Reg. No.																

Question Paper Code	13159

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Third Semester

Electronics and Communication Engineering

20ECPC302 - ELECTROMAGNETIC FIELDS AND WAVEGUIDES

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	If vectors |A.B| = |A×B|, then angle between A and B is (a) 90° (b) 60° (c) 45° (d) 30°	1	K1	CO1
2.	What is the physical significance of the curl of a vector field? (a) It represents the source or sink of the field (b) It represents the rotation or vorticity of the field (c) It represents the magnitude of the field (d) It represents the direction of maximum change in the field	1	K1	CO1
3.	The position vector of the point (1, 2, 0) is (a) **i** + 2**j** + k (b) **i** + 2**j** (c) **i** + **j** +**k** (d) 2**j** + **k**	1	K2	CO1
4.	The force between two charges is 120 N. If the distance between the charges is doubled, the force will be (a) 60 N (b) 30 N (c) 40 N (d) 15 N	1	K1	CO2
5.	Find the magnetic field intensity when the flux density is 8 x 10^{-6} Tesla in the medium of air (a) 6.36 (b) 3.66 (c) 6.63 (d) 3.36	1	K2	CO2
6.	The relation between flux density and vector potential is (a) B = Curl(A) (b) A = Curl(B) (c) B = Div(A) (d) A = Div(B)	1	K2	CO2
7.	What happens to the electric field strength when a dielectric is introduced between charged plates? (a) Increases (b) Decreases (c) Remains the same (d) Becomes zero	1	K1	CO3
8.	A parallel plate capacitor has plates of area 0.1 m² separated by 2 mm. If the dielectric between the plates has a relative permittivity of 4, what is the capacitance? (a) 177 pF (b) 354 pF (c) 708 pF (d) 1416 pF	1	K2	CO3
9.	In a magnetic circuit, the magnetic reluctance is analogous to which quantity in an electric circuit? (a) Resistance (b) Capacitance (c) Inductance (d) Conductance	1	K2	CO3
10.	The displacement current is introduced to modify which of the following? (a) Gauss's law (b) Coulomb's law (c) Faraday's law (d) Ampere's law	1	K1	CO4
11.	Which of the following describes the relationship between the electric and magnetic fields in an electromagnetic wave in free space? (a) The electric field and magnetic field are in phase and perpendicular to each other (b) The electric field and magnetic field are in phase and parallel to each other (c) The electric field lags behind the magnetic field by 90 degrees (d) The electric field and magnetic field are out of phase	1	K1	CO4
12.	Which of Maxwell's equations explains the absence of magnetic monopoles? (a) Gauss's law for electricity (b) Faraday's law (c) Gauss's law for magnetism (d) Ampere's law	1	K1	CO4

13.	What is the major factor for determining whether a medium is free space, lossless dielectric, lossy dielectric, or good conductor? (a) Attenuation constant (b) Constitutive parameters (μ, ε, σ) (c) Loss tangent (d) Reflection coefficient	*1*	*K1*	*CO5*
14.	In a lossless medium, the electric and magnetic fields of a plane wave are (a) Perpendicular to each other and to the direction of propagation (b) Parallel to each other (c) Opposite to each other in magnitude (d) Perpendicular to each other but parallel to the direction of propagation	*1*	*K1*	*CO5*
15.	When a plane wave propagates through a low-loss dielectric, the attenuation constant α is (a) Zero (b) Very large (c) Very small (d) Infinity	*1*	*K1*	*CO5*
16.	The Poynting theorem describes (a) The relationship between electric and magnetic fields (b) The conservation of energy in electromagnetic fields (c) The dependence of power flow on frequency (d) The rate at which electric field strength decays	*1*	*K1*	*CO5*
17.	The waveguide (a = 1.5 cm, b = 1 cm) is loaded with a dielectric ($\varepsilon_r = 4$). Which one of the following is correct? The 8 GHz signal will (a) pass through the waveguide (b) not pass through the waveguide (c) be absorbed in the guide (d) none of the above.	*1*	*K2*	*CO6*
18.	Which of the following is not possible in a circular waveguide? (a) TE10 (b) TE01 (c) TE11 (d) TE12	*1*	*K1*	*CO6*
19.	An evanescent mode occurs when (a) A wave is attenuated rather than propagated. (b) The propagation constant is purely imaginary. (c) m = 0 = n so that all field components vanish. (d) The wave frequency is the same as the cutoff frequency.	*1*	*K1*	*CO6*
20.	The dominant mode of a circular waveguide has a cut-off frequency of 6 GHz. If the frequency of the wave is 12 GHz, the ratio of the guide wavelength to the free-space wavelength is: (a) 0.5 (b) 2 (c) 1 (d) 1.5	*1*	*K2*	*CO6*

