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Reg. No. : .....

Name : .....

First Semester M.Tech. Degree Examination, April 2016
Mechanical Engineering
Branch : Thermal Sciences
MTC – 1001 : ADVANCED THERMODYNAMICS

Time : 3 Hours Max. Marks : 60

***Instructions** : 1) Answer **any six full** questions.*
*2) **Use** of Thermodynamics Tables/Charts **permitted**.*

MODULE – I

1. A compressed air bottle of 0.3 m^3 volume contains air at 35 bar, 40° C. This air is used to drive a turbogenerator supplying power to a device which consumes 5 W. Calculate the time for which the device can be operated if the actual output of the turbogenerator is 60% of the maximum theoretical output. The ambient pressure to which the tank pressure has fallen is 1 bar. For air, assume the ratio of specific heats (γ) for the compression stroke is 1.4. **10**

2. Two kg of hot water (subsystem A), initially at a temperature of 600 K, is mixed with 1 kg of cold water (subsystem B) that is initially at 300 K. What are the equilibrium temperature and entropy if both A and B are isolated sub-systems ? Now assume that the two subsystems are not isolated. Once the composite system reaches equilibrium, heat is removed so that the final entropy value of A and B equals the initial entropy. What is the final temperature ? **10**

3. a) What are the assumptions made in kinetic theory of gases ? **4**

   b) A thin walled vessel of volume V maintained at constant temperature contains a gas which leaks out slowly through a small hole. The pressure outside is low enough so that back leakage into the vessel is negligible. Find the time required for the pressure in the vessel to decrease 1/2 of its original value expressed in terms of area, velocity and volume. **6**

MODULE – II

4. a) Derive a relation to find out coefficient of viscosity. 5

   b) How many photons are there in a cavity of 1 cm^3 volume at a temperature of 300 K ? 5

5. What do you mean by partition function ? What is the most probable distribution of the molecules in a gas among the possible energy level ? 10

6. a) Explain Degeneration of Energy levels. 5

   b) How do you interpret heat and work by microscopic analysis ? 5

MODULE – III

7. Propene (g) at 25° C and 100 kPa is burned with 400% theoretical air at 25° C and 100 kPa. Assume that the reaction occurs reversibly at 25° C, that the oxygen and nitrogen are separated before the reaction takes place (each at 100 kPa, 25° C), that the constituents in the products are separated and that each is at 25° C, 100 kPa. Determine the reversible work for this process. If the above reaction occurs at adiabatic flame temperature, compute the increase in entropy during combustion. 10

8. Derive Saha's equation. Explain its significance in Thermodynamic Analysis. 10

9. A rich mixture of octane (C_8H_{18}) and air, with an equivalence ratio of 1.1, is ignited at 10 bar and 500 K and burns at constant volume. Assuming the combustion is adiabatic, calculate the conditions at the end of combustion allowing for dissociation of the carbon dioxide and water, but neglecting any formation of NO. 10