B.E. Electronics & Communication/Telecommunication Engineering (Model Curriculum)
Semester-V
ET506M - 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) Derive the voltage and current relationships on a transmission line with the help of equivalent circuit. **8**

   b) A 600Ω lossless transmission line is fed by a 50Ω generator. If the line is 200m long and terminated by load of 500Ω, determine in dB's. **8**
   i)   reflection loss
   ii) transmission loss
   iii) return loss

OR

2. a) A 50Ω lossless line connect a signal of 300KHz to a load of 100Ω. If the load power is 50mW. Determine. **8**
   i)   VSWR
   ii) Position of first V_{min} and V_{max}.
   iii) V_{min} and V_{max}
   iv) Impedance at V_{min} and V_{max}.

   b) What is impedance matching. Explain the various methods of achieving impedance matching. **8**

3. a) A point charge $Q_1 = 10\mu C$ is located at $P_1(1,2,3)$ in free space, while $Q_2 = -5\mu C$ is at $P_2 = (1,2,10)$. Find the vector force exerted on Q_2 by Q_1. **8**

   b) Derive the expression for boundary between dielectric and conductor. **8**

OR

4. a) Derive the expression of parallel plate capacitance using Laplace's equation. **8**

   b) In a cylindrical conductor of radius 3mm the current density varies with distance of the axis according to **8**
   $$J = 10^3 e^{-400\rho} \ (A/m^2)$$
   Find the total current I.

5. a) Prove that $$\bar{\nabla} \cdot \bar{J} = -\frac{\partial \rho v}{\partial t}$$ **8**

b) Find the magnetic field intensity at point P (0.01, 0, 0) if the current flow through the cable is 8A centered on the z axis, given a=3mm, b=9mm, c=12mm. **8**

OR

6. a) State and prove Biot-Savart law. **8**

b) In material for which $\sigma = 6 \, mho/m$ and $\varepsilon_r = 2.5$, the electric field intensity is **8**

$E = 250 \sin 10^{10} t$. Find
i) Current density J_C
ii) Displacement current density J_D
iii) The frequency at which amplitude of J_C and J_D is same.

7. a) Derive the relationship 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**
$$\bar{E} = 40\sin\left(30\pi \times 10^6 t - 2\pi z\right)\hat{a}_x + 40\cos\left(30\pi \times 10^6 t - 2\pi z\right)\hat{a}_y \, V/m.$$

Find
a) Frequency of operation   b) The wavelength
c) Direction of propagation of wave   d) Associated magnetic field $\bar{H}$.

OR

8. a) Explain linear and circular polarization of uniform plane wave. **8**

b) Derive the expression of uniform plane wave reflection by a perfect dielectric normal incidence. **8**

9. a) Define- **8**
i) Phase velocity   ii) Group velocity
iii) Intrinsic impedance   iv) Cut-off wavelength

b) The TE_{10} mode is propagated in a rectangular wave guide of dimension a=6cms and **8**
b=4cms. By means of a travelling detector, the distance between a maximum and minimum is found to be 4.55cms. Find the frequency of the wave.

OR

10. a) Prove that **8**
$$C^2 = Vp \cdot Vg$$

b) What is attenuation. Explain various types of attenuation in waveguide. **8**

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