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THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION– 2010/2011

MEX3235 - THERMO-FLUIDS

LIBRARY
01 NOV 2011

DATE : 23rd MARCH 2011
TIME : 1400 HRS. – 1700 HRS.
DURATION : THREE HOURS

ANSWER FIVE 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 C_p= 1.005kJ/kg.K , C_v= 0.718kJ/kg.K, R = 0.287kJ/kg.K, γ = 1.4.

SECTION 1

1. An I.C. Engine operating on the dual combustion cycle has a temperature of the working fluid at the beginning of compression of 27°C. The ratio of the maximum and minimum pressures of the cycle is 70 and compression ratio is 15. The amounts of heat added at constant volume and constant pressure are equal. Determine the thermal efficiency of the cycle.

2. An insulated cylinder of volume 4m^3 contains 20kg of Nitrogen. Paddle work is done on the gas by stirring it till the pressure in the vessel increases from 4bar to 8bar. Determine;

   a) change in internal energy.

   b) work done.

   c) heat transferred.

   d) change in entropy.

3. Steam power plant working on the Rankine cycle operates between 80 bar and 0.1bar. The maximum temperature is 600°C. Determine the following.

   a) Thermal efficiency.

   b) Work ratio.

   c) Specific steam consumption.

4. A cold storage room has walls made out of 220mm of brick on the outside, 90mm of plastic foam and finally 16mm of wood on the inside. The outside and inside air temperatures are 25°C and -3°C respectively. If the inside and outside heat transfer coefficients are 30 W/m2K and 11 W/m2K respectively, and the thermal conductivities of brick, foam and wood are 0.99, 0.022 and 0.17W/mK respectively. Determine;

   a) the rate of heat removal if the total wall area is $85m^2$.

   b) the temperature of the inside surface of the brick.

SECTION 2

5. The diameter of a pipe bend is 400mm at inlet and 200mm at outlet and the flow is turned through 45° in horizontal plane. Neglecting friction, calculate the magnitude and direction of the net force exerted on the bend by water flowing through it at $0.4m^3/s$ when the inlet pressure is 100kPa.

6. Figure Q 6 shows a vertical dock gate which separates two water reservoirs of depth H_1 and H_2. Find the resultant force exerted on the gate and the point of application of this force. Show that if the depth of water on both sides are equal, the distance to the point of application of the resultant force from the free surface is equal to half the depth of the water.

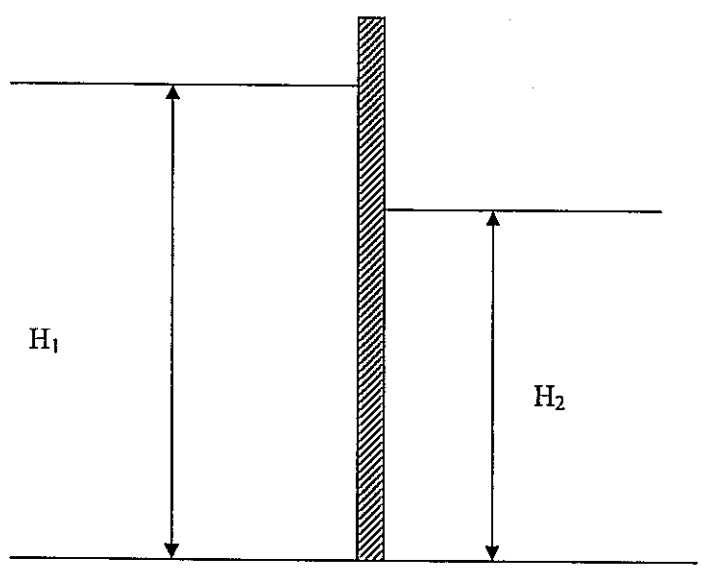


Figure Q6

7. The head capacity characteristics of a centrifugal pump running at constant speed has been prescribed by the relation

   $H = 40 + 52Q - 775Q^2$

   where H is the total head generated measured in meters and Q is the rate of flow in m^3/s. The pump is to deliver water through a pipe line 1000m long and 350mm diameter, the static lift being 25m. Neglecting velocity heads and taking pipe friction coefficient $f = 0.008$, find the discharge and the operating head of the pump.

8. A pumping plant forces water through a 600mm diameter main, the head being 27m. In order to reduce the power consumption, it is proposed to lay another main of appropriate diameter alongside the existing one so that the two pipes may work in parallel for the entire length and reduce the friction head to 9.6m. Find the diameter of the new main if with the exception of the diameter, it is similar to the existing one in every respect.

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