B.E. (SEM.-VIII) (CGS) (Mechanical Engg.)
Cryoginics

30th May 2016
11.00 am to 2.00 pm

QP Code : 735200

(3 Hours)

[Total Marks : 80

N.B. : 1) Solve Q 1 and any Three from Q 2 to Q 6
2) T-S charts of gases are permitted.
3) Assume suitable data if necessary and mention it clearly.

1. Solve **any four**
   (A) Explain the applications of cryogenics. **5**
   (B) When one end of tube is dipped in cryogen, it gets pumped through the tube. State the reason. **5**
   (C) Compare J-T valve and expanders used in gas liquefaction systems . **5**
   (D) Show the configurations of heat exchangers used in cryogenic systems. **5**
   (E) What is super fluid? explain. **5**

2. (A) Derive an expression for the work requirement for thermodynamically ideal liquefaction system. **10**
   (B) Determine the ideal-work requirement for the liquefaction of oxygen, beginning at 101.3 kPa (1·atm) and 300 K. Why it is not practicable? **10**

3. (A) Determine the liquid yield, the work per unit mass compressed and work per unit mass liquefied for the pre cooled Linde-Hampson system using nitrogen as the working fluid. The nitrogen portion of the system operates between 1 atm, 300 K and 200 atm. The state points for the refrigerant portion of the system are as follows: $h_a = 207.94$ kJ/kg; $h_b = 250.2$ KJ/kg and $h_c = 61.23$ kJ/kg at 300 K; $h_d = 61.23$ kJ/kg at 243 K.
   The refrigerant flow rate ratio is 0.1. Find the FOM if ideal work required is 767 kJ/kg liquefaction. **10**
   (B) Why hydrogen, helium and neon gases cannot be liquefied by simple Linde-Hampson liquefaction system? Explain with T-S and schematic sketches of simple Linde - Hampson system. **10**

4. (A) Draw schematic of Dewar vessel and show its elements. **10**

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(B) Draw a reversible isobaric-source refrigeration cycle on Temperature-Entropy co-ordinates and derive the expression **10**

$$COP = \frac{h_2 - h_1}{[T_0(s_2 - s_1)] - (h_2 - h_1)} = \frac{\left(T_2/T_1\right) - 1}{\left(T_0/T_1\right) \ln\left(T_2/T_1\right) - \left(T_2/T_1\right) + 1}$$

where T_1 and T_2 are the minimum and maximum isobaric source temperatures and T_0 is the isothermal sink temperature.

5. (A) Determine the ideal-work requirements for the separation of a mixture of gases consisting of 79% nitrogen and 21% oxygen by weight at 300 K and 101.3 kPa. Consider the gases as ideal gases. **10**

(B) Explain the methods of liquid level measurements in cryogens storage vessels. **10**

6. Write short notes on **any three** - **20**

(A) Insulations used in Cryogenics

(B) Cryogenic liquids help to separate rubber from vehicle old tyres

(C) Blood storage using cryogens

(D) Ortho-para-hydrogen conversion
