Kafrelsheikh University
Faculty of Engineering
Department : Electrical Engineering
Year: 2^{nd} Year Electrical
Subject: Electromagnetic Fields

Final Exam- January 2016
Time allowed: Three hours
Full Marks : 90
Pages: Two pages
Date: 16 /1/2016

This exam constitutes <u>five</u> problems in <u>two</u> page
Please, attempt to solve all problems, assume any missing data.

P-1	
A (8 marks)	**Prove that:** 1. $E = -\nabla V = -grad(V)$ 2. $\rho_v = \nabla.D = Div(D)$ 3. $\nabla.J = -\frac{\partial \rho_v}{\partial t}$
B (5 marks)	For a given non-uniform field $E = ya_x + xa_y + 2a_z$, **Determine** the work expended in carrying 2C charge from B (1, 0, 1) to A (0.8, 0.6, 2).
C (5 marks)	If $D = 2ra_r$ C/m^2, **Find** the total electric flux leaving the surface of the cube $0 \le x, y, z \le 0.4$
P-2	
A (6 marks)	Planes x=2 and y=-3, respectively, carry charges 10 nC/m^2 and 15 nC/m^2. If the line x=0, z=2 carries charge 10π nC/m, and a point charge 2 nC at P(0,0,0), **Calculate *E*** at (1,1,-1).
B (4 marks)	**Transform** the vector field **G** =$(xz/y)\mathbf{a}_x$ into spherical components and variables.
C (8 marks)	The two conducting planes illustrated in Fig. 1 are defined by $0.001 \le \rho \le 0.12\,m, 0 \le z \le 0.1\,m, 0.177 \le \varphi \le 0.188\,rad$. The medium surrounding the planes is air. For region 1: $0.179 \le \varphi \le 0.188\,rad$ neglect fringing and find: (a) $V(\emptyset)$; (b) $D(\rho)$ (c) the Capacitane between the planes.
P-3	
A (5 marks)	Find the capacitance between a conducting cone with its vertex separated from a conducting plane by an infinitesimal insulating gap and its axis normal to the plane as shown in Fig. 2?
B (5 marks)	The surfaces $\rho = 3, \varphi = 100^\circ$, $z = 3$ *and* $z = 4.5$ define a closed surface. Find (a) the enclosed volume; (b) the total area of the enclosing surface; (c) the total length of the twelve edges of the surfaces; (d) the length of the longest straight line that lies entirely within the volume.

