

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013

Subject code: 1721001

Date: 24-12-2013

Subject Name: Cryogenic Systems

Time: 10.30 am – 01.00 pm

Total Marks: 70

Instructions:

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**

Q.1 (a) What do you mean by Joule-Thomson effect? Define Joule-Thomson coefficient. **07**
With usual notations derive the expression for it.

(b) Write note on pulse tube refrigerators. **07**

Q.2 (a) With neat sketch discuss the simple Linde-Hampson system for gas liquefaction. **07**

(b) What are the pay-off functions to indicate performance of gas liquefaction systems? Explain their importance. How will you reach to figure of merit with help of these pay-off functions? **07**

OR

(b) What do you mean by isothermal-source and isobaric-source system with reference to cryogenic refrigeration systems? Compare both the systems. **07**

Q.3 (a) With neat sketch discuss the Linde dual pressure system for gas liquefaction. Is there any decrease in work requirement? How discuss? **07**

(b) Write short notes with neat sketches on Cascade Liquefaction system. **07**

OR

Q.3 (a) What modification in Claude system was carried out by Heylandt? Explain the modified system with neat schematic diagram. **07**

(b) With neat sketch explain Precooled Linde-Hampson system for neon and hydrogen. **07**

Q.4 (a) With neat sketch explain expansion engine refrigeration systems. **07**

(b) With neat sketch explain precooled Joule-Thompson refrigerator. **07**

OR

Q.4 (a) With the help of temperature-entropy diagram explain the working of ideal Philips refrigerator. Discuss how ineffectiveness of a regenerator affects the refrigerating effect. **07**

(b) Determine the refrigeration effect, COP, and the FOM for a precooled liquid-hydrogen refrigerator, if the hydrogen is compressed from 101.3 kPa to 10.13 MPa and 300 K. The main heat exchanger has an effectiveness of 0.98. The nitrogen is compressed from 101.3 kPa to 20.3 MPa and 300 K. The precoolant heat exchanger has an effectiveness of 0.97. The cold exchanger in the hydrogen circuit has an effectiveness of 0.95 and both compressors have overall efficiencies of 75 %.

Q.5 (a) With neat diagram explain PSA system for separation of Nitrogen from air. **07**

(b) Discuss the physical principles of adsorption. Also discuss the BET equation. **07**

OR

Q.5 (a) Define and explain adsorption process. Write the classification of adsorbents and their salient features and properties. **07**

(b) What is adiabatic demagnetization? With neat sketch explain the apparatus to carry out adiabatic demagnetization the process. **07**
