UNIVERSITY EXAMINATIONS 2023/2024

FOURTH YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN PHYSICS, BACHELOR OF SCIENCE (MATHEMATICS
AND PHYSICS) AND BACHELOR OF SCIENCE (PHYSICS)

SPH 3252: THERMAL PHYSICS I

DATE: APRIL 2024   **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) A system receives 12510 of energy while the work done by the system is to the surroundings is 94 Id. Find the change in internal energy   (3 Marks)

b) A chemical reaction leads to expansion of a gas from 6.8 L to 12.6 L at constant pressure of 1.2 atm- Find the work done by the gas to the surroundings   (4 Marks)

c) If 2000 J of heat are added to 200 mL of ethanol [density (p) = 789 Kg•m3 1 initially at $I0^0$C, calculate the final temperature of the sample given that the specific hest capacity of ethanol is 2440J/kg/K   (5 Marks)

d) is there enough heat in 100 cm^3 of water at 25^0C to completely melt 50g of ice at 0^0C? (Heat of fusion of ice = 334 KJ•Kg^{-1} and the Specific heat capacity of water =4200J/kg. show your working   (5 Marks)

e) A mole of hydrogen molecules, each of mass 3.3 x 10^{-27} kg, is contained in a cylinder of volume 0.050 m^3. The molecules have an root mean square speed of 800 m s^{-1}. Calculate the pressure of the gas. (Avogadro constant N_A = 6.0 x 10^{23} mol^{-1})   (4 Marks)

f) The filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure at 70^0C The filament diameter is 0.10 mm and length is 5 cm. considering the radiation, determine the filament temperature   (4 Marks)

g) A long pipe of 0.6 m outside diameter is buried in earth with axis at a depth of 1.8 m. the surface temperature of pipe and earth are 95^0C and 25^0C respectively. Calculate the heat loss from the pipe per unit length. The conductivity of earth is 0.51W/Mk.   (5 Marks)

QUESTION TWO (20 MARKS)

a) A mild steel tank of wall thickness 10 mm contains water at 90^0C. The thermal conductivity of mild steel is 50 W/m^{0}C, and the heat transfer coefficient for inside and outside of the tank area are 2800 and 11 W/m^{0}C, respectively. If the atmospheric temperature is 20^0C, calculate:

  i.   The rate of heat loss per m^2 of the tank surface area   (8 Marks)

 ii.   The temperature of the outside surface tank   (4 Marks)

b) Two large parallel planes with emissivities of 0.3 and 0.5 are maintained at temperatures of 5270 C and 1270C respectively. A radiation shield having emissivities of 0.05 on both sides is placed between them. Calculate;

  i.   Heat transfer rate between them without shield   (4 Marks)

 ii.   Heat transfer rate between them with shield   (4 Marks)

QUESTION THREE (20 MARKS)

QUESTION FOUR (20 MARKS)