



**SF-8168**

**B. E. - II (Sem. IV) (Chemical) Examination**

**May / June - 2011**

**Chemical Engineering Thermodynamics - I**

*(As per New Syllabus)*

Time : 3 Hours]

[Total Marks : 100

**Instructions :**

(1)

नीचे दृशायेव निशानीवाणी विगतो उत्तरवडी पर अवश्य कपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - 2 (Sem. 4) (Chem.)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Chemical Engineering Thermodynamics - I"/>	<input type="text"/>
Subject Code No. : <input type="text" value="8"/> <input type="text" value="1"/> <input type="text" value="6"/> <input type="text" value="8"/>	<input type="text"/>
Section No. (1, 2,.....) : <input type="text" value="Nil"/>	
Student's Signature	

- (2) Figure to the right indicate marks.
- (3) Assume suitable data if necessary and mention it clearly.
- (4) Use of scientific calculator casio fx 82, fx 83, fx 100 or equivalent of other companies are allowed.
- (5) Draw neat and clean figure/diagram whenever necessary.

1 (a) Answer the following : **2×5=10**

- (1) Write down RK and RKS equation.
- (2) Explain the physical significance of the triple point and critical point.
- (3) What do you mean by cyclic process ? State the first law of thermodynamics for cyclic process.
- (4) Write down the Kelvin-Planck and Clausius statement for second law of thermodynamics.
- (5) Write down the principle of corresponding state.

(b) Derive an equation for work done in an adiabatic process involving ideal gas. **1×8=8**

**2** Attempt any **two** :

**8×2=16**

- (a) Calculate the compressibility factor and molar volume for methanol vapour at 500 K and 10 bar by using the RK equations. The critical temperature and pressure of methanol are 512.6 K and 81 bar.
- (b) Water at 368 K is pumped from a storage tank at the rate of 25 m<sup>3</sup>/h. The motor for the pump supplies work at the rate of 2 hp. The water passes through a heat exchanger where it gives up heat at the rate of 42000 kJ/min and is delivered to a second storage tank at an elevation of 20 m above the first tank. What is the temperature of the water delivered to the second storage tank ? Assume that the enthalpy of water is zero at 273 K and the specific heat of water is constant at 4.2 kJ/kg K.
- (c) Two compartments each of 1 m<sup>3</sup> capacity are connected by a valve and insulated from the surroundings and from each other. One compartment contains saturated steam at 683.6 KPa and the other contains steam at the same temperature but at a pressure of 101.3 KPa. The valve is opened and the pressure is allowed to equalise. Determine the change in entropy of the system consisting of the two vessels. Comment on the irreversibility of the process.

**3** Attempt any **two** :

**8×2=16**

- (a) Using the Clausius inequality show that the change in entropy in a process is related to the heat interaction is  $dS \geq \frac{dQ}{T}$ , where the greater than sign refers to an irreversible process and equal to sign refers to a reversible process.
- (b) Show that the ideal gas temperature and the absolute thermodynamic temperature are identical.
- (c) Explain the reversible and irreversible processes with example.

- 4 (a) Answer the following question : 10
- (i) Write down name of basic cycles for liquefaction of a gas.
  - (ii) Principle of refrigeration is based on which law of thermodynamics ? Give name of at least two refrigerants.
  - (iii) Draw pressure/enthalpy diagram for pure substance.
  - (iv) What is Critical point ?
  - (v) Define COP for carnot refrigerator.
- (b) Write a short note on residual properties from Virial equation of state. 8

5 Answer the following : (any two) 16

- (a) What pressure is generated when 1 kgmol of methane is stored in a volume of  $0.125 \text{ m}^3$  at  $323.15 \text{ K}$  ? Base calculations on each of the following :

- (i) The ideal gas equation
- (ii) A generalized correlation

Data given :  $Z^\circ = 0.887$ ,  $Z' = 0.258$ ,  $w = 0.012$

- (b) Determine the enthalpy and entropy changes of liquid water for a change of state from 1 bar and  $298.15 \text{ K}$  to 1000 bar and  $323.15 \text{ K}$ . The following data for water are available :

T/C°	P/bar	$C_P / \frac{\text{kJ}}{\text{kg mol K}}$	$V / 10^{-3} \frac{\text{m}^3}{\text{kg mol}}$	$\beta / \text{K}^{-1}$
25	1	75.305	18.071	$256 \times 10^{-6}$
25	1000	—	18.012	$366 \times 10^{-6}$
50	1	75.314	18.234	$458 \times 10^{-6}$
50	1000	—	18.174	$568 \times 10^{-6}$

- (c) Write a short note on thermodynamic diagrams.

**6** Answer the following : (any **two**)

**16**

- (a) What is difference between turbine and expander ?  
Explain adiabatic expansion process in turbine.
  - (b) Write a short note on compression processes.
  - (c) Write a short note on claudes liquefaction process.
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