#### 0200EET204072302

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# APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S, FE) / S2 (PT) (S, FE) / S4 (WP) (S) Examination December 2024 (2019 Scheme)

## **Course Code: EET204 Course Name: ELECTROMAGNETIC THEORY**

Max. M	arks: 100	Duration: 3 Hours
	PART A (Answer all questions; each question carries 3 ma	rks) Marks
1	Express the point P $(4, 90^{\circ}, 30^{\circ})$ in cartesian coordinates.	3
2	Explain the physical significance of divergence of a vector field	. 3
3	What is an equipotential surface?	3
4	Why electric field is conservative?	3
5	What is continuity equation of current?	3
6	Find the magnetic flux density for the vector magnetic potential	, 3
	$\bar{A} = e^{-x} siny \bar{a}_x + (1 + cosy) \bar{a}_y$	
7	Define propagation constant	3
8	What is Poynting vector?	3
9	What is reflection coefficient of transmission line?	3
10	A loss-less transmission line has characteristics impedance of 7	$70\Omega$ and a phase 3
	constant of 3 rad/m at 100 MHz. Calculate the inductance	per meter and
•	capacitance per meter of the line.	

### PART B

(Answer one full question from each module, each question carries 14 marks)

#### Module -1

- 11 a) State and explain divergence theorem. b) Vector  $\mathbf{A} = \rho \cos\theta \, \bar{a}_{\rho} + \rho z^2 \sin\theta \, \bar{a}_z$  i) Transform A into rectangular coordinates and calculate its magnitude at (3, -4, 0). ii) Transform A into
  - spherical coordinates and calculate its magnitude at (3, -4, 0).
- 12 a) Evaluate both sides of Stoke's theorem for the field  $G = 4xa_x + 2x^2y a_y$  and 10 rectangular path around the region  $1 \le x \le 2$ ,  $-1 \le y \le 2$ , z = 0. Let the positive direction of dS be az
  - b) Define gradient of a scalar function.

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# Module -2

13	a)	f V = $x^2y + \frac{2}{x^2+y^2}$ - 40z, find E, D, & $\rho_v$ at P (1, 2, 3)			
	b)	State Gauss's law & explain any one application of Gauss's law	7		
14	a)	Derive an expression for electric field intensity at a point due to an electric	10		
		dipole			
	b)	Find the capacitance of a parallel plate capacitor a) when the plates are of area	4		
		$1m^2$ , distance between the plates 1 mm, voltage gradient is $10^5$ V/m and the			
		$\rho_s = 2 \mu C/m^2$ . b) When the stored energy is 5mJ and the voltage across the			
		plates is 5V.			
	Module -3				
15	a)	Two extensive homogeneous isotropic dielectrics meet on a plane $z = 0$ . Region 1 ( $z < 0$ )contains a dielectric for which $\varepsilon_{r1} = 2.5$ while region 2 ( $z > 0$ ) is characterized by $\varepsilon_{r2} = 4$ . A uniform electric field $E_1 = -30 \bar{a}_x + 50\bar{a}_y + 70\bar{a}_z V/m$ . Find i) $E_2$ ii) $D_2$ iii) Angles $E_1$ and $E_2$ make with the normal. iv) Angles $E_1$ and $E_2$ make with the interface.	10		
	b)	Write the Maxwell's equations for time varying fields in integral form.	4		
16	a)	Let $\mathbf{A} = (y+z) \mathbf{a}_x + 4xz \mathbf{a}_y$ find vector magnetic potential, magnetic flux density,	10		
		magnetic field intensity & current density at point P (2, -2, 4)			
	b)	Compare conduction current and displacement current	4		
		Module -4			
17	a)	A lossy dielectric material is characterized by $\mu = 2\mu_0$ , $\epsilon = 2\epsilon_0$ , and $\sigma = \frac{0.03S}{m}$ .	10		
		If electric field $\overline{E} = 3e^{-\gamma z} \overline{a}_y V/m$ . At a frequency of 30MHz, determine i)			
		propagation constant ii) Intrinsic impedance iii) Magnetic field of the wave.			
	b)	Explain the significance of intrinsic impedance	4		
18	a)	A uniform plane wave with 10 MHz frequency has average Poynting vector .	8		
		1 W/m <sup>2</sup> . If the medium is perfect dielectric with $\mu_r = 2$ and $\varepsilon_r = 3$ .			
		Find (i) velocity, (ii) wavelength, (iii) intrinsic impedance			
	b)	What is a lossy dielectric?	6		
		Module -5			
19	a)	A distortion less transmission line operating at 250MHz has R = $30\Omega/m$ , L=	8		
		200 nH/m and C= $80pF/m$ . Determine the i) characteristics impedance ii)			
		Propagation constant iii) Velocity of propagation along the line.			

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 b) Define standing wave ratio? What is the value of standing wave ratio for i) Short circuited line ii) Open-circuited line iii) a line terminated by its characteristics impedance.

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20 a) Derive an equation for voltage and current at any point of transmission line
b) A lossless transmission line operating at 4.5GHz has L =2.4μH/m and characteristic impedance Z<sub>0</sub> = 85Ω. Calculate phase constant and phase velocity.





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