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EC – 401

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3036

Roll No. **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

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

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

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

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

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e) Given

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

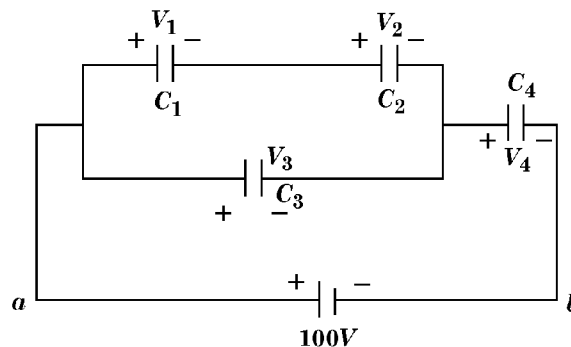
determine the unit vector parallel to \vec{A} at point $P(1, -1, 2)$.

f) Find out the gradient of a scalar

$$\phi = x^2 + y^2 + 2xz.$$

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

- What is the boundary condition for electrostatic potential at an interface between two different dielectric media?
- State and prove Laplace's equation for a simple medium in vector notation.
- Find a mathematical expression for electrostatic energy in terms of field quantities?
- Four capacitors $C_1 = 1 \mu f$, $C_2 = 2 \mu f$, $C_3 = 3 \mu f$ 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 :



- Total equivalent capacitance between $a - b$.

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[Contd...

- 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.

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[Contd...

- c) Derive the formula $P = \frac{1 + \Gamma}{1 - \Gamma}$ 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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