Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III • EXAMINATION – WINTER • 2014

Subject Code: 130405 Date: 18-12-2014

Subject Name: Thermodynamics

Time: 02.30 pm - 05.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 Explain PVT behavior of a pure substance with the help of PT and PV diagram in detail. **14**

Q.2 **(a)** Derive expressions of constants 'a' and 'b' of Vanderwall's equation of state in terms of critical properties of substances. **07**

(b) Derive mathematical expression of the first law of thermodynamics for steady state flow process. **07**

OR

(b) Describe vapor compression cycle or absorption refrigeration cycle with neat diagrams. **07**

Q.3 **(a)** With special reference to mathematical statement of the second law, justify that "All isentropic processes are adiabatic, but all adiabatic processes are not isentropic." Also, derive $\Delta S_{Total} \geq 0$ for heat transfer process. **09**

(b) What are the factors (properties) affects the choice of a refrigerant? Explain in detail **05**

OR

Q.3 **(a)** State and prove Carnot theorem for heat engines. Also, mention corollary to Carnot theorem. **07**

(b) A steel casting [C_p=0.5 kJ kg^{-1} K^{-1}] weighing 40 kg and at a temperature of 450°C is quenched in 150 kg of oil [C_p=2.5 kJ kg^{-1} K^{-1}] at 25°C. If there are no heat losses, what is the change in entropy of (a) the casting (b) the oil, and (c) both considered together? **07**

Q.4 **(a)** Explain criteria of chemical reaction equilibria or phase equilibria in detail. **07**

(b) Differentiate between the following: **07**

(i) Reversible Vs irreversible process

(ii) State function Vs path function

OR

Q.4 **(a)** Define and explain followings with examples of each: **07**

(i) Sensible heat (ii) Latent heat

(iii) Standard heats of formation, reaction and combustion.

(b) Derive Maxwell equations using fundamental property relations for a homogeneous fluid of constant composition. **07**

Q.5 **(a)** Explain various types of thermodynamic diagrams in detail. **07**

(b) Define: Force, temperature, Pressure, Work, Energy, Heat and Enthalpy **07**

OR

Q.5 **(a)** How much heat is required when 200 g of $CaCO_3$ is heated at atmospheric pressure from 30°C to 700°C? **07**

Data: $Cp/R = 12.572 + 2.637 \times 10^{-3}T - 3.12 \times 10^{5}T^{-2}$, T is in K

(b) Mention Various statements of Zeroth, first, second, and third law of thermodynamics. Also, explain limitations of each. **07**

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