

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, 25⁰, 120⁰). 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 \mathbf{E} and \mathbf{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 $\mathbf{E} = 4 \sin(2\pi \times 10^7 t - 0.8x) \mathbf{a}_z$ V/m. Find the relative permittivity and intrinsic impedance of the medium. (5)

PART B*Answer any two full questions, each carries 10 marks.*

- 9 a) Define divergence of a vector field. Explain its physical significance. (4)
- b) Transform the vector $F = \frac{1}{r} \mathbf{a}_r$ 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 carries 10 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}_ϕ . Determine the magnetic field intensity, \mathbf{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 $40 \times 10^6 \Omega^{-1}\text{m}^{-1}$ and relative permeability, $\mu_r=1$. (5)
- 17 a) A transmission line has $R=30\Omega/\text{km}$, $L=100\text{mH}/\text{km}$, $G=0$ and $C=20\mu\text{F}/\text{km}$. 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)
