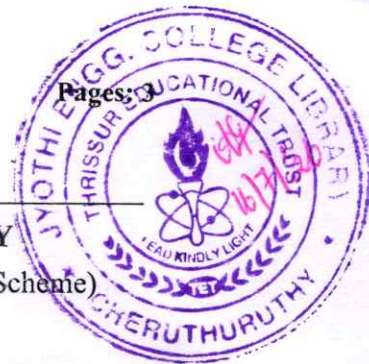




Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP/S2PT) Examinations May 2026 (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 | Convert the point $(3, 120^\circ, 7)$ to rectangular and spherical coordinates. | (3) |
| 2 | Define curl of a vector and explain its physical significance. | (3) |
| 3 | Explain the terms electric potential and potential difference. | (3) |
| 4 | Derive Laplace's equation from Gauss' law. | (3) |
| 5 | State and explain Biot Savart's law. | (3) |
| 6 | Compare conduction current and displacement current. | (3) |
| 7 | Give the expressions for attenuation constant and phase constant in a lossy dielectric medium. | (3) |
| 8 | Explain skin effect and skin depth. | (3) |
| 9 | Explain characteristic impedance of a transmission line | (3) |
| 10 | Explain two methods to reduce electromagnetic interference. | (3) |

PART B

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

Module -1

- 11 a) Vector $\mathbf{B} = \rho \sin \theta \mathbf{a}_\rho - \rho \cos \theta \mathbf{a}_\theta + \rho \mathbf{a}_z$. (i) Express the vector in rectangular coordinates at the point $(1, -3, 4)$, (ii) Express the vector in spherical coordinates at the point $(1, -3, 4)$. (10)
- b) State and prove Stokes theorem. (4)

- 12 a) The vector field $\mathbf{D} = \rho^2 \cos^2 \phi \mathbf{a}_\rho + z \sin \phi \mathbf{a}_\phi$. Determine the flux of $\mathbf{D}$ crossing the closed surface of the cylinder $0 \leq z \leq 1$, $\rho = 4$. Verify the divergence theorem for this case. (10)

- b) State and prove Gauss divergence theorem. (4)

Module -2

- 13 a) State and explain Coulomb's law. Give the expression for electric field intensity at point due to 'n' number of charges. (4)

- b) Derive the expression for electric field intensity at any point due to an electric dipole. (10)

- 14 a) Given the potential $V = \frac{10 \sin \theta \cos \phi}{r^2}$. (a) Find the electric flux density $\mathbf{D}$ at $(2, 90^\circ, 0)$. (b) Calculate the work done in moving a $10 \mu\text{C}$ charge from point $A(1, 20^\circ, 120^\circ)$ to $B(4, 80^\circ, 60^\circ)$. (8)

- b) Derive the capacitance of a coaxial cable of inner radius 'a' and outer radius 'b'. (6)

Module -3

- 15 a) State and explain Ampere's circuital law and its modified form. (5)

- b) Derive the magnetic field intensity at any point due to a finite current carrying wire by applying Biot Savart's law. (9)

- 16 a) Derive the boundary conditions for electric field at a boundary between two dielectric media. (8)

- b) Write Maxwell's equations for time varying field in point form with the significance of each. (6)

Module -4

- 17 a) Derive the wave equations from Maxwell's equations for a lossy dielectric medium. (10)

- b) For aluminium ($\sigma = 3.5 \times 10^7 \text{ S/m}$, $\epsilon = \epsilon_0$, $\mu = \mu_0$) at 150 MHz ; find (a) the propagation constant and (b) skin depth. (4)

- 18 a) State and prove Poynting's theorem. (8)

- b) A plane wave propagating through a medium with $\epsilon_r = 8$, $\mu_r = 2$ has. (6)

$E = 0.5e^{-z/3} \sin(10^8 t - \beta z) \mathbf{a}_z$ V/m. Determine (a) β (b) Intrinsic impedance

(c) Wave velocity (d) expression for H field.

Module-5

- 19 a) Derive the wave equations in a transmission line. (8)

- b) A transmission line operating at 500 MHz has $Z_0 = 80 \Omega$, $\alpha = 0.04$ Np/m, $\beta = 1.5$ rad/m. (6)

Find the line parameters R, L, G and C.

- 20 a) Explain impedance matching. Describe two techniques used for impedance matching in transmission line. (8)

- b) A lossless transmission line with $Z_0 = 50 \Omega$ is 30m long and operates at 2MHz. The line is terminated with a load $Z_L = 60 + j40 \Omega$. If velocity of propagation, $u = 0.6c$ (6)
($c = \text{velocity of light}$) on the line, find (a) reflection coefficient, (b) standing wave

ratio.