Question Paper

Exam Date & Time: 26-Apr-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. (ENGG)
END-SEMESTER THEORY EXAMINATION- APRIL 2018
DATE:26.04.2018
TIME:09.30AM TO 12.30PM

Thermodynamics and Fluid Mechanics [ME 241]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.

Missing data, if any, may be suitably assumed

1) **Differentiate between the followings:** (5)

A) a) Macroscopic and Microscopic point of view
b) Closed system and Open system
c) Isolated system and Adiabatic system
d) Intensive and Extensive property of a system
e) Point function and Path function of a system.

B) Show that the energy is a property of the thermodynamic system. (7)

C) In an engine the charge is at 105 kPa and 310 K at the beginning of compression. It reaches 2.5 MPa after compression by following the law $PV^{1.4}$ =C. Calculate the temperature at the end of compression and work done. (8)

2) Explain the various state of thermodynamic equilibrium of a system. (6)

A)

B) With the help of P-V diagram, derive an expression for the work done in the following cases. (6)

a. Constant volume process
b. Constant pressure process
c. Isothermal process
d. Adiabatic process

C) In a rotary compressor air flows steadily at a rate of 1.5 kg/s. The air enters with a velocity of 80 m/s and leaves at 4.5 m/s. The specific volume at inlet is $0.9m^3$/kg and at the exit is $0.4m^3$/kg. As the air passes through the compressor, the specific enthalpy of air is increased by 110 kJ/kg and losses heat of 20 kJ/kg. Determine a) The inlet and exit areas of the compressor b) The power required to drive the compressor in kW. (8)

3) Show that the COP of a heat pump is greater than the COP of a (6)

	A)	refrigerator.	
	B)	Explain the working of vapour compression refrigeration cycle.	(6)
	C)	An ideal gas occupies 0.3 m^3 of volume at 2 bar pressure. The gas executes a cycle consisting of following processes. (i)1-2 constant pressure process with work interaction of 12 kJ. (ii) 2-3 compression process which follows the law PV = constant and $U_3 = U_2$ (iii) 3-1, constant volume and change in internal energy $U_1 - U_3$ is -40 kJ. Neglect changes in kinetic and potential energy, draw P-V diagram and show that first law is obeyed by the cycle.	(8)
4)		Derive an expression of thermal efficiency of a reversible Carnot cycle.	(6)
	A)		
	B)	Write the two statements of the second law of thermodynamics and show that violation of one equally violates the other.	(6)
	C)	A source at temperature T_1 K supplies heat to a reversible heat engine which rejects heat to a low temperature sink at 780 K. The sink acts as a source for second reversible engine which rejects heat to a cold reservoir at 280 K. Determine T_1, (i) for equal thermal efficiencies of the two engines and (ii) when two engines deliver the same amount of work.	(8)
5)		Explain various properties of fluids and Newton's law of viscosity.	(4)
	A)		
	B)	Explain with suitable sketch the surface tension and capillarity action of liquid and derive the expression for capillary rise of a liquid surface in a small tube.	(6)
	C)	The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 0.6 $N.s/m^2$. The shaft of diameter 0.4 m and rotates at 200 rpm. Calculate the power loss in the bearing for a sleeve length of 90 mm. The thickness of oil film is 1.5 mm.	(10)
6)		Define Pascal's law and with the help of a sketch show that the intensity of pressure is same all directions.	(6)
	A)		
	B)	Calculate the capillary effect in millimeter in a glass tube of 4 mm diameter, when immersed in (i) water, and (ii) mercury. The temperature of the liquid is 20^0 C and the values of the surface tension of water and mercury at 20^0 C in contact with air are 0.073575 N/m and 0.51 respectively. The angle of contact for water is zero and for mercury 130^0. Take density of water at 20^0 C as equal to 988 kg/m^3. Take specific gravity of mercury 13.6.	(8)
	C)	Explain the following states of flow: a.Uniform and non-uniform flow b. Compressible and in-compressible flow	(6)

c. Laminar and turbulent flow

7) Derive Euler's equation of motion and then find Bernoulli's energy equation for incompressible steady flow. (6)

A)

B) Derive continuity equation in three dimensional flows. (6)

C) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 liters/s. Find the reading of the oil-mercury differential manometer. Take C_d=0.98. (8)

8) (8)

A) The efficiency (η) of a fan depends on density (ρ), dynamic viscosity (μ) of the fluid, angular velocity (ω), diameter (D) of the rotor and the discharge (Q). Express (η) in terms of dimensionless parameters using Rayleigh method.

B) Derive the expression for the discharge through a V-notch. (6)

C) Derive Darcy Weisbatch's equation and to determine the loss of head due to friction in pipes. (6)

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