

**B028413(028)**

**B. Tech. (Fourth Semester) Examination,  
April-May 2022**

**AICTE** (New Scheme)

**(Elex. & Tele. Engg. Branch)**

**ELECTROMAGNETIC FIELD THEORY**

*Time Allowed : Three hours*

*Maximum Marks : 100*

*Minimum Pass Marks : 35*

*Note : Attempt all questions. Part (a) from each question is compulsory and carrying 4 marks. Attempt any two parts from part (b), (c) and (d) of each question & carries 8 marks.*

**Unit-I**

1. (a) What do you mean by Divergence, Gradient and Curl?

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(b) Express the vector  $\vec{B} = \frac{10}{r} = \frac{10}{a_r} + r \cos \theta \frac{1}{a_\theta} + \frac{10}{a_\phi}$

in Cartesian coordinate.

(c) Given points  $E(2, 5, 1)$ ,  $F(-1, 4, -2)$  and  $G(3, -2, 4)$ , find :

- A unit vector directed from  $E$  towards  $F$
- The angle between  $R_{EF}$  and  $R_{EG}$
- The length of perimeter of triangle  $EFG$
- The vector projection of  $R_{EF}$  and  $R_{EG}$

(d) State and derive divergence theorem.

### Unit-II

2. (a) What do you mean by Potential Gradient?

(b) A sheet of charge  $\rho_s = 2nC/m^2$  in the plane  $x = 2$  in free space & a line charge  $\rho_L = 20nC/m$  located at  $x = 1, z = 4$ .

- Find vector  $E$  at  $(4, 5, 6)$
- What is the force per unit length on the line charge.

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(c) If  $V = 60 \frac{\sin \theta}{r^2}$   $V$  in free space and point  $P$  is located

at  $(3, 60^\circ, 25^\circ)$ . Find :

- $V_P$
- $E_P$
- $\frac{dV}{dN}$  at  $P$
- $\vec{a}_N$  at  $P$
- $P_v$  at  $P$

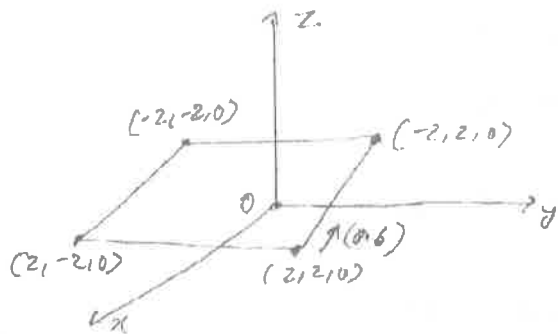
(d) Let vector  $D_1 = 2a_x + 5a_y - 3a_z nC/m^2$  and find :

- Vector  $D_2$
- Vector  $D_{N2}$
- Vector  $D_{t2}$
- The energy density in each region
- The angle that vector  $D_2$  makes with  $a_z$
- $D_2/D_1$
- $P_2/P_1$

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Unit-III

3. (a) Calculate vector Torque on square loop as shown in fig. about on origin at A in the field  $\vec{B}$  given.



$A(0,0,0)$  and  $B = 100\vec{a}_x + 200\vec{a}_y$

(b) Given

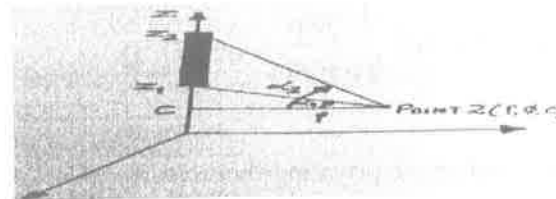
$$\vec{J} = 0 \text{ for } |z| = 0.2 \text{ m}$$

$$\vec{J} = 20 \sin 5\pi z \vec{a}_y \frac{A}{m^2} \text{ for } -0.2 < z < 0.2 \text{ m}$$

Find  $H$  everywhere.

- (c) Show that the magnetic field due to the finite current element shown in fig. is given by :

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$$\vec{H} = \frac{1}{4\pi\rho} (\sin \alpha_2 - \sin \alpha_1) \vec{a}_\phi$$

- (d) If  $B = 0.05 x a_y$  T in a material for which  $\chi_m = 2.5$ ,

find :

- (i)  $\mu_R$
- (ii)  $\mu$
- (iii)  $H$
- (iv)  $M$
- (v)  $J$
- (vi)  $J_b$

Unit-IV

4. (a) State Faraday's law and write its point form.

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- (b) Prove that  $\eta = \sqrt{\frac{j\omega\mu}{\rho + j\omega\epsilon}}$  or  $377 \Omega$ .
- (c) State and prove poynting theorem.
- (d) Assume a homogeneous material as infinite extant with  $\epsilon = 2 \times 10^{-10} \text{ F/m}$ ,  $\mu = 1.25 \times 10^5 \text{ H/m}$  and  $\sigma = 0$ , let  $\vec{E} = 400 \cos(10^9 t - kz) \vec{a}_x \text{ V/m}$ . If all the field very sinusoidaly or consinusoidaly, use Maxwell's equation to find  $\vec{D}, \vec{B}, \vec{H}$  and  $k$ .

### Unit-V

5. (a) What do you mean by stub matching?
- (b) An open write transmission line has  $R = 5 \text{ ohm/m}$ ,  $L = 5.2 \times 10^{-12} \text{ H/m}$ ,  $G = 6.2 \times 10^{-3} \text{ S/m}$  and  $C = 2.13 \times 10^{-10} \text{ F/m}$ . The signal frequency is 4 Ghz. Calculate.
- (i)  $Z_0$
- (ii) Propagation constant
- (iii) Normalized impedance of load  $(100 + 100j)$

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- (iv) Reflection Coefficient
- (c) Derive expression for I/P impedance for transmission line.
- (d) The primary constants for a certain transmission line operating at 7.5 kHz are  $R = 2.6 \Omega/\text{Km}$ ,  $G = 0.11 \mu\text{S}/\text{Km}$ ,  $L = 2.4 \text{ mH}/\text{Km}$ ,  $C = 0.0078 \mu\text{F}/\text{km}$  at the sending end of 50 km length of such transmission line an ideal generator having a voltage 10 V RMS is connected & the o/p end is terminated in a matched load. Calculate the power consumed in the load.