C **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: R3408

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2025

Third Semester

Electronics and Communication Engineering

R21UEC308- ELECTROMAGNETIC THEORY AND TRANSMISSION LINES

(Regulations R2021)

(Smith Chart is to be Provided)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 1 = 5 Marks)

1. According to Faraday's law, EMF stands for _____. CO1- U

   (a) Electromagnetic field (b) Electromagnetic force

   (c) Electromagnetic friction (d) Electro motive force

2. For a perfect dielectric, which parameter will be zero? CO1- U

   (a) Conductivity (b) Frequency (c) Permittivity (d) Permeability

3. One decibel is equal to _____. CO1- U

   (a) 0.115 neper (b) 0.66 neper (c) 0.88 neper (d) 0.98 neper

4. If Z_1 & Z_2 are same reactances, then the ratio of $Z_1/4Z_2$ is _____. CO1-U

   (a) Positive and real (b) Negative and imaginary (c) Zero (d) None of these

5. The velocity with which the energy propagates along a guide is called _____. CO1-U

   (a) Group velocity (b) Phase velocity (c) Space velocity (d) None of these

PART – B (5 x 3= 15 Marks)

6. Justify the magnitude of electric flux density and volume charge density is equal. CO1- U
7. Mention the Maxwell equation for free space. CO1- U
8. Derive the expression characteristic impedance for T and π network. CO1-U
9. Derive an expression for open circuited and short circuited transmission line. CO1-U
10. Justify why rectangular waveguides are preferred over circular waveguide? CO1-U

PART – C (5 x 16= 80 Marks)

11.	(a)	Apply electrostatic principles in spherical coordinates to determine the electric field intensity and electric flux density between two concentric spherical shells placed in free space, given that the inner shell (r = 0.1 m) is at 0 V and the outer shell (r = 0.2 m) is at 100 V.	CO2-App	(16)
		Or		
	(b)	Apply Laplace's equation to derive the expression for the capacitance of a coaxial cable using boundary values (if b>a, V=0 at r=b and V=V_0 at r=a).	CO2-App	(16)
12.	(a)	A 9375 MHz uniform plane wave is propagating in polystyrene. If amplitude of E-fields is 20v/m and the material is assumed to be lossless. (for polystyrene μ_r=1 and ε_r=2.56). Compute the following: i) Attenuation constant ii) Phase constant (ii) wavelength (iv) Velocity of propagation (v) Intrinsic impedance (vi) Propagation Constant (vii) Amplitude of H.	CO3-App	(16)
		Or		
	(b)	Apply Maxwell's equations to examine the electromagnetic wave propagation parameters in free space. Derive the expressions for the electric and magnetic fields of a uniform plane wave propagating in the +z direction.	CO3-App	(16)
13.	(a)	Explain and derive the fundamental expression for a band-pass filter by interpreting its circuit behavior and frequency response characteristics.	CO1-U	(16)
		Or		
	(b)	Extend how to determine the characteristic impedance of a symmetrical T-network by interpreting its open-circuit and short-circuit impedance conditions.	CO1-U	(16)
14.	(a)	Analyze the impedance matching scenario for a transmission line with a characteristic impedance of 50 Ω terminated with a load of 130 + j75 Ω at 10 MHz using the single-stub method. Use the Smith Chart to determine the stub position and length, and interpret how the matching is achieved.	CO5-Ana	(16)
		Or		
	(b)	A 70 Ω lossless used at a frequency where wavelength 80 cm terminated by load of 140 + j91 Ω. Analyze the reflection co-efficient, VSWR and input impedance using smith chart.	CO5-Ana	(16)

15. (a) Compare the solution of electric and magnetic fields of TE waves guided along rectangular waveguide and analyze why it is reflected along the direction of propagation. CO6-Ana (16)

Or

(b) Analyze the field equations for TE waves between parallel planes and compare its characteristics. CO6-Ana (16)