

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 is permitted.

- Q.1 (a)** Prove the equivalency of Kelvin-Planck 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 generator can be related as; **07**

$$\text{COP}_{\text{Ref}} = \text{COP}_{\text{HP}} - 1$$

(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; $C \left[\left(\frac{T_1 - T_2}{T_2} \right) - \ln \frac{T_1}{T_2} \right]$

- 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**
