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	**: DMX3401 Fluid Mechanics and Thermodynamics**
Academic Year	: 2021/22
Date	: 15th Wednesday, February 2023
Time	: 0930-1230hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. Answer **five (05)** Questions only. All questions carry equal marks.
3. Relevant charts/ codes are provided.
4. This is a Closed Book Test (CBT).
5. Answers should be in clear handwriting.
6. Do not use Red colour pen.
7. Take the specific gas constant (R) for air as $0.287kJ/\ kgK$.
8. Density of Water is $1000kg/m^3$
9. For air $C_v = 0.718\ kJ/kg.K$ and $C_p = 1.005\ kJ/kgK$

Q1 (a) Draw p – V diagrams and T- s diagram for four thermodynamic processes indicating their names. (6 marks)

(b) A vessel of 5 m^3 capacity contains air at 100 kPa and temperature of 300K. Some air is removed from the vessel to reduce the pressure and the temperature to 50 kPa and 7°C respectively. Find the amount of air removed and the volume of mass of air removed at initial states of air. Take R = 287 J/kg. K for air. (14 marks)

Q2 (a) Draw p -V diagram and T-s diagram for Otto cycle and name all the processes. (5 marks)

(b) In an SI engine working on the ideal Otto cycle, the compression ratio is 5.5. The initial pressure and temperature are 1 bar and 27°C, respectively. The peak pressure is 30 bar. Determine the pressure and temperature at all points, and the air-standard efficiency (15 marks)

Q3 (a) State the First law of thermodynamics. (5 marks)

(b) A gas contained in a cylinder is compressed from 1 MPa and 0.05 m^3 to 2 MPa. Compression is governed by $pV^{1.4} = constant$. Internal energy of gas is given by; (10 marks)

$U = 7.5\,pV - 425$ kJ.

where p is pressure in kPa and V is volume in m^3.

Determine heat, work done, and change in internal energy

(c) Also find out work interaction, if the 180 kJ of heat is transferred to system between same states. (5 marks)

Q4 (a) Explain the three modes of heat transfer with the examples (6 marks)

(b) Write the Fourier's Law of conduction and explain each term. (4 marks)

(c) A 10m long and 3m high wall is composed of an insulation layer with thermal resistance (R) of 2 m^2 K/W and a wood layer with the same of 0.15 m^2 K/W. Estimate the heat transfer rate through the wall if the temperature difference is 40^0C. (10 marks)

Q5 (a) Write the force momentum equation and explain each term. (5 marks)

(b) The pipe bend shown in figure Q5 is in a horizontal plane. Oil with a specific gravity of 0.86 enters the pipe at section A with a velocity of 3.2 m/s and a pressure of 150 kPa. Determine the force required to hold the bend in place. Neglect any energy loss in the bend. (15 marks)

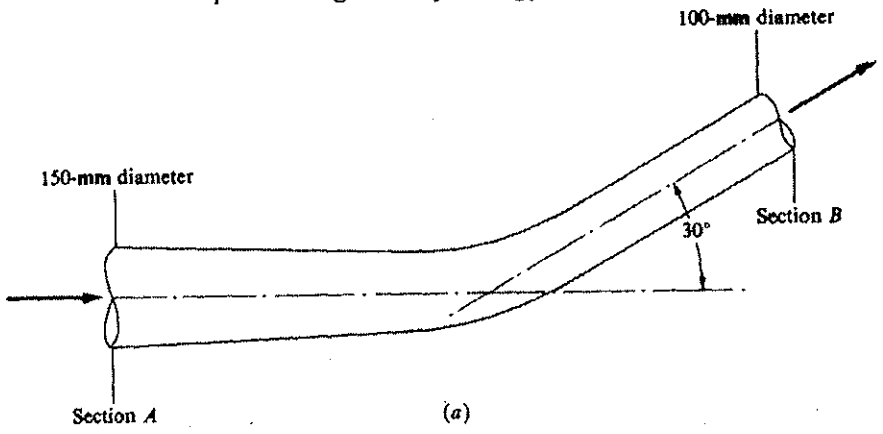

Figure Q5

Q6 (a) Name four flow measuring devices. (4 marks)

