Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S8 (R,S) Examinations April 2026 (2019 Scheme)

Course Code: MET476

Course Name: CRYOGENIC ENGINEERING

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all questions, each carries 3 marks. Marks

1	What are the key properties of helium that make it useful in cryogenic applications?	(3)
2	List any six major developments in cryogenics over the past 150 years.	(3)
3	Why Ortho-Hydrogen to Para-Hydrogen conversion is necessary, before storing liquid hydrogen.	(3)
4	What are the performance parameters to be considered in gas liquefaction systems?	(3)
5	How are cryogenic refrigerators/cryocoolers classified?	(3)
6	Draw the T-s and P-v diagrams of the thermodynamically ideal isothermal source refrigerator and write the expression for the system's COP.	(3)
7	Describe three methods used for the separation of gases on a commercial scale. Write briefly about each method.	(3)
8	Discuss cryo-pumping and its application.	(3)
9	List out three instruments to measure vacuum pressure. Mention the approximate range of vacuum pressures for applying a particular gauge.	(3)
10	Mention any three types of heat exchangers used in cryogenic engineering.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	Regarding common metallic materials used in cryogenic engineering design and construction, write brief notes on the variation of the following properties at cryogenic temperature i) Ultimate strength and yield strength ii) Fatigue strength and impact strength	(10)

b) What is superconductivity? How does BCS theory explain superconductivity? (4)

OR

12 a) Explain the temperature dependence of the following properties of solids, which are of significance in cryogenic engineering: i) Thermal conductivity ii) Specific heat (10)

b) Mention the applications of cryogenics in (a) aviation and aerospace and (b) biology and medicine. (4)

Module II

13 a) Explain the inversion curve, maximum inversion temperature, and Joule–Thomson coefficient. Prove that for an ideal gas, the Joule-Thomson coefficient is zero. (10)

b) Discuss the consequences of operating the simple Linde- Hampson liquefaction system with a gas having a maximum inversion temperature below the atmospheric temperature. (4)

OR

14 a) Explain with a neat schematic Collins Helium liquefaction system. Derive expressions for liquid yield, and compressor work for unit mass compressed (without considering the expander work). (10)

b) Describe the Ortho-Para Hydrogen conversion arrangement in hydrogen liquefier. (4)

Module III

15 a) Explain the working of a Linde-Hampson refrigerator. Derive an expression for the COP of this refrigerator. (10)

b) Discuss the ideal isobaric source refrigerator. Write the expression for COP of the system. (4)

OR

16 a) Explain Philips refrigerator. Derive an expression for COP of Philips refrigerator. (10)

b) With neat sketches, explain the operation of a magnetic refrigerator. (4)

Module IV

17 a) With the help of diagrams, explain the principles of rectification with regard to mixture of gases. What is Murphree efficiency and what is its significance? Derive an expression for the Murphree efficiency. (10)

b) Write short notes on the calculation of the number of theoretical plates for a rectification column. (4)

OR

18 a) Explain different types of cryogenic insulation materials (any five) and compare their performance. (10)

b) What is apparent thermal conductivity? Give the values of apparent thermal conductivity for four typical insulation systems (4)

Module V

19 a) Explain, with a neat schematic diagram, the operation of a thermal conductivity vacuum pressure gauge. (7)

b) Discuss any two instruments used to measure temperature in cryogenic systems (7)

OR

20 a) Write a note on liquid level gauges (any two) used in cryogenic engineering**.** (7)

b) Explain the importance of safety systems in cryogenic storage, transfer, and transportation systems. What are the common safety devices used in these systems? (7)

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