Student Exam No: _____

GANPAT UNIVERSITY

B. TECH. SEMESTER V (ELECTRONICS & COMMUNICATION ENGINEERING)
REGULAR EXAMINATION, NOV-DEC 2013
2EC502 ELECTROMAGNETIC THEORY & WAVE PROPAGATION

[Max. Time: 3 Hrs.] [Max. 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) Explain the line charge density. Drive the expression of electric field intensity for the line charge configuration. 4

(B) Given points A(2,5,-1), B(3,-2,4) and C(-2,3,1) and: 4

(a) $\overline{R_{AB}} \cdot \overline{R_{AC}}$

(b) The angle between $\overline{R_{AB}}$ and $\overline{R_{AC}}$

(c) The length of projection of $\overline{R_{AB}}$ on $\overline{R_{AC}}$

(d) The vector projection of $\overline{R_{AB}}$ on $\overline{R_{AC}}$

(C) An infinitely long uniform line charge is located at y=3, Z=5. If ρ_l= 30nC/m. Find $\bar{E}$ at 4

(a) The origin (b) $P_A(0,6,1)$

OR

Que.-1 (A) Explain the surface charge density. Derive the expression of electric field intensity due to the surface charge configuration. 4

(B) In free space, let $Q_1 = 10nc$ be at $P_1(0,-4,0)$ and $Q_2 = 20nc$ be at $P_2(0,0,4)$ 4

(a) Find $\bar{E}$ at the origin

(b) Where should a 30 nC Point charge be located so that $\bar{E} = 0$ at the origin?

(C) A uniform line charge density of 5nC/m is at y=0, z=2m in free space, while -5nC/m is located at y=0, z=−2m. A uniform surface charge density of 0.3 nC/m^2 is at y=−0.2m. Find $|\bar{E}|$ at the origin. 4

Que.-2 (A) Explain in brief 6

1. Gauss's law
2. Concept of electric flux
3. Electric field intensity

(B) A point charge of 20 nc is located at (4,-1,-3) and a uniform line charge of -25nc/m is lies along the intersection of plane X=−4 and Z=6. Calculate the $\bar{D}$ at (3,1,0). 3

(C) Explain the vector projection and scalar projection in terms of dot product between two vectors 2

OR

Que.-2 (A) Derive the equation of the energy density which is stored in the electrostatic field. 4

(B) Let $\bar{E} = (-6y/x^2)\overline{a_x} + (6/x)\overline{a_y} + 5\overline{a_z}$ V/m and calculate: 3

(a) V_{PQ} given P(-7,2,1) and Q(4,1,2)

(b) V_P if V=0 at Q

(C) The region y<0 contains a dielectric material for which $\varepsilon R1 = 2.5$, while the region y>0 is characterized by $\varepsilon R2$=4. Let $\overline{E_1} = -30\overline{a_x} + 50\overline{a_y} + 70\overline{a_z}$ V/m and find; 4

(a) D_{N2}; (b) D_{t2}; (c) $\overline{D_2}$; (d) θ_2

Que.-3 (A) Derive the expression of potential difference V_{AB} in the field of 4

(1) line charge

(2) Point charge.

(B) Given two vectors $\overline{r_A} = -\overline{a_x} - 3\overline{a_y} - 4\overline{a_z}$ and $\overline{r_B} = 2\overline{a_x} + 2\overline{a_y} + 2\overline{a_z}$ and point C(1,3,4) find: (a) $\overline{R_{AB}}$; (b)$|\overline{r_A}|$; (c) $\overline{a_A}$; (d) a unit vector directed from C toward A. 4

(C) Convert $\bar{A} = 3\overline{a_x} + 4\overline{a_y} + 5\overline{a_z}$ at the point (x=3, y=4, z=5) in spherical co-ordinates. 4

SECTION-II

Que.-4 (A) Derive all the Maxwell's equations for a static field. 6

(B) What is the use of Maxwell's equations ? 2

(C) Derive the wave equation in magnetic as well as electric field for a lossy media. 4

OR

Que.-4 (A) Derive the point form of Ampere's circuital law. 6

(B) Verify Stokes' theorem for the field $\bar{H} = 6xy\,\overline{a_x} - 3y^2\overline{a_y}$ and the rectangular path around the region, $2 \le x \le 5$, $-1 \le y \le 1$, z=0.Let the positive direction of ds be $\overline{a_z}$. 6

Que.-5 (A) Explain in detail, how the tangential and normal component of a vector field changes when the vector travels from one medium to another. 6

(B) Derive an expression for the force experienced by a differential element placed in a magnetic field. 5

OR

Que.-5 (A) What is Electromagnetic Theory? Explain the Biot Savart's law. 6

(B) Explain the salient features of E layer of Ionosphere. 2

(C) Explain the Vector magnetic potential in detail. 3

Que.-6 (A) A 9500 MHz uniform plane wave is propagating in polystyrene. If amplitude of electric field intensity is 20 V/m and the material is assumed to be lossless, Find 6

(i) Phase constant (ii) Wavelength in polystyrene

(iii) Velocity of propagation (iv) Intrinsic impedance

(v) Propagation constant (vi) Amplitude of vector H

(for polystyrene, ϵr = 2.56 and μr = 1)

(B) Explain the application of Electromagnetic theory. 2

(C) Derive the expression for Gauss law in a magnetic field in differential as well as in point form. 4

End of Paper