Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV • EXAMINATION – SUMMER 2013

Subject Code: 141903 **Date: 07-06-2013**

Subject Name: Engineering Thermodynamics

Time: 10:30am – 01:00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Mollier chart and steam tables in permitted.**

Q.1 **(a)** Prove the equivalency of Kelvin-Plank and Clausius statements. **07**

(b) Derive an expression for Otto cycle efficiency with usual notation. **07**

Q.2 **(a)** Discuss macroscopic and microscopic point of view in thermodynamics **04**

(b) Write steady flow energy equation in case of boiler, turbine and condenser. **03**

(c) Prove that all reversible engines operating between same temperatures limits are equally efficient. **07**

OR

(c) Explain the difference between isentropic process and adiabatic process. **07**

Q.3 **(a)** Show that coefficient of performance of heat pump and gerator can be related as; $COP_{Ref} = COP_{HP} - 1$ **07**

(b) A heat pump working on a reversed Carnot cycle takes in energy from a reservoir maintained at 3°C and delivers it to another reservoir where temperature is 77°C. The heat pump drives power for its operation from a reversible engine operating within the higher and lower temperature limits of 1077°C and 77°C. For 100 kJ/s of energy supplied to the reservoir at 77°C, estimate the energy taken from the reservoir at 1077°C. **07**

OR

Q.3 **(a)** Using second laws of thermodynamics check the following and also indicate nature of cycle. **07**

(i) Heat engine receiving 1000 kJ of heat from a reservoir at 500 K and rejecting 700 kJ heat to a sink at 27°C.

(ii) Heat engine receiving 1000 kJ of heat from a reservoir at 500 K and rejecting 600 kJ of heat to a sink at 27°C.

(b) A cool body at temperature T_1 is brought in contact with high temperature reservoir at temperature T_2. Body comes in equilibrium with reservoir at constant pressure. Considering heat capacity of body as C, show that entropy change of universe can be given as; $C\left[\left(\frac{T_1 - T_2}{T_2}\right) - \ln\frac{T_1}{T_2}\right]$ **07**

Q.4 **(a)** Derive the two *T.ds* equations as stated below: **07**

$$Tds = C_p dT - T\left(\frac{\partial v}{\partial T}\right)_p dp \quad \text{and} \quad Tds = C_v\left(\frac{\partial T}{\partial p}\right)_v dp + C_p\left(\frac{\partial T}{\partial v}\right)_p dv$$

(b) What do you understand by Joule-Thomson coefficient? Explain. **07**

OR

Q.4 **(a)** What do you understand by ideal regenerative cycle? Why is it not possible in practice? Also give actual regenerative cycle. **07**

(b) A steam power plant uses steam as working fluid and operates at a boiler pressure of 5 MPa, dry saturated and a condenser pressure of 5 kPa. Determine the cycle efficiency for (i) Carnot cycle (ii) Rankine cycle. Also show the T-s representation for both the cycles. **07**

Q.5 **(a)** Draw the Diesel cycle on p-v and T-s diagram. Also derive expression for air standard efficiency with usual notations for the cycle. **07**

(b) Explain briefly Dalton's law and Gibbs-Dalton law applied to mixture of perfect gases. **07**

OR

Q.5 **(a)** Derive Vander Waal's equation. **07**

(b) Explain in brief how calorific value is determined by calorimeter and Junkers gas calorimeter. **07**

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