Course Code: 23EC4T03

BONAM VENKATA CHALAMAYYA INSTITUTE OF TECHNOLOGY & SCIENCE

**(AUTONOMOUS)**

***II - B. Tech II-Semester Regular Examinations (BR23), Apr/May - 2025***

**ELECTROMAGNETIC WAVES & TRANSMISSION LINES (ECE)**

Time: 3 hours Max. Marks: 70

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*Question Paper consists of Part-A and Part-B*
*Answer **ALL** the question in **Part-A and Part-B***

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PART–A (10X2 = 20M)

| | | Marks | CO | BL |
|---|---|---|---|---|
| 1. a) | Define primary constants of a transmission line. | (2M) | CO1 | BL1 |
| b) | What is the significance of characteristic impedance? | (2M) | CO 1 | BL 2 |
| c) | Define VSWR. | (2M) | CO 2 | BL 1 |
| d) | Explain the concept of a quarter-wave transformer. | (2M) | CO 2 | BL 2 |
| e) | State Gauss's Law. | (2M) | CO 3 | BL 1 |
| f) | Define electric potential. | (2M) | CO 3 | BL 1 |
| g) | Explain the difference between magnetic scalar and vector potentials. | (2M) | CO 4 | BL 2 |
| h) | State Biot-Savart Law. | (2M) | CO 4 | BL 2 |
| i) | Define skin depth. | (2M) | CO 5 | BL 1 |
| j) | What is surface impedance? | (2M) | CO 5 | BL 1 |

PART–B (5X10 = 50M)

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|---|---|---|---|---|
| 2a. | Derive the expressions for phase and group velocities. | 5(M) | CO 1 | BL 3 |
| b. | A transmission line has the following parameters: R = 10 Ω/km, L = 5 mH/km, G = 0.1 mho/km, and C = 10 μF/km. Calculate the characteristic impedance ($Z_o$) of the line. | 5(M) | CO 1 | BL 3 |
| | (OR) | | | |
| 3a. | Explain the characteristics of lossless transmission line. | 5(M) | CO 1 | BL 2 |
| b. | Derive the expression for characteristic impedance. | 5(M) | CO 1 | BL 3 |
| 4. | Explain the construction of the Smith Chart. | 10(M) | CO 2 | BL 2 |
| | (OR) | | | |
| 5. | A 100 Ω transmission line is to be matched to a load of 40 + j30 Ω using a single stub. The frequency of operation is 1 GHz. Determine:<br>i. The length of the stub.<br>ii. The distance of the stub from the load. | 10(M) | CO 2 | BL 3 |
| 6. | Derive Poisson's and Laplace's equations. | 10(M) | CO 3 | BL 4 |
| | (OR) | | | |
| 7a. | Explain the concept of energy density in electrostatic fields. | 5(M) | CO 3 | BL 2 |
| b. | Two charges, Q1 = 10 nC and Q2 = -20 nC, are separated by a distance of 3 m. Find the magnitude of the electrostatic force between them. | 5(M) | CO 3 | BL 3 |

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|---|---|---|---|---|
| 8. | A solenoid has 500 turns per meter and carries a current of 2 A. The radius of the solenoid is 2 cm. Calculate:<br>i. The magnetic field intensity inside the solenoid.<br>ii. The magnetic flux density inside the solenoid.<br>iii. The inductance of the solenoid. | 10(M) | CO 4 | BL 3 |
| | (OR) | | | |
| 9a. | Explain Ampere's Circuital Law and its applications in detail. | 5(M) | CO 4 | BL 2 |
| b. | Derive the expression for magnetic energy. | 5(M) | CO 4 | BL 3 |
| 10. | Derive all the relations between E and H in uniform plane waves. | 10(M) | CO 5 | BL 4 |
| | (OR) | | | |
| 11. | A 5 GHz plane wave propagates in a lossy dielectric medium with $\varepsilon_r = 2.5$, $\mu_r = 1$, and $\sigma = 0.02$ S/m. Calculate:<br>i. The attenuation constant ($\alpha$).<br>ii. The phase constant ($\beta$).<br>iii. The intrinsic impedance ($\eta$).<br>iv. The skin depth ($\delta$).<br>v. The velocity of propagation (v). | 10(M) | CO 5 | BL 3 |

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