Name of the Program: B. Sc. in Civil Engineering   Date: 05 May, 2023
**Semester: 2nd semester**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination   **Summer Semester: 2021 - 2022**
Course Number: PHY 4253   **Full Marks: 150**
Course Title: Physics II   **Time: 3.0 Hours**

There are **8 (Eight)** questions. Answer any **6 (Six)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Any other statements, if necessary.

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1. (a) State what you mean by a capacitor and write down three applications of it.   (05)
                                                                                       (CO1)
                                                                                       (PO1)

    (b) (i) A cylindrical capacitor consists of two co-axial cylinders of radius "a"   (15)
         and "b" and length l. What is the capacitance of the device?   (CO2)
         (ii) Derive the expression of capacitance for a parallel plate capacitor.   (PO2)

    (c) A capacitor C_1 is charged to a potential difference V_o. This charging battery   (05)
         is then removed and the capacitor is connected as in Figure below to an   (CO3)
         uncharged capacitor.   (PO2)
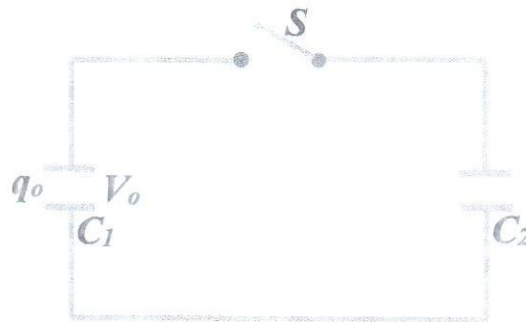
    (i) What is the final potential difference V across the combination?

    (ii) What is the stored energy before and after the switch in Figure is thrown?

2. (a) What is meant by electron's drift speed?   (05)
                                                     (CO1)
                                                     (PO1)

    (b) (i) Obtain the expression of drift speed in terms of current density, electronic   (15)
         charge and number of electrons per unit volume in a conductor.   (CO2)
         (ii) Discuss the Hall effect and deduce the expression of the number of   (PO2)
         charge carriers per unit volume of a material.

(c) A copper strip 2.0 cm wide and 1.0 mm thick is placed in a magnetic field of 1.5 Wm^{-2}. If a current of 200 A is set up in the strip, what Hall potential difference appears across the strip? The density of Cu is 9.0 gm/cm^3 and its atomic weight is 64 gm. Assume Avogadro's number equal to 6.0×10^{23} atoms/mole. **(05) (CO3) (PO2)**

3. (a) Define magnetization and magnetic susceptibility. **(05) (CO1) (PO1)**

(b) Discuss Langevin's classical theory of diamagnetism and show that diamagnetic susceptibility is independent of temperature. **(15) (CO2) (PO2)**

(c) Briefly describe what you understand by ferromagnetism and ferrimagnetism. **(05) (CO3) (PO2)**

4. (a) What is a Galilean transformation? Write down its drawbacks. **(05) (CO1) (PO1)**

(b) Describe Michelson-Morley experiment and obtain the expression of expected fringe shift they derived theoretically. **(15) (CO2) (PO2)**

(c) A spaceship travels at a speed of 0.9c relative to Earth. How much time will pass on the spaceship for every 10 years that pass on Earth? **(05) (CO3) (PO2)**

5. (a) State ultraviolet catastrophe of classical physics for black body radiation. **(05) (CO1) (PO1)**

(b) Mathematically explain the Planck's radiation formula for the interpretation of black body radiation. **(15) (CO2) (PO2)**

(c) Find out the speed of electromagnetic wave in free space. Given that electric permittivity in free space is 8.854×10^{-12} F/m and the magnetic permeability is $4\pi \times 10^{-7}$ H/m. **(05) (CO3) (PO2)**

6. (a) Define photoelectric effect and work function. **(05) (CO1) (PO1)**

(b) Mathematically and physically explain the Einstein's photoelectric effect. **(15) (CO2) (PO2)**

(c) The threshold wavelength for photoelectric emission in tungsten is 260 nm. What wavelength of light must be used in order for electrons with a maximum energy of 1.6 eV to be ejected? **(05) (CO3) (PO2)**

7. (a) State and briefly explain the Compton effect. (05)
(CO1)
(PO1)

   (b) Calculate the change in wave length expected for a photon that is scattered through the angle after colliding with an electron. (15)
(CO2)
(PO2)

   (c) X-rays of wavelength 12 pm are scattered from a target. a) Find the wavelength of the x-rays scattered through 45°. b) Find the maximum wavelength present in the scattered x-rays. (05)
(CO3)
(PO2)

8. (a) Justify the statement that an electron cannot be a nuclear particle. (05)
(CO1)
(PO1)

   (b) Explain the binding energy per nucleon versus mass number curve from mathematical and physical point of view. (15)
(CO2)
(PO2)

   (c) If the number of nucleons in a copper nucleus is 64 and the number of nucleons in an oxygen nucleus is 16, how much larger is a copper nucleus than an oxygen nucleus? (05)
(CO3)
(PO2)