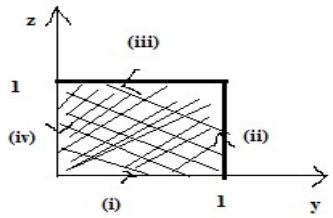
PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21.	Express the following vector $A = \rho\,(z^2+1)a_\rho - \rho z\, cos\varphi\ a_\varphi$ in Cartesian coordinates.	*2*	*K2*	*CO1*
22.	Define Helmholtz's Theorem.	*2*	*K1*	*CO1*
23.	An infinite line charge is uniformly charged with a line charge density of 20n C/m along the z axis. Find E at (6,8,3)m.	*2*	*K2*	*CO2*
24.	Define Lorentz's force equation.	*2*	*K1*	*CO2*
25.	Compare self inductance and mutual inductance.	*2*	*K2*	*CO3*
26.	Explain the importance of the uniqueness theorem in electrostatics.	*2*	*K2*	*CO3*
27.	What is displacement current, and how does it modify Ampere's Law to include time-varying electric fields?	*2*	*K1*	*CO4*
28.	Outline the fundamental postulate of electromagnetic induction.	*2*	*K1*	*CO4*
29.	Find the cut - off frequency of circular waveguide with 2.36 cm diameter filled with air in dominant mode (ha)11 =3.85.	*2*	*K2*	*CO5*
30.	What is the dominant mode of circular waveguide and Why?	*2*	*K1*	*CO6*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31.	a)	Given that $= 2xy\ a_x + 3\ a_y - yz^2 a_z$, Evaluate $\oint_s A\ .ds$ where S is the surface of the cube defined by 0 ≤ x ≤1, 0 ≤y ≤ 1, 0 ≤ z ≤ 1. Also, verify the result by applying divergence theorem.	*10*	*K3*	*CO1*
		OR			
	b)	Suppose V=y^2**i** + (2xy+z^2) **j** +(2yz) **k**. Apply Stoke's theorem for the square surface shown in the figure. 	*10*	*K3*	*CO1*
32.	a)	Apply gauss law to find charge enclosed in hollow sphere whose surface is uniformly charged.	*10*	*K3*	*CO2*
		OR			
	b)	Use amperes cicuital law to determine the magnetic field intensity of coaxial cable.	*10*	*K3*	*CO2*
33.	a)	State and explain the electric boundary conditions between two different dielectric media.	*10*	*K2*	*CO3*
		OR			
	b)	Derive an expression for inductance of a Co axial Cable	*10*	*K2*	*CO3*
34.	a)	Derive Maxwell's equation in both integral and differential forms from basic laws and explain its significance.	*10*	*K2*	*CO4*
		OR			
	b)	Explain Motional emf and transformer emf using Faraday's law of electromagnetic induction	*10*	*K2*	*CO4*
35.	a)	Illustrate the wave propagation in a lossless dielectric and free space with relevant equations.	*10*	*K2*	*CO5*
		OR			
	b)	Derive the expressions for the attenuation constant, phase constant and intrinsic impedance for a uniform plane waves in a good conductor.	*10*	*K2*	*CO5*
36.	a)	Examine the propagation of Transverse Electric mode in a circular waveguide.	*10*	*K3*	*CO6*
		OR			
	b)	A 2-cm by 3-cm waveguide is filled with a dielectric material with ε_r = 4. If the waveguide operates at 20 GHz with TM11 mode, find: (a) cutoff frequency, (b) the phase constant, (c) the phase velocity.	*10*	*K3*	*CO6*