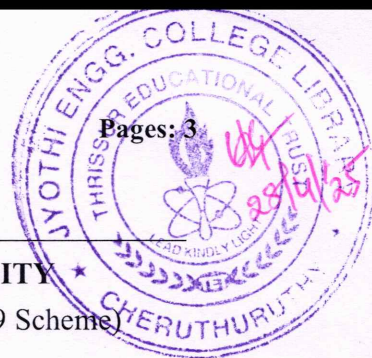


Reg No.: _____

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 $\epsilon_r=4$ and permeability $\mu_r=1$. | (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. (7)
 Calculate the force experienced and field on a 1nC charge located at $(1-3, 7)$.

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 $\epsilon_r = 9$. 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

- 17 a) Derive an expression for net outward power flow associated with an electromagnetic wave, from a surface. (10)
- b) A $50\text{-}\Omega$ lossless line is terminated in a load impedance $Z_L = (30 - j20)\text{ }\Omega$. 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 $Z_0 = 40\text{ }\Omega$, $\alpha = 0.02$ (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 ($a = 4\text{ cm}$ and $b = 3\text{ cm}$) 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)
