 Candidate's Seat No : _____

GUJARAT UNIVERSITY

B. E. Sem III Mech. (Old) Examination

Thermodynamics-I

Thursday, 3rd January, 2008] **[Time : 3 Hours**

Max. Marks : 100

Instructions : (1) Attempt all questions.

(2) Answer to the two sections must be written in separate answer books.

(3) Figures to the right indicate full marks.

(4) Assume additional data if required.

(5) Draw neat sketch wherever required.

(6) Use of steam table, Mollier chart and calculator is permissible.

SECTION - 1

1 (a) Explain a method for finding the volumetric analysis of flue gases. **16**

(b) The following percentage composition by weight is for the sample of a coal :

$C = 82\%$, $H_2 = 10\%$, $O_2 = 6\%$, $N_2 = 1\%$ and $S = 1\%$. Find the minimum quantity of air required for the complete combustion of 1 kg of coal (i.e. A/F ratio). If 20% of excess air is used in the composition, what is the air fuel ratio ?

OR

1 (a) Explain and derive the general energy equation for steady flow process. **16**

(b) What are the requirements of a steady flow process ?

(c) In a boiler, water enters with an enthalpy pf 168 kJ/kg and steam leaves with enthalpy of 2925 kJ/kg. Find the heat transferred per kg of steam. The change in kinetic and potential energies may be neglected.

2 (a) Derive an expression for thermal efficiemncy of Rankine cycle. **16**

(b) Dry and saturated steam at pressure of 11 bar is supplied to a turbine and expanded isentropically to pressure 0.07 bar. Calculate the (i) Heat supplied in kJ/kg (ii) Total change of entropy in kJ/kg-K (iii) Heat rejected in kJ/kg (iv) Theoretical thermal efficiency.

3 With usual notations, prove the following relations **(any two) :** **18**

(i) $C_p - C_v = \dfrac{T\beta^2 v}{k}$

(ii) $\dfrac{dp}{dT} = \dfrac{hg - hf}{T(v_g - v_f)}$

(iii) $\left(\dfrac{\partial u}{\partial s}\right)_v = \left(\dfrac{\partial h}{\partial s}\right)_p = T.$

[P.T.O.

SECTION II

4 (a) Derive an expression for air standard efficiency of Otto cycle. **16**

(b) An air standard Diesel cycle has a compression ratio of 16. The pressure at the beginning of the compression stroke is 1 bar and the temperature is 20°C. The maximum temperature is 1430°C. Determine the thermal efficiency and the mean effective pressure for this cycle.

OR

4 (a) Define Clausius Inequality and prove it. **16**

(b) Define entropy and show that it is a property of the system.

(c) Show that heat transfer is a function of enthalpy alone during any process, if the pressure remains constant.

5 (a) What are the limitations of the first law of thermodynamics ? **16**

(b) Show that the thermodynamic temperature scale is independent of the working fluid.

(c) Discuss the perpetual motion machines of the first and second kind.

6 Attempt **any three** of the following : **18**

(a) What do you mean by available and unavailable energy ? Derive an expression for availability of a non-flow process.

(b) Define and explain reversible process. State the types of irreversibilities that come across when thermodynamic processes are perfomed. What is their effect ?

(c) Write note on absolute temperature scale.

(d) Show the equivalence of Clausius and Kelvin Plank statements.

(e) Explain entropy and disorder.