Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Examination (Regular and Supplementary), December 2020

Course Code: ME467
Course Name: Cryogenic Engineering

Max. Marks: 100 Duration: 3 Hours

PART A
Answer any three full questions, each carries 10 marks. Marks

1	a)	Discuss the applications of cryogenics in aerospace (any two) and medicine (any three).	(5)
	b)	Draw the Pressure-Temperature diagram of He-4 and indicate the salient points in the diagram.	(5)
2	a)	Explain the temperature dependence of the mechanical properties of solids, which are of significance in cryogenic engineering.	(6)
	b)	Explain (a) Fountain effect (b) Mechanocaloric effect.	(4)
3	a)	Explain Joule-Thompson expansion and adiabatic expansion. What is the advantage of adiabatic expansion?	(6)
	b)	Explain the cascade system for the liquefaction of gases. Why thermodynamically it is considered to be very attractive?	(4)
4	a)	Explain the simple Linde- Hampson liquefaction system. Derive expressions for liquid yield, work requirement per unit mass liquified, and FOM.	(8)
	b)	Why the simple Linde-Hampson system cannot be used for liquefaction of Helium, Neon, and Hydrogen?	(2)

PART B
Answer any three full questions, each carries 10 marks.

5	a)	What are ortho-hydrogen and para-hydrogen? Why is it necessary to provide ortho-para conversion arrangement in hydrogen liquefiers?	(5)
	b)	With the help of diagrams, explain the Simon helium liquefier. Derive an expression for liquid yield in Simon helium liquefier.	(5)
6		Explain the liquid Nitrogen precooled Claude system for the liquefaction of Neon or Hydrogen. Derive expressions for liquid yield, work requirement per unit mass liquified, and FOM. Assume that the expansion work output is used to provide part of the compressor work requirement.	(10)

7	a)	Prove that COP of an ideal Stirling cycle refrigerator with perfect regeneration is the same as that of Carnot refrigerator.	(4)
	b)	Explain the working of a Claude refrigerator. Derive an expression for COP of Claude refrigerator considering the compressor and expander efficiencies.	(6)
8	a)	Discuss, with a suitable example, the effect of regenerator effectiveness on the performance of a cryogenic refrigerator.	(6)
	b)	Discuss the working of a magnetic refrigerator.	(4)

PART C
Answer any four full questions, each carries 10 marks.

9		Explain with the help of a diagram, a typical storage vessel for a cryogenic liquid.	(10)
10	a)	Explain different types of cryogenic insulation materials and compare their performance.	(6)
	b)	What are the factors to be considered for selecting insulation for a particular application?	(4)
11		Explain the features of cryogenic fluid transfer systems	(10)
12		Explain the measurement of temperature using 1. Resistance thermometer 2. Magnetic thermometer.	(10)
13		Explain with the help of diagrams any two methods of cryogenic liquid level measurement.	(10)
14	a)	Briefly mention the different non-storage type heat exchangers used in cryogenic equipment.	(5)
	b)	Explain cryo-pumping and its application.	(5)

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