Mansura University
Faculty of Engineering
Mech. Power Eng. Dept.

3rd Year of Mechanical
Mechanical Lab
8 June 2013 -Time : 3 hours
Full Mark: 60

Answer the following questions. Assume any necessary assumptions.

Question No. 1 (12 marks)

In a certain experiment, cylindrical sample of diameter 5 cm and length 10 cm is used. Three thermocouples are used on each face and their temperatures are 100,99 and 103 °C on one face and 30, 29 and 31°C on the other face when the electric heater is observed to draw 1.1 A and 220V.

Explain the experimental procedures and determine the thermal conductivity of the sample.

Question No. 2 (12 marks)

On way of measuring the convection heat transfer coefficient of the air is to make flow of cold air over tube of banks which are arranged in-line the tube is 1.2 cm diameter and 20 cm length and made from brass and the next tabulation is determine for measuring the temperature of the tube with time:-

Time(sec)	Temperature(°C)
0	95
20	85
40	60
60	50
85	32
110	20

Explain the experimental procedures and determine the convection heat transfer coefficient of the air.

Properties of brass are(k=110 W/m.K, ρ= 8530 kg/m^3 and Cp= 380 J/kg.K).

Question No. 3 (12 marks)

a) State two methods of flow rate measurements and discuss their theory of operation.

b) In the flow rate measurements by weir, a V-weir of 90° angle was used. The actual flow rate was measured by an orifice that has the following relationship:-

$$Q\left(lit/min\right) = 16.92 \times [H_o\,(cm)]^{0.5}$$

The following table listed the measured reading of the orifice manometer deflection H_o (cm water), and the head over the weir h_w (mm water) measured from the V-weir apex. Knowing that the theoretical flow rate over the V-weir is:-

H_o (cm water)	H_w (mm water)
0.7	26
3.2	34
10.0	43
25.2	52
54.5	60

$$Q_{th} = \frac{8}{15} \times (2g)^{0.5} \times (h_w)^{5/2}$$

Estimate the discharge coefficient C_d for the given weir.

Question No. 4 (12 marks)

In the experiment of velocity distribution measurements, a pitot tube with manometer of 30° inclination angle with the horizontal was used. The pipe diameter is 1 inch.

The following table displays the measured data; where r is the radius at which the Pitot tube is placed (mm) and h is inclined manometer deflection (cm) .

r (mm)	h (cm water)
0	10.5
2	9.4
4	9
6	8.3
8	7.3
10	6.2
12	3.2

You are asked to:-

a) Plot the velocity distribution.

b) Calculate the average velocity, momentum flux and kinetic energy flux.

c) Calculate the amount of flow rate in lit/min.

Question No. 5 (12 marks)

a) Show the type of fluidized bed combustion systems, and list its advantages.

b) In a fluidized bed test, the pressure drop along the furnace is measured and recorded at different values of velocities at cold and hot (800°C) operation. The following table presents the obtained data. Find the minimum fluidization velocity.

Velocity (cm/s)	0	10	12	16	18	20	23	25	30	40	100	140
Δp cold (kPa)	0	0.42	0.77	1.52	1.92	2.32	2.81	3.6	3.9	4.2	4.1	1.1
Δp hot (kPa)	0	0.7	1.3	2.5	3.1	3.7	3.9	4	3.9	3.9	3.9	3.9

Good luck   *Dr. A. Abd Elsalam*