Reg. No.															

Question Paper Code	12823

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Third Semester

Electronics and Communication Engineering

(Common to Computer and Communication Engineering)

20ECPC302 - ELECTROMAGNETIC FIELDS AND WAVEGUIDES

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Define Magnetic Vector Potential.	2	K1	CO2
2.	A uniform spherical volume charge distribution contains a total charge of 10^{-8}C. If the radius of the spherical volume is $2x10^{-2}$m, find ρ_v.	2	K2	CO2
3.	Define magnetization.	2	K1	CO3
4.	Find the capacitance of the capacitor with a stored energy of 10 μJ with an applied voltage of 5 volts.	2	K2	CO3
5.	List the properties of uniform plane waves.	2	K1	CO4
6.	In a medium, the electric field intensity E = 10sin (1000t-10x) **axe**/m. calculate the displacement current density (ε_r = 80, ε_0 = 8.854 $x10^{-12}$ F/m).	2	K2	CO4
7.	Prove that intrinsic impedance of free space is 377 ohm.	2	K1	CO5
8.	Find the intrinsic impedance of perfect dielectric having dielectric constant ε_r =3and μ_r =6.	2	K2	CO5
9.	Write the relationship between phase velocity and group velocity.	2	K1	CO6
10.	Define dominant mode and degenerate mode in a waveguide.	2	K1	CO6

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Derive an expression for electric field intensity at any point due to an infinite uniformly charged sheet with density ρ_S C/m^2.	13	K3	CO2
		OR			
	b) i)	State and explain the Ampere's Circuital law.	3	K2	CO2
	ii)	Using Ampere's Circuital law derive the magnetic field intensity of coaxial cable at all regions.	10	K3	CO2
12.	a)	In a slab of dielectric material for which ε =2.4 ε_0 and V=300z^2 V, Find (i) **D** and ρ_v (ii) **P** and ρ_{pv}.	13	K2	CO3
		OR			
	b)	Derive the boundary conditions of the normal and tangential components of electric and magnetic field at the interface of two media with different dielectrics.	13	K3	CO3

13. a) i) Show that the ratio of the amplitude of the conduction current density and displacement current density is $\sigma/\omega\varepsilon_r$. *5 K3 CO4*

ii) For the applied field E , deduce the amplitude ratio if the $E = E_m e^{-t/\lambda}$ where λ is real constant. *8 K3 CO4*

OR

b) Derive the non homogeneous wave equation for the electric and magnetic fields. Comment on the solutions to these equations. *13 K3 CO4*

14. a) Show that Energy produced per unit volume per second is equal to sum of energy stored per unit volume per second and the energy crossed per unit volume per second. *13 K3 CO5*

OR

b) Derive the necessary equations and discuss in detail the wave propagation in a good conducting medium and good dielectric medium. *13 K3 CO5*

15. a) An air filled rectangular copper waveguide with a = 2.28 cm and b = 1.01 cm cross section and l=30.48cm is operated at 9.2 GHz with a dominant mode. Find the cut off frequency, guide wavelength, phase velocity and characteristic wave impedance. *13 K3 CO6*

OR

b) Describe the propagation of TE waves in a rectangular waveguide with necessary expressions for the field components. *13 K2 CO6*

PART - C (1 × 15 = 15 Marks)

16. a) Find out the curl of each of the vector field *15 K3 CO1*

$A = yza_x+4xya_y+ya_z$ at (1,-2,3)

$B = \rho z \sin\phi\, a_\rho+3\rho z^2 \cos\phi\, a_\phi$ at $(5, \boldsymbol{\pi}/2,1)$

$C = 2r\cos\theta\cos\phi a_r + r^{0.5} a_\phi$ at $(1, \boldsymbol{\pi}/6,\boldsymbol{\pi}/3)$.

OR

b) Prove the Stoke's theorem for a flat square surface in the XY plane bounded by(000),(1,0,0),(1,1,0)&(0,1,0) where the vector field function is $F = 2xy\, a_x - y\, a_z$. *15 K3 CO1*