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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth semester B.Tech examinations (S), September 2020

Course Code: EE302

Course Name: ELECTROMAGNETICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1 Given the two points A (2, 3,-1) and B (4, 25^0, 120^0). Find the Spherical coordinates of A and Cartesian coordinates of B. (5)

2 Obtain Poisson's equation from Gauss's law (5)

3 Explain (i) scalar magnetic potential and (ii) vector magnetic potential (5)

4 Show that the displacement current through a parallel plate capacitor is equal to the conduction current *I* flowing in the external circuit. (5)

5 A coaxial cable carries a dc voltage *V* and current *I*. Show that the power flow is VI using Poynting's theorem. (5)

6 In a transverse electromagnetic wave, electric field intensity is given by $\mathbf{E}=E_m\sin(\omega t-\beta z)\mathbf{a}_y$ in free space, Sketch **E** and **H** at t=0. (5)

7 Derive the expressions for attenuation constant and phase constant for a uniform plane wave propagating in a conducting medium. (5)

8 In a non-magnetic medium, electric field intensity is $\mathbf{E}=4\sin(2\pi\times10^7 t-0.8x)\mathbf{a}_z$ V/m. Find the relative permittivity and intrinsic impedance of the medium. (5)

PART B

Answer any two full questions, each carries10 marks.

9 a) Define divergence of a vector field. Explain its physical significance. (4)

b) Transform the vector $F=\frac{1}{r}a_r$ in spherical coordinates into a vector in Cartesian coordinates. (6)

10 a) State and prove Stokes theorem. (5)

b) What is an electric dipole? Derive an expression for the electric field intensity at any point due to dipole. (5)

11 a) State Gauss's law. Using Gauss's law, derive an expression for electric field intensity due to an infinite plane sheet of charge. (6)

b) If the electric potential in a region is given by, $V = 2x^2y + 20z - \frac{4}{x^2+y^2}$ volts. (4)
Find electric field intensity and electric flux density at P (6, -2.5, 3).

PART C

Answer any two full questions, each carries10 marks.

12 a) Consider an infinitely long straight conductor carrying current I. Calculate the magnitude of magnetic flux density at a distance r from the conductor assuming the permeability of the medium to be equal to μ (5)

b) A square loop of side 10 cm centered at the origin carries 100A in the counter clockwise direction. Calculate the magnetic field intensity at the centre of the loop. (5)

13 a) A circular loop located on $x^2 + y^2 = 9, z = 0$, carries a direct current of 10A along $\mathbf{a}_\Phi$. Determine the magnetic field intensity, $\boldsymbol{H}$ at (0, 0, 4). (6)

b) Derive the expression for electrostatic energy stored in an assembly of N point charges. (4)

14 a) Derive the electrostatic boundary conditions at the interface between two perfect dielectrics. (6)

b) Explain the inconsistency of Ampere's circuital law for time varying fields. (4)

PART D

Answer any two full questions, each carries 10 marks.

15 State and prove Poynting's theorem and explain the physical significance of Poynting's vector. (10)

16 a) Derive the wave equation for electric field in phasor form. (5)

b) Calculate the skin depth and wave velocity at 2 MHz in aluminium with conductivity $40\times10^6\ \Omega^{-1}m^{-1}$ and relative permeability, μ_r=1. (5)

17 a) A transmission line has R=30Ω/km, L=100mH/km, G=0 and C=20μF/km. At a frequency of 1 kHz, calculate the characteristic impedance and propagation constant of the line. (6)

b) Define standing wave ratio. How is it related to voltage reflection coefficient? (4)

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