Course Type	Course Code	Name of Course	L	T	P	Credits
DE	**NMED516**	**Cryogenic Engineering**	3	0	0	3

Course Objectives

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

To encourage the dissemination of information concerning low temperature processes, techniques, and bringing all those together in all discipline concern with the application of low temperature technologies.

Learning Outcomes

Upon successful completion of this course, students will:

- be able to know the field of basic thermodynamics, heat transfer, fluids, materials and insulation in cryogenic engineering.
- be able to know the different cryogenic liquefaction cycles.

Unit No.	Topics to be Covered Lecture	Lecture Hours	Learning Outcomes
1	Basic thermodynamics and heat transfer, heat leak and pressure drop in cryogenic transfer lines, properties of cryogenic fluids, material properties at cryogenic temperatures, cryogenic insulations	8 L	Introduce the students to the field of basic thermodynamics, heat transfer, cryogenic fluids, materials and insulation in cryogenic engineering
2	Liquefaction Cycles: Carnot liquefaction cycle, Joule Thomson Effect, Linde Hampson Cycle, Claudes Cycle, Helium Refrigerated Hydrogen Liquefaction Systems	10 L	Students will learn different cryogenic liquefaction cycles
3	Cryogenic Refrigerators: J. T. Cryocoolers, Stirling Cycle Refrigerators, G. M. Cryocoolers, Pulse Tube Refrigerators	8 L	Students will learn different cryogenic refrigerators
4	Cryogenic Instrumentation: strain, displacement, pressure, flow, liquid level, density and temperature.	8 L	Students will learn basic instruments used in cryogenic engineering
5	Cryogenic Equipment: compressor, pumps, expansion engines, valves, heat exchangers, storage, transfer of liquefied gases.	8 L	Students will learn basic components used in cryogenic engineering
	Total	42 hrs	

Text Books

1. Cryogenic Engineering, Klaus D. Timmerhaus, Richard Reed, Springer, New York, 2010.

2. Fundamentals of Cryogenic Engineering, MamataMukhopadhyay, PHI Learning Pvt. Ltd., 2010.

Reference books

1. Cryogenic Systems, Randall F. Barron, McGraw-Hill, 1985.

2. Cryogenic Heat Transfer, Gregory Nellis and Randall F. Barron, CRC Press, 1999.