United International University

School of Science and Engineering

Final Term Examination Year 2021 Trimester: Fall

Course: PHY 2105 Title: Physics Sec: A-D

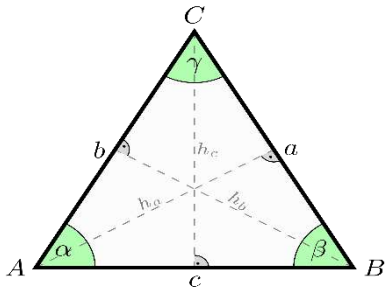
Full Marks: 40; Time: 2 hours +15 Minutes

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

Questions no 1, 2, 3 and 4 are mandatory to answer. Answer any one from question no 5 and 6.

1.	**(a)** If two charges of equal magnitude are separated by a fixed distance r, what will be impact of electrostatic force on the charge? What is the graphical relation between charge and electrostatic force? Can it be possible to apply the Coulomb's force in Navigation system? Justify your answer.	**2**	**CO1**
	(b) Is there any major difference between electric potential and electric potential energy? Justify your answer. How can you draw an electric potential graph varying in between -8V to +6V?	**2**	**CO1**
	(c) Suppose you imagine the angle between area vector and electric field vector is θ which produces a Gaussian surface. Now, how can you get the electric flux ϕ will be (i) zero, (ii) maximum, (iii) minimum, (iv) +ve flux, and (v) –ve flux.	**2**	**CO1**
2.	**(a)** The nucleus in an iron atom contains 26 protons. The electrostatic force between them to have a magnitude of 5.70 N. (i) What must be the distance between two point charges inside nucleus? (ii) A particle of charge +(last two digits of your ID)× 10^{-6} C is 12.0 cm distant from a second particle of charge -0.5×(last two digit of your ID)× 10^{-6} C. Calculate the magnitude of the electrostatic force between the particles and which type of force is it? [Given, k=9x10^{9} Nm^2C^{-2}, m_p=1.67x10^{-27} kg, m_e=9.1x10^{-31} kg, q=1.6x10^{-19} C, and G=6.673x10^{-11} Nm^2kg^{-2}]	**4**	**CO3**
	(b) What is the Coulomb force between two 5gm pennies +(sum of last two digit of your ID) m apart if we remove all the electrons from the aluminum ($^{27}_{13}Al$) atoms? (ii) What is their acceleration as they separate? [Given Avogadro number, N_A=6.023×10^{23}, e^- =e=1.6×10^{-19} C, and coulomb constant k=8.99×10^{9} Nm^2C^{-2}]	**3**	**CO3**
	(c) Two point charges -4q and -7q are placed 20 cm apart. At what point on the line joining them the electric field is zero?	**2**	**CO3**
3.	**(a)** An electric dipole consists of charges +2*e* and -2*e* separated by (last two digits of your ID)× 10^{-2} nm and is existed in an electric field of field strength (sum of last two digit of your ID) x 10^{6} N/C. Calculate the magnitude of the torque on the dipole when the dipole moment is (i) parallel to, (ii) perpendicular to, and (iii) antiparallel to, the electric field and also calculate (iv) the maximum and the minimum value of the potential energy induced due to electric dipole.	**4**	**CO3**
	(b) Hydrogen sulfide (H_2S) is a molecule that has a permanent dipole moment with dipole charge q=$\|\pm 18e\|$. The dipole distance of H_2S molecule is (last two digits of your ID) fm. (i) What is the dipole moment? (ii) If the molecule is placed in an electric field of (sum of last two digit of your ID) x10^{3} N/C with rotating angle 105^{o}, what is the torque exert on it? and (iii) What is the potential energy?	**3**	**CO3**
4.	**(a)** What is the electric potential at the centre point *P* (common cross section point of all heights), located at the centre of an equilateral triangle of point charges shown in figure below? The distance *a* is 370 cm, and the charges are q_1=117μC, q_2= -42μC, and q_3=51μC which are located at vertices	**4**	**CO3**

A, B, C, respectively. Given that the height *Aa=Bb=Cc* and from median all distances *Pa=PA=PB=Pb=PC=Pc* are equal. The height is exactly the $\frac{2}{a}$ times of its area.



(b) A surface measures a velocity vector $\vec{v} = 3\hat{\imath} + 7\hat{\jmath} + 5\hat{k}$ which forms a Gaussian surface. The area vector of that surface is $\vec{A} = -6\hat{\imath} - 11\hat{\jmath}$. Take that the velocity vector is perpendicular to the surface to be directed "outward". Calculate (i) the electric flux through the surface and (ii) the net charge through the Gaussian surface. [Given $\epsilon_o = 8.854 \times 10^{-12}\ F/m$] **3** **CO3**

(c) An electric field of magnitude (last two digits of your ID) x10^5 N/C acting at a positive test charge Point P which is quite a far distance away from (sum of last two digit of your ID) nC of negative charge. (i) What is the distance between the negative charge and the point P? (ii) For the same distance what is the voltage required to move charges from one place to another? [Given, k=9x10^9 Nm^2C^{-2}] **3** **CO3**

5. **(a)** Find out the electric field due to an electric dipole. **4** **CO2**

(b) Establish a relation between torque $\vec{\tau}$, electric dipole moment $\vec{p}$, and electric field $\vec{E}$. **4** **CO2**

6. **(a)** Find out the electric potential due to an electric dipole. **4** **CO2**

(b) Suppose you imagine a Gaussian surface in the form of a closed cylinder surrounds a section of very large, uniformly charged cylindrical rod. Now applying the Gauss's law, find out the electric field. **4** **CO2**

CO1: Define different physical quantities with examples. **CO2:** Find out/Derive/Show/Discuss the various equations of Electric Field, Electric Potential, Electric Potential Energy, Gauss's law, etc. **CO3:** Evaluate different numerical problems based on the basic characteristics of Electric Field, Electric Potential, Electric Potential Energy, Coulomb's law, Gauss's law, etc.