(b) Determine the pressure difference of the points A and B of the manometer arrangement shown in Figure Q6. The specific gravity of Benzene, Mercury, Kerosene, and water are 0.88, 13.6, 0.82 and 1 respectively. (16 marks)

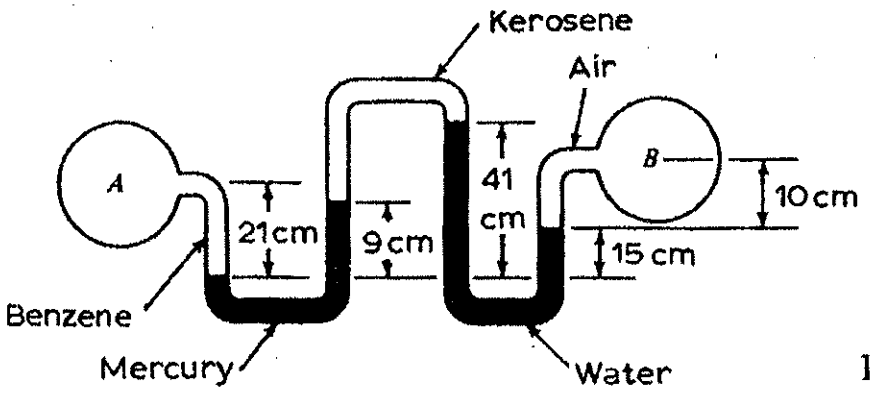

Figure Q6

Q7 (a) Explain the term "stability" of a floating in a liquid. (5 marks)

(b) A barge with 7 m width and 14m long floats in water as shown in Figure Q7. Determine the weight of the loaded barge. (15 marks)

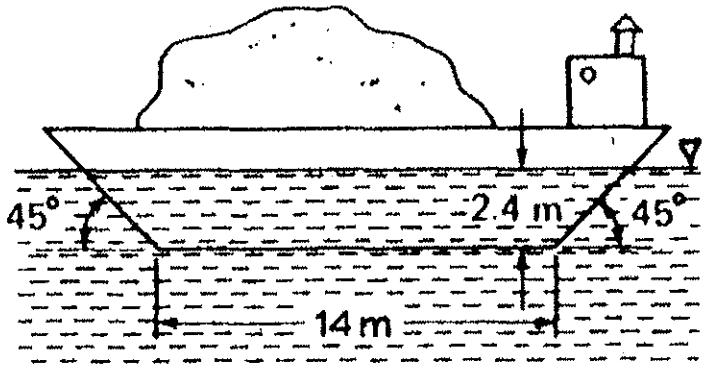

Figure Q7

Q8 (a) Explain the term center of pressure in fluid mechanics (5 marks)

(b) Figure Q8 shows a dam of length(L) of 30.5 m, that retains 8 m of fresh water and is inclined at an angle θ of 60°. Calculate the magnitude of the resultant force on the dam and the location of the center of pressure. (15 marks)

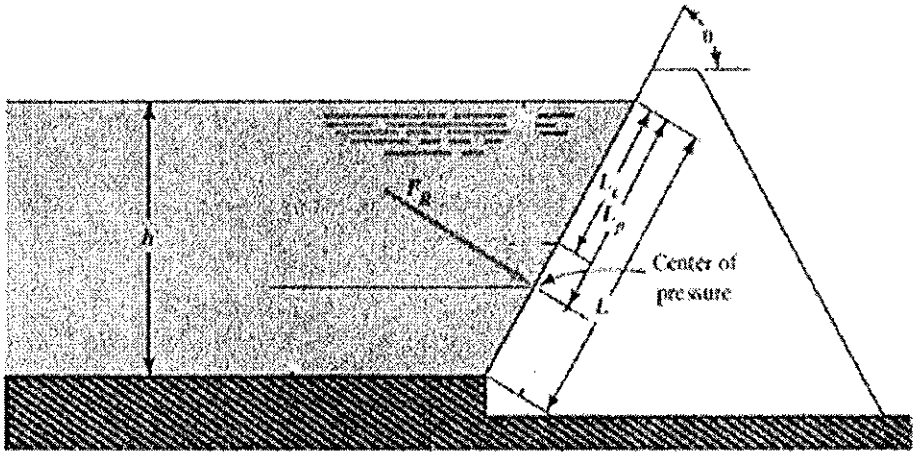

Figure Q8

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