Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	THERMOFLUIDS
COURSE CODE	:	BDX 20203
PROGRAMMECODE	:	BDX
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS.
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.**
		3. STUDENTS ARE **PHOHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Define the following properties of fluids and also mention their units:-

(i) Mass density

(ii) Specific weight

(iii) Specific volume

(iv) Specific gravity

(8 marks)

(b) The space between two square flat plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate which moves at 2.5 metre per sec requires a force of 98.1 N to maintain the speed. Determine the

(i) the dynamic viscosity of the oil in poise, and

(ii) the kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95.

(9 marks)

(c) Discuss the following types of fluid flows:

(i) Steady and unsteady flows

(ii) Laminar and turbulent flows

(iii) Compressible and incompressible flows

(iv) Rotational and irrotational flows

(8 marks)

Q2 (a) An oil of viscosity 9 poise and specific gravity 0.9 is flowing through a horizontal pipe of 60 mm diameter. If the pressure drop in 100 m length of the pipe is 1800 kN/m^2, determine:

(i) The rate of flow of oil;

(ii) The center-line velocity;

(iii) The total frictional drag over 100 m length;

(iv) The power required to maintain the flow;

(v) The velocity gradient at the pipe wall;

(vi) The velocity and shear stress at 8 mm from the wall.

(18 marks)

(b) Describe the following losses in pipe with suitable sketches:

(i) Loss of head due to sudden enlargement

(ii) Loss of head due to sudden contraction

(iii) Loss of head at the entrance of the pipe

(iv) Loss of head at the exit of the pipe

(v) Loss of head due to obstruction in a pipe

Mention the methods of preventing the separation of boundary layer.

(7 marks)

Q3 (a) Define the following terms with suitable sketches:

(i) System

(ii) Boundary

(iii) Difference between closed and open system

(iv) Cyclic process

(v) Reversible process

(vi) Isothermal process

(12 marks)

(b) Define the following terms related to steam formation:

(i) Sensible heat of water

(ii) Latent heat

(iii) Dryness fraction

(iv) Superheated steam

(8 marks)

(c) When a stationary mass of gas was compressed without friction at constant pressure its initial state of 0.4 m^3 and 0.105 MPa was found to change to final state

of 0.20 m^3 and 0.105 MPa. There was a transfer of 42.5 kJ of heat from the gas during the process. How much did the internal energy of the gas change?

(6 marks)

Q4 (a) When a system is taken from state l to state m, in **FigureQ4(a),** along path lqm, 168 kJ of heat flows into the system, and the system does 64 kJ of work:

(i) How much will be the heat that flows into the system along path lnm if the work done is 21 kJ?

(ii) When the system is returned from m to l along the curved path, the work done on the system is 42 kJ. Does the system absorb or liberate heat, and how much of the heat is absorbed or liberated?

(iii) If Ul = 0 and Un = 84 kJ, find the heat absorbed in the processes ln and nm.

(18 marks)

(b) A Carnot cycle operates between source and sink temperatures of 250°C and – 15°C. If the system receives 90 kJ from the source, find:

(i) Efficiency of the system;

(ii) The net work transfer;

(iii) Heat rejected to sink.

(7 marks)

Q5 (a) An insulated cylinder of volume capacity 4 m^3 contains 20 kg of nitrogen. Paddle work is done on the gas by stirring it till the pressure in the vessel gets increased from 4 bar to 8 bar. Determine:

(i) Change in internal energy,

(ii) Work done,

(iii) Heat transferred, and

(iv) Change in entropy.

Take for nitrogen : $C_p = 1.04$ kJ/kg K, and $C_v = 0.7432$ kJ/kg K.

(16 marks)

(b) Mention the following statements of second law of thermodynamics:

(i) Clausius statement

(ii) Kelvin-Planck statement

(iii) Find the co-efficient of performance and heat transfer rate in the condenser

of a refrigerator in kJ/h which has a refrigeration capacity of 12000 kJ/h when power input is 0.75 kW.

(9 marks)

Q6 (a) Describe the working of Otto cycle with suitable p-V and T-s diagram. In a constant volume 'Otto cycle', the pressure at the end of compression is 15 times that at the start, the temperature of air at the beginning of compression is 38°C and maximum temperature attained in the cycle is 1950°C. Determine:

(i) Compression ratio:

(ii) Thermal efficiency

(iii) Work done. Take adiabatic index for air as 1.4.

(12 marks)

(b) An engine with 200 mm cylinder diameter and 300 mm stroke works on theoretical Diesel cycle. The initial pressure and temperature of air used are 1 bar and 27°C. The cut-off is 8% of the stroke. Determine:

(i) Pressures and temperatures at all salient points.

(ii) Theoretical air standard efficiency.

(iii) Mean effective pressure.

(iv) Power of the engine if the working cycles per minute are 380.

Assume that compression ratio is 15 and working fluid is air. Consider all conditions to be ideal

(13 marks)

-END OF QUESTIONS –

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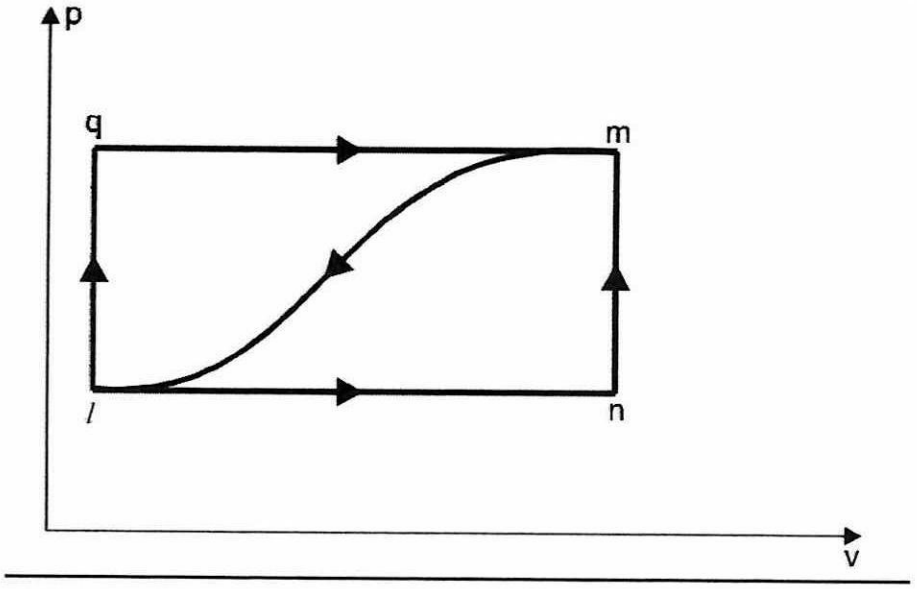

FigureQ4(a)