Code: 9D17101

M.Tech I Semester Supplementary Examinations August/September 2018

ADVANCED THERMODYNAMICS

(Refrigeration & Air Conditioning)

(For students admitted in 2013, 2014, 2015 & 2016 only)

Time: 3 hours Max. Marks: 60

Answer any FIVE questions

All questions carry equal marks

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1 (a) Define volumetric expansivity and isothermal compressibility.

(b) Give the Gibbs phase rule for a non-reactive system. Why is the triple point of a substance non-variant?

2 (a) Show that the slope of an isentropic is greater than that of an isotherm on p-v plot. How meaningful is it for estimating the work of compression?

(b) What is the energy equation? How does this equation lead to the derivation of the Stefan Boltzmann law of thermal radiation?

3 A mixture of ideal gases consists of 3 kg of nitrogen and 5 kg of carbon-dioxide at a pressure of 300 kPa and a temperature of 20°C.

Find: (i) The mixture mole fraction of each constituent.

(ii) Equivalent molecular weight of the mixture.

(iii) The equivalent gas constant of the mixture.

(iv) The partial pressure and partial volumes.

(v) The volume and density of the mixture.

(vi) The Cp and Cv of the mixture.

4 If the mixture is heated at a constant volume to 40°C. Find the changes in internal energy, enthalpy and entropy of the mixture. Find the changes in the in internal energy, enthalpy and entropy of the mixture if the heating is done at constant pressure. Take for CO_2 and N_2 to be 1.286 and 1.4 respectively.

5 (a) Calculate the decrease in available energy when 25 kg of water at 95°C mix with water at 35°C the pressure being taken as constant and the temperature of the surroundings being 15°C (Cp of water = 4.2 kJ/ kg K).

(b) How does the energy value provide a useful measure of the quality of energy?

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6 An insulated steam turbine, receives 30 kg of steam per second at 3 MPa, 350°C. At the point of in the turbine where the pressure is 0.5 MPa, steam is bled off for processing equipment at the rate of 5 kg/s. The temperature of this steam is 200°C. The balance of the steam leaves the turbine at 15 kPa, 90% quality. Determine the availability per kilogram of the steam entering at both points at which steam leaves the turbine, the isentropic efficiency and the second-law efficiency for the process.

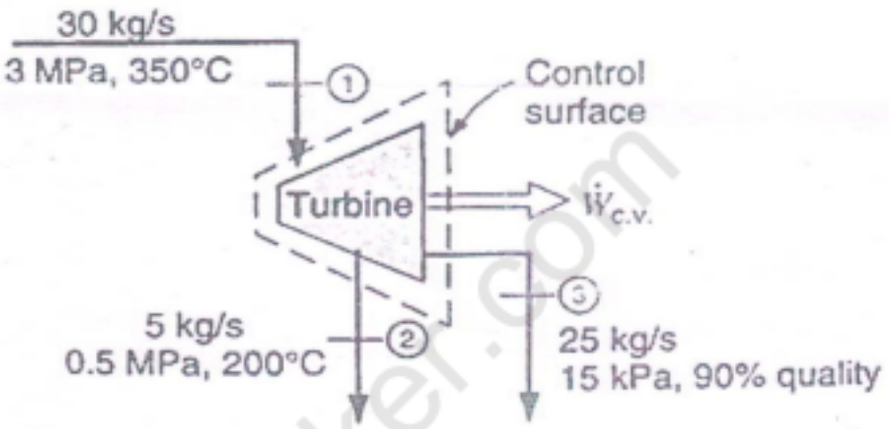
Control volume: Turbine

Inlet state: P_1, T_1 Known; State fixed.

Exit state: P_2, T_2 Known; P_3, x_3 Known; both the states fixed.

Process : SSSF

Model: Steam tables.



7 (a) For the same compression ratio and heat rejection, which cycle is most efficient: Otto, Diesel or Dual? Explain with P-v and T-s diagrams.

(b) Mention the merits and demerits of the Stirling and Ericsson cycles.

8 Write short notes on:

(a) With neat sketch, the working of MHD generator.

(b) Working of Hydrogen-Hydrogen fuel cell.

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