

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-III Examination-Dec.-2011

Subject code: 130405**Date: 13/12/2011****Subject Name: Thermodynamics****Time: 2.30 pm -5.00 pm****Total marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Notations used have their conventional meanings.

- Q.1** (a) Derive the expressions for constants 'a' and 'b' in terms of critical properties for a gas obeying Berthelot equation of state. **07**
- (b) Differentiate between the following: **07**
- (i) Reversible Vs irreversible process
 - (ii) State function Vs path function

- Q.2** (a) Mention Various statements of Zeroth, first, second, and third law of thermodynamics. Also, explain limitations of each. **07**
- (b) Explain PVT behavior of a pure substance with the help of PT and PV diagrams. **07**

OR

- (b) A gas is confined by a piston, 10 cm in diameter, on which rests a weight. **07**
The mass of the piston and the weight together is 30 kg. The local acceleration of gravity is 9.805 m/s^2 , and atmospheric pressure is 101.22 kPa.
- (i) What is the force in newtons exerted on the gas by the atmosphere, the piston, and the weight, assuming no friction between the piston and the cylinder?
 - (ii) What is the pressure of the gas in kPa?
 - (iii) If the gas in the cylinder is heated, it expands, pushing the piston and weight upward. If the piston and weight are raised 40 cm. What is the work done by the gas in kJ? What is the change in potential energy of the piston and the weight?

- Q.3** (a) State and prove Carnot theorem for heat engines. **07**
- (b) If 10 mol of ethylene is heated from 200 to 1000°C in a steady-flow process at approximately atmospheric pressure, what is its entropy change? **07**
The heat capacity equation for ethylene is:

$$\frac{C_{P,ms}^{ig}}{R} = 1.424 + 14.394 \times 10^{-3} T_{lm} - 4.392 \times 10^{-6} T_{am} T_{lm}$$

OR

- 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." **07**

- (b) A quantity of an Ideal gas, $C_p = (7/2) R$, at 20°C and 1 bar having a volume of 70 m^3 , is heated at constant pressure to 25°C by the transfer of heat from a heat reservoir at 40°C . Calculate the heat transfer to the gas, the entropy change of the heat reservoir, the entropy change of the gas, and ΔS_{Total} . What is the irreversible feature of the process? **07**
- 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**
- OR**
- Q.4 (a)** What is the final temperature when heat in the amount 930 kJ is added to 25 moles of ammonia initially at 260°C in a steady-flow process at approximately 1 atm? **07**
 $C_p^{\text{ig}}/R = 1.702 + 9.081 \times 10^{-3} T - 2.164 \times 10^{-6} T^2$, T is in K
- (b) With special reference to PH diagram, TS diagram and Mollier diagrams, explain various types of thermodynamic diagrams in detail. **07**
- Q.5 (a)** Describe the factors (properties) affecting the choice of a refrigerant. **07**
 (b) Explain criteria of chemical reaction equilibria in detail. **07**
- OR**
- Q.5 (a)** Describe both types of vapor compression refrigeration cycle with the help of neat diagrams. **07**
 (b) Discuss basic fundamentals of phase equilibria with examples. **07**
