THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION– 2007/2008

MEX3235 - THERMO-FLUIDS
MEX3232 - THERMODYNAMICS AND FLUID MECHANICS

DATE	:	23rd APRIL 2008
TIME	:	0930 HRS. – 1230 HRS.
DURATION	:	TWO AND QUARTER HOURS

ANSWER FOUR QUESTIONS SELECTING AT LEAST ONE QUESTION FROM EACH SECTION. ALL QUESTIONS CARRY EQUAL MARKS. YOU MAY OBTAIN TABLES OF THERMODYNAMICS AND TRANSPORT PROPERTIES OF FLUIDS ON REQUEST.

Density of water = 1000kg/m^3. Acceleration due to gravity=9.81m/s^2.
For air Cp=1.005kJ/kg.K , Cv=0.718kJ/kg.K, R=0.287kJ/kg.K, γ=1.4.

1. *Part –B consists of eight questions..*
2. *All questions carry equal marks.*
3. *Time allocation for* ***Part B*** *is 2hrs and 15minutes.*
4. *Do not spend more than 20-25 minutes for each question.*
5. *Hand over* ***Part*** *B separately.*

PART B
SECTION 1

1. The minimum pressure and temperature in an Otto cycle are 100kPa and 27°C. The amount of heat added to the air per cycle is 1500kJ/kg. Determine the pressures and temperatures at all points of the air standard Otto cycle. Also calculate the thermal efficiency of the cycle. The compression ratio is 8:1.

2. (a) Starting from the two basic equations $Tds = dh - vdP$ and $dh = C_p dT$, show that the entropy change of an ideal gas from state 1 to state 2 can be expressed as

$$S_2 - S_1 = C_P \ln\frac{T_2}{T_1} - R\ln\frac{P_2}{P_1}$$

(b) Using above equation show that the expression for an isentropic process can be expressed as PV^{γ} = constant

(c) Calculate the change in entropy per kilogram as air is heated from 300K to 600K while pressure drops from 400kPa to 300kPa.

3. Determine the thermal efficiency of a Rankine cycle using steam as the working fluid in which the condenser pressure is 10kPa. Steam enters the turbine at 4MPa and 400°C. Also determine the work ratio and specific steam consumption.

4. State the steady flow energy equation for the open system flow process and briefly explain each term.

A small liquid water pump is located 15m down in a well as shown in Figure Q4 , taking water in at 10°C, 90kPa at a rate of 1.5kg/s. The exit line is a pipe that goes up to receiver tank maintaining a pressure of 400kPa. Assume the process is adiabatic with the same inlet and exit velocities and that the water stays 10°C. Find the required pump work. (enthalpy difference for a small water pump $\Delta h = (P_1 - P_2)v$, where v is the specific volume of water.)

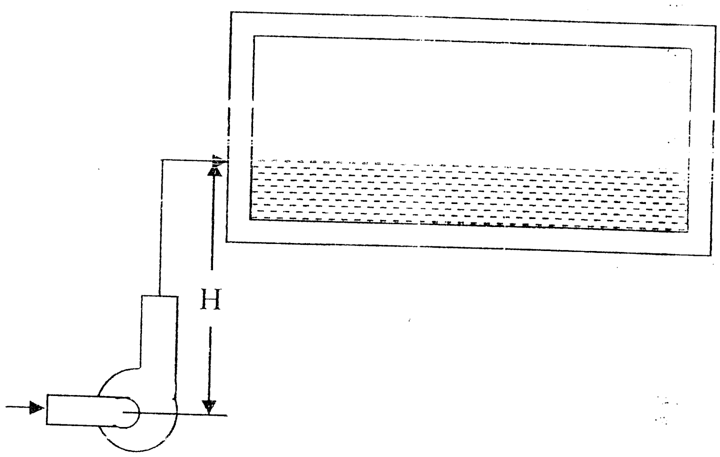

Figure Q4

SECTION 2

5. The figure Q5 shows a Y-fitting provided to connect a 120mm diameter pipe to two pipes of diameter 90mm and 60mm respectively. The discharges in the 120mm diameter and 60mm diameter pipes are 15litres/sec.and 5litres/sec respectively. The pressure in the 120mm diameter pipe is 30kPa. Determine the pressure in the other two pipes and the forces exerted by water on the Y-fitting. Assume all pipes are on the same horizontal plane.

