Printed Pages : 4 EME303

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0430 Roll No.

B.Tech

(SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10

THERMODYNAMICS

Time : 2 Hours] *[Total Marks : 50*

Note : *(1) Answer **all** questions.*

(2) Use of steam tables and Mollier chart is permitted.

*(3) Make **suitable** assumptions in case of missing data, if any and state the assumption made.*

1 Answer any **four** of the following : **3.5×4**

(a) Briefly describe the 'principle of corresponding states' and 'quasi static process'.

(b) State Zeroth law of thermodynamics and its application.

If temperature of a body is 26°C, then find its temperature in °K and °F.

(c) Steam at 9 MPa and 600°C passes through a throttling process such that the pressure is suddenly dropped to 0.4 MPa. Find the expected temperature after throttling.

(d) Air at 420°C and 7 kPa enters a nozzle with 400 m/s velocity and leaves at temperature of 255°C. For specific heat of air (R=2875/kg.K) at constant pressure as 1 kJ/kg.K determine the air velocity and mass per unit area at the exit of nozzle. What is first law of thermodynamics for a closed system?

(e) Enlist the limitations of First law of thermodynamics.

(f) Explain the 'free expansion' and 'hyperbolic process.'

2 Answer any **two** of the following : **6×2=12**

(a) (i) A Carnot engine operates between temperatures T_1 and T_2 with efficiency η_1 and other Carnot engine operates between temperatures T_2 and T_3 with efficiency η_2. Show that the Carnot engine operating between temperatures T_1 and T_3 will have efficiency given as $(\eta_1 + \eta_2 - \eta_1 \cdot \eta_2)$. **4**

(ii) Explain the perpetual motion machine of second kind and its relevance. **2**

(b) Three reversible engines operate in series between two heat reservoirs of extremities being at 1000 K and 300 K. Considering the work produced by each engine to be in the proportion of 5:4:3 determine temperature of intermediate reservoirs. **6**

(c) Explain Carnot theorem and show that no heat engine working between two fixed temperatures can have efficiency greater than that of a reversible engine working between same temperatures. 6

3 Answer any **two** of the following : 6×2=12

(a) Determine the change in entropy in each processes for the definite quantity of air following three processes in thermodynamic cycle and also show them on p-V and T-s diagram. 6

Process 1-2 : Constant volume heating from 1 bar, 288 K and 0.02 m^3 to 4.2 bar.

Process 2-3 : Constant pressure cooling.

Process 3-1 : Isothermal heating upto initial state.

Take $C_{p,\,air} = 1$ kJ/kgK.

(b) Show that the change of entropy of a perfect gas undergoing change of state from 1 to 2 can be given as 6

$$s_2 - s_1 = m\left[c_v \ln \frac{p_2}{p_1} + c_p \ln \frac{v_2}{v_1}\right]$$

(c) (i) Determine the second law efficiency of an engine having efficiency of 35% operating between reservoirs of 600 K and 300 K. 3

(ii) Describe the 'Helmholtz function' and 'Gibbs function' briefly. 3

4 Answer any **two** of the following : 6×2=12

(a) 2 kg of steam at pressure of 10 bar, 225°C undergoes a reversible polytropic expansion following index 1.2 upto pressure of 1 bar. Determine the final temperature, work done and heat transfer. **6**

(b) Explain the working of a two stroke SI engine giving neat sketches and differentiate between two stroke and four stroke spark ignition engine. **6**

(c) Explain simple Rankine cycle with neat schematic diagram and also show different processes involved in it on T-s dioagram, h-s diagram and p-v diagram. **6**