Reg. No.															

Question Paper Code	13638

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Third Semester

Electronics and Communication Engineering

(Common to Fourth Semester - Computer and Communication Engineering)

20ECPC302 - ELECTROMAGNETIC FIELDS AND WAVEGUIDES

Regulations - 2020

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	When two vectors are perpendicular, their (a) Dot product is zero (b) Cross product is zero (c) Both are zero (d) Both are not necessarily zero	1	K1	CO1
2.	A charge located at point p (5, 30º, 2) is said to be in which coordinate system? (a) Cartesian system (b) Cylindrical system (c) Spherical system (d) Space system	1	K2	CO1
3.	Evaluate Gauss law for $D = 5r^2/4$ i in spherical coordinates with r = 4m and $\theta = \pi/2$. (a) 600 (b) 599.8 (c) 588.9 (d) 577.8	1	K2	CO2
4.	Gauss law can be used to compute which of the following? (a) Permittivity (b) Permeability (c) Radius of Gaussian surface (d) Electric potential	1	K1	CO2
5.	A dielectric can be made a conductor by (a) Compression (b) Heating (c) Doping (d) Freezing	1	K1	CO3
6.	The capacitance of a material refers to (a) Ability of the material to store magnetic field (b) Ability of the material to store electromagnetic field (c) Ability of the material to store electric field (d) Potential between two charged plates	1	K1	CO3
7.	The first Maxwell law is based on which law? (a) Ampere law (b) Faraday law (c) Lenz law (d) Faraday and Lenz law	1	K1	CO4
8.	The Maxwell second equation that is valid in any conductor is (a) $\nabla X H = Jc$ (b) $\nabla X E = Jc$ (c) $\nabla X E = Jd$ (d) $\nabla X H = Jd$	1	K1	CO4
9.	For a dielectric, the condition to be satisfied is (a) $\sigma/\omega\varepsilon > 1$ (b) $\sigma/\omega\varepsilon < 1$ (c) $\sigma = \omega\varepsilon$ (d) $\omega\varepsilon = 1$	1	K2	CO5
10.	The Bessel function is denoted by (a) $J_n(ha)$ (b) $J_m(ha)$ (c) $J_n(hb)$ (d) $J_m(hb)$	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

		Marks	K – Level	CO
11.	State Stoke's theorem.	2	K1	CO1
12.	Given a point in spherical coordinates, how would you calculate its corresponding Cartesian coordinates?	2	K2	CO1
13.	Compare Poisson's and Laplace's equation.	2	K2	CO2
14.	Give equation of Ohm's law in point form.	2	K1	CO2
15.	A parallel plate capacitor has an area of $0.8m^2$ separation of 0.1mm with a dielectric for which ϵ_r =1000 & a field of 10^6 v/m. Calculate C.	2	K2	CO3
16.	What are boundary conditions for electric fields?	2	K1	CO3
17.	Summarize the differential form of Maxwell's Equation.	2	K2	CO4
18.	State Faraday's Law.	2	K1	CO4

19.	Define phase velocity.		*2*	*K1*	*CO5*
20.	Define loss tangent of medium.		*2*	*K1*	*CO5*
21.	Why rectangular waveguides preferred over circular waveguides?		*2*	*K1*	*CO6*
22.	What is a Circular Waveguide?		*2*	*K1*	*CO6*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Verify stokes theorem for the vector A= 4x a_x – $2y^2$ a_y +z^2 a_z taken over the cube bounded between x=0, x=1, y=0, y=1 and z=0, z=1.	*11*	*K3*	*CO1*
		OR			
	b) (i)	Obtain the value of α if magnetic field B is a solenoid where B=25x a_x+12y a_y+ αz a_z.	*6*	*K3*	*CO1*
	(ii)	Determine the gradient of scalar system t = x^2y+e^z at point P (1, 5, 2).	*5*	*K3*	*CO1*
24.	a)	State and prove Gauss's Law and derive electric field intensity of straight line.	*11*	*K2*	*CO2*
		OR			
	b)	Using Biot Savart's law, derive magnetic field intensity on the axis of a circular loop carrying current I.	*11*	*K2*	*CO2*
25.	a)	Consider an interface between two different dielectric mediums and evaluate the electric boundary conditions at the interface.	*11*	*K3*	*CO3*
		OR			
	b) (i)	Given the potential V= (10 sinθ cosφ) /r^2. Estimate the electric flux density at (2, π/2, 0).	*6*	*K3*	*CO3*
	(ii)	Solve the energy stored in a 10 μF capacitor which has been charged to a voltage of 400V.	*5*	*K3*	*CO3*
26.	a)	Use the fact that the divergence of the electric and magnetic fields is zero in free space to analyze a wave equation for both electric and magnetic fields.	*11*	*K3*	*CO4*
		OR			
	b)	Examine the differential and integral forms of Maxwell's equations.	*11*	*K3*	*CO4*
27.	a)	Use Poynting theorem to examine the relationship between the electric and magnetic fields in terms of energy transport.	*11*	*K3*	*CO5*
		OR			
	b)	Examine the propagation of electromagnetic plane waves in lossless dielectrics compared to good conductors.	*11*	*K3*	*CO5*
28.	a)	Derive the propagation of TE waves in a rectangular waveguide with necessary expressions for the field components.	*11*	*K2*	*CO6*
		OR			
	b)	Derive the TM field components using Bessel equation in circular waveguides.	*11*	*K2*	*CO6*