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THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION– 2009/2010

MEX3235 - THERMO-FLUIDS

DATE : 24th MARCH 2010
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/kgK , C_v=0.718kJ/kgK, R=0.287kJ/kgK, γ=1.4.

SECTION 1

1. 0.2m^3 of an ideal gas at a pressure of 2000kPa and 327°C is expanded isothermally to 5 times the initial volume. It is then cooled to 25°C at constant volume and then compressed back polytropically to its initial state. Determine:
   i. Index of the Polytropic compression
   ii. Net work done
   iii. Heat transfer during the complete cycle.

2. 1kg of air is taken through a Diesel cycle. Initially the air is at 15°C and 1 bar. The compression ratio is 15 and the heat added is 1850kJ. Calculate:
   i. Ideal cycle efficiency
   ii. Mean effective pressure.

3. One kilogram of fluid enters a nozzle with velocity of 3300m/min and enthalpy of 2900kJ/kg. The enthalpy of the fluid at exit is 2760kJ/kg. The nozzle is placed horizontally. The inlet area of the nozzle is 0.095m^2, specific volume at inlet is 0.19m^3/kg and specific volume at exit is 0.5m^3/kg. Determine:
   i. Velocity of fluid at exit
   ii. Mass flow rate
   iii. Exit area of the nozzle

4. Steam at 15bar and 300°C is supplied to an engine working on Rankine cycle. The exhaust takes place at 0.8bar. Calculate :
   (i) Thermal efficiency.
   (ii) Work ratio.
   (iii) Specific steam consumption.

SECTION 2

5. Two reservoirs are connected by a pipe 2000m long. The difference in levels of the water surfaces of the reservoirs is 20m. It is proposed to increase the flow to the lower reservoir by 30% by attaching another pipe of the same diameter from the upper reservoir to join the main pipe at a junction. Find the length of this additional pipe. Find also the head at the junction.

6. A jet of water of diameter 40mm strikes a cart and deflects through an angle 45° as shown in Figure Q6. The horizontal component of the resultant force on the cart is absorbed by the spring. The stiffness of the spring is 1.6kN/m. Determine:
   i. Amount by which the spring is compressed.
   ii. Reaction force on the wheels due to jet striking the cart

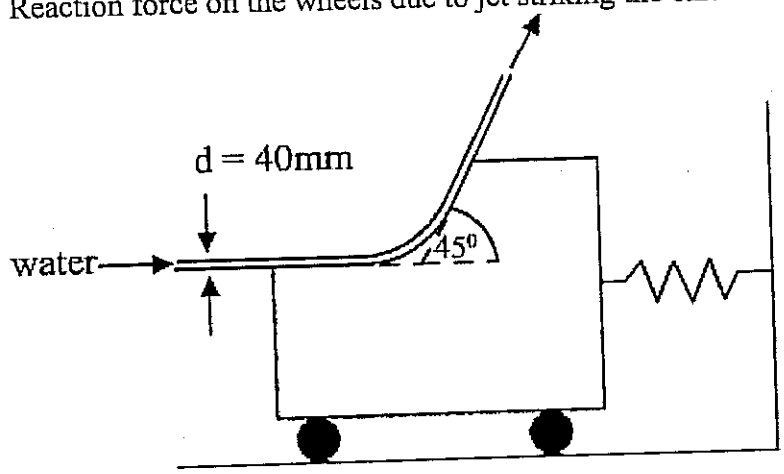


Figure Q6

7. A centrifugal pump is required to deliver 50l/s of water to a height of 30m through a 100m long pipe of 150mm diameter. The inlet losses in the suction pipe are estimated to be 0.35m. Assuming an overall efficiency 70% and taking friction coefficient as 0.015 for the pipe line, determine the power required to drive the pump.

8. A rectangular gate of dimensions 5m×1.5m is hinged at its base A and inclined at 60° with the horizontal. The gate is kept in stable position by hanging a 50kN weight at its upper end through a pulley system as shown in Figure Q8. Find the height h of water at which the gate begins to fall. Neglect the weight of the gate and frictional effects at the hinge and pulley.

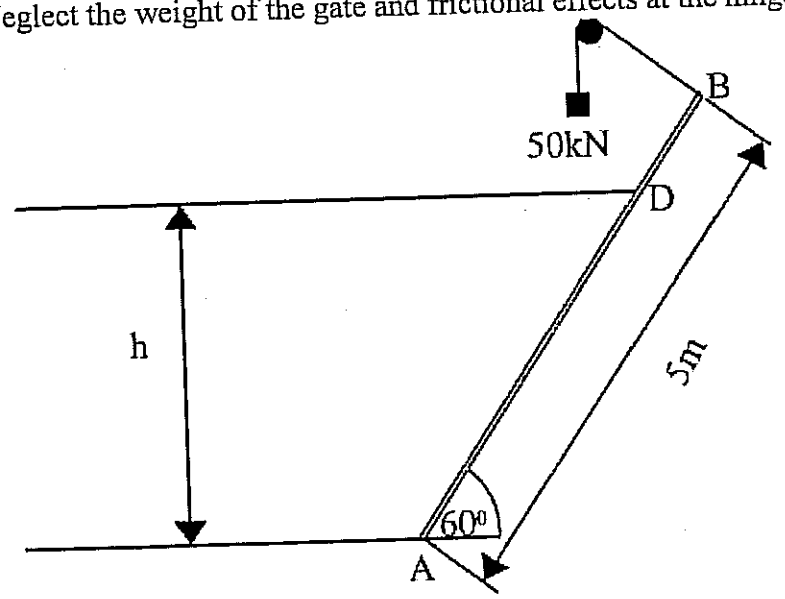


Figure Q8

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