



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part time)
Subject Code: 2961908
Semester – VI
Subject Name: Cryogenics Engineering

Type of course: Elective

Prerequisite: Basic knowledge of thermodynamics, Heat transfer, Refrigeration and Air conditioning

Rationale: The course is designed to give fundamental knowledge of types of cryogenic engineering, fluids, behavior of materials and properties at low temperature, cryogenic hazards and prevention, safety, cryogenic refrigeration and liquefaction, insulation, system requirement and measuring instruments

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Cryogenic engineering, Properties of Cryogenic Fluids like Oxygen, Nitrogen, Argon, Neon, Fluorine, Helium, Hydrogen; Properties of Cryogenic Materials - mechanical, thermal, and electrical; Super conductivity; Hazards and prevention – physical hazard, chemical hazard, physiological hazard and preventions, Safety in cryogenic fluid handling, storage and use.	8
2	Applications of cryogenic systems: Super conductive devices such as bearings, motors, cryotrons, magnets, D.C. transformers, tunnel diodes, space technology, space simulation, cryogenics in biology and medicine, food preservation and industrial applications, nuclear propulsions, chemical propulsions.	6
3	Cryogenic Refrigeration & Liquefaction: Refrigeration: Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled joule–Thomson refrigeration systems, COP, FOM Liquefaction: Introduction, Principle and Methods of production of low temperature	10



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	thermodynamically ideal systems, Joule Thomson effect, liquefaction systems such as Linde Hampton, Precooled Linde Hampton, Claude System	
4	Cryogenic insulation: Various types such as expanded foams, gas filled & fibrous insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multi-layer insulation, comparison of performance of various insulations.	6
5	Cryogenic System Requirements: Cryogenics Heat Exchangers, Compressors, Expanders, Effect of various parameters in performance and system optimization, Storage equipment for cryogenic fluids, industrial storage and transfer of cryogenic fluids	8
6	Cryogenic instrumentation: Properties and characteristics of instrumentation, strain displacement, pressure, flow, liquid level, density and temperature measurement in cryogenic range.	4

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	30	50	10	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Cryogenic systems-Baron, McGraw-Hill book
2. Cryogenic fundamentals-Haselden, Academic press New York
3. Cryogenic technology –Vance
4. Cryogenic engineering –T. M. Flynn
5. Cryogenic engineering –Scott
6. Low Temperature Superconductivity & Superconductivity By Christian Enss & Siegfried Hunklinger



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Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Basic knowledge of cryogenics, materials, fluids, hazard & safety	19
CO-2	Production of low temperature	24
CO-3	Design of cryogenic systems	33
CO-4	Cryogenic applications	14
CO-5	Cryogenic instrumentations	10

List of Experiments:

1. Study of cryogenic properties of hydrogen and helium.
2. Study of low temperature measurement instrument.
3. Study of flow measurement and quality measurement instrument.
4. Study of liquid level measurement.
5. Study of insulation used in cryogenic equipment.
6. Study of cryogenic application (superconductivity)
7. Study of cryogenic application in space technology.
8. Study of cryogenic application in bio medical and food preservation.
9. Study of safety while handling fluid.
10. Study of ideal liquefaction system