R09

Code No: 09A30305

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B.Tech II Year I Semester Examinations, May/June-2013
Thermodynamics
(Common to ME, AE, AME, MIM)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a) Define Thermodynamic Equilibrium. What are the conditions necessary to establish thermodynamic equilibrium to a system?

b) In a closed system, the gas is compressed frictionally from a volume of $0.01m^3$ and a pressure of 0.70kpa to a volume of $0.025m^3$ in such a manner that $p(v+0.030)$ = constant, where V is in m^3. Calculate the work done by the gas. [15]

2.a) Define Zeroth law of thermodynamics. Write its importance in thermodynamics.

b) A Spherical balloon containing 5 kg of air at 200kpa and 500k. The balloon material is such that the pressure inside is always proportional to the square of the diameter. Determine the work done when the volume of the balloon doubles as a result of heat transfer. [15]

3.a) Derive an expression for Maxwell relations.

b) 1 kg water initially at 25^0C is heated to 90^0C using an electric heating coil. Assume that the heat losses to the surroundings at 300k are negligible. Calculate the first law and second law efficiencies of the process. [15]

4.a) Describe the phase-change process of water using a T-V diagram.

b) Find the Internal energy of 1 kg if steam at a pressure of 10 bar, when the condition of steam is
i) Wet with a dryness fraction of 0.85.
ii) Dry and saturated.
iii) Superheated, the degree of Superheat being 50^0C.
The specific heat of superheated steam at constant pressure is 201kJ/kgk. [15]

5. A piston-cylinder arrangement contains 1 kg of water at 100 Kpa. The initial volume is $0.5m^3$. The heat transferred to the water is an amount which is just necessary to case a slow expansion at constant temperature. The process is terminated when the volume is doubled. Determine the magnitude of heat transfer. Solve the problem if the process of expansion is hyperbolic. [15]

6.a) Express Dalton's law of partial pressures. Does this law hold exactly for ideal gas mixtures.

b) A vessel of $0.35m^3$ capacity contains 0.4 kg of carbon monoxide and 1 kg of air at 20^0C. Calculate:
i) Partial pressure of each constituents
ii) The total pressure in the vessel, and the gravitational analysis of air is to be taken as 23.3% oxygen and 76.7% Nitrogen. [15]

7. An engine working on Otto cycle has a total volume of $0.45m^3$, pressure 1 bar and temperature 27^0C at the beginning of the Compression Stroke. At the end of the Compression Stroke, the pressure is 11 bar, and 210 kJ of heat is added at constant volume. Calculate
   a) The pressure, temperature and volume at the salient points in the cycle.
   b) Percentage clearance volume.
   c) Net work done per cycle.
   d) The Ideal power developed by the engine if the no. of working cycles per minute is 210. Assume Cp = 1.005 kJ/kg-k (v=0.717 kJ/kg-k). [15]

8.a) Draw a neat sketch combined Gas-Vapour power cycle and explain its working principle.

b) What is regeneration? Draw Schematic and T-S diagram for an ideal regenerative cycle. [15]

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