Code : 021307

B.Tech. 3rd Semester Exam., 2013

THERMODYNAMICS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) All questions carry equal marks.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

(v) Use of Tables and Charts permitted.

1. State whether the following statements are True or False (any *seven*) :

(a) The sum of internal energy and pressure volume product is called enthalpy.

(b) Diesel cycle consists of two constant volumes and two adiabatic processes.

(c) For the same compression ratio and same heat input the thermal efficiency of Otto cycle is less than that of Diesel cycle.

(d) Intensive properties are independent of the mass of the system.

(e) An isolated system is one which permits the passage of energy only.

(f) Liquids have two specific heats.

(g) Thermal power plant works on Rankine cycle.

(h) Sublimation is the process of changing from solid state to direct gas state.

(i) On psychrometric chart, DBT lines are horizontal.

(j) During sensible cooling process, specific humidity decreases.

2. *(a)* State and explain zeroth law of thermodynamics.

(b) Derive an expression of displacement work for an adiabatic process.

(c) What do you mean by flow work?

3. *(a)* Show that the efficiency of all reversible heat engines operating between the same temperature levels is the same.

(b) What is a Carnot cycle? Derive its efficiency with the help of p-V diagram and block diagram.

4. 2 kg of ice at –6 °C is exposed to the atmosphere which is at 25 °C. The ice melts and comes into thermal equilibrium with the atmosphere. Determine—

   (a) the entropy increase of the universe;

   (b) the minimum amount of work necessary to convert the water back into ice at –6 °C.

5. *(a)* What do you mean by triple point?

   (b) A large insulated vessel is divided into two compartments, one containing 5 kg of dry saturated steam at 2 bar and the other 10 kg of steam, 0·8 dry at 5 bar. If the partition is removed and the steam is mixed thoroughly and allowed to settle, find the final pressure, steam quality and entropy change.

6. *(a)* What is the reversible cycle that represents the simple steam power plant? Draw the flow, *p-V*, *T-S* and *h-S* diagrams of this cycle.

   (b) What do you understand by the mean temperature of heat addition?

   (c) How are the maximum temperature and maximum pressure in the Rankine cycle fixed?

7. *(a)* Develop an expression for the thermal efficiency of an air-standard Diesel cycle.

   (b) Compare the efficiency of Otto, Diesel and dual cycles in the following cases with the help of *p-V* and *T-S* diagrams :

   (i) For the same compression ratio

   (ii) For the same maximum pressure and temperature

8. 3 kg of air at 40 °C DBT and 20 °C WBT is adiabatically mixed with 2 kg of air at 25 °C DBT and 10 °C DPT. Determine the final specific humidity and temperature of the mixture without using psychrometric chart.

9. *(a)* A mixture of ideal gases consists of 2 kg of O_2 and 4 kg of CO_2 at a pressure of 3 bar and temperature of 25 °C. If the mixture is heated at constant pressure to 50 °C, find the change in entropy of the mixture.

   (b) Write the Maxwell's equations.

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