Roll Number:_____

Thapar University, Patiala
Department of Chemical Engineering
Mid Semester Examination

B. E. (Second Year): Semester-IV	Course Code: UES-011
	Course Name: Thermo-Fluids
20th March, 2017; Monday, 08:00-10:00 Hrs	**(Thermodynamics)**
Time: 2 Hours, M. Marks: 50	Name of Faculty: VKS/SKA/VKB/SKS/RGU

Note: **Attempt all questions, and all parts of a question at a same place.**
Attempt the paper as per the portion you have studied i.e.Thermodynamics/Fluid Mechanics.
Write either Thermodynamics or Fluid Mechanics, as per you are attempting, at the top of your answer sheet. Also, write the Tutorial Group on the top of the ANSWER SHEET.
Assume missing data, if any, suitably.
Use of steam table is allowed.

Q1. A system of volume V contains a mass m of gas at pressure P and temperature T. The macroscopic properties of the system obey the following relationship:

$$[P + (a/V^2)](V - b) = mRT$$

where a, b, R are constants. Obtain an expression for work done by the system during a constant temperature reversible expansion from volume V_1 to volume V_2. Calculate the work done by a system which contains 10 kg of this gas expanding from 1 m^3 to 10 m^3 at a temperature of 293 K. (Given a = 157 kNm^4, b = 1.07×10^{-2} m^3, R = 0.278 kJ/kg-K) **10**

Q.2 (a) A piston–cylinder device initially contains 50 Litre of liquid water at 40°C and 200 kPa. Heat is transferred to the water at constant pressure until the entire liquid is vaporized. **3.5**
(i) What is the mass of the water?
(ii) What is the final temperature?
(iii) Determine the total enthalpy change.

(b) Complete the following table using steam tables. **4.5**

S. No.	Temperature, T (°C)	Pressure, P (kPa)	Enthalpy, h (kJ/kg)	Quality, x	State
1	140		1800		
2		950	752.74		
3		800	3162.2		

(c) A rigid tank with a volume of 2.5 m^3 contains 15 kg of saturated liquid–vapor mixture of water at 75°C. Now the water is slowly heated. Determine the temperature at which the liquid in the tank is completely vaporized. **2**

Q.3 (a) Two kg water at 120°C with a quality of 25% has its temperature raised by 20°C in a constant volume vessel. What are the heat transfer and work in the process? **4**

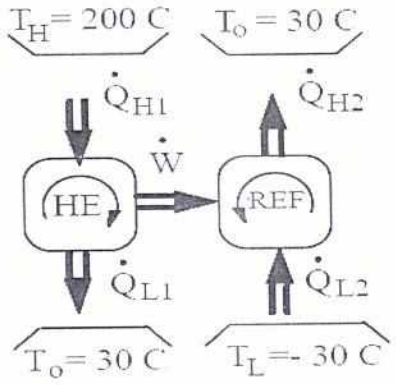
(b) A piston/cylinder contains 50 kg of water at 200 kPa with a volume of 0.1 m^3. Stops in the cylinder are placed to restrict the enclosed volume to a maximum of 0.5 m^3. The water is now heated at constant pressure until the piston reaches the stops. Find the necessary heat transfer. **6**

[PTO]

Q.4 Steam at 1.8MPa and 400°C steadily enters a nozzle whose inlet area is 0.02 m^2. The mass flow rate of steam through the nozzle is 5 kg/s. Steam leaves the nozzle at 1.4MPa with a velocity of 275m/s. Heat losses from the nozzle per unit mass of the steam are estimated to be 2.8kJ/kg. Determine (a) the inlet velocity and (b) the exit temperature of the steam. 5+5

Q.5 (a) An inventor claims to have invented a heat engine that develops a thermal efficiency of 80 percent when operating between two heat reservoirs at 950 K and 300 K. Evaluate his claim. 3

(b) We wish to produce refrigeration at −30°C. A reservoir, shown in figure below, is available at 200°C and the ambient temperature is 30°C. Thus, work can be done by a cyclic heat engine operating between the 200°C reservoir and the ambient. This work is used to drive the refrigerator. Determine the ratio of the heat transferred from the 200°C reservoir to the heat transferred from the −30°C reservoir, assuming all processes are reversible. 7



