Question Paper

Exam Date & Time: 07-May-2019 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
III SEMESTER B.Sc. (Applied Sciences) in Engg.
END SEMESTER THEORY EXAMINATION APRIL/MAY 2019
THERMAL ENGINEERING [IME 231]

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

Answer 5 out of 8 questions.

Any missing data if any, may be suitably assumed.
Use of Thermodynamic data handbook is permitted.

1) A) Differentiate between, (5)
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) With the help of sketch explain Joule's experiment applied to the 1st law of thermodynamics (5)

C) A gas of 0.015 m^3 at constant pressure of 2060 kN/m^2 expands to a pressure of 210 kN/m^2 by following the law $PV^{1.35} = C$. Determine the network transfer by the gas during the process (10)

2) A) What are similarities and dissimilarities between work and heat transfer of a system. (4)

B) Explain the first law of thermodynamics applied to a closed system executing a cyclic process and an open system executing a process. (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 0.9 m^3/kg and at the exit us 0.4 m^3/kg. As the air passes through the compressor the specific enthalpy of air is increased by 110 kJ/kg and losses of heat of 20 kJ/kg. Determine, (10)
(a) The inlet and exit areas of the compressor in m^2
(b) The power required to drive the compressor in kW.

3) A) 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)

B) Show that the internal energy is the property of a system. (4)

	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)
4)		Define the two parallel statements of second law of thermodynamics and show that violation of one equally violates the other	(6)
	A)		
	B)	Define and derive the relationship between COP of Refrigerator and Heat pump.	(4)
	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.	(10)
5)		Explain different methods to improve the efficiency of a Rankine Vapour Cycle.	(6)
	A)		
	B)	Explain the working of Ideal Regenerative cycle with the help of sketch and T-S diagram of the cycle.	(4)
	C)	An steam power plant operates on a theoretical reheat cycle. The steam from boiler at 150 bar and 550^0C expands through the high-pressure turbine. It is reheated at constant pressure at 40 bar to 550^0C and expands through the low pressure turbine to a condenser pressure if 0.1 bar. Draw T-s and h-s diagrams and find (a) Quality of steam at low pressure turbine, (b) Thermal efficiency of the cycle, and (c) Steam rate in kg/kWh.	(10)
6)		Derive an expression for air standard efficiency of constant pressure cycle in terms of cut off ratio and compression ratio.	(6)
	A)		
	B)	Explain and compare efficiencies of Otto and Diesel air standard cycles.	(4)
	C)	In an SI engine working on an ideal otto cycle, the compression ratio is 3.5. The pressure and temperature at the beginning of compression are 1 bar and 27^0C respectively. The peak pressure is 30 bar. Determine the pressure, temperature at the salient points and the air standard efficiency of the cycle.	(10)
7)		Obtain an expression for Works of Compression in a 2-Stage compressor with perfect inter cooling.	(6)
	A)		
	B)	Explain advantages of multistage reciprocating compression.	(4)
	C)	A single cylinder, double -acting reciprocating air compressor receives air at 1 bar, 17^0C compresses it to 6 bar according to law $PV^{1.25}$ =Constant. The cylinder diameter is 300 mm. The average piston speed is 150 m/min at 100 rpm. Calculate the power required in kW during the compression. Neglect clearance.	(10)

8) A) With a neat sketch explain the working of vapor Absorption refrigeration system. (6)

B) Explain the Morse test to determine the performance of SI Engines. (4)

C) A refrigerator used R-12 as a working refrigerant and it operates on an ideal vapour compression refrigeration cycle. The temperature of refrigerant in the evaporator is -20^0C and in the condenser is 40^0C. The refrigerant is circulated at the rate of 0.03 kg/s and leaving evaporator in saturated vapour condition. Determine the COP and capacity of refrigeration plant in tons of refrigeration. (10)

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