Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject code: 731002 Date: 28-11-2013

Subject Name: Advanced Cryo Coolers

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)** Describe the theoretical procedure for loss analysis of the Stirling cryocooler. **07**

(b) Enlist the suitable assumptions to be made while designing the cryocooler. Also describe the generalized design procedure of a cryocooler. **07**

Q.2 **(a)** Explain the effect of various parameters on the effectiveness of the cryocooler regenerator. **07**

(b) Describe the Cool-down characteristic of J-T cryocooler with different supply pressure, temperature and mass flow rate of working fluid. **07**

OR

(b) A He^3-He^4 dilution cryocooler operates with a flow of He3 of 1.53×10^{-4} mol/s. The liquid He^3 enters the mixing chamber at 0.04 K and the dilute phase leaves the mixing chamber at 0.03 K. Determine the heat transfer ate to the mixing chamber from the low temperature region. **07**

Q.3 **(a)** Explain construction and working of a typical Magnetic Refrigerator with necessary figures. **07**

(b) Write the momentum, continuity and energy equations for a short channel, according to the linear thermo-acoustic theories with necessary explanation. **07**

OR

Q.3 **(a)** Explain the effects of phase angle, frequency and regenerator material on the performance of the Two Stage G-M cryocooler. **07**

(b) Describe the effects of valve timing on performance of the pulse tube cryocooler. **07**

Q.4 **(a)** Explain with necessary figures the Thermodynamic Nonsymmetry Effect on pulse tube refrigerator. **07**

(b) Differentiate between three different geometries for pulse tube cryocoolers with their merits and demerits. **07**

OR

Q.4 **(a)** Give justifications for the need of precooling in Mixed Gas J-T cryocooler with necessary figures. **07**

(b) Describe working of Sorption compressor and Electrochemical compressor used for cryocoolers. **07**

Q.5 **(a)** Describe the physical model and governing equations along with boundary conditions for numerical simulation of the two stage double inlet OPTR with He^4 as working gas. **07**

(b) Explain the selection procedure of gas mixture components for Mixed Refrigerant J-T cryocooler. **07**

OR

Q.5 **(a)** Describe the concept of microgravity applicable to dilution refrigerator. Also write the merits of it. **07**

(b) Explain characteristics of miniature cryocoolers for space craft applications. **07**

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