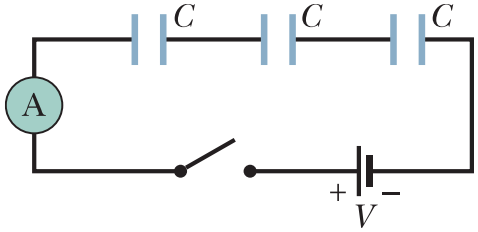
United International University

School of Science and Engineering

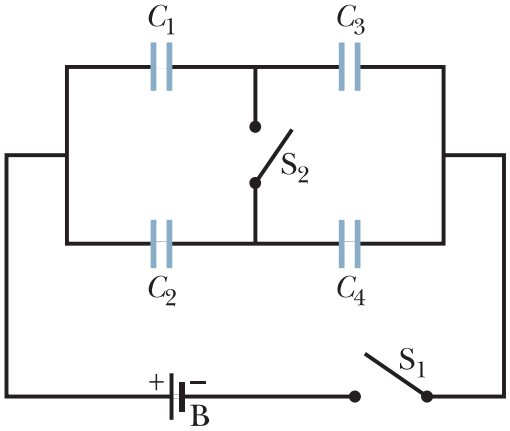
Final Examination; Year 2021; Trimester: Spring
Course: PHY 2105; Title: Physics; Sec: A-E
Full Marks: 40; Time: 1 hr 45 mins + 15 mins uploading time

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.

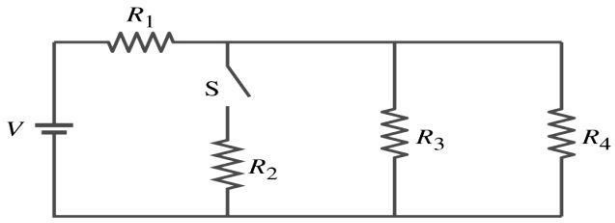
1.	(a) Justify that the dielectrics should not conduct current to construct a capacitor.	2	CO1
	(b) Justify that the resistance can vary for the same material with a certain change of parameters, but resistivity does not.	2	CO1
	(c) To have maximum use of electrical power what combination of four bulbs should you use? Justify your answer.	2	CO1
	(d) Define work function and threshold frequency.	2	CO1
2.	(a) Analyze the following figure with an open switch, a battery of potential difference 20 *V*, a current-measuring meter A, and three identical uncharged capacitors of capacitance 10 μ*F*. When the switch is closed and the circuit reaches equilibrium, what are (i) the potential difference across each capacitor and (ii) the charge on the left plate of each capacitor? (iii) During charging, what net charge passes through the meter?	4	CO3



	(b) Analyze the following figure to evaluate the charge on (i) capacitor 1, (ii) capacitor 2, (iii) capacitor 3, and (iv) capacitor 4 if only switch S_1 is closed. If both switches are closed, what is the charge on (v) capacitor 1, (vi) capacitor 2, (vii) capacitor 3, and (viii) capacitor 4. All C_1=C_3=10μF, C_2=C_4=20μF, and B has 9V.	5	CO3



3.	(a) Find the current and the voltage across each resistor. Given, R_1=R_2=R_3=R_4=3kΩ and V=3.5V.	3	CO3



(b) (i) What is the Coulomb force between two 5gm pennies three meter 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^- =1.6×10^{-19} C, and coulomb constant k=8.99×10^9 Nm^2C^{-2}] 4 CO3

4. (a) Calculate the wavelength of light, work function and threshold voltage, illuminating a barium surface if the threshold frequency of barium is 6.07 x 10^{14} Hz and the kinetic energy of the electron emitted is 1.31×10^{-18} J. Given, h=6.634×10^{-34} Js and c=3×10^8 ms^{-1}. 4 CO3

(b) A nervous engineer worries that the two metal shelves of his wood frame bookcase might obtain a high voltage if charged by static electricity, perhaps produced by friction. (i) What is the capacitance of the empty shelves if they have area 1.00 × 10^2 m^2 and are 0.200 m apart? (ii) What is the voltage between them if opposite charges of magnitude 2.00 nC are placed on them? (iii) To show that this voltage poses a small hazard, calculate the energy stored and (iv) also calculate the energy density produced by it. 4 CO3

5. (a) Find out the electric potential due to an electric dipole. Rewrite the case if the electric charge is continuous. 4 CO2

(b) Establish a relation between drift velocity and number density of electrons as well as the relation between conductivity and current density. 4 CO2

6. (a) Find out the equivalent capacitance, C_{eq} for series and parallel combinations of four capacitors with each has the half capacitance of the previous one. 4 CO2

(b) Suppose the voltage varies sinusoidally with time as $V = V_0 cos 2\pi f t$. Find out the average electric power $\bar{P}$ in a typical home. Also compare with necessary figures for average power and electric power. Draw rms voltage figure for above mentioned dynamic equation of the voltage equation. 4 CO2

CO1: Define/Justify/State different physical quantities with examples.
CO2: Derive/Show/Discuss the various equations of Electric Field, Potential and Electricity, and Capacitance.
CO3: Evaluate different numerical problems based on the basic characteristics of Coulomb's law, Electric Field, Electric Potential, Electricity and EMF, Capacitor and capacitance, and Particle properties of wave.