Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –III Examination Dec. - 2011

Subject code: 731002 **Date: 08/12/2011**

Subject Name: Advanced Cry 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.**
4. **Use of scientific calculators and gas properties charts/tables permitted.**

Q.1 **(a)** Write the momentum, continuity and energy equations for a short channel, according to the linear thermo acoustics theories with necessary explanation. **07**

(b) Explain approximate design method for single stage pulse tube Cryocooler. **07**

Q.2 **(a)** Explain with figure construction and working of Two Stage Stirling type PTR. **07**

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

OR

(b) Describe about Physical Model and governing equations along with boundary conditions for numerical simulation of the two stage double inlet OPTR with Helium-4 gas. **07**

Q.3 **(a)** Explain working of He^3-He^4 dilution Cryocooler to attain the temperature of 0.040 K in mixing chamber with schematic diagram. **07**

(b) Explain with flow diagram the mixed gas J-T Cryocooler with pre-cooling. Also write the advantages and disadvantages of J-T coolers. **07**

OR

Q.3 **(a)** Explain with neat sketch the construction of He^3-He^4 dilution refrigerator precooled by G-M two stage Cryocooler to achieve temperature of 0.015 K. **07**

(b) A He^3-He^4 dilution Cryocooler operates with a flow of He^3 of 1.53×10^{-4} mol/s. The liquid He^3 enters the mixing chamber at 0.04 K, **07**

and the dilute phase leaves the mixing chamber at 0.030 K. Determine the heat transfer rate to the mixing chamber from the low temperature region.

Q.4 **(a)** Give typical gas mixtures components with their proportions and merits applicable to J-T Cryocoolers. **07**

(b) Describe Cool-down characteristics of the J–T cooler with different (a) supply pressure, (b) temperature and (c) mass flow rate and pressure. **07**

OR

Q.4 **(a)** Describe the major manufacturing considerations of rare earth powder used in cryocoolers regenerators. **07**

(b) Explain construction and working of a typical Magnetic Refrigerator with figure. **07**

Q.5 **(a)** Explain the need of high frequency pulse tube cooler for space applications. **07**

(b) Explain construction and working of a typical rotary valve used for PTR with neat figure. **07**

OR

Q.5 **(a)** Discuss the effects of valve timing on performance of the pulse tube cryocooler. **07**

(b) Describe the criteria for selection of the Cryocoolers. **07**

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