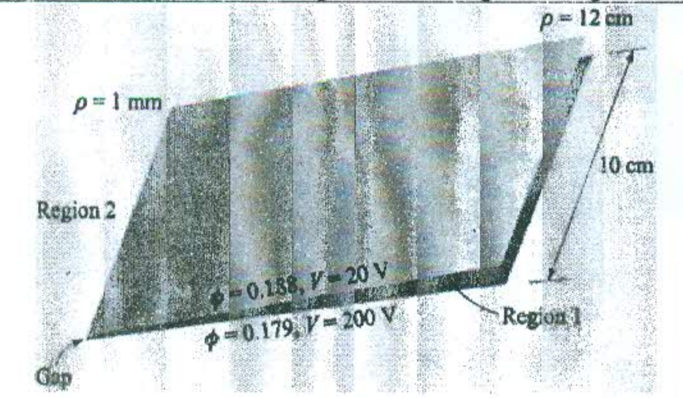


Fig. 1

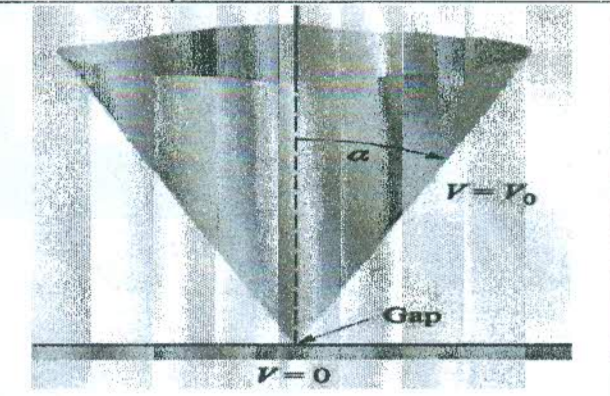
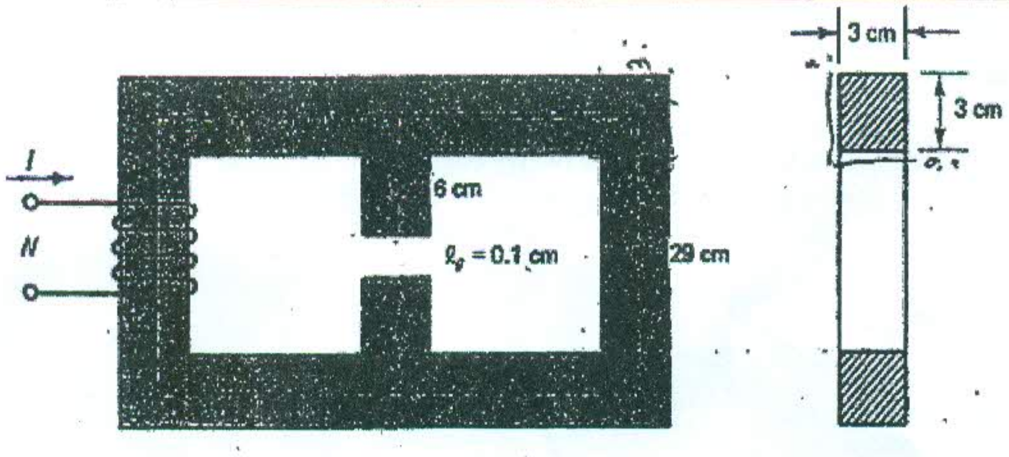


Fig. 2

C (8 marks)	Evaluate the electrostatic fields due to a two line charges at point M(x,y,z), if line one of ρ_{l1} C/m extended from point P(0,0,+5) to positive infinity and the other line of ρ_{l2} C/m extended from point P(0,0,-8) to negative infinity.
P-4	
A (6 marks)	**Describe** the analogy between each of: • electrical circuits and magentic fields. • Electric and magnetic fields.
B (6 marks)	**What** are the diffeneces between the following pairs; • magnetic and electric flux. • Magenctic field density and field intensity • Integral and differential forms of maxwell's equations.
C (6 marks)	A charged particle of mass of 2.5 kg and chage 3 C starts at point (1, -2, 0) at velocity 4ax+3az in an electric field 12ax+10ay V/m. At time t=1 sec, **Determine**: • The acceleration of the particle and the velocity • Kientic energy and its position
P-5	
A (6 marks)	**Mention what are the meant by**: Stokes's theaorm, Ampere law, magnetic force equation, magnetic materials and curl operator.
B (6 marks)	**Consider** the magnetic circuit shown in Figure 3. The magnetic flux is generated by a mmf = NI (ampere turns). The ferromagnetic core has a relative permeability $\mu_r = 4000$, and square cross-sectional area of side length of 3 cm, the outer dimensions are 50x 29 cm. The air gap length equals 0.1 cm. 1. **Draw** the equivalent circuit. 2. **Determine** the flux in the air gap if NI =200 AT. 3. **Determine** the mmf required to produce a flux density in the air gap of B = 1.5 Wb/m^2.
C (6 marks)	Suppose that the magnetic field inensity H is defined as: $H = \begin{cases} 0.2z^2\, a_x & z > 0 \\ 0 & elsewhere \end{cases}$, **Obtain** **1)** $\oint H.dL$ about the square path with side length of 5 cm, centered at (0,0,2). **2) curl (H),** **3)** $\nabla.H$
	 **Figure 3: Ferromagnetic circuit with air gap**

Best wishes
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