



**B.E DEGREE EXAMINATIONS: NOV/DEC 2023**

(Regulation 2018)

Seventh Semester

**AERONAUTICAL ENGINEERING**

U18AEE0004: Cryogenic Engineering

**COURSE OUTCOMES**

- CO1:** Apply classical thermodynamics principles to various cryogenics systems.  
**CO2:** Solve unique problems of heat transfer in cryogenic applications.  
**CO3:** Explain about thermo-physical properties of cryogenic system.  
**CO4:** Identify typical cryogenic insulation system for space propulsion.  
**CO5:** Illustrate general safety principles to various cryogenics systems.

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 2 = 20 Marks)**

**(Answer not more than 40 words)**

- |  |     |                   |
|--|-----|-------------------|
| 1. Define cryogenics and give examples for cryogens.         | CO1 | [K <sub>1</sub> ] |
| 2. Explain why liquid helium II is called as superfluid.     | CO1 | [K <sub>2</sub> ] |
| 3. Define latent heat of vaporization.                       | CO2 | [K <sub>1</sub> ] |
| 4. Differentiate between boiling and evaporation.            | CO2 | [K <sub>2</sub> ] |
| 5. What is meant by cryocooler?                              | CO3 | [K <sub>1</sub> ] |
| 6. Define regenerative and recuperative type heat exchanger. | CO3 | [K <sub>2</sub> ] |
| 7. Classify the insulations                                  | CO4 | [K <sub>1</sub> ] |
| 8. What is meant by apparent thermal conductivity?           | CO4 | [K <sub>2</sub> ] |
| 9. State the purpose of cryopump.                            | CO5 | [K <sub>1</sub> ] |
| 10. Define the term flammability.                            | CO5 | [K <sub>1</sub> ] |

**Answer any FIVE Questions:-**

**PART B (5 x 16 = 80 Marks)**

**(Answer not more than 400 words)**

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|--|---|-----|-------------------|
| 11. a) Draw the phase and T-S diagram for liquid hydrogen and briefly discuss about its properties and applications. | 7 | CO1 | [K <sub>3</sub> ] |
|--|---|-----|-------------------|

b)	Explain the following: i) Joule Thomson expansion, ii) Reversible adiabatic turbine expansion, and iii) Expansion by using external refrigerant.	9	CO1	[K <sub>3</sub> ]
12.	Describe in detail about the various applications of cryogenics.	16	CO1	[K <sub>3</sub> ]
13. a)	Explain various types of boiling occur during heat transfer process.	8	CO2	[K <sub>4</sub> ]
b)	Discuss various modes of heat transfer occurs in cryogenic environment.	8	CO2	[K <sub>4</sub> ]
14.	Elaborate the response of mechanical properties in the material when it's subjected to cryogenic temperature.	16	CO3	[K <sub>4</sub> ]
15. a)	Explain the following cryogenic insulations: i) Expanded foam & ii) Multilayer insulation.	8	CO4	[K <sub>3</sub> ]
b)	With T-s diagram, explain the working principle of Stirling refrigeration cycle.	8	CO4	[K <sub>3</sub> ]
16.	Elaborate the safety considerations for liquid oxygen.	16	CO5	[K <sub>3</sub> ]

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