choice based (prod) 20×3+03+10=73

29/11/2017 SE (SEM III) App Thermo

Q. P. Code: 25657

3 HOURS Max. Marks: 80

Instructions:

1. Q.No. 1 is compulsory.
2. Attempt any THREE questions out of remaining five questions.
3. Assume suitable data wherever necessary.
4. Use of steam tables and moiller chart is permitted.

Q.No.1 Attempt **any FOUR**. 5*4=20

a) A piston- cylinder arrangement is containing a fluid at a pressure of 4 bar and with specific volume of 0.20 m^3/kg allows the fluid to expand reversibly to a pressure of 0.8 bar according to the law $p = c/v^2$, where 'c' is a constant. Determine the work done by the fluid on the piston.

b) What are the limitations of First Law of Thermodynamics and state Kelvin-Planck and Claussius statements of second law of thermodynamics?

c) State and prove Carnot's theorem.

d) State and prove Clausius inequality.

e) Calculate the state of steam i.e. whether it is wet, dry or superheated for the following cases: i) Steam has a pressure of 15 bar and specific volume of 0.12 m^3/kg. ii) Steam has a pressure of 10bar and temperature 200^0C. iii) Steam has a pressure of 30bar and if 2700 kJ/kg of heat is required to generate steam.

f) Obtain an expression for air standard efficiency of Diesel cycle.

Q.No.2 a) Obtain the expressions for change in entropy of the non-flow processes i.e. Isobaric, Isochoric, Isothermal and Isentropic. 10

10

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b) A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During the cycle, the sum of all heat transfer is -150 kJ and the system completes 100 cycles per minute. Complete the following table and calculate the net rate of work output.

Process	Q (kJ/min.)	W (kJ/min.)	dU (kJ/min.)
1-2	0	2150	.....?
2-3	20000	0	.....?
3-4	-2000	.....?	-36000
4-1	......?	.....?	....?

Q.No.3 a) A perfect gas flows through a nozzle where it expands in a reversible adiabatic manner. The inlet conditions are 22 bar, 500^0C and 38 m/sec. at the exit the pressure is 2 bar. Determine the exit velocity and exit area if the flow rate is 4 kg/sec. take R=190 J/kgK and γ=1.35. 10

b) Two reversible heat engines A and B are arranged in series. A receives 30 kJ at a temperature of 500°C from a heat source, while engine B is in communication with a cold sink at a temperature of 5°C. If the work output of A is twice that of B, calculate the intermediate temperature between A and B and thermal efficiency of each engine. 10

Q.No.4 a) 0.2 m^3 of air at 2 bar and 80°C is compressed to 0.05 m^3 according to the law $pV^{1.35} = C$. Now the heat is added at constant volume until its pressure is 12 bars. Calculate the change in entropy in each process undergone. 10

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b) 3 kg of steam at 9 bars and 260^0C undergoes a constant pressure process. The resulting steam is wet having dryness fraction 0.6. Calculate work done, change in enthalpy and heat transferred assuming non-flow process.

Q.No.5 a) An air standard Otto cycle has a compression ratio of 9. At the start of the compression process, the temperature is 27^0C and the pressure is 1 bar. If the maximum temperature of the cycle is 1200^0C, calculate the heat supplied per kg of air, net work done per kg of air and the thermal efficiency of the cycle. 10

b) In a Rankine cycle steam enters the turbine at 130 bars and 500^0C. If the exhaust pressure is 0.07 bar and all the processes are reversible find the cycle thermal efficiency, work ratio and steam rate. 10

Q.No.6 a) Steam is at a pressure of 2.5 bar and 150^0C. Find the condition of the steam, its enthalpy and entropy. 05

b) Write short notes on: 15

i. Joule Thompson porous plug experiment.

ii. Entropy, a property of the system.

iii. Equivalence of Kelvin-Planck and Clausius statements

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