COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Electronics and Communications Engineering

Lecturer: Associate Prof. Dr. Hussein Hamed Mahmoud Ghouz

Course: Electromagnetic-I

Course Code: EC341 **Time : 60 Min.**

Date : Sat. Dec., 13, 2014 **Total Marks : 20**

12TH Exam Fall 2014/2015

Answer the Following Questions

Q.1: A cross section view of two concentric conducting spheres having radii **"r_1"** and **"r_2"** is shown in **Fig.1**. The inner conductor is kept at constant potential $V=V_o=10.0$ volt while the outer conductor is grounded. The space between the inner and outer conducting spheres is filled with lossless dielectric material. Assume: $\mathbf{r_2= 10.0r_1}$ (r_1=1.5 mm), ε_r**=4.7**. Solve the Laplace equation to find the following: **(4-mark each)**

1. The electric field intensity, polarization and induced charge densities in each region

2. The electrostatic potential and the capacitance in each region

Q.2: A small charged dielectric sphere having a diameter **D=5.0** mm and a volume charge density ρ_v**=400.0** nc/m^3 is located at the point P_1 **(1.25 m, 0.75 m)** in the region between two infinite conducting ground planes form a right angle as shown in **Fig.2**. Using the image method to find the following: **(4-mark each)**

1. The induced surface charge density on the ground planes: ρ_{x-y} and ρ_{y-z}

2. The force between the charged sphere and the ground planes: F_{QG}

Q.3: Given two infinite and isolated conducting planes as shown in **Fig.3**. The first conductor plane is inclined by an angle of **15^o** with respect to the x-y plane and it has a zero potential. The second conductor plane has an angle of **50^o** with respect the first plane, and it has a constant potential $V=V_o=5.0$ volt. Using the Laplace equation to find the following: **(2-mark each)**

1. The electric field E_P at any point between the conducting planes

2. The induced surface charge densities on the ground planes

This question is optional with additional 4-Mark added to the 7th Grade (1-Marh each):

Q.opt: A Charged Disk having inner radius $b_1=20$ cm, outer radius $b_2=50$ cm, and charge density $\rho_s=10$ nc/m^2 is located in x-y plane as shown in **Fig.4**. Find the following:

1. The electric potential at the point **P (0, 0, h=1.0 m)**, then, plot V_p

2. The electric field at the point **P (0, 0, h)**, then, plot E_p

3. The electric field at the point **P** if $b_1 \rightarrow 0$ and $b_2 \rightarrow \infty$ using **Gauss' Law**

4. The force acting on a point charge **Q=-15.0** mc located at the point P (0, 0, 1.5h)

GoodLuck

P.T.O

Formula Sheet

$k=1/(4\pi\varepsilon_o)=9\times10^9$

$$\nabla V=\frac{\partial V}{h_1\partial u_1}\mathbf{a}_{u1}+\frac{\partial V}{h_2\partial u_2}\mathbf{a}_{u2}+\frac{\partial V}{h_3\partial u_3}\mathbf{a}_{u3}$$

$$\nabla^2 V=\frac{1}{h_1h_2h_3}\left(\frac{\partial}{\partial u1}\left(h_2h_3\left(\frac{1}{h_1}\frac{\partial V}{\partial u_1}\right)\right)+\frac{\partial}{\partial u2}\left(h_1h_3\left(\frac{1}{h_2}\frac{\partial V}{\partial u_2}\right)\right)+\frac{\partial}{\partial u3}\left(h_1h_2\left(\frac{1}{h_3}\frac{\partial V}{\partial u_3}\right)\right)\right)$$

$$\int\frac{xdx}{(x^2+a^2)^{1/2}}=\sqrt{x^2+a^2}\qquad\int\frac{xdx}{(x^2+a^2)^{3/2}}=\frac{-1}{\sqrt{x^2+a^2}}$$

$$\int\frac{dx}{(x^2+a^2)}=\frac{1}{a}\tan^{-1}\frac{x}{a}\qquad\int\frac{dx}{(x^2+a^2)^{3/2}}=\frac{x}{a^2\sqrt{x^2+a^2}}$$

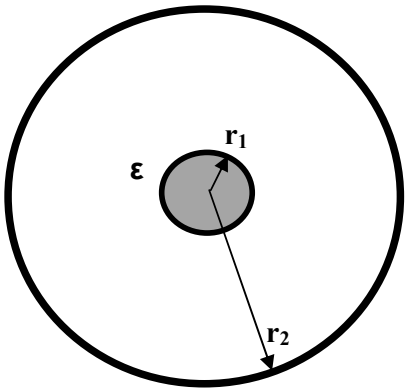

Fig.1

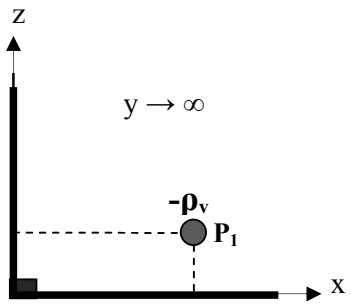

Fig.2

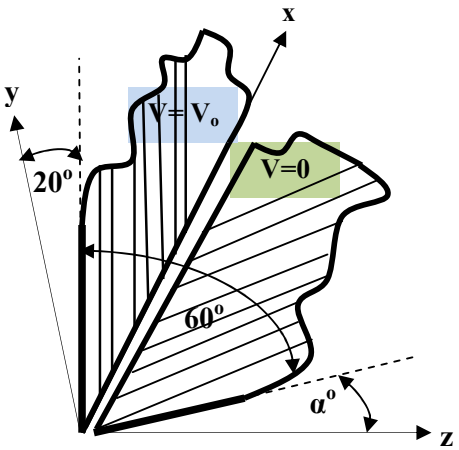

Fig.3

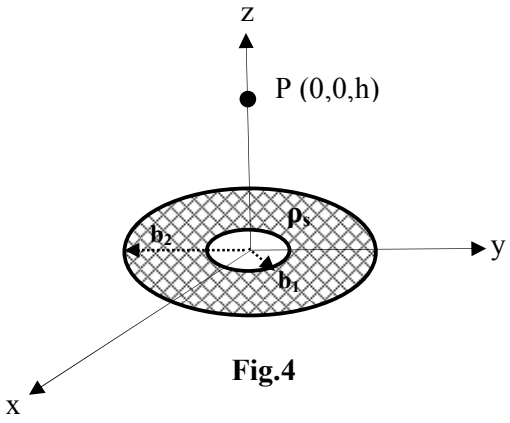

Fig.4