SECOND SEMESTER EXAMINATION 2005

THERMODYNAMICS

Question 1

a) A tank has a volume of 0.5m^3 and contains 10 kg of an ideal gas having a molecular weight of 24. The temperature is 25^0 C .What is the pressure ?
b) Helium contained in a cylinder fitted with a piston expands reversibly according to the law $pV^{1..5}$=constant The initial pressure temperature and volume is 5 bar ,222k and 0.055m^3. After the expansion the pressure is 2 bar.Calculate the work done during the process.
c) A tank containing N is heated and stirred by a paddle wheel . the work input to the paddle is 6000kj. Heat coming out from the tank is 4000kj. Determine the change in the internal energy of the nitrogen in the cylinder.
d) A cylinder fitted with a piston has a volume of .04635m^3 and contains dry saturated steam at .4pa. What is the mass of the steam?
e) An inventor has claimed to have invented a heat engine that takes 100kj of heat from a temperature of 600k and rejects 40kj at a temperature of 300k. Justify whether the claim is true or false.
f) A system performs an irreversible process at 200k and receives 200j of heat from the surrounding. Then which of the following relations is correct for the entropy change of the steam:
   (a) Δs=1 J/K
   (b) Δs > 1 j/k
   (c) Δs< 1 j/k
   (d) Δs= 0 j/k
g) A rigid vessel of volume .8m^3 contains 1 kg of Steam at a pressure of 2 bar. What is the dryness fraction of he steam?
h) What is the mass of the air contained in a room 6mx9m x4m if the pressure is 101 kpa and temperature is 25^0 C? Consider air as an ideal gas with a molecular weight of 29.
i) A rigid vessel of volume 0.03m^3 contains a mixture passes through the critical stare. Find out the mass of the mixture.
j) A reversible heat engine temperature of 800k and has to reject a heat at a sink temperature of 200k . Find the amount of heat rejected by the engine to the sink and the work developed.

Question 2

a) Starting with the statement of first law for a cyclic process, show that internal energy is a property of a steam.(5)
b) A cylinder fitted with a piston has an initial volume of 0.1 m^3 and contains N at 150 kpa , at 25C . The piston is moved, compressing the N, and the work done on the nitrogen is 20kj.Determine the amount and the direction of the heat transfer.Consider nitrogen as an ideal gas and having specific heat at constant volume.c_v=0.75kJ/Kg ^{0}C(5)

Question 3

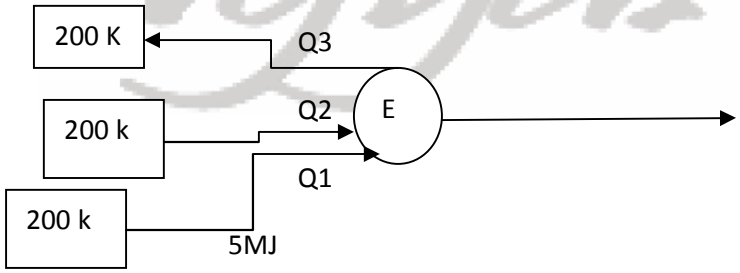
a) Define enthalpy of a system . Under what condition the change in enthalpy in a process executed by a closed system equals to heat to the heat transfer in the process.(2+3)
b) Air at a pressure if 1 bar and 25^0 C enters an insulated diffuser with a velocity of 1000km/hr where the velocity is reduced to zero at the diffuser outlet. Determine the temperature of the air at the diffuser outlet. Consider air as an ideal gas with a specific heat at constant pressure c_p=1 Kj/Kg ^{0}C(5)

Question 4

a) A heat engine operating between two reservoirs at 1000k and 300k is used to drive a heat pump which extracts heat from the reservoir at 250k at a rate that at which the engine rejects heat to it. If the efficiency of the engine is 80% of the maximum possible , and COP of the heat pump is 1/3 of the maximum possible, What is the temperature of the reservoir to which the heat pump rejects heat. What is the rate of heat rejection of the heat pump if the rate of heat supply to the engine is 50 kw?(6+4)

Question 5

A reversible engine as shown in the figure during the cycle of operation draws 5 Mj from the 400k reservoir and does 840kj of work. Find the amount and direction of heat interaction with other reservoirs . Also compute the change ; in entropy of the reservoirs .(10)



Question 6

1 kg of air contained in a cylinder and piston arrangement at 8 bar and 100^0 C expands to a pressure of 1 bar in a reversible isothermal process . Determine the change in entropy of air in the process .Consider air as an ideal gas. Derive any formulae you use.(take molecular weight of air as 29)(10)

Question 7

A cylinder fitted with a piston has a volume of 0.1 m^3 and contains .5 kg of steam at .5 Mpa . Heat is transferred to the steam until the temperature is 3000^0 C , while the pressure remains constant .Determine the heatand work transferred fot this process.

Question 8

State and explain any two of the following: (2.5X4)

a) Thermodynamic equilibrium.
b) Reversible and irreversible processes.
c) Clausius inequality.
d) Principle of increase of entropy.

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