

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-GURAJADA VIZINAGARAM**  
**II B. Tech I Semester Regular/Supply Examinations, November – 2025**  
**ELECTROMAGNETIC FIELD THEORY**  
**(EEE)**

Time: 3 hours

Max. Marks: 70

*Question paper consists of Part A, Part B.*  
*Part A is compulsory, Answer all questions.*  
*In Part B, Answer any one question from each unit.*

\*\*\*\*\*

**PART-A****(20 Marks)**

- 1 a) Find the unit vector in the direction of  $A = 3i + 4j + 0k$ . [2]
- b) Write Maxwell's first equation in electrostatics (differential form). [2]
- c) What is the dipole moment? Write its SI unit. [2]
- d) Write Ohm's law in point form. [2]
- e) Define the force on a moving charge in a magnetic field. [2]
- f) State Biot-Savart's law. [2]
- g) Define coefficient of coupling. [2]
- h) State Lenz's law and its significance in inductance. [2]
- i) List the four Maxwell's equations in integral form. [2]
- j) Define displacement current. [2]

**PART-B****(50 Marks)****Unit-1**

- 2 a) Apply Gauss's law to find E due to an infinite sheet of charge. [5]
  - b) A potential function is given by  $V = 3x^2 + 2y^2 + z^2$ . Find  $E$  at (1, 2, 3). [5]
- (OR)
- 3 a) Derive the expression for E due to a uniform surface charge. [5]
  - b) State and explain the Divergence theorem. [5]

**Unit-2**

- 4 a) Derive the continuity equation for current [7]
  - b) Explain the concept of relaxation time and its significance in conductors. [3]
- (OR)
- 5 a) Derive the expression for the capacitance of a coaxial cable. [5]
  - b) A coaxial cable has inner radius 2 mm and outer radius 5 mm, filled with a dielectric of  $\epsilon_r = 3$ . Find its capacitance per meter. [5]

**Unit-3**

- 6 a) Derive the expression for the force per unit length between two infinitely long, parallel current-carrying conductors. [5]
- b) Two parallel wires 10 cm apart carry 5 A and 10 A in opposite directions. Find the force per meter between them. [5]

(OR)

- 7 a) Apply Ampere's law to determine H inside an infinite sheet of current. [5]
- b) Explain the difference between Biot-Savart's law and Ampere's law. [5]

**Unit-4**

- 8 a) Derive the relation between mutual inductance (M), self-inductances ( $L_1$  and  $L_2$ ), and coefficient of coupling (k). [5]
  - b) Explain the concept of magnetic flux linkage and its relation to inductance. [5]
- (OR)

- 9 a) Derive an expression for the inductance per unit length of a coaxial cable. [5]
- b) Calculate the energy density in a field with  $B=0.1$  T and  $\mu=4\pi \times 10^{-7}$  H/m. [5]

### **Unit-5**

- 10 a) Explain how Maxwell's equations lead to the existence of electromagnetic waves. [5]  
b) Explain the concept of displacement current and derive its expression. [5]  
(OR)
- 11 a) Derive the Poynting theorem from Maxwell's equations. [5]  
b) Define Poynting vector and explain its significance in electromagnetic power flow. [5]

\*\*\*\*\*