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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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



Course Code: EET204

Course Name: ELECTROMAGNETIC THEORY

Max. Marks: 100

Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks)

	Marks
1 State Stoke's theorem	3
2 Write the differential elements in cylindrical co-ordinate system	3
3 Find \bar{D} at P (6, 8, -10) caused due to a point charge of 30mC at the origin.	3
4 Derive Poisson's equation	3
5 State Biot-Savart law	3
6 Calculate the inductance of a solenoid of 200 turns wound tightly on a cylindrical tube of 6cm diameter. The length of the tube is 60m and the solenoid is in air.	3
7 What is meant by depth of penetration?	3
8 What are the characteristics of uniform plane wave?	3
9 For an open wire overhead line phase constant is 0.04 rad/km. Find the wavelength and velocity at a frequency of 1600Hz.	3
10 Explain electromagnetic interference	3

PART B

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

Module -1

- 11 a) Given a vector field $\bar{F} = \rho \cos^2 \theta (\bar{a}_\rho + z\bar{a}_\theta)$ is in cylindrical system were $(0 \leq z \leq 2, \rho = 2)$. Verify divergence theorem 8
- b) Define curl of a vector field and its physical significance 6
- 12 a) Explain rectangular to spherical co-ordinate transformation with necessary diagram 7
- b) Transform the vector $\bar{D} = r^2 \bar{a}_r + r \cos \theta \bar{a}_\theta$ which is in spherical co-ordinate system to cartesian co-ordinate system 7

Module -2

- 13 a) Two-point charges each of $10\mu\text{C}$ are placed in free space at points $(-2,0,0)$ and $(2,0,0)$ respectively. What is the value of point charge placed at point $(0,0,2)$ if the total force at point $(0,0,2)$ is $2.55\bar{a}_z\text{N}$? 5
- b) Derive an expression for electric field intensity due to a uniformly charged infinite line charge having charge density $\rho_l\text{ C/m}$ placed along z axis 9
- 14 a) An electric potential is given by, 7

$$V = \frac{60\sin\theta}{r^2}\text{ Volts.}$$
 Find V and \bar{E} at $P(3, 60^\circ, 25^\circ)$.
- b) Derive the expression for capacitance of a coaxial capacitor of length L , where the inner conductor has radius a and the outer conductor has radius b . 7

Module -3

- 15 a) Explain why scalar magnetic potential can be defined only for region where the current density is zero? 4
- b) A current filament carries a current of 5A in \bar{a}_z direction on z-axis. Find magnetic field intensity \bar{H} at point $(2,2,4)$ due to this filament if it extends from (i) $z=0$ to 6m (ii) $z=-\alpha$ to α 10
- 16 a) Write Maxwell's equation in integral form along with its physical significance 8
- b) Region 1, where $\mu_{r1} = 4$, is the side of the plane $y + z = 1$ containing the origin (Ref Fig. 1). In region 2, $\mu_{r2} = 6$. $B_1 = 2\bar{a}_x + 1\bar{a}_y$ Tesla. Find B_2 and H_2 . 6

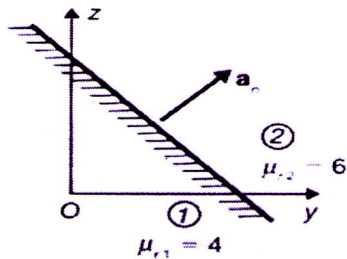


Fig.1

Module -4

- 17 a) Derive the expressions for constants describing propagation of a uniform plane wave in good conductor 7
- b) The time-domain expression for the magnetic field of a plane wave travelling in a loss-less medium is given by the following expression: 7

$$H(x, t) = 0.2 \cos(6\pi \times 10^8 - 10.2x) \bar{a}_z \text{ A/m.}$$
 Find i) Direction of wave

propagation ii) Dielectric constant and intrinsic impedance iii) Time domain expression of the electric field iv) Time average power density.

- 18 a) A wave propagating in a loss-less dielectric has components $\vec{E} = 200\cos(10^8t - \beta z)\vec{a}_x$ V/m and $\vec{H} = 2\cos(10^8t - \beta z)\vec{a}_y$ A/m. If the wave is travelling at a velocity of 0.2 times the velocity in free space, find (i)intrinsic impedance (ii)phase constant (iii)relative permittivity (iv)wavelength 7
- b) Derive electromagnetic wave equation in phasor form 7

Module -5

- 19 a) Define the terms SWR and impedance matching 6
- b) A distortion less transmission line operating at 500 MHz has characteristics impedance 80Ω , attenuation constant 0.04 Np/m, phase constant 1.5 rad/m. Find the line parameters and wavelength of the signal. 8
- 20 a) What are the primary constants of transmission line? 6
- b) A transmission line has the following per unit length parameters, $L = 0.1\mu H$, $R = 5\Omega$, $C = 300pF$, $G = 0.01$ mho. Calculate the characteristics impedance of the line at 500 MHz. Obtain the same parameters for the lossless line at 500MHz. 8
