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## EC-502(N)

B. E. (Fifth Semester) EXAMINATION, June, 2011

(Electronics & Communication Engg. Branch)

ELECTROMAGNETIC THEORY

[EC-502(N)]

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

**Note :** Attempt all questions. Assume suitable data if any missing. All questions carry equal marks.

1. (a) State and prove Gauss law for static electric field. 5  
(b) Give the physical significance of gradient, divergence and curl. 9  
(c) Point charges 5 nC and - 2 nC are located at (2, 0, 4) and (-3, 0, 5) respectively. Find the electric field E at (1, -3, 7). 6

Or

- (a) State and derive Stokes theorem. 5  
(b) State and prove the Divergence theorem. Discuss its uses. 6  
(c) Charges + Q and + 3 Q are separated by a distance 2 m. A third charge is located such that the electrostatic system is in equilibrium. Find the location and the value of the third charge in terms of Q. 9

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2. (a) Starting from Gauss's law derive Poisson's and Laplace's equations. 12
- (b) Derive an expression for the energy stored in an electric field. 8

Or

- (a) What is the electric field intensity at a distance of 20 cm from a charge of 0.2 microcoulombs in a vacuum ? 6
- (b) If a potential :

$$V = x^2 yz + A y^3 z$$

- (i) find 'A' so that Laplace's equation is satisfied
- (ii) with the value of 'A', determine electric field at (2, 1, -1).
3. (a) Calculate the magnetic flux density produced by a current loop of radius 'R' on the axis when the loop is carrying a current 'I' and situated in air. 10
- (b) Calculate the magnetic flux density produced by an infinite thin long wire carrying current 'I' at a distance 'R'. 7
- (c) Write Lorentz's force equation. 3

Or

- (a) Derive the expression for the energy stored in a magnetic field. 5
- (b) State Biot-Savart law. 3
- (c) What is the relation between vector magnetic potential A and the magnetic flux through a given area. 4
- (d) State law of conservation of magnetic flux. 3
- (e) Compare the usefulness of Ampere's circuital law and Biot-Savart law in determining B of a current carrying circuit. 5

4. (a) Define the words 'vector magnetic potential'. 3  
 (b) Given that : 12  

$$E = a_y 0.1 \sin(10\pi x) \cos(6\pi 10^9 t - \beta z) \text{ V/m}$$
  
 In air, find H and  $\beta$ .  
 (c) Write Maxwell's equation in point form. 5

Or

- (a) Given  $E = a_y E_1 \sin(\omega t - \beta z)$  in free space find D, B and H. 13  
 (b) Obtain the expression for inductance of a toroid. 7  
 5. (a) Prove the transverse nature of uniform plane wave. 5  
 (b) Explain the following terms : 9  
 (i) Total internal reflection  
 (ii) Brewster's angle  
 (iii) Oblique incidence  
 (c) Derive wave equation in term of magnetic field. 6

Or

- (a) Explain instantaneous, average and complex pointing vector. 9  
 (b) An EM wave propagating in a certain medium is described by : 11

$$E = 25 \sin(2\pi 10^6 t - 6x) a_z \frac{\text{V}}{\text{m}}$$

- (i) Determine the direction of wave propagation.  
 (ii) Compute the period T, the wavelength and velocity.  
 (iii) Sketch the wave at  $t = 0, T/8, T/4$  and  $T/2$ .