# 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.*

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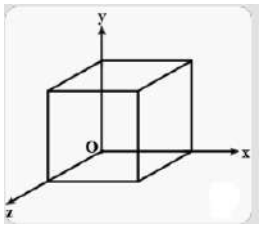
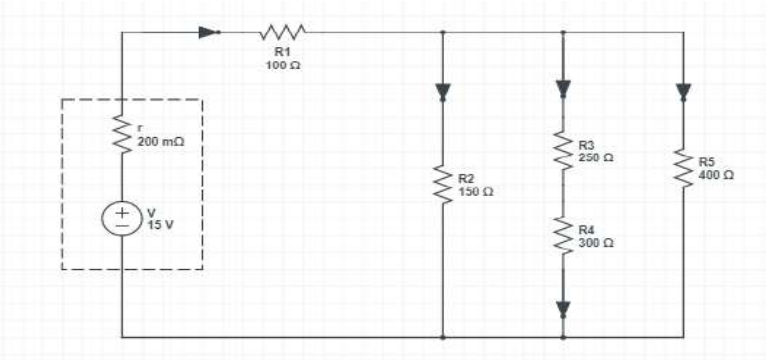
| **1.** | **(a)** If two charges of equal magnitude are separated by a fixed distance r, what will be impact of electrostatic force on the charge? | 1 | CO1 |
| | **(b)** What is electric potential energy? Is there any major difference between electric potential and electric potential energy? If any 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, $k=9\times10^{9}$ $Nm^2C^{-2}$, $m_p=1.67\times10^{-27}$ kg, $m_e=9.1\times10^{-31}$ kg, $q=1.6\times10^{-19}$ C, and $G=6.673\times10^{-11}$ $Nm^2kg^{-2}$] | 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 of the cube is 4m.   | 3 | CO3 |
| **3.** | **(a)** Hydrogen sulfide ($H_2S$) is a molecule that has a permanent dipole moment with dipole charge $q=\lvert\pm 18e\rvert$. 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 $2.3\times10^{3}$ N/C with rotating angle $105^{o}$, 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 $m_e=9.1\times10^{-31}$ kg and charge $e= -1.6\times10^{-19}$ 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 $3.75\times10^{-2}$ 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, $e= 1.6\times10^{-19}$ 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 |

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| **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.