Question Paper

Exam Date & Time: 05-Jun-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. DEGREE MAKE UP EXAMINATION - MAY /JUNE 2018
DATE: 5 JUNE 2018
TIME : 9.30 AM TO 12.30 PM

Thermodynamics and Fluid Mechanics [ME 241]

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

Answer ANY FIVE full Questions.
Missing data, if any, may be suitably assumed

1)		Differentiate between; i) Heat and work ii) Path function and point function iii) Intensive and Extensive properties iv) Isolated system and Adiabatic system	(4)
	A)		
	B)	Explain the state of thermodynamic equilibrium of a system.	(6)
	C)	The pressure-volume relation for a non-flow reversible process is P= (8 - 4V) bar, where V is in m^3. If 130 kJ of work is supplied to the system, calculate final pressure and volume of the system. Take initial volume = 0.5 m^3.	(10)
2)		Explain Joule's experiment of first law of thermodynamics applied to a closed system.	(6)
	A)		
	B)	Obtain an expression for PdV work done in the following cases and show the processes on P-V diagram. i) Polytropic process ii) Isothermal process iii) Adiabatic process.	(6)
	C)	An engine cylinder of diameter 22.5 cms has a stroke of 37.5 cm. The swept volume is 4 times the clearance volume. The pressure of gases at the beginning of expansion stroke is 1570 kPa. Find the work done during expansion stroke assuming the process as reversible adiabatic. Assume γ= 1.4.	(8)
3)		State the assumptions made & derive an expression for a	(6)

	A)	steady flow energy equation applied to an open thermodynamics system.	
	B)	Show that the energy is the property of a thermodynamic system.	(6)
	C)	In a rotary compressor air flow 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 0.9m3/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 and b) The power required to drive the compressor in kW.	(8)
4)		Write the statements of the second law of thermodynamics.	(4)
	A)		
	B)	Write the statements of the second law of thermodynamics and show that violation of one equally violates the other.	(6)
	C)	A reversible heat engine operates between two reservoirs at temperature of 820^{0}C and 27^{0}C. The engine drives a reversible refrigerator which operates between reservoirs at 27^0 C and -15^{0}C. The heat transfer to the heat engine is 2000 kJ and the network available for the combined engine refrigerator system is 300 kJ. Evaluate i) Heat transfer to the refrigerant and the net heat transfer to the reservoir at 27^{0}C	(10)
5)		Explain various properties of fluids and Newton's law of viscosity.	(6)
	A)		
	B)	Explain surface tension and capillarity action of liquid and derive the expression for capillary rise of a liquid surface in a small tube.	(6)
	C)	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)
6)		Define Pascal's law and show that the intensity of pressure is same all directions.	(6)
	A)		
	B)		(6)

Derive continuity equation in three dimensional flows.

C) An inverted U-tube monometer is connected to two horizontal pipes A and B through which water is flowing. The vertical distance between the axes of these pipes is 30 cm. When an oil of specific gravity 0.8 is used as a gauge fluid, the vertical heights of water columns in the two limbs of the inverted monometer [when measured from the respective center lines of the pipes] are found to be same and equal to 35 cm. Determine the difference of pressure between the pipes. (8)

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

A)

B) Derive Darcy equation for loss of head due to friction in pipes. (6)

C) An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/s. Find the head loss due to friction and the power required to maintain the flow for a length of 1000 m. Take γ = 0.29 stokes. (8)

8) Derive the expression for the discharge through a venturimeter. (6)

A)

B) State Buckingham's π-theorem and explain methods of selecting repeating variables. (6)

C) The resisting force of a supersonic plane during flight can be considered as dependent on the length of the aircraft L, velocity V, viscosity μ, mass density ρ, Bulk modulus K. Express the fundamental relationship between resisting force and these variables. (8)

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