Student Exam No: _____

GANPAT UNIVERSITY

B. TECH. SEMESTER V (ELECTRONICS & COMMUNICATION ENGINEERING)
REGULAR EXAMINATION, NOV-DEC 2012
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) Drive the expression of electric field intensity for the surface charge configuration. 4

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

(C) Three point charges $Q_1 = 10^{-6}$ C, $Q_2 = 10^{-6}$ C and $Q_3 = 0.5\times 10^{-6}$ C are located at the corners of an equilateral triangle of 50cm side. Determine the magnitude and direction of force on Q_3. 4

OR

Que.-1 (A) Explain the Coulomb's law and also explain the 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) 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 the concept of electric flux and electric flux density. 4

(B) Explain the concept of work done and the potential difference. 3

(C) Find the flux density at a point A(6,4,-5) caused by 4

(i) A point charge of **20mc** at the origin

(ii) A uniform line charge ρ_l= **20** $\mu c/m$ on the Z-axis

(iii) A uniform charge density ρ_s = **60** $\mu c/m^2$ at a plane X=8

OR

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

(B) Derive the boundary condition at a conductor free space boundary. 3

(C) Given the flux density $\bar{D} = (2cos\theta/r^3)\overline{a_r} + (sin\theta/r^3)\overline{a_\theta}$ C/m^2, evaluate both sides of the divergence theorem for the region defined by $1<r<2$, $0<\theta<\pi/2$, $0<\emptyset<\pi/2$. 4

Que.-3 (A) Explain the Dot product and Cross product for vectors. 4

(B) A point charge of 6nc is located at the origin in free space. Find V_P if point P is located at P(0.2,-0.4,0.4) and; (a) V=0 at infinity (b) V=0 at (1,0,0) (c) V=20v At (-0.5, 1,-1) 4

(C) For the point P $(3,60^\circ,2)$ in cylindrical co –Ordinates and the potential field $V=10(\rho+1)z^2cos\emptyset$ V in free space. Find at P; (a) V ; (b) $\bar{E}$; (c) $\bar{D}$; (d) $\frac{dV}{dN}$ 4

SECTION-II

Que.-4 (A) Describe and Derive the expression for displacement current and also state the Biot Savart's law.. 6

(B) If $\bar{B} = 0.05x\ \overline{a_y}$ Tesla in a material for which $\chi_m = 2.5$. Calculate μ_r $\bar{H}, \bar{M}$. 3

(C) Derive the Lorent'z Force equation. 3

OR

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

(B) If a scalar potential is given by $\emptyset = xyz$, Prove that, $\bar{F}$ = grad $\emptyset$ is irrotational. 3

(C) Define a Uniform Plane wave. Also explain 'Skin Effect'. 3

Que.-5 (A) Derive all the Maxwell's equations for a time varying field. 6

(B) The region x<0 contains dielectric medium for which $\varepsilon_{r1}=4$ while region x>0 is characterized by $\varepsilon_{r2}=2$. If $\bar{E}_1 = 50\overline{a}_x - 30\overline{a}_y + 60\overline{a_z}$ (KV/m). Find $\bar{E}_{N1}$, θ_1 , E_{t1} , $\bar{E}_2$, θ_2. 5

OR

Que.-5 (A) A charge of 10nC is moving with a velocity of $10^7(-0.5\overline{a}_x + \overline{a}_y - 0.71\overline{a_z})$ m/s.Determine the force exerted on the test charge when, 6

i. A magnetic induction, $\bar{B} = (\overline{a}_x + 2\overline{a}_y + 3\overline{a_z})$ mWb/m^2 is applied.

ii. $\bar{E} = (3\overline{a}_x + 2\overline{a}_y + \overline{a_z})$ KV/m is applied.

iii. Both $\bar{B}$ and $\bar{E}$,mentioned above are applied simultaneously.

(B) Explain Faraday's law. Also explain the types of emf resulted from Faraday's experiment. 5

Que.-6 (A) Derive the solution of Wave equation for Uniform plane wave. 4

(B) What is Ionospheric wave propagation? List down the salient features of D-layer in Ionosphere. 4

(C) Explain in brief 4

i. Stokes' theorem

ii. Ampere's Circuital law

End of Paper