CRYOGENIC TECHNOLOGY

Full Mark: 70
Duration: 3 hours

Answer any SIX Questions including Q.No. 1 which is compulsory
The figures in the right hand margin indicate marks.

1. a) Explain the significance of magnetic properties of cryo-fluids.   2×10
    b) Why the gas is liquefied at low temperatures? Explain.
    c) How to evaluate gaseous mixture properties?
    d) Differentiate between Argon and Helium separation processes.
    e) What is magnetic cooling? How is it achieved?
    f) Explain the importance of demagnetization process.
    g) How does cryogenic refrigeration system work?
    h) Explain the material used for super conductor.
    i) Discuss the function of cryotrons.
    j) What are practical applications of cryogenic fluids in medicine?

2. a) What are the desirable thermal, mechanical and electric properties cryogenic
    fluids? Explain their importance in cooling process.   5
    b) How to liquefy the Helium gas? Explain the procedure with a suitable diagram. 5

3. a) Derive the equation for minimum work required for gas liquefaction process.   5
    b) Determine the liquid yield, the work per unit mass compressed, the work per unit
    mass liquefied, and the figure of merit for a simple Linde-Hampson system using
    Argon as the working fluid. The system operates between 101.3 kPa and 293 K at
    point 1 and 20.67 MPa at point 2. The system may be assumed reversible, except for
    the expansion through the expansion valve. Draw the neat sketch for the arrangement
    and represent the cycle on T-S chart.   5

4. a) A natural gas stream has a volumetric composition of 80% methane, 12% ethane,
    3% propane, 1% butane and 4% nitrogen. Assuming that all the gases are in mixture
    follows the ideal gas equation of state; evaluate the ideal work of separation at 300K
    in kJ/kg of propane if i) all the gases are separated and ii) only the ethane and the
    propane are separated individually from the other gases that remain mixed.
    b) What are different methods of gas purifications systems used? Explain.   5

5. a) What is cascade refrigeration system? Explain the method to low temperatu
    production using cascade system.   5
    b) An ideal Joule Thompson refrigeration system operates between 300 K and 70
    using Nitrogen as working fluid. The gas is compressed from 50.7kPa to 15.2 MI
    Determine the coefficient of performance and figure of merit of this system.   5

6. a) Draw the simple diagram of magnetic refrigeration system and explain the constructional and operational features. 5

b) Discuss the principles of storage and handling cryogenic fluid at very low temperatures. 5

7. a) What is the measurement techniques used for the low temperature? Explain them. 5

b) What is the system performance parameter for gas liquefaction system? How these parameters are related? Explain. 5

8. a) How does the cryo-rocket work? What are different types of working fluids used in cryo-rockets? Explain their characteristics. 5

b) What are different cooling systems used for the preservation of blood and tissues of human body? Explain. 5