Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP) Examination January 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 Define the curl of a vector field and explain its physical significance. (3)

2 Express the point (-2,6,3) in spherical coordinate system. (3)

3 Explain the conservative nature of electrostatic field. (3)

4 Capacitance of a parallel plate capacitor having plate area 100 cm^2 and separated by 2mm is $2\times 10^{-4}\mu F$. Find the electric flux and potential gradient in kV/cm when 20kV is applied across the plates. (3)

5 State Ampere's circuital law and express it in point form. (3)

6 Find the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2\times10^{-4}$ mho/m and $\varepsilon r = 81$. (3)

7 Define Poynting theorem with mathematical representation. (3)

8 A uniform plane wave is travelling through a lossless dielectric medium with $\varepsilon r = 4$ and $\mu_R = 1$. Find the intrinsic impedance of the medium. (3)

9 Define Standing wave ratio and how it is related to reflection coefficient. (3)

10 What is electromagnetic interference? List any 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) Verify Stokes' theorem for a vector field $\boldsymbol{F} = \rho^2 \cos\varphi\, \boldsymbol{a_\rho} + z\sin\varphi\, \boldsymbol{a_z}$ around a path L defined by $0 \le \rho \le 3$, $0 \le \varphi \le 45^0$ and $z = 0$. (10)

b) Define gradient of a scalar field and mention its physical significance (4)

12 a) Explain the transformation of a vector from spherical coordinate system to Cartesian coordinate system. (7)

b) State and prove Gauss divergence theorem. (7)

Module -2

13 a) State and prove Gauss's law. Using Gauss's law, find the electric field intensity due to an infinite line charge distribution. (7)

b) A charge of 1C is placed at point (2,0,0) and another charge Q is placed at point (-2,0,0). Find the value of Q which will make y component of total electric field intensity zero at the point (1,2,2). (7)

14 a) Derive the expression of capacitance of a coaxial cable. (7)

b) What is the potential at the centre of a square with side 2m length, when the charges 2μC, -4μC, 6μC and 2μC are located at its four corners. (7)

Module -3

15 a) State and explain Biot Savart's Law. Find the expression for magnetic field intensity at a point on the axis of a circular current carrying loop. (10)

b) A flat perfectly conducting surface in xy plane is situated in a magnetic field of $\mathbf{H}=3\cos x\,\mathbf{a}_x + z\cos x\,\mathbf{a}_y$ A/m. Find the current density on the conducting surface. (4)

16 a) Derive the boundary conditions for electric field at the interface between two dielectric media. (6)

b) Obtain maxwell's equations in differential form for time varying field from Ampere's circuital law and Faradays law. (8)

Module -4

17 a) Derive wave equation in phasor form, obtain expression for propagation constant, attenuation constant and phase constant. (14)

18 a) A lossy dielectric is characterised by $\varepsilon_r = 2.5$ and $\mu_r = 4$ and $\sigma = 10^{-3}$ mho/m at a frequency of 10 MHz. Find i) Attenuation constant ii) Phase constant iii) velocity of propagation iv) wave length and v) intrinsic impedance (10)

b) Explain skin effect and skin depth. (4)

Module -5

19 a) What are transmission line parameters? Explain the significance of each parameter. (8)

b) A low-loss coaxial transmission line with a characteristic impedance of 75 Ω is terminated with a resistive load of 25 Ω. Calculate the voltage standing wave ratio on the line. Also find the minimum voltage if the maximum voltage on the standing wave pattern is 20 V. (6)

20 a) A transmission line has following parameters per unit length. R = 2Ω, L = 0.2μH, C=200pF and G=0.005mho. Calculate the propagation constant and characteristic (8)

impedance of the line at 1 GHz.

b) What is impedance matching? Describe any two impedance matching methods (6)

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