



University of Technology

Department of Electromechanical Engineering

Branch: 2<sup>st</sup> Systems

Subject: Eng. Thermodynamic and Fluids

Second Year

Time Allowed: 3hrs

Date: / / 2014

Examiners: Ass. Prof. Dr. Hashim A. Hussein & Lec. Dr. Khalid Faisal sultan

Name: ID No:

Signature:

**Section A (Thermodynamic)**

**Note:- Answer three questions only**

**Q.1 [10 M]** Show that the thermal efficiency of the Carnot cycle is given by the expression.

$$\eta_{car} = \frac{T_1 - T_2}{T_1}$$

$T_1$  = Maximum absolute temperature of the cycle

$T_2$  = Minimum absolute temperature of the cycle

**Q.2 [10 M]** A quantity of steam a pressure of 2.1 MPa and 0.9 dry occupies a volume of 0.256 m<sup>3</sup>. It is expanded according to the law  $PV^{1.25} = C$  to pressure of 0.7MPa. Determine

- The mass of steam present.
- The external work done.
- The change of internal energy.
- The heat exchange between the steam and surrounding stating the direction of transfer

| P<br>MPa | Tf<br>C <sup>0</sup> | hf<br>KJ/Kg | hfg<br>KJ/Kg | hg<br>KJ/Kg | m <sup>3</sup> /Kg |
|----------|----------------------|-------------|--------------|-------------|--------------------|
| 0.7      | 165                  | 697.1       | 2064.9       | 2762.0      | 0.273              |
| 2.1      | 214.9                | 920.0       | 878.2        | 2798.2      | 0.0949             |

**Q.3 [10 M]** A turbine operating under steady flow condition receives steam at the following state pressure 13.8 bar, specific volume = 0.143 m<sup>3</sup>/Kg , internal energy=2590 kJ/kg, Velocity =30 m/s . The state of steam leaving the turbine is pressure 0.35 bar

Specific volume = 4.37 m<sup>3</sup>/kg

Internal energy =2360 kJ/kg

Velocity =90 m/s.

Heat is lost to the surrounding at a rate of 0.25kJ /sec, find the mass rate of steam flow if the power developed by the turbine is 102.8 kW.

**Q.4 [10 M]** It is required maintain a refrigerator at a temperature of 288 K in a summer day, when the outside ambient temperature is 306 K. the amount of heat rejected from the refrigerator is at the rate of 1230J/determine the maximum possible value of (C.O.P)<sub>R</sub> and compute the maximum possible amount of power which has been added to the refrigerator.

Follow please →

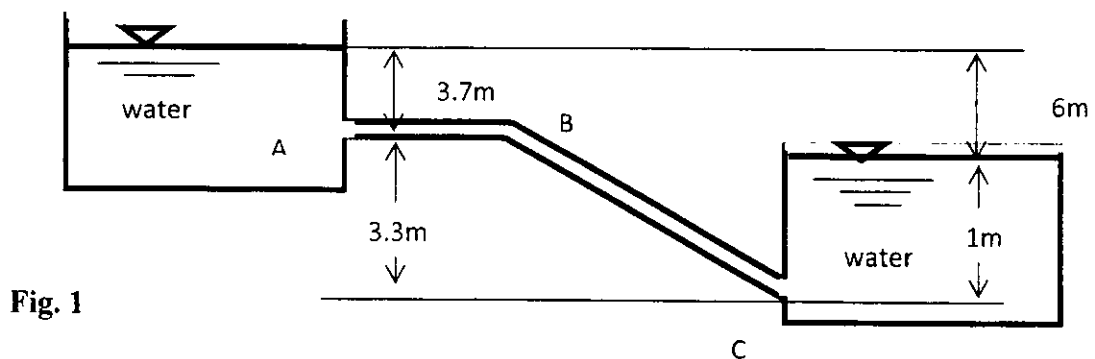
**Section B (Fluids)      Note:- Answer three questions only**

**Q.5. [10 M]**

- A- Sketch the boundary layer over a horizontal flat plate.
- B- A smooth flat plate 1.5m long, 30 cm wide is placed in a stream of air at 8m/s. Calculate thickness of boundary layer and skin friction drag force.  $\rho=1.2 \text{ kg/m}^3$ ,  $\nu=15 \times 10^{-6} \text{ m}^2/\text{s}$ . Assume laminar flow.

**Q.6. [10 M]**

- A- Derive of Darcy equation and explain by equations the total energy degradations when a fluid flows between two reservoirs if the connection of pipes in series and in parallel.
- B- A Pipe ABC connecting two reservoirs is of 75mm diameter. From A to B it is horizontal and from B to C it falls 3.3 m. The length of AB and BC are 24m and 15m respectively. If the water level in the reservoir at A is 3.7m above the pipe and the level in the second reservoir is 1m above the pipe at C, Find the quantity which will flow and the absolute pressure head in the pipe at B. Assume  $f$  is 0.006 and take the entrance energy degradation as being equal to  $0.5 \frac{u^2}{2g}$ . The water barometer is 10.35m. See fig 1.



**Q.7 [10 M]**

- A- A liquid with a constant density ( $\rho$ ) is flowing at an unknown velocity ( $V_1$ ) through a horizontal pipe of cross – sectional area ( $A_1$ ) at a pressure ( $P_1$ ), and then it passes to a section of the pipe in which the area is reduced gradually to ( $A_2$ ) and the pressure ( $P_2$ ). Assume no friction losses. Find the velocities ( $V_1$ ) and ( $V_2$ ) if the pressure difference ( $P_1 - P_2$ ) is measured.
- B- The velocity distribution within the fluid flowing over a plane is given by  $[u = 0.75y - y^2]$  where  $u$  is the velocity in (m/s) and  $y$  is a distance above the plate in (m). Calculate the shear stress at the wall and at the 200mm above the wall. Take  $\mu = 0.84 \text{ p}_a \text{ s}$ .

**Q.8 [10 M]**

- A- Prove that the pressure is the same in all the directions at a point in a static fluid for the three – dimensional case.
- B - The action of a propeller is change the momentum of the fluid within which it is submerged and thus to develop a thrust that used for propulsion .Calculate ,theoretical efficiency ,the thrust, the pressure difference across the propellers and the theoretical power required for an airplane travelling 600km/h through still  $\gamma = 10 \text{ N/m}^3$ , discharges 1200  $\text{m}^3/\text{s}$  through two 1.8 m diameter propellers .

**GOOD LUCK**