



# COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electrical & Computer Control Engineering

Lecturer : Dr. M. Abdel-Rahim

Course : Electric & Magnetic Fields (1)

Course Code : EE 331

Marks : 40

Date : 20 / 1 / 2016

Time : 2 hour

## Final Exam

### Answer the following questions :-

1-(a) A charge  $Q_1 = 0.1 \mu\text{C}$  is located at the origin in free space, while  $Q_2 = 0.2 \mu\text{C}$  is at  $A(0.8, -0.6, 0)$ . Find the locus of points in the  $z = 0$  plane at which the x- component of the force on a third positive charge is zero.

(b) Surface charge density is positioned in free space as follows:  $20 \text{ nC/m}^2$  at  $x = -3$ ,  $-30 \text{ nC/m}^2$  at  $y = 4$ , and  $40 \text{ nC/m}^2$  at  $z = 2$ . Find the magnitude of  $\mathbf{E}$  at:

(i)  $P_A (4, 3, -2)$ ; (ii)  $P_B (-2, 5, -1)$ ; (iii)  $P_C (1, 1, 1)$ ;

(10marks) (A5)

2- (a) A uniform volume charge density of  $80 \mu\text{C/m}^3$  is present throughout the region  $6 \text{ mm} < r < 8 \text{ mm}$ . Let  $\rho_v = 0$  for  $0 < r < 6 \text{ mm}$ .

(i) Find the total charge inside the spherical surface  $r = 8 \text{ mm}$ .

(ii) Find  $D_r$  at  $r = 8 \text{ mm}$ .

(iii) If there is no charge for  $r > 8 \text{ mm}$ , find  $D_r$  at  $r = 15 \text{ mm}$ .

(b) ) Let  $\mathbf{D} = (8x^2yz^2 + 3xz^3) \mathbf{a}_x + 6x^2yz^2 \mathbf{a}_y + 12x^2yz^2 \mathbf{a}_z \text{ nC/m}^2$ .

Find the total charge enclosed in a cube having a volume  $10^{-6} \text{ m}^3$  located at  $(1, 2, 5)$ .

(10marks) (A5)

3- (a) Given a surface charge density of  $5 \text{ nC/m}^2$  on the plane  $x = 4$ , a line charge density of  $40 \text{ nC/m}$  on the line  $x = 2, y = 3$ , and a  $3 \mu\text{C}$  point charge at  $P(-3, -1, -4)$ , find  $V_{AB}$  for points  $A(2, 5, 0)$  and  $B(3, 4, 1)$ .

(b) ) Let  $V = 4(x+3)^2(y+1)^3(z+4)^3 \text{ V}$  in free space. At  $P(3, -2, 5)$  find :

(i)  $V$ ; (ii)  $\mathbf{E}$ ; (iii)  $\mathbf{D}$ ; (iv)  $\rho_v$ .

(10marks) (C1)

Members of course Examination Committee:	Signature:	Date:
Lecturer: : Dr. M. Abdel-Rahim	M. Abdel-Rahim	5/1/2016
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4- (a) Point charges of  $5 \mu\text{C}$  and  $-5 \mu\text{C}$  are located at  $(0,0, 1)$  and  $(0,0, -1)$ , respectively. Treating these two charges as a dipole at the origin, calculate:

(i)  $V$  at P  $(2,0,5)$ ;      (ii)  $|\mathbf{E}|$  at P.

Now find the exact values for (iii)  $V$  at P; (iv)  $|\mathbf{E}|$  at P.

(b) Let  $\epsilon_{R1} = 2.5$  for  $0 < y < 1$  mm,  $\epsilon_{R2} = 4$  for  $1 < y < 3$  mm, and  $\epsilon_{R3}$  for  $3 < y < 5$  mm. conducting surfaces are present at  $y = 0$  and  $y = 5$  mm.

Calculate the capacitance per square meter of surface area if:

(i)  $\epsilon_{R3}$  is air;

(ii)  $\epsilon_{R3} = \epsilon_{R1}$ ;

(iii)  $\epsilon_{R3} = \epsilon_{R2}$

(10marks) (CI)

GOOD LUCK

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