The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: DMX3535/MEX3235 Thermo - Fluids**
Academic Year	: 2017/18
Date	: 3rd February 2019
Time	: 1330-1630hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **eight (8)** questions in **three (3)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Steam tables will be provided on request.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

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1. A differential mercury (specific gravity of 13.6) manometer is connected to two points *A* and *B* of two pipes as shown in figure Q1. The pipe *A* contains a liquid of specific gravity (S_1) 1.5 while pipe *B* contains a liquid of specific gravity (S_2), 0.9. The pressures at *A* and *B* are 1 *Pa* and 1.8 *Pa* respectively. Find the difference in mercury level in the differential manometer.

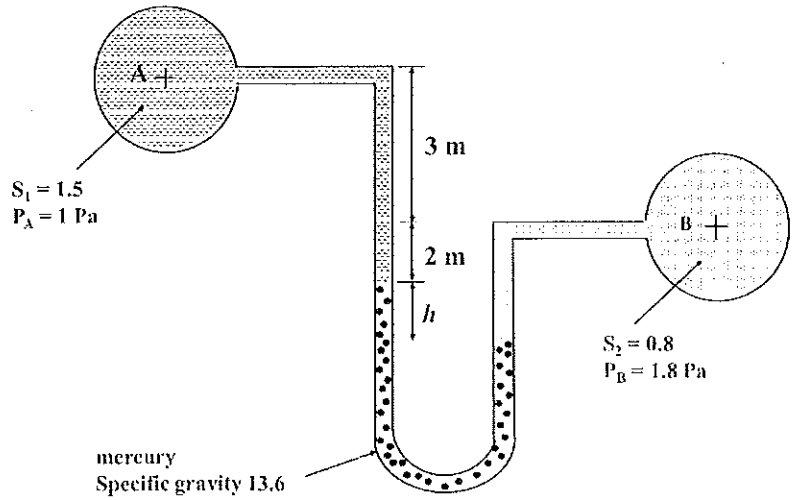

Figure Q1

2. (i) An isosceles triangular plate of base 4 m and height 4 m, is immersed vertically in an oil of specific gravity 0.9 as shown in Figure Q2. Determine the total pressure and the distance to the centre of pressure from the free surface of oil if the base of the plate coincides with the free surface of oil.

(ii) Calculate the new distance to the centre of pressure if the vertex of the triangle coincides with the free surface of oil.

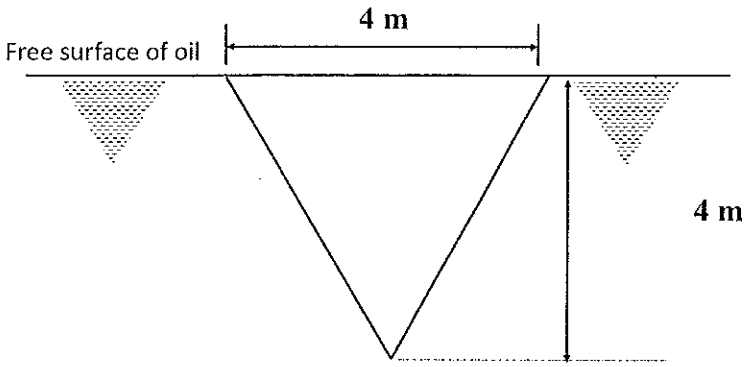

Figure Q 2

3. A venturimeter is inserted in a vertical pipe carrying oil of specific gravity 0.8 as shown in Figure Q3. The pipe and throat diameters are respectively 20 cm and 10 cm. The difference of levels of Mercury (specific gravity 13.6) manometer is 30 cm. Determine the flow rate of oil if the direction of flow is upwards.

