

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE – PILANI, HYDERABAD CAMPUS
INSTRUCTION DIVISION, FIRST SEMESTER 2016-2017
(COURSE HANDOUT: PART-II)

Date: 01/08/2016

In addition to Part-I (a general handout for all courses appended to the time-table), this handout provides the specific details of this course.

Course No. : ME G537
Course Title : CRYOGENIC ENGINEERING
Instructor-in-charge : R. PARAMESHWARAN

1. Course Description

Introduction to cryogenics and its applications, properties of cryogenic fluids, properties of materials at cryogenic temperature, gas-Liquefaction and refrigeration systems, gas separation, cryocoolers, cryogenic insulations, vacuum technology, instrumentation in cryogenics, safety in cryogenics.

2. Scope and Objective

The purpose of this course is to provide introductory knowledge of the cryogenic principles and the engineering aspects of low temperature applications. The course also gives detailed knowledge and state-of-the-art review of a variety of cryogenic systems pertaining to the potential research and real-world applications. Besides the theoretical knowledge, the course will also embark with interactive approach to mathematically analyze the cryogenic systems design. The course will certainly interest students aiming to build-up a research career in Cryogenic Engineering.

Prerequisites: Thermodynamics, Heat transfer, Refrigeration systems

3. Text Books:

- T1. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, Springer Science+Business Media New York, 1989.
- T2. S. S. Thipse, Cryogenics: A Textbook, Narosa Book Distributors Pvt Ltd India, 2013.

Reference Books:

- R1. Valery V. Kostionk, Digumarti Bhaskara Rao, A Text Book Of Cryogenics, Discovery Publishing House India, 2003.
- R2. Guglielmo Ventura, Lara Risegari, The Art of Cryogenics Low-Temperature Experimental Techniques, Imprint: Elsevier Science, First Edition, 2008.

4. Course Plan

Lecture No.	Learning objectives	Topics to be covered	Book
1-4	Introduction to fundamentals of Cryogenics and its applications	Overview of thermodynamics basics, refrigeration cycles, Cryogenics, and applications.	T1, T2
5-8	Properties of cryogenic fluids	Study of cryogenic fluids, types and their properties.	T2
9-14	Material properties at cryogenic temperature	Mechanical, Thermal, and Electrical properties, Superconductivity.	T1, T2

15-18	Liquefaction cycles	Principles of refrigeration and liquefaction, Joule-Thomson expansion, Isentropic expansion, Cascade processes,	T2
19-23	Cryo-refrigerators and its types	Types of cryo-refrigerators, Thermodynamic analyses of systems.	T1
24-28	Critical components in liquefaction systems	Heat exchangers, Compressors, Expanders, Performance parameters of critical components, system optimization.	T1
29-32	Cryogenic gas separation and rectification column analysis	Ideal separation of gases, characteristics of Mixtures, principles of gas separation, types of separation and purification systems	T2
33-35	Storage and transfer Systems	Storage systems for cryo-liquids, transfer systems, insulation concepts, Industrial storage and transfer, cooling of storage and transfer	T2
36-38	Cryogenics design, instrumentation and safety	Properties, characterization, basic instrumentation concepts, safety in handling cryogenic fluids and systems	T1, T2
39-42	On-going research in cryogenics	Recent trends in cryogenics, materials and applications.	T2

5. Evaluation Scheme

Evaluation Component	Duration	Weighting (%)	Date & Time	Nature of Component
Test-I	60 min	15	9/9, 8.30-9.30 AM	CB
Test-II	60 min	15	24/10, 8.30-9.30 AM	CB
Project	---	30	To be announced in the Class	OB
Seminar	---	10	To be announced in the Class	OB
Comprehensive Exam	3 hours	30	03/12 FN	CB

6. Chamber Consultancy Hour: To be announced in the class room.

7. Notices: All notices concerning this course shall be displayed only on the Mechanical Engineering Notice Board. Besides this, students are advised to visit regularly CMS (the Institute's web based course management system) for latest updates.

8. Make-up Policy: Make-up shall be given only to the genuine cases with prior confirmation. Request for the make-up tests, duly signed by the students, should reach the under signed well before the scheduled test.

**Instructor-in-Charge
ME G537**