B.E. / B.Tech. Electronics & Communication/Telecommunication Engineering (Model Curriculum)
Semester-V

ET506M / ELECT1 - Electromagnetic Waves

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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 of transmission line and explain primary and secondary constant. **8**

B) Define **8**
i) Wavelength. ii) Velocity of propagation.
iii) Group velocity. iv) Skin effect.

OR

2. A) Derive an expression for the characteristics impedance Z_0, attenuation constant α, velocity of propagation VP and wavelength of a transmission line in terms of primary constant. **8**

B) An open wire telephone line has $R = 10\Omega$ per km, L = 0.0037 Henery per km, $C = 0.0083 \times 10^{-6}$ farad per km and $G = 0.4 \times 10^{-6}$ ohms per km. Determine its Z_0, α and β at 1000 Hz. **8**

3. A) Cylindrical surface of $\rho = 2, 4$ and 6m carry uniform charge densities of $20\text{nc}/\text{m}^2$, $-4\text{nc}/\text{m}^2$ and ρ_{SO} respectively. **8**
i) Find $\bar{D}$ at $\rho = 1, 3$ and 5 m.
ii) Determine ρ_{SO} such that $\bar{D} = 0$ at $\rho = 7\text{m}$.

B) Derive the mathematical expression for boundary condition between dielectric and conductor. **8**

OR

4. A) The point A and B in cartesian co-ordinate system are given as $A(2, 5, -3)$ and B(-3, 1, 4). **8**
i) Find distance between the point A and B.
ii) Find distance from origin to the midpoint the line AB.
iii) Find the unit vector in the direction of $\bar{R}_{AB}$
iv) Find the point of intersection of the line AB and x = 0 plane.

B) Prove the divergence theorem for the region $r \leq a$ (in spherical co-ordinate system) having the flux density $\bar{D} = \dfrac{5r}{3}\bar{a}r$ **8**

5. A) State and prove Biot-Savart Law. **8**

B) Derive the expression for $\bar{H}$ at any point due to a co-axial cable. **8**

OR

6. A) In material for which $\sigma = 6\dfrac{\text{mho}}{\text{m}}$ and $\in_r = 2.5$, the electric field intensity is **8**

$E = 250 \sin 10^{10} t$ find J_C and J_D the frequency at which amplitude of J_C and J_D is same.

B) Derive the maxwell equations for time varying fields. **8**

7. A) Derive the relation between $\bar{E}$ and $\bar{H}$ in a uniform plane wave. **8**

B) The electric field of a uniform plane wave is given by. **8**

$\bar{E} = 40 \sin\left(30\pi \times 10^6 t - 2\pi_Z\right)\hat{a}x + 40\cos\left(30\pi \times 10^6 t - 2\pi z\right)\hat{a}y \text{ v/m}$

Find
i) Frequency of operation.
ii) The wavelength.
iii) Direction of propagation of wave
iv) Associated magnetic field $\bar{H}$.

OR

8. A) What is polarization. State their types and explain in brief. **8**

B) Explain reflection and refraction of plane wave with mathematical expression. **8**

9. A) Derive the wave equation for a TM wave and obtain all the field components in a rectangular waveguide. **8**

B) What is attenuation. Derive mathematical expression of attenuation in circular waveguide. **8**

OR

10. A) Determine the cut-off wavelength for the dominant mode in a rectangular waveguide of breadth 10cms for a 2.5 GHz signal propagated in this waveguide in the dominant mode calculate the guide wavelength the group velocity and phase velocity. **8**

B) Describe the method of designing the modes of transmission in a rectangular waveguide. What do you mean by the dominant mode. **8**

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