

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2021****Subject Code:3141009****Date:08/09/2021****Subject Name:Electromagnetic Theory****Time:02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

Q.1 (a)  $\vec{P} = 2\hat{a}_x - \hat{a}_z, \vec{Q} = 2\hat{a}_x - \hat{a}_y + 2\hat{a}_z, \vec{R} = 2\hat{a}_x - 3\hat{a}_y + \hat{a}_z$  3

Determine

1.  $\vec{P} \cdot \vec{Q} \times \vec{R}$
2.  $\vec{P} \times (\vec{Q} \times \vec{R})$

(b) Prove that the divergence of curl of any vector field is zero. 4

(c) Given the point P(-2,6,3) and  $\vec{A} = y\hat{a}_x + (x+z)\hat{a}_y$ . Express P and vector A in cylindrical co-ordinate system. 7

Q.2 (a) State and explain Gauss's Law. 3

(b) State and explain Divergence Theorem. 4

(c) Derive the expression for the electric flux density due to infinite sheet of charge lying on the z=0 plane. 7

**OR**

(c) Derive the expression for the electric flux density due to infinite line charge placed on the z axis. 7

Q.3 (a) Two dipoles with dipole moment  $-5az$  nC.m and  $9az$  nC.m are located at the points (0,0,-2) and (0,0,3) respectively. Find the potential at the origin. 3

(b) Derive the expression  $\vec{E} = -\nabla V$  4

(c) The point charges -1nC, 4nC and 3nC are located at (0,0,0), (0,0,1) and (1,0,0) respectively. Find the energy in the system. 7

**OR**

Q.3 (a) Write Maxwell's equation in differential form and integral form for static electric and magnetic fields. 3

(b) State and prove Stokes's Theorem. 4

(c) 7

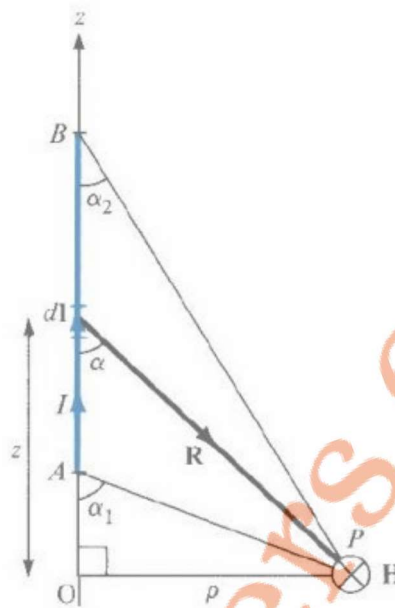


Figure 1

Derive the expression for the magnetic field at the point P due to a straight current carrying filamentary conductor of finite length AB, shown in figure 1.

Q.4 (a) State and explain Faraday's Law. 3

(b) Derive the expression for Lorentz force equation. 4

(c) 7

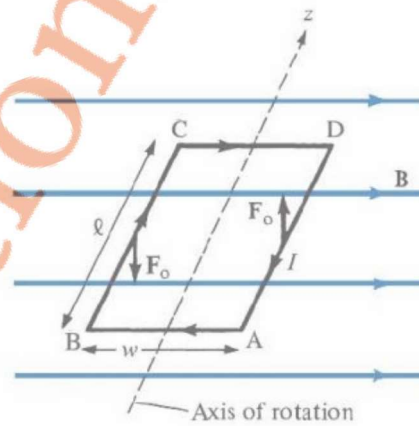


Figure 2

Obtain the expression of magnetic dipole moment for a rectangular planar loop placed in uniform magnetic field as shown in figure 2.

OR

Q.4 (a) Explain the concept of conduction current and convection current. 3

(b) Briefly describe magnetic boundary condition between two different media. 4

- (c) Explain the boundary condition between two dielectric material having permittivity  $\epsilon_1$  and  $\epsilon_2$ . 7
- Q.5 (a) Explain the concept of retarded potential. 3
- (b) Explain the concept of skin effect. 4
- (c) Write short note on wave propagation in good conductor. 7

OR

- Q.5 (a) Define following terms: 3
1. Standing wave ratio
  2. Reflection coefficient
  3. Characteristic impedance
- (b) Obtain the expression of impedance for a lossless transmission line terminated in short circuit. 4
- (c) Draw the equivalent circuit of the transmission line and derive its voltage and current equations. 7

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