

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

- 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 $p(v+0.030) = \text{constant}$, 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°C is heated to 90°C 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 of 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°C .
The specific heat of superheated steam at constant pressure is 201kJ/kgk . [15]
5. A piston-cylinder arrangement contains 1 kg of water at 100Kpa . The initial volume is 0.5m^3 . The heat transferred to the water is an amount which is just necessary to cause 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°C . 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°C 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
- The pressure, temperature and volume at the salient points in the cycle.
 - Percentage clearance volume.
 - Net work done per cycle.
 - The Ideal power developed by the engine if the no. of working cycles per minute is 210. Assume $C_p = 1.005\text{ kJ/kg-k}$ ($\gamma=0.717\text{ kJ/kg-k}$). [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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