III B. Tech I Semester Supplementary Examinations, May/June -2024
ELECTROMAGNETIC WAVES AND TRANSMISSION LINES
(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
*****

UNIT-I

1. a) Discuss the characteristics and properties of lossless transmission lines. Explain how these lines differ from lossy transmission lines and provide examples of situations where lossless transmission lines are applicable in engineering. [7M]

   b) Measurements on a lossy transmission line at 800 MHz indicate Z0 = 50 + j0 Ω, α = 0.01 Np/m and β = 4 rad/m. determine the line parameters R, L, G and C. [7M]

(OR)

2. a) Explain the propagation constant (γ) of a transmission line. How does it relate to attenuation and phase shift? Provide mathematical expressions for calculating γ and discuss its significance in signal transmission. [7M]

   b) The voltage reflection coefficient due to load connected to a lossless transmission line of characteristic impedance 100 Ω and working at 3 GHz is 0.5, 450 . Assuming the load voltage to be 10 V, calculate the r.m.s voltage and current at intervals of one fourth wave length from the load up to a distance 5 cm. [7M]

UNIT-II

3. a) Define the reflection coefficient in transmission lines. Discuss its physical significance and how it relates to the impedance mismatch between a transmission line and its load. Include the formulas for calculating the reflection coefficient. [7M]

   b) Derive the input impedance of lossless λ/4 transmission line? [7M]

(OR)

4. a) Discuss the characteristics of low-loss radio frequency transmission lines. What materials and design considerations contribute to low loss at high frequencies? Provide examples of applications where low-loss RF lines are crucial. [7M]

   b) For a uniform transmission line, Zoc =50+j25Ω, Zsc =60-j20Ω. Find Zo? [7M]

UNIT-III

5. a) Describe how UHF transmission lines can be treated as circuit elements for impedance transformations. Discuss the use of A/8, A/4, and A/2 lines in impedance matching and transformations, providing mathematical relationships and practical examples. [7M]

   b) Point charges 4 mC and -3 mC are located at (2, 1, -3) and (-1, -2, 4) respectively. Calculate the electric force on a 12 nC charge located at (0, 3, 1) and the electric field intensity at that point. [7M]

(OR)

6. a) Discuss the quarter-wave transformer and its role in impedance matching. Explain how a quarter-wave transformer is constructed and used to transform the impedance of a transmission line to match a load impedance. Provide mathematical expressions and practical examples. [7M]

b) On a flat conducting surface, if a surface charge density ρs = 1 coulomb per square meter is placed on it, what would be the value of the electric field strength E at its surface? [7M]

UNIT-IV

7. a) Discuss the concept of magnetic energy and its significance in magnetic systems. Explain how the energy stored in magnetic fields is calculated and provide examples of its practical applications. [7M]

b) A uniform plane wave propagating in a medium has E = 2e' (sin(10* t − βz)V/m. If medium is characterized by εr=1, μr=20, σ =3mhos/m, find α and β. [7M]

(OR)

8. a) Discuss the forces experienced by charged particles moving through magnetic fields. Derive Ampere’s Force Law and explain how it relates to the velocity and charge of a particle. [7M]

b) A parallel plate capacitor with plate area of 5 cm2 and plate separation of 3 mm has a voltage 50 sin 103 t applied to its plates. Calculate the displacement current assuming ε = 2ε0. [7M]

UNIT-V

9. a) Explain the concepts of Brewster angle, critical angle, and total internal reflection in the context of wave propagation at material interfaces. Discuss how these angles are calculated and their practical implications. [7M]

b) A perpendicularly polarized wave is incident at an angle of θ I = 15 0 .It‘s Propagating from medium 1 to medium 2. Medium 1 is defined by ε r1 =8.5, μ r1 =1, σ 1 =0 and medium 2 is free space. If E I =1.0 mV/m , Determine E r, H I , H r. [7M]

(OR)

10. a) Define polarization in electromagnetic waves and discuss the different types of polarization. Explain how polarization affects the orientation of the electric field vector. [7M]

b) An circularly polarized wave has an electric field of E = Sin (ωt-βz) a x V/m. Find power per unit area conveyed by the wave in free space? [7M]