MECHANICAL ENGINEERING DEPARTMENT, IIT, DELHI

(MEL-140) ENGG. THERMODYNAMICS

MAJOR TEST

Max. Marks: 100 **Date: 28-11-2006**
(RRG) **Time: 3:30 – 5:30 P.M.**

(Note: Use of steam Tables is permitted)

1. (a) Energy Conversion from fossil fuels is NOT cyclic thermodynamically. What are its consequences? suggest a few truly cyclic energy conversion systems for future. (8)

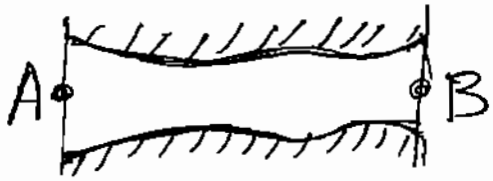
(b) Write the Energy equation applicable during various strokes of a four-stroke diesel engine, clearly demarcating the thermodynamic system during each strike. Also, indicate these processes on a p-v diagram. (10)

(c) Indicate a typical vapour eompression refrigeration cycle on p-v, p-h and T-s diagrams. (6)

2. (a) What is the significance of thermodynamie scale of temperature? How does Second law of Thermodynamics lead to the formulation of such a scale? (8)

(b) 1.4 kg/sec of air is flowing adiabatically in a duct A-B with following conditions:

T_A=700 K P_A=220 kPa
V_A=50 m/s
T_B=610 K P_B=100 kPa



Find the change in entropy between A and B as well as the direction of flow, Inlet and exit areas of the duct, Is the flow process reversible? (10)

(c) Three Carnot Engines working between maximum temperature of 1000 K and minimum temperature of 300 K are in a series combination. The work produced by these engines is in the ratio of 5:4:3. Calculate the temperatures of the intermediate reservoirs. (6)

P.T.O.

3. (a) In a throttling calorimeter sampling steam from a boiler at a pressure of 20 bar, the following readings are recorded:

p=1 bar T=130^{0}C.

Calculate the dryness fraction of the sample of stream from boiler. Sketch the process in throttling calorimeter on a p-h and h-s diagram. (8)

(b) A thermal power plant operates on Rankine cycle with superheat and reheat with following conditions:

Superheater outlet pressure and temperature:

3 MPa and 450^{0}C

Reheater outlet pressure and temperature =0.6 MPa and 450^{0}C.

Condenser pressure =10 kPa.

Calculate the salient states of the cycle and draw a schematic diagram of the system and its T-s diagram. Determine thermal efficiency, specific steam consumption and heat rejected in the condenser. (18)

4. (a) What do you understand by 'Availability'. Derive an expression for availability function for a closed system. (8)

(b) A heat pump operates on reverse Joule cycle and is used to provide process heat to a milk dryer. It operates with a pressure ratio of 6:1, ambient pressure and temperature of 1 bar and 27^{0}C and heat provided to the dryer is 300 kJ /kg of air flow. Find the minimum temperature of the cycle and its COP. (10)

(c) Briefly describe **any two** of the following, pointing out their specific applications:

(i) Vapour-absorption refrigeration system.

(ii) Air standard cycle for S.I. engines.

(iii) Ideal regenerative cycle.

(8)