

Roll No

MMTP-102

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

Examination, June 2013

Thermodynamics And Combustion

Time : Three Hours

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Maximum Marks : 70

Note: Attempt any five questions out of nine. All questions carry equal marks.

1. a) Differentiate between
 - i) Saturated liquid & compressed liquid
 - ii) Saturated vapour & superheated vapour.
 - b) An ideal gas at a given state expands to a fixed final volume first at constant pressure and then at constant temperature. For which case work done greater.
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2. A reversible heat engine operates between two reservoirs at temperature of 60°C and 40°C . The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40°C and -20°C . The heat transfer to the heat engine is 2000kJ and the net work output of the combined engine refrigerator plant is 360kJ .
 - a) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C .
 - b) Reconsider (a) given that the efficiency of the heat engine and the C.O.P. of the refrigerator are each 40% of their maximum possible values.

3. a) What do you mean by phase and reaction equilibrium.
b) Show that for a system to be stable, these conditions are satisfied
 - i) $C_p > 0$ (thermal stability)
 - ii) $\left(\frac{\partial p}{\partial V}\right)_T < 0$ (mechanical stability)
4. a) Why are the temperature and pressure dependent properties in the saturated mixture region.
b) A 1.8 m³ rigid tank contains steam at 220°C. one third of the volume is in the liquid phase and the rest is in the vapor form. Determine
 - i) Pressure of the steam
 - ii) Quality of the saturated mixture
 - iii) Density of the mixture
5. Steam flows through a small turbine at the rate of 5000kg/h entering at 15 bar, 300°C and leaving at 0.1bar with 4% moisture. The steam enters at 80m/sec at a point 2m above the discharge and leaves at 40m/sec. Compute the shaft power assuming that the device is adiabatic but considering kinetic and potential energy changes. How much error would be made if these terms were neglected? Calculate the diameter of the inlet & discharge tubes.
6. a) Explain how thermodynamic properties are evaluated from an equation of state.
b) Derive $U = F - T\left(\frac{\partial F}{\partial T}\right)_P = -T^2\left(\frac{\partial F/T}{\partial T}\right)_P$.

7. a) How does flame propagate. Discuss the theory of flame propagation.
b) Discuss the combustion phenomena of gaseous fuel.
8. Derive the maximum Joule-Thomson inversion temperature in terms of critical temperature T_c predicted by
 - i) Vander waal's equation
 - ii) Redlich-kwong equation
 - iii) Dielectric equation
9. Write short notes on any two:
 - i) Reaction rate of first, second and higher order
 - ii) Importance of clapeyron's equation
 - iii) Laminar and turbulent flame during combustion.

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