11/12/18

S.E. Sem III Mech

SE

Paper / Subject Code: 51625 / Thermodynamics

Sem III (Mechanical) "R 2019" Nov - Dec 2022

01/12/2022

Duration: 3hrs **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.

(2) Attempt any three questions out of the remaining five.

(3) All questions carry equal marks.

(4) Assume suitable data, if required and state it clearly.

(5) Use of steam table and Mollier Diagram is permitted.

Q.1 Attempt any four. [20]

a State Zeroth law of Thermodynamics and its significance.

b State and prove the Clausis inequality.

c Define Joule Thomson coefficient and State its significance.

d Draw P-V & T-S diagram for Stirling cycle and Ericsson cycle.

e Explain the effect of varying back pressure on nozzle performance.

Q.2 a 3 kg of air at a pressure of 150 kPa and temperature 360 K is compressed polytropically to 750 kPa according to law P $V^{1.25} = C$. The gas is then cooled to initial temperature at constant pressure. The air is then expanded at constant temperature till it reaches the original pressure of 150 kPa. Draw the cycle on a P-V diagram and determine net work and heat transfer. [10]

b A carnot heat engine which operates between temperature levels of 927°C and 33°C rejects 30 kJ to the low temperature sink. The engine drives a heat pump which receives 270 kJ of heat from a low temperature reservoir and rejects it to the surrounding at 33°C. Determine the temperature of the reservoir from which the heat pump receives the heat. [10]

Q.3 a In a steady flow process, the fluid flows through a machine at the rate of 15 kg/min. The entrance and exit parameters of the machine are velocity 5 m/s and 8 m/s, Pressure 100 kPa and 700 kPa, Specific volume 0.45 m³/kg and 0.125 m³/kg respectively. The working fluid leaves the machine with internal energy 160 kJ/Kg greater than at the entrance and during the process 7200 kJ/min of heat is lost to the surrounding. Assuming the entrance and exit pipe to be at the same level, calculate the shaft work. [10]

b (i) Prove that Entropy is property of the system. [10]

(ii) Draw & Explain T-S diagram of Water.

Q.4	a	Air enters a compressor in a steady flow at 140 kPa, 17°C & 70 m/s and leaves at 350 kPa, 127°C & 110m/s. The environment is at 100 kPa, 7°C. Calculate per kg of air (i) The actual amount of work required (ii) The minimum work required (iii) The irreversibility of the process.	[10]
	b	(i) Define (a) Dryness fraction (b) Critical point (c) Triple point (d) Degree of superheat. (ii)Write a short note on the Reheat Rankine cycle.	[10]
Q.5	a	In an air standard diesel cycle, the compression ratio is 16. At the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of constant pressure process is 1480 °C. Calculate the cycle efficiency & Mean Effective Pressure.	[10]
	b	(i) Air at 320 kPa, 300 K and Mach Number = 0.6 flows through a duct. Determine the velocity, stagnation temperature & pressure. (ii) Explain the principle of increase of entropy.	[10]
Q.6	a	In a Rankine cycle the steam at the inlet to the turbine is at 100 bar and 500°C. If the exhaust pressure is 0.5 bar. Determine Rankine efficiency.	[10]
	b	(i) Explain Sonic velocity and Mach number. (ii)Compare the Otto and Diesel cycle for the same compression ratio.	[10]

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