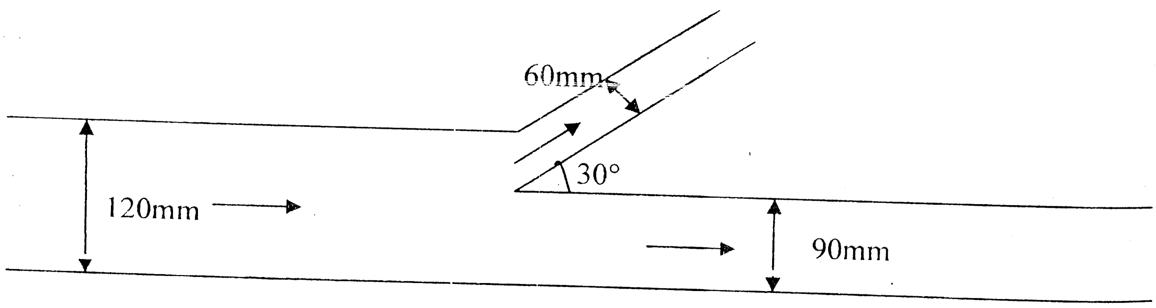

Figure Q5

6. An inclined rectangular sluice gate 4m wide and 1 m deep has been installed to control the discharge of water as shown in Figure Q6. The upper end A is hinged and lies at a distance of 2m from the free surface of water. What force normal to the gate be applied at the lower end B to open it?

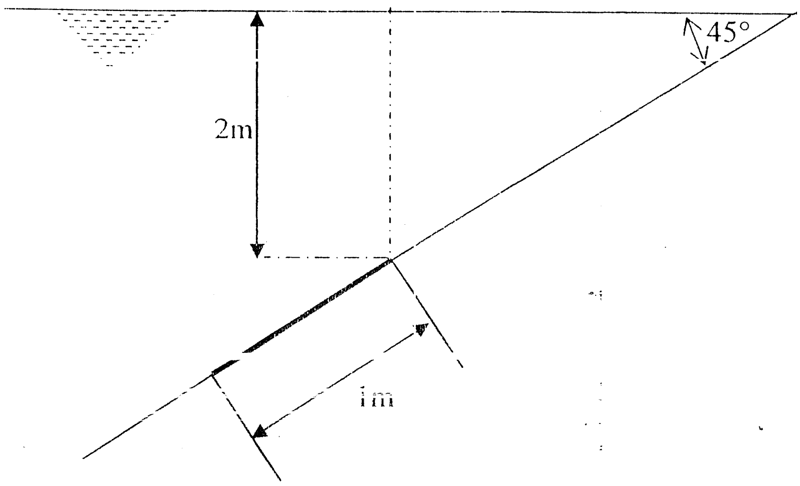

Figure Q6

7. A single acting reciprocating pump has a plunger diameter of 150mm and a stroke length of 300mm. The pump runs at 35rev/min and lifts water through a height of 20m. Calculate the theoretical discharge and the theoretical power required. If the actual discharge is 2.885*l*/s find the slip of the pump.

8. Two sharp ended pipes of diameter 50mm and 100mm respectively, each of length 100m are connected in parallel between two reservoirs which have a difference of level of 10m. If the coefficient of friction for each pipe is $4f = 0.32$, calculate the rate of flow for each pipe and also the diameter of a single pipe 100m long which would give the same discharge, if it were substitute for the two original pipes.