

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC303

Course Name: APPLIED ELECTROMAGNETIC THEORY

Max. Marks: 100

Duration: 3 Hours

Smith Chart to be supplied.

PART A

Answer any two full questions, each carries 15 marks.

Marks

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|---|--|---------|
| 1 | a) Point charges 5 nC and -2 nC are located at (2,0, 4) and (-3,0, 5), respectively.
(i) Determine the force on a 1nC point charge located at (1, -3, 7).
(ii) Find the electric field E at (1, - 3 , 7). | (7) |
| | b) State and explain Maxwell's equations in the integral and differential forms. | (8) |
| 2 | a) Give Poisson's and Laplace equation in electrostatics. Give application | (7) |
| | b) A plane wave propagating through a medium with $\epsilon_r = 8$ $\mu_r = 2$ has $E = 0.5e^{-z/3} \sin(10^8 t - \beta z) a_x$ V/m. Determine
(i) β
(ii) The loss tangent
(iii) Intrinsic impedance
(iv) Wave velocity
(v) H field | E = (8) |
| 3 | a) Derive the expression of capacitance of two wire transmission line. | (8) |
| | b) State and prove boundary conditions for E and H in accordance with Maxwell's equations. | (7) |

PART B

Answer any two full questions, each carries 15 marks.

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|---|---|-------|
| 4 | a) In free space, $H = 0.2 \cos(\omega t - \beta x) a_z$ A/m. Find the total power passing through:
(i) A square plate of side 10 cm on plane $x + z = 1$
(ii) A circular disc of radius 5 cm on plane $x = 1$. | (8) |
| | b) Derive an expression for characteristic impedance of a transmission line and show that it is resistive at radio frequencies. | (7) |
| 5 | a) What is polarisation? Explain the different types of Polarisation? | (7) |
| | b) A telephone line has $R = 30\Omega/\text{km}$, $L = 100\text{mH}/\text{km}$, $G = 0$, and $C = 20\mu\text{F}/\text{KM}$. At $f = 1$ KHz, obtain: i) Characteristic impedance ii) propagation constant iii) phase velocity. | (8) |
| 6 | a) Derive the expression for the ratio of reflected to incident electric field strength for an insulator with oblique incidence. | (7.5) |

- b) Derive the expression of input impedance due to a transmission line terminated by a load. Also find the expression for SWR. (7.5)

PART C

Answer any two full questions, each carries 20 marks.

- 7 a) Derive the expression for r-circles and x-circles in Smith chart. (10)
- b) Determine, assuming TE₁₀ mode of propagation, the cut-off frequency, cut-off wavelength, guide wavelength, phase constant, phase velocity, group velocity and wave impedance in the case of a hollow rectangular metallic waveguide of dimensions 6cm and 3 cm, respectively, when the applied signal frequency is 5GHz (10)
- 8 a) A $100 + j150 \Omega$ load is connected to a 75Ω lossless line. Using Smith Chart, find: (10)
- (i) Γ
 - (ii) s
 - (iii) The load admittance Y_L
 - (iv) Z_{in} at 0.4λ from the load
- b) Obtain the waveguide solution to Maxwell's wave equations (10)
- 9 a) Explain single stub matching using analytical method. (10)
- b) A hollow rectangular waveguide has dimensions of $a = 4\text{cm}$ and $b = 2\text{cm}$. Calculate the amount of attenuation if the frequency is 3.5 GHz. Assume dominant mode. (10)
