S.E Sem III Mech R-2019 C-Scheme Nov 2023.

Duration: 3Hrs 2/12/23 [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, mollier diagram.

Qu.1 Attempt any Five of the following [20]

a) State the zeroth law of thermodynamics. What is its significance?

b) Difference between heat engine, refrigerator, heat pump

c) Show that internal energy is property of system

d) Define a) Wet steam b) Superheated steam c) Dryness fraction d) Saturation temperature.

e) What is cut off ratio? What are assumptions of air standard cycle?

f) Explain Joule –Thomson coefficient? Define inversion point and inversion curve.

g) Explain the effect of variation in back pressure on C-D nozzle performance.

Qu.2 a) 0.2 m^3 of an ideal gas at a pressure of 2 Mpa and 600K is expanded isothermally to 5 times the initial volume. It is then cooled to 300K at constant volume and then compressed back polytropically to its initial state. Determine the net work done and heat transfer during the cycle. Draw P-V and T-S dia. [12]

b) State and explain the Kelvin plank and Clausius statements of the second law of thermodynamics [08]

Qu.3 a) A household refrigerator absorbs heat at 2°C and reject heat to the surrounding at 50°C. It compressor is driven by 3 kw motor and 50 MJ/hr are absorbed at the low temperature. Evaluate the amount of heat rejected per hr and the irreversibility in J/hr. [06]

b) Prove that Steady flow energy equation. Apply to it compressor and Turbine. [06]

c) In centrifugal compressor, the suction and delivery pressure are 100kpa and 550 kpa resp. The compressor draws $15m^3$/min of air which has a specific volume of $0.77m^3$/kg. At delivery point the specific volume is $0.20m^3$/kg. The compressor is driven by a 40 kw motor and during passage of air through the compressor, the heat lost to the surrounding is 30 kJ/kg of air. Neglect KE, PE. Make calculations for increase in internal energy per kg of air. [08]

Qu.4 a) Explain various components of a simple steam power plant with sketch [06]

b) Write short note on Mollier's Diagram [04]

c) State the Maxwell's relation. [06]

d) Define 1) Mach No., 2) Stagnation temperature,3) Stagnation Pressure 4) Sonic flow. [04]

Qu.5 a) Derive an expression of air standard efficiency for Diesel cycle. [08]

b) In a thermal power plant operating on an ideal Rankine cycle, steam at 15 bar and 250°C enters a turbine which generates 40 kw indicated power. If the steam consumption is 300 kg/hr and condenser is maintained at 0.15 bar, determine the final condition of steam, Rankine efficiency and relative efficiency. Neglect pump work. [12]

Qu.6 a) Explain the Rankine Reheat cycle with the help of T-S diagram. [08]

b) Consider an air standard Otto cycle that has a heat addition of 2800 kJ/kg of air, a compression ratio of 8, and a pressure and temperature at the beginning of compression process of 1 bar, 300K. Determine a) The maximum pressure and temperature in the cycle. b) The thermal efficiency c) Mean effective pressure. [12]

Take C_P =1.005 KJ/kg K, C_V = 0718 KJ/kg K, R = 287 KJ/kgK.

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