

II B. Tech I Semester Supplementary Examinations, January - 2023
ELECTROMAGNETIC FIELDS
 (Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answer **ALL** the question in **Part-A**
 3. Answer any **FOUR** Questions from **Part-B**

PART -A Marks:14

1. a) State and explain Gauss's law. (3M)
- b) Write ohm's law in point form. (2M)
- c) Write the maxwell's third equation and its significance. (2M)
- d) What is a magnetic dipole? How does it differ from electric dipole? (2M)
- e) A solenoid has an inductance of 20 mH. If the length of the solenoid is increased by two times and the radius is decreased to half of its original value, find the new inductance. (3M)
- f) List the differences between statically and dynamically induced emf. (2M)

PART -B Marks:56

2. a) Derive Poisson's and Laplace's equations from fundamentals. (7M)
- b) In free space, $D = 2y^2a_x + 4xya_y - a_z$ mC/m². Find the total charge stored in the region $1 < x < 2$, $1 < y < 2$, $-1 < z < 4$. (7M)
3. a) Derive the boundary conditions between the perfect dielectrics of permittivities ϵ_1 and ϵ_2 . (7M)
- b) A parallel plate capacitor has plate area 200 cm² and plate separation of 3 mm. The charge density is 1 μ C/m² and air is the dielectric. Find (i) the capacitance of the capacitor (ii) Voltage between the plates (iii) the force with which the plates attract each other. (7M)
4. a) Derive an expression for magnetic field intensity at the center of a square current loop. (7M)
- b) Determine H at P₂(0.4, 0.3, 0) in the field of an 8A filamentary current directed inward from infinity to the origin on the positive x- axis and then outward to infinity along the y-axis. (7M)
5. a) Explain and derive Lorentz force equation. (7M)
- b) The point charge Q=18nC has a velocity of 5×10^6 m/s in the direction $a_v = 0.04a_x - 0.05a_y + 0.2a_z$. Calculate the magnitude of force exerted on the charge by the field (i) $B = -3a_x + 4a_y + 6a_z$ (ii) $E = -3a_x + 4a_y + 6a_z$ (iii) B and E acting together (7M)

6. a) Derive the expression for self-inductance of a coaxial cable of inner radius 'a' and outer radius 'b'. (7M)
- b) Determine the inductance of a solenoid of 2500 turns wound uniformly over a length of 0.25m on a cylindrical paper tube, 4 cm in diameter and the medium is air. (7M)
7. a) State and explain faraday's laws of electromagnetic induction. (7M)
- b) A parallel-plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage $50 \sin 10^3 t \text{ V}$ applied to its plates. Calculate the displacement current assuming $\epsilon = 2\epsilon_0$ (7M)