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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R,S) (FT/WP) / (S2 PT) Exam April 2025 (2019 Scheme)

Course Code: EET 204

Course Name: ELECTROMAGNETIC THEORY

Max. Marks: 100

Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks)

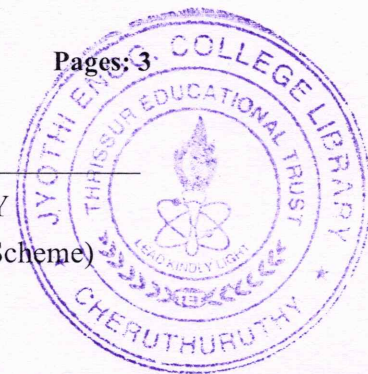
Marks

- | | | |
|----|----------------------------------------------------------------------------------------------------------------------------------|-----|
| 1 | State and explain Stokes's theorem. | (3) |
| 2 | Convert point P (1, 3, 5) from Cartesian to Spherical coordinates. | (3) |
| 3 | Define Coulomb's law and give the expression for force experienced between two point charges in vector form. | (3) |
| 4 | Given the potential $V = \frac{10}{r^2} \sin\theta \cos\phi$, find Electric flux density at $(2, \frac{\pi}{2}, 0)$. | (3) |
| 5 | State and explain Ampere's circuital law. | (3) |
| 6 | What is the difference between conduction current density and displacement current density? Write down the expressions for each. | (3) |
| 7 | Derive the relation between phase velocity and group velocity. | (3) |
| 8 | Explain three characteristics of uniform plane waves. | (3) |
| 9 | Explain characteristic impedance of a transmission line. | (3) |
| 10 | What is standing wave ratio? | (3) |

PART B

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

Module -1



- 11 a) Convert the vector $\mathbf{A} = 6\mathbf{a}_x + \mathbf{a}_y$ into cylindrical and spherical coordinate system at the point P (- 2, 6, 3). (10)
- b) What do you mean by del (∇) operator? Write down the expression for ∇ in Cartesian, cylindrical and spherical coordinate system. (4)
- 12 a) What do you mean by divergence of a vector field? State and explain Gauss divergence theorem. (7)
- b) Determine the divergence of the following vector field and evaluate the same at the specified point $\mathbf{B} = \rho z \sin\varphi \mathbf{a}_\rho + 3\rho z^2 \cos\varphi \mathbf{a}_\varphi$ at $(5, \frac{\pi}{2}, 1)$ (7)

Module -2

- 13 a) Define Gauss's law and derive Maxwell's first equation from Gauss's law. (6)
- b) Using Gauss's law, obtain the expression for electric field intensity due to infinite line charge distribution. (8)
- 14 a) Define electric potential and obtain the relation between electric field intensity and potential. (6)
- b) Two point charges $-4 \mu\text{C}$ and $5 \mu\text{C}$ are located at (2, -1, 3) and (0, 4, -2) respectively. (8)
- Find the potential at (1, 0, 1) assuming zero potential at infinity.

Module -3

- 15 a) Define Biot-Savart's Law and derive the expression for magnetic field intensity due to a finite and infinite wire carrying current. (8)
- b) With neat sketches, derive the boundary conditions of electric field for conductor dielectric interface. (6)

- 16 a) Derive Maxwell's Equation in Differential and Integral form for time varying field (14)
and explain the significance of each Maxwells equation.

Module -4

- 17 a) Derive wave equation from Maxwells equation. (10)
b) Define skin depth and skin effect. (4)
- 18 a) Obtain the expression for attenuation constant and phase constant for plane wave (8)
propagating in a lossy medium.
b) State and explain Poynting theorem. (6)

Module -5

- 19 a) What are the different parameters of a transmission line? Explain each parameter. (4)
b) Derive wave equation in a transmission line. (10)
- 20 a) A distortionless transmission line has $Z_0 = 60 \Omega$, $\alpha = 20 \text{ mNp/m}$, $u = 0.6c$, where (14)
 c is the speed of light in a vacuum ($3 \times 10^8 \text{ m/s}$). Find R, L, G, C and λ at 100 MHz.
