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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B.Tech II Year I Semester Examinations, November/December-2013

Thermodynamics

(Common to ME, AE, AME, MIM)

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

Answer any five questions

All questions carry equal marks

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1.a) Prove that work is a path function and not a state function.
 b) Explain different types of Thermodynamic systems with suitable example. [15]

2.a) What are the modes in which energy is stored in a system?
 b) A Blower handles 1 kg/s of air at 20^0C and consumes a power of 15 KW. The inlet and outlet velocities of Air are 100 m/s and 150 m/s respectively. Find the exit air Temperature, assuming adiabatic conditions take Cp of air as 1.005 kJ/kg^{0}K. [15]

3.a) Define and prove clausius inequality.
 b) A heat engine is used to drive a heat pump. The heat transfers from the heat engine and from the heat pump are used to heat the water circulating through the radiators of a building. The efficiency of heat engine is 27% and COP of the heat pump is 4. Evaluate the ratio of the heat transfer to the circulating water to the heat transfer to the heat engine. [15]

4.a) Explain the process of transformation of water from freezing state to superheated state with suitable graph.
 b) Consider nitrogen gas at 145 K with specific volume of 0.0022 m^3/kg. Calculate its pressure using Redlich Kwong equation and compare with pressure obtained by ideal gas equation. Use P_c = 3390 KPa, T_c = 126.2 K. [15]

5.a) Explain the Vander Waals equation and the limitations of the same.
 b) 2 kg of Air at 6.86 bar abs. and 90^0C pass through a reversible non – flow polytrophic process represented by $\rho \upsilon^{1.1}$ = constant till the pressure falls to 1.37 bar. Find
 (i) The final Temperature, specific volume, and change in entropy.
 (ii) Work and heat transfer
 (iii) What will be the answers if the process was irreversible and adiabatic between the same end states? [15]

6.a) Derive Dalton's Law of partial pressures. Does this law hold exactly for ideal gas mixtures.
 b) A vessel of 6 m^3 capacity contains two gases A and B in proportion of 45% and 55%, respectively at 30^0C. If the gas constant R for these gases is 0.288 kJ/kg. K and 0.295 kJ/kg. K and total weight of the mixture is 2 kg. Calculate
 i) The partial pressure.
 ii) The total pressure, and
 iii) The mean value of R for the mixture. [15]

7.a) Explain the four processes that constitute the Ericsson cycle. Show that the regenerative Ericsson cycle has the same efficiency as the Carnot cycle.

b) An engine working on the Otto cycle is supplied with air at 0.1 Mpa, 35^0C. The compression ratio is 8. Heat supplied is 2100 kJ/kg. Calculate the maximum pressure and Temperature of the cycle, the cycle efficiency and the mean effective pressure. For air $C_p = 1.005$, $c_v = 0.718$, and $R = 0.287$ kJ/kg^{0}K. [15]

8.a) Explain the Air refrigeration process on Bellcoleman cycle and derive the equation for COP.

b) Explain vapour absorption refrigerator cycle with line diagram. [15]

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