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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree (S,FE) Examination May 2023 (2015 Scheme)

Course Code: EE302

Course Name: ELECTROMAGNETICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks. Marks

1 Given $A = (ycosax)\boldsymbol{a_x} + (y + e^x)\boldsymbol{a_z}$, find curl of **A** at the origin. (5)

2 A point charge of 9 nC is located at (3,4,0). Calculate the electric field intensity vector in free space at (3,4,9) due to this point charge. (5)

3 Derive an expression for magnetic field intensity at a point due to a line charge using Ampere's Circuital Law. (5)

4 Differentiate between conduction current density and displacement current density. (5)

5 Verify Poynting's theorem for power flow through a coaxial cable (5)

6 What is the advantage of using phasor form of representation? Write down all the four Maxwell's equations in phasor form. (5)

7 Define skin depth. What will be the effect on skin depth of a medium, if its conductivity increases to 4 times its original value? (5)

8 Explain impedance matching and Voltage Standing Wave Ratio (VSWR). (5)

PART B

Answer any two full questions, each carries10 marks.

9 a) Express vector $B = \frac{10}{r}\boldsymbol{a_r} + rcos\theta\boldsymbol{a_\theta} + \boldsymbol{a_\varphi}$ in cylindrical coordinates. Also find **B** (5, π/2, -2). (5)

b) Apply Gauss's law to find the expression for Electric field Intensity and Electric flux density at a point due an infinite sheet of charge. (5)

10 a) Determine the divergence of these vector fields: (5)

(i)$P = x^2yz\boldsymbol{a_x} + xz\boldsymbol{a_z}$

(ii) $Q = \rho sin\varphi\boldsymbol{a_\rho} + \rho^2z\boldsymbol{a_\varphi} + zcos\varphi\boldsymbol{a_z}$

b) Derive the expression of capacitance between two parallel conductors of a transmission line. (5)

11 a) Using Gauss theorem derive an expression for electric field intensity due to a uniformly charged sphere of radius R with volume charge density ρ_v C/m^3. (6)

b) If the electric potential in a region is a given by $V= x^2 + y^2 -2z$, then calculate the electric field intensity at (3, 2, 1). (4)

PART C

Answer any two full questions, each carries10 marks.

12 a) State and explain Biot-Savart Law. (3)

b) Apply Biot-Savart's Law to derive an expression for magnetic field intensity due to a circular loop of current carrying conductor. (7)

13 a) Define (i) Scalar magnetic potential and (ii) Vector magnetic potential (5)

b) State Faraday's Law. Derive the integral form and point form of Faraday's Law. (5)

14 a) Derive an expression for energy stored in an electrostatic field in terms of electric flux density. (6)

b) Explain the continuity equation. (4)

PART D

Answer any two full questions, each carries 10 marks.

15 a) Derive wave equation in free space from Maxwell's equations. (5)

b) Define intrinsic impedance of a medium. Calculate the intrinsic impedance of free space. (5)

16 State and explain Poynting theorem. Also derive an expression for complex average pointing vector. (10)

17 a) In a lossless medium for which $\eta = 60\pi$, $\mu_r=1$ and $H = -0.1cos(\omega t - z)a_x + 0.5sin(\omega t - z)a_y\, A/m$. Calculate ε_r, ω, and **E**. (7)

b) Explain Electromagnetic Interference (3)

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