00171

THE OPEN UNIVERSITY OF SRI LANKA

FACULTY OF ENGINEERING TECHNOLOGY

DIPLOMA IN TECHNOLOGY

FINAL EXAMINATION 2009/2010

MEX3212 Basic thermo fluids/MEX2331 Heat and fluids

DATE : March 15, 2010

TIME : 0930 – 1230hrs

DURATION : 3 hours

Read the following instructions carefully before answering the questions

1. This question paper consists of **eight** questions. Answer **any five** questions **only.**
2. All questions carry equal marks.
3. Time allocation for the paper is **03hrs.**
4. Do not spend more than **30 – 35** minutes for a question.

Q1. (a) Write down with usual notation the Fourier's equation for heat conduction through a rod.

(b) One end of a brass rod is kept in boiling water at 100 °C. The other end is in ice at 0 °C. During a period of 1 hour 18g of ice was melted by the heat conducted through the rod. Find the amount of heat required to melt 1g of ice. The length and the cross sectional area of the rod is 1 m and 2 cm^2 respectively.

Q2. (a) Derive an expression for heat transfer through a multi layer wall made up of three different materials. Hence define the overall heat transfer coefficient.

(b) A composite slab is made out of two parallel layers A and B. The thermal conductivity of A and B are 70 WmK and 140WmK respectively. The thickness of the layers A and B are 50mm and 30 mm respectively. The outer surface of A is maintained at 100 °C. The outer surface of B is at 5 °C. Determine,

(i) the temperature at the interface.

(ii) the rate of heat flow through the slab.

Q3. Heat transfer in a parallel flow heat exchanger is given by the following equation.

$$Q = UA\left(\frac{\Delta t_1 - \Delta t_2}{ln\frac{\Delta t_1}{\Delta t_2}}\right)$$

(i) Name each term of the above equation and state their SI units of measurement.

(ii) Sketch the variation of temperature of the cold and hot fluids along the heat exchanger and show the Δt_1 and Δt_2.

(iii) If the temperatures of the two fluids are as given below, calculate the heat transfer per unit area taking overall heat transfer coefficient as 600 W/m^2K.

Hot fluid: inlet temperature = 100 °C, Outlet temperature = 70 °C

Cold fluid: Inlet temperature = 30 °C, Outlet temperature = 50 °C

Q4. (a) State the types of energy in a flowing fluid. Write down the Bernoulli's equation applied between points A and B in a flow.

(b) Water flows through a pipe of diameter 25 cm with a velocity of 16 m/s under a pressure of 55 N/cm^2. If the pipe is 60 m above the datum line, find the total energy of water and discharge rate.

Q5. (a) State the Archimedes principle.

(b) A wooden cube of side 20 cm and density 900 kg/m^3 floats across the interface of water and a liquid of relative density 0.8 as shown in Figure Q5. Find the portion of the cube above the interface.

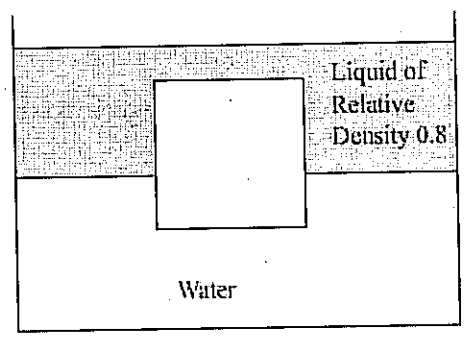


Figure Q5

Q6. (a) Show that the fluid pressure at a depth of h from the surface of reservoir is given by hρg.

(b) Figure Q6 shows a U-tube manometer used to measure fluid pressure in a pipe. Determine the value of h if the pressure inside the pipe is 200k Pa. The density of the fluid is 1200 kg/m^3. The density of the manometer fluid is 13600 kg/m^3. Atmospheric pressure is 10^5 Pa

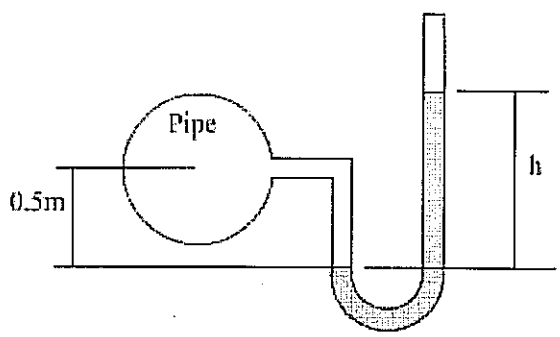


Figure Q6

Q7. (a) State the Boyle's law and Charle's law. Show how these two laws can be combined to give

$$\frac{PV}{T} = Constant$$

(b) A glass capillary tube sealed at one end contains air trapped by a column of mercury 24 cm long. The length of the air column is 40 cm, when the tube is horizontal and 30.4 cm when the tube is vertical with open end upward.

Calculate the atmospheric pressure in meters of mercury and the length of the air column when the tube is vertical with the open end downwards.

Q8. (a) What is meant by stoichiometric air fuel ratio in combustion?

(b) A hydrocarbon having the chemical formula C_6H_{14} is burnt in with sufficient air supply.

(i) Write the balanced chemical equation for the combustion of the fuel.
(ii) Calculate the percentage of combustion products.
(iii) How many moles of water vapour would be produced by 0.5 g of the fuel?
(iv) If 0.18 g of water vapour is found in the combustion products, determine the mass of the fuel burnt.