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GANPAT UNIVERSITY

B. TECH SEM. V ELECTRONICS & COMMUNICATION ENGINEERING

EXAMINATION NOV/DEC-2011

EC 502 ELECTROMAGNETICS THEORY

TIME: 3 HOURS **TOTAL MARKS: 70**

INSTRUCTIONS:

1. Attempt all questions.
2. Answers to the two sections must be written in separate answer books.
3. Figures to the right indicate full marks.
4. Assume suitable data, if necessary.

SECTION-I

Que.-1 **(A)** Given the two vectors, $\bar{r}_a = 2a_x - 3a_y - 6a_z$ and , $\bar{r}_b = = 2a_x + 3a_y + 5a_z$ and point C(1, 2, 6), find 6

(a) r_{ab} (b) Magnitude of $\bar{r}_a$ (C) Unit vector from C towards A.

(B) Transform the following vector to spherical co ordinate at the point specified: 6

(a) $5a_x$ at B($r = 4, \theta = 25^\circ, \emptyset = 120^\circ$),

(b) $4a_x - 2a_y - 4a_z$ at P(x= −2, y= −3, z= −4).

OR

Que.-1 **(A)** The three vertices of a triangle are located at A(6,-1,2), B(-2,3,-4), C(-3, 1, 5). Find (a) R_{ab} (b) R_{ac} (c) the angle θ_{BAC} at vertex A. 6

(B) Transform Cartesian coordinate into Spherical coordinate. 6

Que.-2 **(A)** Calculate E at M(3, −4, 2) in free space caused by 5

(a) charge Q_1=2 μc at P_1(0,0,0)

(b) charge Q_2=3 μc at P_2(−1, 2, 3)

(B) Let D= $(2/z^2)(yza_x - xza_y - 2xya_z)$ c/m^2 use the gauss's law to determine the charge enclosed in cubical region 2< x, y, z< 3.

OR

Que.-2 **(A)** Let D=$(8x+4x3)a_x - 2ya_y + 2za_z$ c/m^2 use the gauss's law to determine the charge enclosed in cubical region –a< x, y, z< a. 6

(B) Briefly explain boundary conditions on electrostatic field. 5

Que.-3 **(A)** An electric field is given as E= $6y^2za_x + 12\ xyza_y + 6xy^2a_z$ v/m, an incremental path is represented by dl= $-3a_x + 5a_y - 2a_z$ μm. find the work done in moving a 2μc charge along this path if location of path is at 6

(a) P_a(0, 2, 5) (b) P_b(1, 1, 1)

(B) Define the following terms :

(i) Current density (ii) Electric flux density (ii) volume charge density

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SECTION-II

Que.-4 (A) What Maxwell equations stand for? Also derive them for time varying field. 6

(B) A loop of wire is constructed of three straight segments connecting (0,0,0) to (0.6,0,0) to (0.4,1,0.7) to (0,0,0). A current of 8 mA is in the $\bar{a}_x$ direction in the first segment. Given a uniform magnetic flux density $\mathbf{B} = 0.2\bar{a}_x - 0.1\bar{a}_y + 0.2\bar{a}_z$ T. Find (a) the force on the segment extending from (0,0,0) to (0.6,0,0) ; (b) the total force on the loop; (c) the torque on the loop about an origin at (0,0,0). 6

OR

Que.-4 (A) Briefly explain the boundary condition of magnetic field. 6

(B) Let $V_m = 2x^2 + 4x - 2y^2$ A in a certain region of free space. Find the vector force exerted on a wire segment in this region if it extends from the origin to ; (a) P_A(1, 0, 0) and carries 5A in the $\overline{a_x}$ direction ; (b) P_B (0, 0, 1) and carries 5A in the $\overline{a_z}$ direction ; (c) P_C (0.6, 0.8, 0) and carries 5A away from the origin. 6

Que.-5 (A) Derive the point form of Ampere's Circuital law. 5

(B) By expanding equation $\bar{\nabla} \times \bar{\nabla} \times \bar{A} = \bar{\nabla}(\bar{\nabla} * \bar{A}) - \bar{\nabla}^2 \bar{A}$ in Cartesian Coordinates, show that 6

$$\bar{\nabla}^2 \bar{A} = \bar{\nabla}^2 A_x \overline{a_x} + \bar{\nabla}^2 A_y \overline{a_y} + \bar{\nabla}^2 A_z \overline{a_z}$$ is correct.

OR

Que.-5 (A) State and explain the Biot-savarat law, Ampere's circuital law. 5

(B) Evaluate both sides of stoke's theorem for the field 6

$$H = \left(\frac{y^2 z}{x}\right) \overline{a_x} + \left(\frac{0.5 y^2 z^2}{x^2}\right) \overline{a_z}$$

And find current in the $\overline{a_y}$ direction crossing the square in the plane y=2 bounded by x=z=1 and x=z=2.

Que.-6 (A) Given points A(1,2,4), B(-2,-1,3), and C(3,1,-2), let a differential current element with I = 6A and magnitude of $\mathbf{dL} = 10^{-4}$ m be located at A. The direction of **dL** is from A to B. Find **dH** at C. 4

(B) There are two differential current filaments. The filaments 1 is $I_1 \overline{dL_1} = -3\overline{a_y}$ (A.m) at P_1(5, 2, 1) and filament 2 is $I_2 \overline{dL_2} = -4\overline{a_z}$ (A.m) at P_2(1, 8, 5). Determine the differential force on filament 2. 4

(C) A current density $6\,\overline{a_x}$ A/m lies in the Z= 0 plane and a current filament is Located at Y= 0, Z = 4m. Determine the current I and its direction if $\bar{H} = 0$ at point (0, 0, 1.5m). 4

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