

USN

--	--	--	--	--	--	--	--	--	--

15EC36

Third Semester B.E. Degree Examination, Feb./Mar. 2022 Engineering Electromagnetics

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. State and explain Coulombs law and show its vector form. (04 Marks)
 b. Define Electric field Intensity and Electric flux density. (04 Marks)
 c. A 20nc point charge is located at P(2, 4, -3) in free space
 i) Find E(r) ii) Find E at A(-3, 2, 0) (08 Marks)

OR

- 2 a. Derive the expression for Electric field Intensity due to Infinite line charge (08 Marks)
 b. A line charge $\rho_L = 50\text{nc/m}$ is located along the line $x = 2, y = 5$ in free space. i) Find E at P(1, 3, -4) ii) If the surface $x = 4$ contains a uniform surface charge density $\rho_s = 18\text{nd/m}^2$, at which point in the $z = 0$ plane is $E_{\text{total}} = ?$ (08 Marks)

Module-2

- 3 a. State and prove Gauss's law. (06 Marks)
 b. Define the terms : i) Potential and ii) Potential difference. (04 Marks)
 c. Calculate the workdone in moving 4c charge from B(1,0,0) to A (0, 2, 0) along the path $y = z - 2x, z = 0$ in the Field 'E'. 1) $5ax \text{ V/m}$ 2) $5x ax \text{ V/m}$ 3) $5x ax + 5y ay \text{ V/m}$. (06 Marks)

OR

- 4 a. Derive the Expression for equation of continuity. (06 Marks)
 b. Explain the potential field of a point charge (04 Marks)
 c. Let $D = (10r^2 + 5e^{-r}) a_r \text{ C/m}^2$.
 i) Find ρ_v as a function of r
 ii) Find the total charge lying within the sphere radius 'a' centered the origin. (06 Marks)

Module-3

- 5 a. Derive Poisson's and Laplace equations. (04 Marks)
 b. State and prove uni-queness theorem. (06 Marks)
 c. The potential on the plane $x - 2y + 5z = 2$ is 50V, point P (2, 3, -7) lies on a parallel conducting plane having a potential of -360V
 i) Find V at A (-1, 4 6)
 ii) Find E (x, y, z) (06 Marks)

OR

- 6 a. State and explain Biot - Savert's law. (06 Marks)
 b. State and explain Ampere's Circutal law. (04 Marks)
 c. The magnetic field intensity is given as $H = (3/\rho)a_\rho + 12(z - 5)a_\phi + 2\rho^2 \sin \phi a_z$ in free space. Determine the value of surface integral $\int_S (\nabla \times H) \cdot ds$ over the paraboloidal surface $-z = \rho^2, 0 \leq z \leq 3$. (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

Module-4

- 7 a. Derive an equation for the magnetic force between two differential current Elements. (08 Marks)
- b. An air core toroid has 500 turns, mean radius of 15cm cross sectional area of 6cm^2 . The magneto motive force is 2000A.t. Calculate total reluctance, Flux, Flux density, Field intensity. (08 Marks)

OR

- 8 a. Derive the Boundary conditions at the boundary between two magnetic of different permeability's. (08 Marks)
- b. Find the force per meter length between two parallel wires separated by 10cm in air carrying current of 10A in the same. (04 Marks)
- c. Write a note on Magnetic circuit. (04 Marks)

Module-5

- 9 a. List point form and integral form of Maxwell's equations for steady and time varying fields. (06 Marks)
- b. A 300MHz wave propagating through fresh water. Assuming a lossless medium $\mu_2 = 1$, $\epsilon_r = 78$ (at 300MHz). Find the β , v , λ , η if $E_0 = 0.1\text{VM}$, also find E_x and H_y . (10 Marks)

OR

- 10 a. State and prove Poynting theorem. (08 Marks)
- b. Using Maxwell's equation derives an expression for uniform plane wave in free space. (08 Marks)