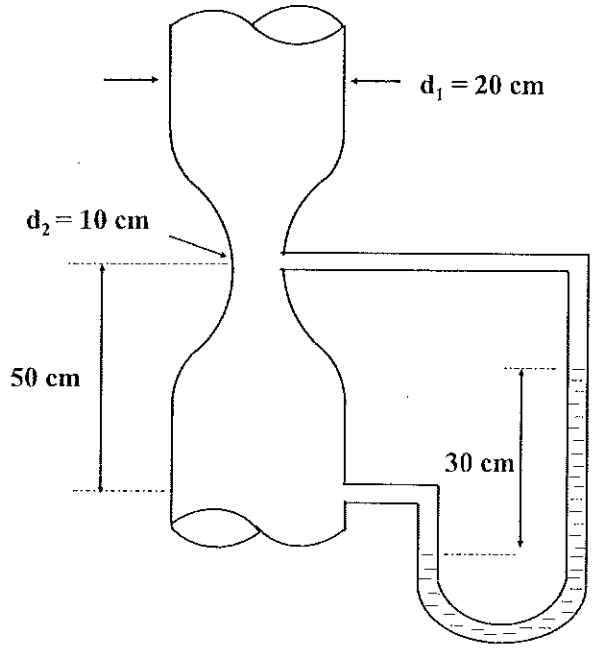

Figure Q 3

4. An air duct of 1 m^2 area gradually reduces to 0.5 m^2 area with a 45^0 bend as shown in figure Q 4. Find the magnitude and direction of the force required to hold the duct stationary, if the velocity and pressure of the flow at the inlet is 10 m/s and 30 kPa respectively. The density of air is 1.16 kg/m^3.

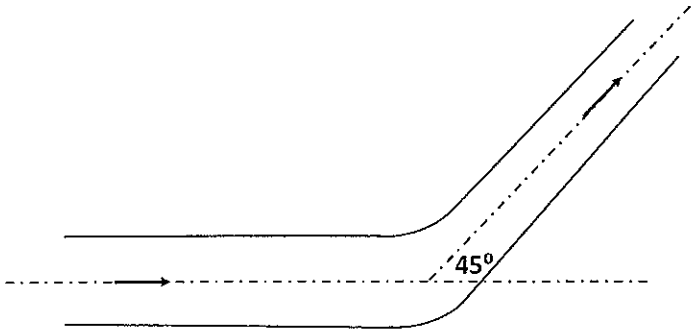

Figure Q 4

5. (i) State the first law of thermodynamics.

   (ii) Air undergoes a polytropic compression in a piston–cylinder assembly from $p_1 = 1\ bar, T_1 = 22^0C$ to $p_2 = 5\ bar$. Employing the ideal gas model, determine the work and heat transfer per unit mass, in kJ/kg, if the index of compression, $n = 1.3$.

   (For air, $C_p = 1.005\ kJkg^{-1}K^{-1}$, $C_v = 0.718\ kJkg^{-1}K^{-1}$, $R = 0.287kJkg^{-1}K^{-1}$.)

6. A Steam turbine plant operates on an ideal Rankine cycle. Saturated vapor enters the turbine at 2.0 MPa and saturated liquid exits the condenser at a pressure of $10kPa$.
   Determine the following.

   (i) Work done from the turbine.
   (ii) Rate of heat transfer, from the condensing steam as it passes through the condenser.
   (iii) Thermal efficiency.

7. (i) Draw $P - v$ diagram and $T - S$ diagram for the Otto cycle.

   (ii) An air-standard Otto cycle of compression ratio 8 is executed with a starting pressure 1 bar and temperature300 K. The maximum temperature during the cycle is $2000K$. Determine the temperature and pressure at the end of each process and the thermal efficiency. Take $\gamma\ as$ 1.4.

8. (i) State the steady flow energy equation describing all the terms.

   (ii) Steam enters a turbine operating at steady state with a mass flow rate of4600 kg/h. The turbine develops a power output of 1000 kW. At the inlet, the pressure is 60 bar, the temperature is 400^0C, and the velocity is 10 m/s. At the exit, the pressure is0.1 bar, the quality of steam is 0.9 (90%), and the velocity is 50 m/s. Calculate the rate of heat transfer between the turbine and surroundings.