GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Cryogenic Engineering

Course / Subject Code : ME01074011

Course / Subject Name : Cryogenics Fundamentals

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC

Prerequisite:	Basic knowledge of thermodynamics and physics.
Rationale:	Cryogenic Engineering has diversified applications in different areas in today's world. These include the major fields like Super conductive devices such as bearings, motors, cryotrons, tunnel diodes, Space technology, biology and medicine, food preservation and various industrial applications. This course is designed for engineers to get the basics of cryogenics and prepare for addressing challenging aspects in this domain.

Course Outcome:

On successful completion of the course, the students will be able to

No	Course Outcomes	RBT level
1	Understand the behavior of properties of various materials at cryogenic temperature.	R/U
2	Understand measurement of following properties such as temperature, pressure, flow, fluid quality and liquid level at low temperature.	R/U/A
3	Explain about different types of insulations used for cryogenic applications.	R/U/A
4	Summarize various applications of cryogenic systems and different hazards at low temperatures.	R/U

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Properties of engineering materials at cryogenic temperatures:** Mechanical, Thermal, Electric & Magnetic properties, super conducting materials, thermos-electric materials, composite materials, properties of cryogenic fluids, super fluidity of He 3 & He 4.	10	20
2	**Measurement systems for low temperatures:** Temperature measurements, pressure measurements, flow measurements, liquid level measurements, fluid quality measurements.	11	25
3	**Cryogenic insulation:** Various types such as expanded foams, gas filled& fibrous insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multi-layer insulation, Microsphere insulation, comparison of performance of various insulations.	12	25
4	**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	15
5	**Hazards:** Physical hazards, Chemical hazards, Physiological hazards, combustion hazards, oxygen hazards, accidents in cryogenic plants & prevention	6	15
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**40**	**30**	**10**	**0**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Cryogenic systems by Randell F Baron
2. Cryogenic fundamentals by Haselden, Academic press New York
3. Cryogenic technology by Vance

4. Advance cryogenic by bailey, plenum press
5. Cryogenic engineering by Scott

(b) Open-source software and website:

1. Cryogenic Engineering by M D Atrey (NPTEL)
   nptel.ac.in/courses/112/101/112101004/

Suggested Course Practical List:

1. To understand behavior of properties of hydrogen and helium at cryogenic temperature.
2. To study about construction, working principal and characteristics of various temperature measuring instruments.
3. To study about construction, working and characteristics of various fluid quality and liquid level measuring instruments.
4. To study various insulations used in cryogenic equipment.
5. To find the thermal conductivity of powder insulation by boil off calorimeter method.
6. To discuss and elaborate various applications of cryogenics such as Superconductivity and Space technology.
7. To discuss and elaborate application of cryogenics in Food preservation
8. To discuss and elaborate application of cryogenics in Bio medical field and cryo surgery.
9. To study about safety while handling cryogenic fluid.
10. Industry visit to explore Application of Cryogenic Engineering.

List of Laboratory/Learning Resources Required:

Suggested Project List:

Suggested Activities for Students: Students are required to download 3-5 research papers from reputed international journals on the recent advancement in the areas of cryogenics. They need to go through the same and prepare a review for the research papers.

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