5. Write short notes on any two of the following: (5x2)

A. Otto Cycle.

B. Gibbs Phase Rule.

C. Application of S.F.E.E.

–x–x–x–

TME-302 Printed Pages : 4

Paper ID & Roll No. to be filled in your Answer Book

Roll No. | | | | | | | | | | |

B.Tech.

UTU END SEMESTER EXAMINATION, 2013-14

Engineering Thermodynamics

Time : Two Hours] [Max. Marks : 50

Note: Attempt all questions. Assume missing data suitably. Marks distribution is given for each question. Steam Table is allowed.

1. Attempt any two questions. (5x2)

A. Derive the equation $\left(\frac{\partial C_p}{\partial P}\right)_T = -\left(\frac{\partial^2 V}{\partial T^2}\right)_P$ and prove that C_p of an ideal gas is a function of T only.

B. Explain Joule-Kelvin effect. What is inversion temperature?

C. Explain with the help of mathematical expressions which Property of a system increases when the heat is transferred: (a) at constant volume, (b) at constant pressure?

2. Attempt any two questions. (5x2)

A. Write down the first and second *TdS* equations, and derive the expression for the difference in heat capacities, C_p and C_v. What does the expression signify?

B. Prove that the available energy of a fluid at a higher temperature is more than that a lower temperatu and decreases as temperature decreases.

C. What is the critical state? Explain the terms critical pressure, critical temperature and critical volume of water.

3. Attempt any two questions. (5x2)

A. A single stage reciprocating air compressor has a swept volume of 2000 cm^3 and runs at 8000 rpm. It operates on a pressure ratio of 8, with a clearance volume of 5% of the swept volume. Assume NTP room conditions and at inlet (p=101.3 kPa, t=15°C), and polytropic compression and expansion wit n=1.25. Calculate (i) indicated power, (ii) volumetric efficiency, (iii) mass flow rate, (iv) free air delivery (FAD), (iv) isothermal efficiency, and (v) actual power needed to drive the compressor, if mechanical efficiency is 0.85.

B. What is the second law of thermodynamics? Prove that the violation of the Kelvin-Planck's statement violates the Clausius' statement.

C. A body of constant heat capacity--- C_p and initial temperature T_1 is placed in contact with a heat reservoir at temperature T_2 and comes to thermal equilibrium with it. If $T_2>T_1$, calculate the entropy change of the universe and show that this is always positive.

4. Attempt any two questions. (5x2)

A. For the same compression ratio and heat rejection, which cycle is most efficient: Otto, Diesel or Dual? Explain with p-v and T-s diagrams.

B. An engine cylinder has a piston of area 0.12 m^2 and contains gas at a pressure of 1.5MPa. The gas expands according to a process which is represented by a straight line on a pressure-volume diagram. The final pressure is 0.15MPa. Calculate the work done by gas on piston if the stroke is 0.30m.

C. Derive an expression for availabilities of a closed system and a steady flow open system.