Code No: 113AB **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, February/March - 2016

THERMODYNAMICS

(Common to ME, AE, AME, MSNT)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A **(25 Marks)**

1.a) What do you understand by macroscopic and microscopic viewpoints? Explain. [2]

b) What is constant volume gas thermometer? Why is it preferred to a constant pressure gas thermometer? [3]

c) State and discuss the 'Clausis' theorem. [2]

d) Differentiate reversible and irreversible processes. Entropy remains constant in a reversible adiabatic process. Justify. [3]

e) Define ideal gas. And show that for ideal gas internal energy depends only on its temperature. [2]

f) Draw P-V diagram for water and a pure substance other than water. Also draw P-T diagram of water. [3]

g) Draw psychrometric chart and show psychrometric processes in the chart. [2]

h) What is the difference in wet bulb temperature, dew point temperature, and thermodynamic wet bulb temperature? [3]

i) Draw P-V, T-S diagrams of Sterling cycle, and explain. [2]

j) Compare efficiencies of Otto and dual cycle. [3]

PART-B **(50 Marks)**

2.a) Give the differential form of S.F.E.E. Under what condition the S.F.E.E. does reduces to Euler's equation.

b) A mass of 8 kg gas is expands in a flexible container so that the p-v relationship is in the form of $pv^{1.2}$=const. the initial pressure is 1000 kPa and the initial volume is 1 m^3. The final pressure is 5 kPa. If the specific internal energy of the gas is decreases by 40 kJ/kg, find the heat transfer in magnitude and direction. [5+5]

OR

3.a) A cylinder, A_{cyl} = 7.012 cm^2 has two pistons mounted, the upper one, m_{p1} = 100 kg, initially resting on the stops. The lower piston has 2 kg water below it, with a spring in vacuum connecting the two pistons. The spring force fore is zero when the lower piston stands at the bottom, and when the lower piston hits the stops the volume is 0.3 m^3. The water, initially at 50 kPa, V = 0.00206 m^3, is then heated to saturated vapor.
i) Find the initial temperature and the pressure that will lift the upper piston.
ii) Find the final T, P, v and work done by the water.

b) Nitrogen gas flows into a convergent nozzle at 200 kPa, 400 K and very low velocity. It flows out of the nozzle at 100 kPa, 330 K. If the nozzle is insulated, find the exit velocity. [5+5]

4.a) Prove that the COP of the reversible refrigerator operating between two given temperatures is the maximum.

b) Water is heated at a constant pressure of 0.7 MPa. The boiling point is 164.97^{0}C. The initial temperature of water is 0^{0}C. The latent heat of evaporation is 2066.3 kJ/kg. Find the increase of entropy of water if the final temperature is steam. [5+5]

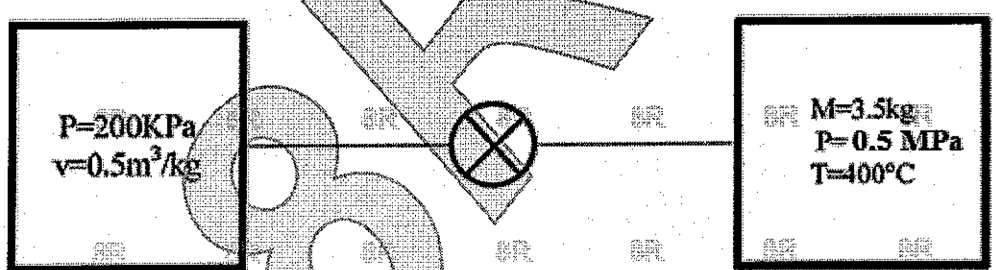
OR

5.a) It is decided to produce refrigeration at -30^0 C. The work can be obtained by a cyclic heat engine operating between the 200^{0}C reservoir and the ambient of 30^0 C. Determine the ratio of heat transferred from 200^{0}C reservoir to the heat transferred from the -30^0 C reservoir, assuming all process are reversible.

b) Differences in surface water and deep-water temperature can be utilized for power generation. It is proposed to construct a cyclic heat engine that will operate near Hawaii, where the ocean temperature is 20^{0}C near the surface and 5^{0}C at some depth. What is the possible thermal efficiency of such a heat engine? [5+5]

6.a) A 1 m^3 tank is filled with a gas at room temperature 20^{0}C and pressure 100 kPa. How much mass is there if the gas is:
i) Air ii) Neon or iii) Propane.

b) Two tanks are connected as shown in figure, both containing water. Tank A is at 200 kPa, V=1m^3 and tank B contains 3.5 kg at 0.5 MPa, 400^{0}C. The valve is now opened and the two come to a uniform state. Find the specific volume. [5+5]



OR

7.a) Ammonia exists as a saturated mixture at 240.21 kPa and -14.6^{0}C in a rigid vessel with a volume of 1.0 m^3. The specific volumes of saturated liquid and saturated vapour are 1.5195 l/kg and 0.50063 m^3/kg. The quantity of ammonia is 0.275 kg vap/kg. What is total mass of ammonia inside the vessel?

b) A rigid close tank of volume 3 m^3 contains 5 kg of wet steam at a pressure of 200 kPa. The tank is heated until the steam becomes dry saturated. Determine final pressure and heat transfer to the tank. [5+5]

8.a) An ideal gas of molecular weight 30 and γ = 1.3 occupies a volume of 1.5 m^3 at 100 kPa and 77^{0}C. The gas is compressed according to the law $pv^{1.25}$= const. to a pressure of 3 MPa. Calculate the volume and temperature at the end of compression and heating, work done, heat transferred and the total change of entropy.

b) How the partial pressure in a gas mixture is is related to the mole fraction? [6+4]

OR

9.a) On a particular day the weather forecast states that the dry bulb temperature is 37^0C, while the relative humidity is 50% and the barometric pressure is 101.325 kPa. Find the humidity ratio, dew point temperature and enthalpy of moist air on this day.

b) A constant volume chamber of 0.3 m^3 capacity contains 1 kg of air at 5^0C. Heat is transferred to air until the temperature is 100^0C. Find the work done, heat transfer, change in internal energy, enthalpy and entropy. [5+5]

10.a) In an air standard Otto cycle, the compression ratio is 7 and the compression begins at 35^0C and 0.1 MPa. The maximum temperature of the cycle is 1100^0C. Find (i) the temperature and the pressure at various points in the cycle, (ii) the heat supplied per kg of air, (iii) work done per kg of air, (iv) the cycle efficiency.

b) A refrigerator works on the carnet cycle in temperature between -70^0C and 270^0C. It makes 500 kg of ice per hour at -50^0C from water at 140^0C. Find H.P required to drive the compressor and C.O.P. of the cycle. Take specific heat of ice as 2.1 kJ/kg-K and latent heat as 336 kJ/kg? [5+5]

OR

11.a) A water cooler using R12 refrigerant works between 30^0C to 9^0C. Assuming the volumetric and mechanical efficiency of the compressor to be 80% and 90% respectively, and the mechanical efficiency of motor to be 90% and 20% of useful cooling is lost into water cooler, find:

i) The power requirement of the motor

ii) Volumetric displacement of the compressor given C_p (saturated vapour at 30^0C) = 0.7 kJ/kg K.

b) In a stirling cycle the volume varies between 0.03 m^3 and 0.06 m^3, the maximum pressure is 0.2 MPa, and the temperature varies between 540^0C and 270^0C. The working fluid is air (an ideal gas). Find the efficiency and the work done per cycle for both simple cycle and cycle with ideal regenerator. Compare the results with Carnot cycle with same temperature limits. [5+5]

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