Name of Faculty	:	Faculty of Engineering & Technology
Name of Program	:	Master of Technology (M. Tech)
Course Code	:	1MTE06
Course Title	:	Advanced Cryogenic Engineering
Type of Course	:	PE
Year of Introduction	:	2023-24

Prerequisite	:	Fundamental knowledge of low temperature refrigeration
Course Objective	:	To give introductory knowledge of cryogenic
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	Understand the concept of cryogenic fundamental.
	CO2	Learn the requirement and use of proper insulation.
	CO3	Understand about the concept of cryocooler and application in various fields.
	CO4	Select the proper cryogenic fluid for particular applications like, cryo metallurgy, medical applications etc.
	CO5	Learn about the cryogenic refrigerators for different applications

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**SEE**	**CIA**	**SEE**	**CIA**	
03	00	02	04	70	30	30	20	150

*Legends: **L**-Lecture; **T**–Tutorial/Teacher Guided Theory Practice; **P** – Practical, **C** – Credit, **SEE** – Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.))*

Course Content

Unit No.	Topics	Teaching Hours	Weightage
1	Introduction to Cryogenic: Properties of engineering materials at cryogenic temperatures, mechanical properties, thermal properties, electric & magnetic properties, super conducting materials, thermo electric materials, composite materials, cryo metallurgy, properties of cryogenic fluids, super fluidity of He3 & He4.	4	15%
2	Cryogenic Insulation:	5	20%

	expanded foams, gas filled & fibrous insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multilayer insulation, comparison of performance of various insulations		
3	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	5	20%
4	Cryogenic Refrigeration System: Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled Joule–Thomson refrigeration systems, expansion engine and cold gas refrigeration systems	5	25%
5	Advanced Cryo coolers: Philips refrigerators, Importance of regenerator effectiveness for the Philips refrigerators, Gifford single volume refrigerator, Gifford double volume refrigerators analysis, COP, FOM, regenerators, pulse tube refrigerators, various types of pulse tube refrigerator	5	20%

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

Suggested List of Experiments/Tutorials

Sr. No.	Name of Experiment/Tutorial	Teaching Hours
1	To determine the thermal conductivity of given metal rod	02
2	To determine the thermal conductivity of the given composite walls.	02
3	To determine Stephan Boltzmann constant experimentally.	02
4	To determine heat transfer co-efficient by forced convection.	02
5	To determine heat transfer co-efficient by natural convection.	02
6	To determine the overall heat transfer co-efficient of shell and tube type heat exchangers.	02
7	To determine the emissivity of gray body.	02
8	To study film and drop wise condensation and to determine the film co-efficient	02
9	To measure convective heat transfer co-efficient and effectiveness of the fin under forced convection.	02
10	To measure convective heat transfer co-efficient and effectiveness of the fin under natural convection	02

Suggested Learning Websites

Sr. No.	Name of Website
1	https://nptel.ac.in

Reference Books

Sr. No.	Name of Reference Books
1	Cryogenic process engineering, Thomas M Flynn, Informa Health Care
2	Miniature refrigerators for cryogenic sensors and cold electronics, Graham Walker, Clarendon Press
3	Cryogenic Regenerative Heat Exchangers, R.A. Ackermann, Springer
4	Cryogenic technology & applications, A R Jha, Butterworth-Heinemann