Exam No: _____

GANPAT UNIVERSITY

B. TECH SEM- IV (ELECTRICAL)

REGULAR EXAMINATION– APRIL-JUNE 2016

2EE402: Engineering Electromagnetics

TIME: 3 HRS **TOTAL MARKS: 60**

Instructions: (1) This Question paper has two sections. Attempt each section in separate answer book.
(2) Figures on right indicate marks.
(3) Be precise and to the point in answering the descriptive questions.

SECTION: I

Q.1

(A) Given the vector $M = -10a_x + 4a_y - 8a_z$ and $N = 8a_x + 7a_y - 2a_z$, find: (a) a unit vector indirection of $-M + 2N$; (b) the magnitude of $5a_x + N - 3M$; (c) $|M||2N|(M+N)$ (5)

(B) A vector field S is expressed in rectangular coordinates as (5)

$$s = \{125/[(x-1)^2 + (y-2)^2 + (z+1)^2]\}\{(x-1)a_x + (y-2)a_y + (z+1)a_z\}$$

(a) Evaluate S at $P(2, 4, 3)$. (b) Determine the unit vector that gives the direction of S at P.
(c) specify the surface $f(x, y, z)$ on which $|S| = 1$.

OR

Q. 1

(A) Show that the vector fields $A = \rho\cos\phi a_\rho + \rho\sin\phi a_\phi + \rho a_z$ and $B = \rho\cos\phi a_\rho + \rho\sin\phi a_\phi - \rho a_z$ are everywhere perpendicular to each other. (5)

(B) Express the uniform vector field $F = 5a_x$ in cylindrical components. (5)

Q.2

(A) Explain Faraday's experiment in static electric field. What are the essential steps in his experiment? (5)

(B) Differentiate between cross product and dot product of two vectors. (5)

OR

Q.2

(A) By applying Gauss's law to the differential volume element prove that (5)

$$charge\ \ enclosed\ \ in\ \ volume\,\Delta v = \left(\frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}\right) \times volume\,\Delta v$$

(B) Let $D = 4xya_x + 2(x^2 + z^2)a_y + 4yza_z C/m^2$ and evaluate surface integrals to find the total charge enclosed in the rectangular parallelepiped $0 < x < 2, 0 < y < 3, 0 < z < 5$m. (5)

Q.3 **Attempt any two.**

(A) Explain the energy-band structure in conductor, insulators and semiconductors. (5)

(B) Explain the Biot-Savart law which expresses magnetic field intensity with neat diagram and equation. (5)

(C) Explain the boundary conditions for perfect conducting material. (5)

SECTION: II

Q.4
(A) Derive the equation for electric field intensity due to a sheet of charge with uniform surface charge density $\rho_S C/m^2$ on an infinite plane. (5)

(B) A uniform volume charge density of $0.2\mu C/m^3$ is present throughout the spherical shell extending from r = 3cm to r = 5cm. If $\rho_v = 0$ elsewhere, find: (a) the total charge present throughout the shell, and (b) r_1 if half the total charge is located in the region 3cm < r < r_1. (5)

OR

Q.4
(A) Let a point charge $Q_1 = 25nC$ be located at $P_1(4, -2, 7)$ and a charge $Q_2 = 60nC$ be at $P_2(-3, 4, -2)$. (a) if $\varepsilon = \varepsilon_0$, find E at $P_3(1, 2, 3)$ (b) at what point on the y-axis is $E_x = 0$? (5)

(B) Derive the equation for electric field intensity at point $P(\rho, \phi, z)$ due to infinite line charge present on z-axis having uniform line charge density ρ_L C/m. (5)

Q.5
(A) A current density is given in cylindrical coordinates as $\bar{J} = -10^6 z^{1.5} a_z \ A/m^2$ in the region $0 \le \rho \le 20\mu m$; for $\rho \ge 20\mu m$, $\bar{J} = 0$. Find the total current crossing the surface z = 0.1 m in a_z direction. If the charge velocity is $2\times10^6 m/s$ at z=0.1, find ρ_v there. (5)

(B) Explain the significance of curl and divergence of vector field. (5)

OR

Q.5
(A) Derive Maxwell's equation from Faraday's law for transformer and motional EMF. (5)

(B) Derive Laplace's and Poisson's Equations in Cartesian co-ordinate system. (5)

Q.6 **Attempt any two.**
(A) Four 10nC positive charges are located in the z = 0 plane at the corners of a square 8 cm on a side. A fifth 10nC positive charge is located at a point 8 cm distance from the other charges. Calculate the magnitude of the total force on this fifth charge for $\varepsilon = \varepsilon_0$. (5)

(B) Derive Capacitance due to spherical cable. (5)

(C) Two dipoles with dipole moments $-5a_z$ nc/m and $9a_z$ nc/m are located at points (0,0,-2) and (0,0,3) respectively. Find potential at the origin. (5)

----------END OF PAPER----------