Roll No .....

MMTP-102

M.E./M.Tech., I Semester

Examination, December 2015

Thermodynamics and Combustion

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions.
ii) All questions carry equal marks.

1. What is meant by thermodynamic system? How do you classify it? Differentiate closed and open system. Derive equation $PV^{\gamma} = C$ for adiabatic system.

2. Explain Zeroth Law of thermodynamics? State the Kelvin-Plank statement of second law of thermodynamics. Discuss availability and irreversibility.

3. What is the difference between a heat pump and refrigerator? What is the process involved in Carnot cycle? Explain laminar and turbulent flame.

4. What is meant by principle of increase of entropy? A heat pump pumps 10MJ/KWhr to the high temperature reservoir. What is the COP? If the Carnot engine efficiency is 50%. Find COP of Carnot refrigerator working between same temperatures.

5. Find the entropy of the universe where 1000kj of heat is transferred from 800K to 500K. Give the expressions for change in entropy during constant pressure and polytropic process. Show on T-S diagram. Discuss triple point of water.

6. What is equation of state? Discuss various phases of gases. Explain the use second and higher order reactions.

7. Using the Clausius-Clapeyron equation, derive an approximate equation for the saturated vapour pressure p_s as a function of temperature T, assuming T is well below the critical temperature. Assume that the specific enthalpy of evaporation h_{fg} is constant over the range of interest and make other approximations as you see fit. Using your expression, estimate the saturated vapour pressure ratio (p_{s2}/p_{s1}) for water for $T_1 = 40°C$ and $T_2 = 100°C$. Compare your result to the value obtained from the steam tables in the Data Book. Discuss open cycle gas turbine.

8. The following second order, irreversible gas phase reaction $AB \rightarrow A + B$, where $k = 2.0 \times 10^4$ cm^3/mol.min is allowed to decompose isothermally in a constant pressure batch reactor. The reactor initially contains pure AB with a volume of $2.0 m^3$ at 2.5 atm and 500°C. Assuming ideal behavior, determine the time for the reaction to reach 90% conversion. Explain principle of rocket motors.

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