Midterm Examination PHY2323 Summer 2016

Prof: Reza Khanbabaie Time: 2 hrs Number of pages: 1

- Please write your name and Student number.
- Using Cell phone is NOT allowed. Using calculator is allowed.
- The exam is closed book. Using any book or solution manual is not allowed.
- Write all details of the solutions. Write the units of final answers clearly.

1. If $\vec{A} = (4x+9y)\,\hat{x} - 14yz\,\hat{y} + 8x^2 z\,\hat{z}$, evaluate $\int \vec{A}.d\vec{l}$ from *P(0,0,0)* to *Q(1,1,1)* along the following paths:

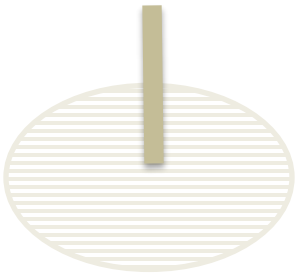
a) $x=t$, $y=t^2$, and $z=t^3$

b) the straight line joining *P(0,0,0)* to *Q(1,1,1)* (5 points)

2. If the flux density $\vec{D}$ in a region is given as $\vec{D} = (2+16\rho^2)\,\hat{z}$, determine the total flux $\int \vec{D}.d\vec{S}$ passing through a circular surface of radius $\rho = 2$ in the *xy* plane.

(5 points)

3. A thin rod of length R with a uniform charge q is located on the axis of a thin disc of radius R and uniform charge Q, as the figure. One end of the rod is connected to the center of the disc. Calculate the force exerted to the rod due to the disc. [Assume that the electric field of a disc with radius R and surface charge density of ρ_s at a point on its z-axis is:



$E_z = \frac{\rho_s}{2\varepsilon_0}\left(1 - \frac{z}{\sqrt{R^2+z^2}}\right)$ and $\int \frac{x\,dx}{\sqrt{x^2+a^2}} = \sqrt{x^2+a^2} + C$]. (7 points)

4. (a) Find the electric potential at a point on the axis of a uniformly charged disc of radius *b*, and the surface charge density of ρ_s C/m^2. (b) Also, determine the $\vec{E}$ field at that point. [Hint: $\int \frac{x\,dx}{\sqrt{x^2+a^2}} = \sqrt{x^2+a^2} + C$] (6 points)

5. Calculate the capacitance of two spherical shells of radii *a* and *b* using Laplace's equation. The inner shell is at a potential of V_0, and the outer shell is grounded.

(7 points)