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 $(3,120^0,7)$ 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 $\mathbf{B}= \rho sin\emptyset \boldsymbol{a}_\rho - \rho cos\emptyset \boldsymbol{a}_\emptyset + \rho \boldsymbol{a}_z$. (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 $\mathbf{D}=\rho^2\cos^2\emptyset\mathbf{a}_\rho + z\sin\emptyset\mathbf{a}_\emptyset$. Determine the flux of **D** crossing the closed surface of the cylinder $0 \le z \le 1$, $\rho = 4$. 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 $V = \frac{10sin\theta cos\emptyset}{r^2}$. (a) Find the electric flux density D at $(2,90^0,0)$. (b) Calculate the work done in moving a 10 μC charge from point $A(1, 20^0,120^0)$ to $B(4, 80^0,60^0)$. (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 form Maxwells equations for a lossy dielectric medium. (10)

b) For aluminium ($\sigma=3.5x10^7$ S/m, $\varepsilon=\varepsilon_0$, $\mu=\mu_0$) at 150MHz, 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 $\varepsilon_r=8$, $\mu_r=2$ has $\mathbf{E}=0.5e^{-z/3}\sin(10^8t-\beta z)\mathbf{a_z}$ V/m. Determine (a) β (b) Intrinsic impedance (c) Wave velocity (d) expression for H field. (6)

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. Find the line parameters R, L, G and C. (6)

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 (c=velocity of light) on the line, find (a) reflection coefficient, (b) standing wave ratio. (6)

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