Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- IVth SEMESTER–EXAMINATION – MAY/JUNE- 2012

Subject code: 141903 **Date: 23/05/2012**

Subject Name: Engineering Thermodynamics

Time: 10:30 am – 01:00 pm **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 properties tables is permitted.**

Q.1 **(a)** Define Thermodynamic system. Also explain different thermodynamic systems with appropriate examples. **07**

(b) Explain concept of Quasi-static process with necessary figure. **04**

(c) Differentiate between Intensive and Extensive properties of system. **03**

Q.2 **(a)** Prove that 'Energy' is a point function of a system undergoing change of state. **07**

(b) An air compressor compresses atmospheric air at 0.1 MPa and 27^0 C by 10 times of inlet pressure. During compression the heat loss to surrounding is estimated to be 5% of compression work. Air enters in compressor with velocity of 40 m/s and leaves with 100 m/s. Inlet and exit cross-section areas are 100 cm^2 and 20 cm^2 respectively. Estimate the temperature of air at exit from compressor and power input to compressor. **07**

OR

(b) Prove the equivalency of Kelvin-Plank and Clausius statements. **07**

Q.3 **(a)** Explain Clausius inequality for reversible and irreversible cyclic processes. **07**

(b) Air at 20^0 C and 1.05 bar occupies 0.025 m^3. The air is heated at constant volume until the pressure is 4.5 bar, and then cooled at constant pressure back to original temperature. Calculate (i) The net heat flow from the air. (ii) The net entropy change. Also draw the processes on T-s diagram. **07**

OR

Q.3 **(a)** Define "Availability". Also derive expression for availability in a non-flow system. **07**

(b) 5 kg of air at 550 K and 4 bar is enclosed in a closed system. (i) Determine the availability of the system if the surrounding pressure and temperature are 1 bar and 290 K respectively. (ii) If the air is cooled at constant pressure to the atmospheric temperature, determine the availability and effectiveness. **07**

Q.4 **(a)** Write brief note on the followings: **06**

(i) Helmholtz function (ii) Gibbs Function (iii) Irreversibility

(b) Give comparison of Carnot cycle and Rankine cycle for vapour. **04**

(c) In a steam power cycle, the dry and saturated steam is supplied at 15 bar. If the condenser pressure is 0.4 bar, calculate the Carnot and Rankine cycle efficiencies neglecting the pump work. **04**

OR

Q.4 **(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) In an ideal Brayton cycle, the ambient air at 1 bar - 300 K is compressed to 6 bar and the maximum cycle temperature is limited to 1200 K. if the heat supply is 120 MW, find (i) The thermal efficiency of the cycle (ii) work ratio (iii) power output and (iv) mass flow rate of air. Also show the cycle on p-v and T-s diagram. **07**

Q.5 **(a)** Explain the method of determination of calorific value of a given fuel by Bomb calorimeter with neat sketch. **07**

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

OR

Q.5 **(a)** State the Avogadro's law. **02**

(b) A mixture of hydrogen and oxygen is to be made so that the ratio of H_2 and O_2 is 3:1 by volume. If the pressure and temperature are 1 bar and 30^0 C respectively. Calculate (i) the mass of O_2 required (ii) the volume of the container. **05**

(c) Following results were obtained when a sample of gas was tested by Junker's gas calorimeter. **07**

Volume of sampled gas : 0.08 m^3
Pressure of gas supply : 52 mm of water, temperature of gas: 12^0 C
Barometric pressure : 750 mm of Hg
Weight of water heated by gas : 30 kg
Temperature difference of circulated water: 15^0 C
Steam condensate collected : 0.06 kg
Determine the higher and lower calorific value per m^3 of gas at temperature of 15^0 C and barometric pressure of 760 mm of Hg.

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