B. Tech.

(SEM. IV) EXAMINATION, 2006-07
ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours]   *[Total Marks : 100*

Note :   *(1)   Attempt all the questions.*

   (2)   All questions carry equal marks.

   (3)   Assume missing data suitably, if any.

   (4)   Smith chart provided to the students.

1   Attempt any four of the following :   5×4=20

   a)   Differentiate between a scalar quantity and a scalar field and vector quantity and a vector field?

   b)   What is the physical definition of the curl of a vector field?

   c)   Discuss the Cartesian coordinate system.

   d)   Given

$$\overline{A} = 2x - 3y + z$$

$$\overline{B} = 2x - \overline{y} + 3z$$

$$\overline{C} = 4x - 2y - 2z$$

   Find that $\overline{C}$ is perpendicular to both $\overline{A}$ and $\overline{B}$.

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e) Given

$$\bar{A} = \hat{x}(2x + 3y) - \hat{y}(2y + 3z) + \hat{z}(3x - y),$$

determine the unit vector parallal to $\bar{A}$ at point $P(1, -1, 2)$.

f) Find out the gradient of a scalar $\phi = x^2 + y^2 + 2xz$.

2 Attempt any **four** of the following :   5×4=20

a) What is the boundary condition for electrostatic potential at an interface between two different dielectric media?

b) State and prove Laplaces' equation for a simple medium in vector notation.

c) Find a mathematical expression for electrostatic energy in terms of field quantities?

d) Four capacitor $C_1 = 1\,\mu f$, $C_2 = 2\,\mu f$, $C_3 = 3\,\mu f$ and $C_4 = 4\,\mu f$ are connected as in fig. below. A D.C voltage of 100 V is applied to the external terminal $a - b$. Determine :
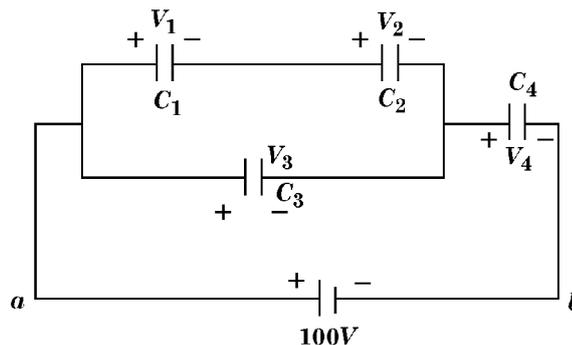
(i) Total equivalent capacitance between $a - b$.

ii) Charge on each capacitor

iii) The potential difference across each capacitor.

e) State and explain Coulomb's law

f) Is gauss's law useful in finding the electric field vector of a finite line charge? Explain.

3 Attempt any **two** of the following :   **10×2=20**

a) i) State and explain the Lorentz's force equation.

ii) State and explain the Ampere's circuital law.

b) The potential field at any point in a space containing dielectric material of relative permittivity 2.1 is given by

$$V = 5x^2y + 3yz^2 + 6xz$$ volt where x, y, z

are in meters. Find the volume charge density

at point   m.

c) Derive an expression of magnetic energy in terms of field quantity.

4 Attempt any **two** of the following :

a) Write the differential form of Maxwell's equations. Are all four Maxwell's equations independent? Explain.

b) State and explain the Poynting theorem.

c) Derive the formula $P = \dfrac{1 + \Gamma}{1 - \Gamma}$ where $P =$ standing wave ratio ; $\Gamma =$ reflection coefficient.

5 Attempt any **two** of the following :   **10×2=20**

a) Explain the double stub method for impedance. matching on a transmission line. What are the advantages of double stub over the single stub ?

b) A 100 ohm line with air dielectric is terminated by a load impedance of $75 + j40$ ohm and is excited at 1GHz by a matched generator. Find the position of a single matching stub of 100 ohm impedance on the line, and determine the length of the stub.

c) What is a Smith chart and why is it useful in making transmission line calculation?

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