Question Paper

Exam Date & Time: 14-Nov-2018 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTER FOR APPLIED SCIENCES
THIRD SEMESTER BSC APPLIED SCIENCES THEORY EXAMINATION NOVEMBER 2018
THERMAL ENGINEERING [IME 231]

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

DESCRIPTIVE

Answer 5 out of 8 questions.

Answer ANY FIVE full Questions.
Missing data, if any, may be suitably assumed
Use of thermodynamics data hand book and steam tables permitted.

1) Differentiate between the following with suitable example: (8)

1A) a) Macroscopic and Microscopic point of view
b) Closed system and Open system
c) Intensive and Extensive property of a system
d) Point function and Path function of a system.

1B) Define Zeroth law of thermodynamics and explain how to measure temperature of a body using zeroth law of thermodynamics. (4)

1C) The pressure volume relation for a non-flow reversible process is P = [8-4V] where P in bar, 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 = 0.5K m^3. (8)

2) Explain Joule's experiment of Ist law of thermodynamics applied to a closed system executes a complete cycle. (5)

2A)

2B) Express assumptions made & derive an expression of a steady flow energy equation applied to an open thermodynamics system. (5)

2C) 3 kg of air at a pressure of 150 kPa and temperature 360 K is compressed polytropically to 750 kPa according to law $PV^{1.2}$ = C. The air is then cooled to initial temperature at constant pressure. The air is then expanded at constant temperature till it reaches original pressure of 150 kPa. Draw the cycle on P-V diagram and determine the net amount of work transfer. (10)

3) Define the two parallel statements of second law of thermodynamics and show that violation of kelvin-plank statement equally violates the Clausius statement. (6)

3A)

3B) Prove that entropy is property of the system. (4)

3C) 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 at 780 K acts as a source for second reversible engine which rejects heat to a cold reservoir at 280 K. Determine T_1 (10)
(i) for equal thermal efficiencies of the two engines
(ii) when two engines deliver the same amount of work.

4) Explain various Methods to improve the efficiency of Rankine Vapour Cycle. (5)

4A)

4B) Explain the working of Ideal Reheat Rankine cycle with the help of reheat Rankine cycle and T-S diagram. (5)

4C) A steam power plant operates on a simple Rankine cycle. The pressure and temperature of steam entering the turbine are 4 Mpa and 400^0 C respectively. The (10)

turbine efficiency is 90% and pump efficiency is 85%. Calculate the quality of steam entering the condenser and the thermal efficiency of the cycle.

5) Derive an expression for air standard efficiency of constant pressure cycle in terms of cut off ratio and compression ratio. (6)

5A)

5B) Explain and compare efficiencies of Otto and Diesel air standard cycles. (4)

5C) An air standard diesel cycle has a compression ratio of 16. The temperature before compression is 27^0C and the temperature after expansion is 627^0 C. Determine, (10)
(a) The network output per unit mass of air,
(b) Thermal efficiency of the cycle,
(c) Specific air consumption in kg/ kW.h and (d) Mean effective pressure.

6) Obtain an expression for Works of Compression in a 2-Stage compressor with perfect inter cooling. (5)

6A)

6B) Explain advantages of multistage reciprocating compression. (5)

6C) A single acting air compressor has a cylinder base of 15 cm and piston stroke of 25 cm. The crank speed is 600 rpm. Air taken from atmosphere condition of 1 bar and 27^0 C is delivered at 11 bar. Assuming that both compression and expansion process are according to the law $PV^{1.25}$ =C and the clearance is 5%, determine (10)
(a) Power required to drive the compressor assuming mechanical efficiency of 80% and
(b) volumetric efficiency.

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

7A)

7B) Explain Factors effecting the co-efficient of performance of Vapor compression refrigeration system. (4)

7C) A simple vapour compression plant produces 5 tonnes of refrigeration. The enthalpy values at inlet to compressor, at exit from the compressor and at exit from the condenser are 183.14, 209.41 and 74.59 kJ/kg respectively. Estimate, (10)
(i) the refrigerant flow rate,
(ii) The COP,
(iii) The power required to drive the compressor and
(iv)The rate of heat rejected to the condenser.

8) What are the different modes of heat transfer? Explain briefly. (4)

8A)

8B) Explain the Morse test to determine the performance of SI Engines. (6)

8C) The following observations are recorded in a test of one hour duration on a single cylinder four stroke S.I engine. Bore = 220 mm, stroke = 300 mm, fuel used =4 kg, calorific value of fuel = 42,000 kJ/kg, Speed 300 rpm, mean effective pressure = 5 bar, load on break drum = 60 kg, spring balance reading = 30 N, diameter of break drum = 1.4m, quantity of cooling water = 500 kg, temperature rise of cooling water = 20^0 C, air-fuel ratio = 16, exhaust gas temperature = 410^0C, C_p of exhaust gas = 1.1 kJ/kg, ambient temperature = 30^0C. Calculate the following (10)
(i) Mechanical Efficiency,
(ii) Indicated thermal efficiency, and
(iii) draw a heat balance sheet in kJ/min.

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