

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 $\text{He}^3\text{-He}^4$ 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 $\text{He}^3\text{-He}^4$ dilution refrigerator precooled by G-M two stage Cryocooler to achieve temperature of 0.015 K. **07**
- (b) A $\text{He}^3\text{-He}^4$ 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**
