



## End Term (Odd) Semester Examination November 2025

Roll no.....

Name of the Course and semester: B.Tech (ECE)

Name of the Paper: Electromagnetic Waves

Paper Code: TEC 503

Time: 3 hours

Maximum Marks: 100

### Note:

- (i) All the questions are compulsory.
- (ii) Answer any two sub questions from a, b and c in each main question.
- (iii) Total marks for each question is 20 (twenty).
- (iv) Each sub-question carries 10 marks.

Q1.

(2X10=20 Marks)

a. Explain the spherical coordinate system and show the relationship between the Cartesian and cylindrical coordinate systems. CO1

b. Given vectors  $\vec{A} = 2\hat{a}_x + 2\hat{a}_y - \hat{a}_z$ ,  $\vec{B} = \hat{a}_x - 3\hat{a}_y + 4\hat{a}_z$  and  $\vec{C} = \hat{a}_x - \hat{a}_y + \hat{a}_z$ , determine CO1

(i)  $|\vec{A} + \vec{B} + \vec{C}|$

(ii)  $\vec{A} - \vec{B} + \vec{C}$

(iii) dot product of  $\vec{B}$  and  $\vec{C}$

(iv)  $\vec{A} \times \vec{B} \cdot \vec{C}$

c. State and explain:

CO1

(i) Divergence theorem (ii) Stokes' theorem. Give the relevance of these theorems to electromagnetic problems

Q2.

(2X10=20 Marks)

a. What is Magnetic flux density? Discuss the different properties of magnetic flux lines. CO2

b. Explain Biot-Savart's law. Determine the magnetic field due to a straight current-carrying conductor of finite length using Biot-Savart's law. CO2

c. What is a Electrostatics boundary condition? Explain boundary conditions in two different Dielectric media in detail. CO3

Q3.

(2X10=20 Marks)

a. What do you mean by an electromagnetic wave? Discuss the wavelength and time period of a wave moving in the positive x-axis. CO4

b. What is magnetic boundary condition? Explain boundary conditions in two different magnetic media in detail. CO4

c. Derive the general expressions for reflection coefficient, transmission coefficient, and standing wave ratio for a plane wave in the case of normal incidence. CO3

Q4.

(2X10=20 Marks)

a. What is lossless transmission line? Define the following parameters of lossless transmission line. CO4

(i) propagation constant

(ii) phase velocity

(iii) characteristics impedance



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- b. Write the difference between waveguide and the transmission line. Explain TEM, TE, TM mode in rectangular waveguide. CO5
- c. A distortionless line operating at 120 MHz has  $R = 20 \Omega/m$ ,  $L = 0.3 \mu H/m$  and  $C = 63 pF/m$ . Determine propagation constant( $\gamma$ ), phase velocity( $V$ ) and characteristics impedance ( $Z_0$ ). CO5
- Q5. (2X10=20 Marks)
- a. Explain the phenomenon of total internal reflection (TIR) of a plane electromagnetic wave at a dielectric interface. Derive the condition for total internal reflection and obtain an expression for the critical angle. CO3
- b. Discuss in detail how the polarization of an electromagnetic wave is affected at the interface of two dielectric media. CO3
- c. Derive the expressions for reflection and transmission coefficients when a plane wave is obliquely incident on a dielectric interface. CO4