B. Sc. Engg. (CEE)/ 1st semester 08 December, 2023 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination **Winter Semester: 2022 - 2023**
Course Number: PHY 4153 **Full Marks: 150**
Course Title: Physics I **Time: 3.0 Hours**

There are **8 (Eight)** questions. Answer 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) Briefly describe the reverberation and reverberation time. (05) (CO1) (PO1)

   (b) Find the expressions for the growth and decay of sound intensity inside a room based on the Sabine's reverberation formula. Obtain an expression for the reverberation time. (15) (CO2) (PO2)

   (c) The volume of a room is 1200 m^3. The areas of wall, floor and ceiling are 150, 110 and 120 m^2, respectively. The average absorption coefficient for wall, floor and ceiling are 0.03, 0.80 and 0.06, respectively. Calculate the average sound absorption coefficient and the reverberation time. (05) (CO3) (PO2)

2. (a) State cardinal points of an optical system. Briefly describe the cardinal points with illustration. (05) (CO1) (PO1)

   (b) Find an expression for the equivalent focal length f of two thin lenses of focal lengths f_1 and f_2. The separation between the lenses is d. (15) (CO2) (PO2)

   (c) Two identical thin convex lenses of focal lengths 10 cm each are coaxial and 6 cm apart. Find the equivalent focal length and the positions of the principal points. Also find the position of the object from the first lens for which the image is formed at infinity. (05) (CO3) (PO2)

3. (a) Briefly explain the monochromatic and chromatic aberration. (05) (CO1) (PO1)

   (b) Using a clear optical diagram describe the astigmatism in a lens. (15) (CO2) (PO2)

   (c) Two glasses have dispersive powers in the ratio 3:4. These glasses are to be used in the manufacture of an achromatic objective of focal length 25 cm. What are the focal lengths of the lenses? (05) (CO3) (PO2)

4. (a) Explain the term achromatism of a lens. (05) (CO1) (PO1)

(b) Find an expression for the axial chromatic aberration in a lens. (15) (CO2) (PO2)

(c) A converging achromat of 50 cm focal length is to be constructed out of a thin crown glass lens and a thin flint glass lens, the surfaces in contact having a common radius of curvature of 35 cm. Calculate the radius of curvature of the second surface of each lens, given that the values of the dispersive powers and refractive indices are 0.018 and 1.51 for crown glass, and 0.035 and 1.71 for flint glass. (05) (CO3) (PO2)

5. (a) Write down the differences between free path and mean free path of gas molecules. (05) (CO1) (PO1)

(b) Obtain the relations of the root mean square velocity and average velocity of gas molecules using Maxwell's velocity distribution law. (15) (CO2) (PO2)

(c) Consider that all molecules of nitrogen gas are in a random motion in a container. The diameter of N_2 molecules is about 3×10^{-10} m and the number of molecules per unit volume is 0.2687×10^{26}. Calculate the mean free path (in meter) of the molecules. (05) (CO3) (PO2)

6. (a) Discuss briefly what led Van der Waals to modify the ideal gas equation and what were his corrections. (05) (CO1) (PO1)

(b) Show that, for both ideal and real gases, the ratio of adiabatic to isothermal elasticities is equal to the ratio of specific heats at constant pressure and constant volume. (15) (CO2) (PO2)

(c) Calculate the Van der Waals constants for dry air. Given that critical temperature, T_c=132 K, critical pressure, P_c=37.2 atm, gas constant, R=82.07 cm^3-atm-K^{-1}. (05) (CO3) (PO2)

7. (a) Write down both first and second laws of thermodynamics. (05) (CO1) (PO1)

(b) State and prove Carnot's theorem. (15) (CO2) (PO2)

(c) A Carnot engine takes 250 Cal of heat from the source whose temperature is 450 K and rejects 150 Cal of heat to the sink. What is the efficiency of the engine? (05) (CO3) (PO2)

8. (a) Distinguish between un-polarized and polarized lights. (05) (CO1) (PO1)

(b) Discuss how ordinary light can be polarized by reflection and refraction and explain these polarizations by Fresnel's elastic solid theory. (15) (CO2) (PO2)

(c) How will you orient a polarizer and an analyzer so that a beam of natural light is reduced to 0.5 of its original intensity. (05) (CO3) (PO2)