R07

Code: R7210305

B.Tech II Year I Semester (R07) Supplementary Examinations, May 2013

THERMODYNAMICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 80

Answer any FIVE questions
All questions carry equal marks

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1. (a) Explain what do you understand by thermodynamic equilibrium.
   (b) A piston and cylinder machine containing a fluid system has a stirring device in the cylinder. The piston is frictionless and it is held down against the fluid due to the atmospheric pressure of 101.325 KPa. The stirring device is turned 10,000 revolutions with average torque against the fluid of 1.275 Nm. Meanwhile the piston of 0.6 m diameter moves out 0.8 m. Find the network transfer for the system.

2. (a) What is a constant volume gas thermometer? Why is it preferred to a constant pressure gas thermometer?
   (b) A blower handles 1 kg/s of air at 20°C and consumer a power of 15 KW. The inlet and outlet velocities of air area 100 m/s and 150 m/s respectively. Find the exit air temperature assuming adiabatic conditions. Take C_p = 1.005 kJ/kg K.

3. (a) State and explain the second law of thermodynamics, deduce the expressions for thermal efficiency of heat engine and COP in refrigerator/heat pump.
   (b) A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. What is the least rate of heat rejection per KW net output of the engine?

4. (a) Explain briefly about Mollier Diagram. Why isobars are on Mollier diagram diverge from one another.
   (b) Draw the phase equilibrium diagrams on P-V, T-S and h-s plots with relevant constant property line. Explain their features.

5. (a) Derive an expression of work transfer for an ideal gas in a reversible isothermal process.
   (b) A mixture of ideal gases consists of 3 kg of nitrogen and 5 kg of carbon dioxide at a pressure of 300 KPa and a temperature of 20°C. Find:
      (i) Mole fraction of each constituent. (ii) Equivalent gas constant of the mixture.
      (iii) Partial pressures and partial volumes. (iv) Density of mixture. (v) C_p and C_v.

6. (a) Explain and derive Classius-Clapeyron equation. What are the advantages of this?
   (b) Atmospheric air at 1.0132 bar has a DBT of 32°C and WBT of 26°C. Compute: (i) partial pressure of water vapour (ii) specific humidity (iii) DPT (iv) enthalpy of the mixture.

7. (a) What is an air standard cycle? Derive an expression for air standard efficiency of Otto cycle.
   (b) In an air standard diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15 °C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of constant pressure process is 1480°C.
   Calculate: (i) cut-off ratio (ii) heat supplied per kg of air (iii) efficiency of the cycle (iv) MEP.

8. (a) With the help of a neat sketch. Explain the working principle of Bell-Coleman cycle. Show it on P-V and T-S diagrams.
   (b) Explain the effect of superheating and subcooling on the vapour compression refrigeration cycle. Show it on T-S and p-h charts.

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