Roll Number:_____

Thapar University, Patiala

Department of Civil/Chemical Engineering

MID SEMESTER EXAMINATION

B. E. (Second Year): Semester-IV (2016/17)	Course Code: UES011 Course Name: Thermo-Fluids **(Fluid Mechanics)**
March 20, 2017	Monday, 08.00 – 10.00 Hrs
Time: 2 Hours, M. Marks: 50	Name Of Faculty: DNR, RBB, TPK, RKA, AC

Note: Attempt all questions and all parts of a question at same place
Attempt the paper as per the portion you have studied i.e Thermodynamics or Fluid Mechanics
Write either Thermodynamics or Fluid Mechanics as per you are attempting at the top of your answer sheet. Also write your tutorial group at the top of the answer sheet.
Assume missing data, if any, suitably

Q.1	Oil of mass density 800 kg/m^3 is flowing in a pipe. A U-tube manometer is connected in pipe A as shown in Figure 1 to measure the pressure at that point. Find the pressure in the pipe. The manometric liquid present in the manometer is mercury.	(07)
Q.2	A gate having a shape of a quadrant of circle of radius 2 m has to resist water force as shown in Figure 2. Find the resultant water pressure, its location and direction. Take width of gate as unity.	(07)
Q.3	A 60^0 horizontal bend in pipeline conveying water gradually reduces from 0.6 m to 0.3 m diameter. At the larger end the gauge pressure is 171.675 kN/m^2. Determine the magnitude and direction of the force exerted on the bend when the flow is 876 lit/sec.	(07)
Q.4	Determine the displacement thickness and momentum thickness for the following velocity distribution $\frac{u}{U} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$ Where δ is boundary layer thickness and U is free stream velocity.	(07)
Q.5	A pipeline 0.225 m in diameter and 1850 m long has a slope of 1vertical: 200 Horizontal for the first 790 m and 1 vertical in 100 horizontal for the next 790 m. The pressure at the upper end of the pipeline is 107.91 kPa and at the lower end is 53.955 kPa. Determine the discharge through the pipe considering the friction factor of the pipe is 0.032.	(07)
Q.6	Justify or discard the following statements with reasons. (No marks will be awarded for writing only 'true' or 'false') (a) Viscosity of gas decreases with increase in temperature. (b) Shear stress distribution is linear for a steady laminar flow in a pipe. (c) Excess pressure inside a cylindrical liquid jet is $8\sigma/d$ where σ is surface tension and d is the diameter of the cylinder.	(15)

[PTO]

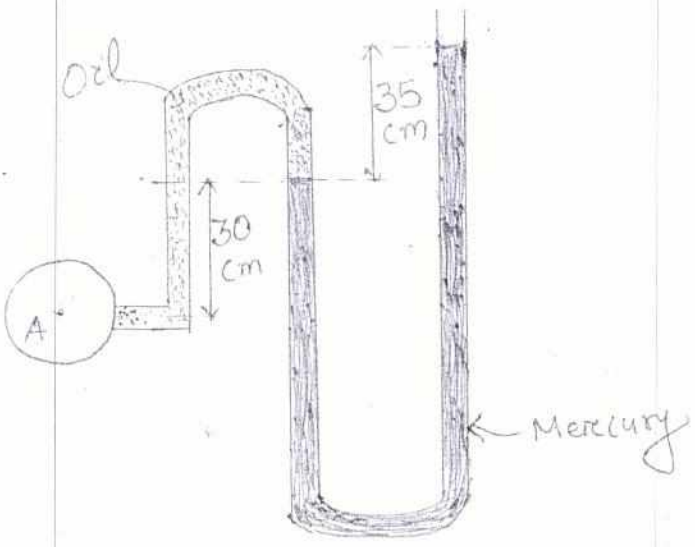


Figure 1

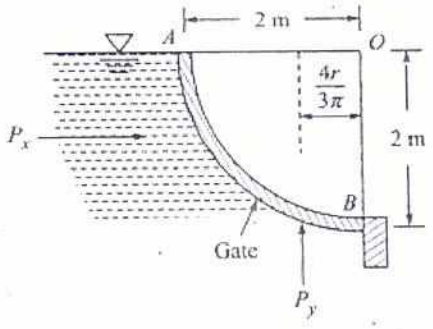


Figure 2