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RN-6723

B. E. III (Sem. V) (Chemical) Examination

May / June – 2010

Chemical Engineering Thermodynamics-I

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. 3 (Sem. 5) (Chemical)**

Name of the Subject :

☛ **Chemical Engineering Thermodynamics-1**

☛ Subject Code No. : **6 7 2 3** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Answer to the **two** sections are to be written in **separate** answer books.
(3) Figures to the right indicate marks.
(4) Assume suitable data, if necessary.
(5) Use of scientific calculator Casio Fx82, Fx83, Fx100 or equivalent of other companies are allowed.

SECTION - I

1 (a) Define the following terms : **5 × 1=5**
(i) Zeroth law of thermodynamics
(ii) Phase
(iii) Isolated system
(iv) Work
(v) Control volume.

(b) Attempt the following : **5 × 1=5**
(i) What is Fixed Point?
(ii) Explain thermometric property.
(iii) What are intensitve and extensive properties?
(iv) What are the modes in which the energy is stored in a system?
(v) Explain the terms 'source' and 'sink'.

(c) Attempt the following : **5×2=10**

(i) Write S.F.E.E. for heat exchanger.

(ii) Show that heat transfer through a finite temperature difference is irreversible.

(iii) Give e.g. of high grade energy and low grade energy.

(iv) Show that energy is a property of the system.

(v) What are the indicated power and the brake power of an engine?

2 Attempt any **two** : **2×8=16**

(i) Explain indicator diagram and the terms calculated.

(ii) Show that the adiabatic mixing of two fluids is irreversible.

(iii) Give the applications of the steady flow energy equation and its derivation.

3 Solve any **two** of the following : **2×7=14**

(i) A domestic Food Freezer maintains a temperature of –15°C. The ambient temperature is 30°C. If heat leaks into the Freezer at the continuous rate of 1.75 kJ/s, what is the least power necessary to pump this heat out continuously?

(ii) In a steam power station, steam flows steadily through a 0.2 m diameter pipeline from the boiler to the turbine. At the boiler end, the steam condition are found to be P = 4 MPa, t = 400°C, h = 3213.6 kJ/kg and V = 0.073 m^3/kg. At the turbine end, the conditions are found to be : P = 3.5 MPa, t = 392°C, h = 3202.6 kJ/kg and V = 0.084 m^3/kg. There is a heat loss of 8.5 kJ/kg from the pipeline. Calculate the steam flow rate.

(iii) 680 kg of Fish at 5°C are to be frozen and stored at –12°C. The specific heat of fish above freezing point is 3.182, and below freezing point is 1.717 kJ/kgK. The freezing point is -2°C and the latent heat of fusion is 234.5 kJ/kg. How much heat must be removed to cool the fish, and what percent of this is latent heat?

SECTION - II

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

(i) Define Joule-Kelvin coefficient.

(ii) Define critical pressure ratio

(iii) What is refrigeration?

(iv) Mention a few common refrigerants.

(v) Enlist different stages in vapour compression refrigeration cycle.

(b) A vapour compression heat pump system uses R-12 as the working fluid. The refrigerant enters the compressor at 2.4 bar, 0°C with a volumetric flow rate of 0.6 m^3/min compression is adiabatic to a bar. 60°C and the saturated liq. exists the condenser at a bar determine 8

(i) The power input to the compressor
(ii) The heating capacity of the system
(iii) The coefficient performance (C.O.P)
(iv) The isentropic compressor efficiency.

5 Attempt any **two** : **8×2=16**

(i) Explain the measurement of quality of steam by means of throttling calorimeter using T-S and h-S plots .
(ii) Explain h-s diagram for pure substance.
(iii) Derive Maxwell's equation.

6 Attempt any **two** : **8×2=16**

(i) Explain absorption refrigeration cycle in detail with neat diagram and appropriate plots.
(ii) Explain Joule-Kelvin effect and derive $\mu_j = 0$ for an ideal gas.
(iii) What is polytropic process? Derive the relations among P, ϑ and T of an ideal gas in polytropic process.