United International University
School of Science and Engineering
Final Term Examination; Year 2020; Trimester: Fall
Course: PHY 105/2105; Title: Physics; Sec: A-F
Full Marks: 25; Time: 1 Hour 30 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? 1 CO1

   (b) What is electric potential energy? Is there any major difference between electric potential and electric potential energy? If any write down it. Graphically show the different electric potentials. 2 CO1

   (c) What is rms voltage? Draw a rms voltage graph if peak voltage is 40V. What is the main difference between ac and dc current? Mention at least two sources of AC and DC voltage source. 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 point charges? (ii) What is the magnitude of the gravitational force between those same two protons? [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}] 2 CO3

   (b) What is the net charge enclosed by the Gaussian cube due to the side of right, left, top and bottom (shown in Fig below) which lies in the electric field $\vec{E} = 5\hat{\imath} - 4\hat{\jmath}$? The length of each side 3 CO3
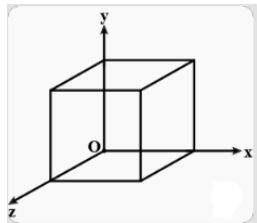
   of the cube is 4m.

3. **(a)** Hydrogen sulfide (H_2S) is a molecule that has a permanent dipole moment with dipole charge $q=|\pm18e|$. The dipole distance of H_2S molecule is 3.5 fm. (i) What is the dipole moment? (ii) If the molecule is placed in an electric field of $2.3x10^3$ N/C with rotating angle 105°, what is the torque exert on it? and (iii) What is the potential energy? 2.5 CO3

   (b) An electron is projected perpendicularly to an upward electric field of **E= 1020 N/C** after travelling a distance 40 mm**.** If the electron is vertically deflected 3.6 cm due to electric field, what is the speed of electron travelling inside the electric field? Given, mass $m_e=9.1x10^{-31}$ kg and charge $e= -1.6x10^{-19}$ Coulomb. 2.5 CO3

4. **(a)** A 9 m length copper wire in a home has a diameter of 6 mm and carries a current of 16mA flown for 17 minutes. The electric field inside in the wire is found as $3.75×10^{-2}$ V/m. Determine the (i) resistivity and (ii) electric power, also express power in BOT unit, of the wire. Assume the temperature inside the wire is 20°C. [Given, $e= 1.6x10^{-19}$ Coulomb] 2.5 CO3

   (b) Using VDR and CDR principle, find out the (i) currents I, the voltage drop V_x across 150 Ω in I_1 current passing, and (ii) terminal voltage of the battery in the circuit shown below? 2.5 CO3
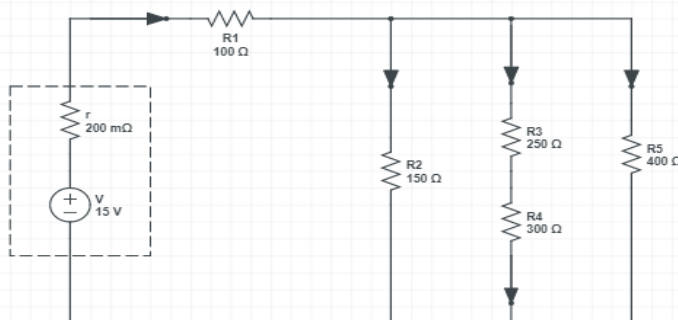
5. **(a)** Establish a relation between torque $\vec{\tau}$, electric dipole moment $\vec{p}$, and electric field $\vec{E}$. 2.5 CO2

(b) Find out the electric field due to an electric dipole. 2.5 CO2

6. **(a)** Find out the electric potential due to a group of point charges. 2.5 CO2

(b) Establish a relation between drift velocity and number density of electrons. 2.5 CO2

CO1: Define different physical quantities with examples. **CO2:** Find out/Derive/Show/Discuss the various equations of Electric Field, Electric Potential, and Current, Resistance and EMF, etc. **CO3:** Evaluate different numerical problems based on the basic characteristics of Electric Field, Electric Potential, Gauss's law, Combination of resistors, VDR-CDR rules, Energy stored and power dissipation in a circuit, etc.