is connected to a load  $(50+j50)\Omega$ . The maximum voltage measured on the line 50v. Find the power delivered to the load and the peak voltage at the load end of the line. **6**
3. a) State Gauss Law & explain application of Gauss law. **8**
- b) A 2-mC (mill coulomb) positive charge is located in vacuum at P1 (3, -2, -4), and a  $5-\mu\text{C}$  (micro coulomb) negative charge is at P2 (1, -4, 2). (a) Find the vector force on the negative charge. (b) What is the magnitude of the force on the charge at P1? **8**

**OR**

4. a) Explain Poissons and Laplace's equations. **8**
- b) What is the magnetic field intensity due to a straight current carrying filamentary conductor of finite length. **8**
5. a) Derive Maxwell equation in general form. **8**
- b) An air filled parallel plate capacitor is made up of circular disc of area of  $2\text{m}^2$ . The spacing between the disc is 0.1m. If a voltage  $20 \cos 10^3 t$  volt is applied across the capacitor plate. Find the displacement current density and the magnetic field between the capacitor plate. Also show that the current flowing between the capacitor terminal is equal to the displacement current. **8**

**OR**

6. a) Derive the equation for transformer emf. 8
- b) A circular loop of N turns of conducting wire lies in the xy-plane with its centre at the origin of a magnetic field specified by  $B = a_2 B_0 \cos(\pi r / 2b) \sin \omega t$ , where b is the radius of the loop and  $\omega$  is the angular frequency. Find the emf induced in the loop. 8

7. a) What is intrinsic impedance of a medium? What is its significance? 8
- b) Derive the expression for the attenuation constant. 8

**OR**

8. a) Derive wave equation in phasor form. 8
- b) A uniform plane wave at frequency of 300 MHz travels in vacuum along +y direction. The electric field of the wave at some instant is given as  $E = 3\hat{a}_x + 5\hat{a}_z$ . Find the phase constant of the wave and also the vector magnetic field. 8
9. a) Write a brief note on excitation of modes in rectangular waveguide. 4
- b) An air filled parallel plane wave guide carries the  $TM_2$  Mode. The height of the waveguide is 20 cm. If the phase velocity of the mode is  $1.5c$ , find the frequency and guided wavelength of the mode. 6
- c) A parallel plane waveguide 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 0.1 A/m. Find the electric field inside the waveguide. 6

**OR**

10. a) There is a rectangular hole of 5 cm diameter through which a rectangular waveguide carrying dominant mode at 10GHz is to pass. What should be the waveguide dimension so that maximum power is transmitted through the waveguide and the peak electric field does not exceed 1kV/m? 8
- b) Find the cut-off frequency of the  $TE_{10}$  Mode wave operating at 1 GHz frequency that propagates in between the parallel plates separated by a distance of 3cm in air. 8
- c) 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

\*\*\*\*\*