



SF-6509

B. E. - II (Sem. - IV) (Electrical) Examination
May/June - 2011
Engineering Electromagnetics

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दर्शाविए निशानीवाणी विगतो उत्तरवही पर अवश्य कर्तवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - 2 (SEM. - 4) (ELECTRICAL)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="ENGINEERING ELECTROMAGNETICS"/>	<input type="text"/>
Subject Code No. : <input type="text" value="6"/> <input type="text" value="5"/> <input type="text" value="0"/> <input type="text" value="9"/>	Section No. (1, 2,.....) : <input type="text" value="1&2"/>
Student's Signature	

- (2) Attempt all questions.
- (3) Figure to the **right** indicate full marks.
- (4) Assume necessary data wherever required.
- (5) Scientific calculator up to Casio-100D, 100MS series is permitted.

Q-1 (a)

SECTION - I

(06)

- 1) Define Electric flux density
- 2) _____ Force is exerted when two point charges are alike.
- 3) Electric flux density D is _____ to the Electric equipotential lines.
(a) Normal (b) Tangential (c) Opposite (d) not related to
- 4) Point form of ohm's law is _____
- 5) ϵ_0 is called _____
- 6) What do you mean by term Divergence?

(b) 1) Find vector A directed from P (2, -4, 1) to Q (0, -2, 0) in Cartesian coordinate. Also find its unit vector. (08)

2) If $\mathbf{a} = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$, $\mathbf{b} = -\mathbf{i} + 2\mathbf{j} + \mathbf{k}$ and $\mathbf{c} = 3\mathbf{i} + \mathbf{j}$ find t such that $(\mathbf{a} + t\mathbf{b})$ is perpendicular to \mathbf{c} .

3) explain dot product and cross product for two vectors

4) Derive electric field intensity using coulombs law of charge

(c) Given the three points A (2, -1, 2), B (-1, 1, 4) and C (4, 3, -1). Find the angle between R_{AB} and R_{AC} . Also find area of triangle ABC. (06)

- Q-2 (a) Explain the concept of Electric flux density and its relation with Electric field Intensity. (05)
- (b) In free space let $Q_1 = 10 \text{ nc}$ be at $P_1 (0, -4, 0)$ and $Q_2 = 20 \text{ nc}$ at $P_2(0,0,4)$. Find E at the Origin. (05)
- (c) State and explain Divergence theorem (05)

OR

- Q-2 (a) Explain the concept of Point charge, line charge and surface charge with necessary equations. (07)
- (b) A sheet of charge $\rho_s = 5 \text{ nC/m}^2$ is present at the plane $x=3$ in free space and a line charge of having density $\rho_l = 30 \text{ nC/m}$ is located at $x=1$ and $z=1$. Find the E at (1) origin (2) at $P(2,5,1)$ (15)

Q-3 Attempt any Three

- Two line charges, each of 8 nc/m are located at $x = 1, z = 2$ and $x = -1, y = 2$ respectively, in free space. if potential at origin is 100 v , then find potential at $P(4, 2, 3)$.
- Derive the boundary conditions at a conductor free space boundary.
- Explain the concept of potential gradient and derive the relationship between E and V.
- Derive the integral and point form of continuity equation.
- Derive the equation of energy stored in electrostatic fields.

SECTION – II

- Q-4 (a) Fill in the following blanks. (07)
- In cylindrical coordinates, the equation $\frac{\partial^2 \psi}{\partial \rho^2} + \frac{1}{\rho} \frac{\partial \psi}{\partial \rho} + \frac{\partial^2 \psi}{\partial z^2} + 10 = 0$ is called _____ equation. 01
 - State Biot-Savart's law. 01
 - For the currents & closed paths of following figures. Calculate the value of $\oint H \cdot dl$ 01
 - The motional electric field intensity, $E_m =$ _____. 01
 - Unit of magnetic field intensity is _____. 01
 - The cross product of E and H is known as _____. 01
 - The square root of ratio of permeability to permittivity is called _____. 01

(b) Match the following as per Maxwell's law: (03)

Significance of Law	Differential form
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- | | |
|---------------------------|--|
| 1. Faraday's Law | a. $\nabla \cdot D = \rho_v$ |
| 2. Ampere's circuital Law | b. $\nabla \times H = J + \frac{\partial D}{\partial t}$ |
| 3. Gauss's Law | c. $\nabla \times E = -\frac{\partial B}{\partial t}$ |

(c) Solve Laplace's Equation to find the potential in capacitance assuming that the potential field varies (07)

- (i) With y only
(ii) With r only.

(d) Derive all the Maxwell's Equations in point form. (03)

Q-5 (a) Using Vector magnetic potential concept derive expression of magnetic field intensity H due to an infinite current element on z-axis carrying a current of I Amp in $+a_z$ direction. (06)

(b) A charge $Q = 5 \times 10^{-18} C$ is moving through a uniform magnetic field $B = -0.4a_x + 0.2a_y - 0.1a_z T$, with a velocity (09)

$$v = (2a_x - 3a_y + 6a_z)10^5 \text{ m/sec at } t = 0.$$

(a) What electric field is present at $t = 0$ if the net force on the electron is zero?

(b) If the electric field intensity is entirely in the a_x direction and $|F_{net}| = 2 pN$ at $t = 0$, at E_x .

OR

Q-5 (a) A current sheet, $K = 40a_z A/m$, is located in free space at $x = 0.25m$, and a second sheet, $K = -40a_z A/m$, is at $x = -0.25m$. (08)

(a) Let $V_m = 0$ at P(0.1,0.2,0.3) and find $V_m(x, y, z)$ for $-0.25 < x, y, z < 0.25$.

(b) Let $A = 0$ at P and determine $A(x, y, z)$ for $-0.25 < x, y, z < 0.25$.

(b) A differential current loop lies in the x-y plane in a magnetic field \bar{B} . Find the total torque on the loop in terms of its differential area & also write it in terms of magnetic dipole moment. (07)

Q-6 (a) Derive expression for Poynting Vector. (05)

(b) 1) A Vector field is given as $F = 2y a_x + (5 - 2x) a_y + (z^2 - 2) a_z$, Find the divergence of F. (04)

2) A Scalar field $f(x, y, z) = 2x + 6y z^2$, calculate the gradient of the scalar field in cylindrical coordinate system.

(c) Discuss main properties of diamagnetic, paramagnetic & ferromagnetic materials. (06)

OR

- Q-6 (a) State Faraday's Law of Electromagnetic Induction and hence show that $\text{curl } E = -\frac{\partial B}{\partial t}$. (08)
- (b) A filamentary current of 10 A is directed in from infinity to the origin on the positive x axis, and then back out to infinity along the positive y axis. Use the Biot-Savart's law to find H at P(0,0,1). (04)
- (c) A negative point charge, $Q = -40 \text{ nc}$, is moving with a velocity of $6 \times 10^6 \text{ m/s}$ in a direction specified by the unit vector $a_v = 0.48a_x - 0.6a_y + 0.64a_z$. Find the magnitude of the vector force exerted on the moving particle by the field. (03)
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