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RN-8171

B. E. - II (Sem. IV) (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. - 2 (Sem. 4) (Chemical)**

Name of the Subject :

☛ **Chemical Engineering Thermodynamics - I**

☛ Subject Code No. : **8 1 7 1** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Figures to the right indicate marks.

(3) Assume suitable data, if necessary.

(4) Use of scientific calculator casio Fx 82, Fx 83, Fx100 or equivalent of other companies is allowed.

SECTION - I

1 (a) Answer the following : **6×1=6**

(i) $\oint \frac{dQ}{T}$ is _____ for reversible cycle.

(ii) Give the sign conventions for work transfer.

(iii) What is phase?

(iv) Define thermodynamic process.

(v) Give van der waals' equation of state.

(vi) What is Entropy?

(b) Answer the following : (any **seven**) **7×2=14**

(i) Explain Thermodynamic Equilibrium.

(ii) What are macroscopic ***vs*** microscopic viewpoint?

(iii) Difference between path function and point function.

(iv) Explain specific heat and latent heat.

(v) Explain law of corresponding states.

(vi) Write S.F.E.E. for turbine and compressor.

(vii) Show that energy is property function.

(viii) Explain temperature dependence of the heat capacity.

2 Attempt any **two** : **8×2=16**

(i) Explain inequality of Claussius.

(ii) Explain specific heat at constant volume and constant pressure.

(iii) Explain mass balance and energy balance in a steady flow process (SFEE)

3 Solve any **two** : **7×2=14**

(i) One kg of ice at -5°C is exposed to the atmosphere which is at 20°C. The ice melts and comes into thermal equilibrium with the atmosphere.

Determine the entropy increase of the universe.

(ii) (a) Calculate the heat required to raise the temperature of 1 mole of methane from 533.15 to 873.15 K (260 to 600°C) in steady flow process at a pressure sufficiently low that methane may be considered an ideal gas.

Data :

$$C_p^{ig} / R = A + BT + CT^2 + DT^{-2}$$

$$A = 1.702,\ B = 9.081 \times 10^{-3}$$

$$C = -2.164 \times 10^{-6}$$

(b) Explain Cp for mixture. **3**

(iii) A fluid is confined in a cylinder by a spring loaded, frictionless piston so that the pressure in the fluid is a linear function of the volume (P = a + bv). The internal energy of the fluid is given by the following equation

U = 34 + 3.15 pV

where U is in kJ, P is in kPa and V in cubic metre. If the fluid changes from an initial state of 170 kPa, 0.03 m^3 to a final state of 400 kPa, 0.06 m^3, with no work other than that done on the piston. Find the direction and magnitude of the work and heat transfer.

SECTION - II

4 Attempt the following : **2×5=10**

(i) What is one tonne of refrigeration?

(ii) List out different methods for the liquefaction of gases.

(iii) What is nozzle?

(iv) What is coefficient of performance for refrigerator system?

(v) What is internal energy?

5 Attempt any **two** : **2×8=16**

(i) Write down in detail about vapour compression refrigeration cycle with neat sketch.

(ii) Write down in detail about two phase system.

(iii) A domestic food freezer maintains a temperature of $-15^{o}C$. The ambient air temperature is $30^{o}C$. 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 continuously?

6 Attempt any **three** : **3×8=24**

(i) Define absorption refrigeration cycle in detail with neat sketch.

(ii) Write down in detail about Maxwell relations.

(iii) Write down in detail about thermodynamic diagram with neat sketch.

(iv) A cyclic heat engine operates between a same temp of 1073 K and sink temperature of 303 K. Calculate the least rate of heat rejection per kW net output of the engine.