Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R,S) / (WP), S4 (PT) Exam April 2025 (2019 Scheme)

Course Code: ECT302

Course Name: ELCTROMAGNETICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1	A circular cylinder of radius r = 5 cm is concentric with the z-axis and extends between z = −3 cm and 3 cm. Find the volume of the cylinder	(3)
2	Express Maxwell's equations for time varying field in point form	(3)
3	Define electric flux and electric flux density? Write relation between E & D.	(3)
4	Derive the expression for the inductance of a co-axial cable.	(3)
5	Compute the reflection coefficients of an electric field wave travelling in air and incident normally on a boundary between air and a dielectric having permittivity ε_r=4 and permeability μ_r =1.	(3)
6	What is meant by uniform plane waves? Also, why are electromagnetic waves called as transverse electromagnetic waves?	(3)
7	Differentiate elliptical and circular polarisation	(3)
8	Define Standing wave ratio and explain the relation with reflection co-efficient of a transmission line.	(3)
9	A transmission line has a characteristic impedance of 50Ω and a resistance of 0.1Ω / m. If the line is distortion less, find the attenuation constant (in Np/m) is	(3)
10	Explain why TEM wave cannot propagate in a single conductor hollow waveguide.	(3)

PART B

Answer one full question from each module, each carries 14 marks.

Module I

11 a) State and derive Gauss's law in point form. (7)

b) Point charges 5nC and -2nC are located at (2, 0, 4) and (-3, 0, 5) respectively. Calculate the force experienced and field on a 1nC charge located at (1-3, 7). (7)

OR

12 a) A spherical volume of radius a contains a uniform volume charge density ρ_v. Use Gauss's law to determine D for (a) $R \leq a$ and (b) $R \geq a$. (10)

b) Given $V = x^2 y + xy^2 + xz^2$, (a) find the gradient of V, and (b) evaluate it at $(1,-1,2)$ (4)

Module II

13 a) Derive continuity equation from fundamental laws. (7)

b) Derive an expression for magnetic energy of a continuous distribution of current in a volume. (7)

OR

14 a) Derive the boundary conditions for electric field components that are tangential and normal at the interface between two dissimilar dielectric materials. (7)

b) Define capacitance. Determine the capacitance of a two-wire transmission line. (7)

Module III

15 a) Derive the expression for Brewster angle for parallel polarised wave. (7)

b) A 10-MHz uniform plane wave is travelling in a nonmagnetic medium with $\mu = \mu_0$ and $\varepsilon_r = 9$. Find (a) the phase velocity, (b) the wave number, (c) the wavelength in the medium, and (d) the intrinsic impedance of the medium. (7)

OR

16 a) Derive the equation for transmission and reflection coefficients of an electromagnetic wave incident normally on the boundary between two different regions. (8)

b) The electric field of a traveling electromagnetic wave is given by $E(z,t) = 10\cos(\pi \times 10^7 t + \pi z/15 + \pi/6)$ (V/m). Determine (a) the direction of wave propagation, (b) the wave frequency f, (c) its wavelength λ, and (d) its phase velocity (6)

Module IV

47

17 a) Derive an expression for net outward power flow associated with an electromagnetic wave, from a surface. (10)

b) A 50-Ω lossless line is terminated in a load impedance $Z_L = (30 - j20)\ \Omega$. Calculate Γ and S (4)

OR

18 a) Derive the expression for propagation constant of transmission line. (8)

b) A distortionless transmission line operating at 125 MHz has $Z_0 = 40\ \Omega$, $\alpha = 0.02$ (Np/m), and $\beta = 0.75$ rad/m. Find the line parameters R , L , G , and C (6)

Module V

19 a) Derive the expression for r circles and x circles in Smith chart. (10)

b) A rectangular waveguide of internal dimensions (a = 4cm and b = 3 cm) is to be operated in TE_{11} mode. Find the minimum operating frequency (4)

OR

20 a) Derive the expression all the Electric and magnetic field components for Transverse Magnetic Modes. (10)

b) Explain Group velocity and Phase velocity. (4)

****

148