Cryogenic Technology: Materials, Processes & Equipment

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Overview

Cryogenic technology deals with production, maintenance and applications of low temperature, typically below -150˚C. With the advancement of technology and growth of human knowledge, cryogenics is gaining more relevance in all spheres of social milieu. Today cryogenics is applied in all most all spheres of technology such as medical, biological and food preservation processes, in industrial gas sectors such as natural gas, oxygen, nitrogen, argon, neon, hydrogen, in high energy particle physics, nuclear industries, electronics industries as well as in futuristic technology like superconducting power applications, fusion reactors for power generation and deep space probe.

In view of the growing demand of cryogenics, both at national and global levels, this course is conducted to impart basic understandings on theories and practices of cryogenic engineering. Efforts will be made to address the broader spectrum of issues covering the fundamental aspects as well as state-of-the-art techniques in the realm of cryogenic technology. The participant will learn to use the fundamentals, equations and concepts in their particular applications of research, developmental activities and operations of cryogenic installations.

Internationally acclaimed academics and researchers with proven knowledge, experience, and demonstrable ability in teaching consultancy, research, and training in the field of Cryogenic Engineering will deliver lectures and discuss examples in this course.

The course will be divided into two modules:

A.Cryogenic Fundamentals: Introduction, properties of cryogenic fluids, basic thermodynamics & transport processes, materials properties at low temperature, cryogenic refrigerators & liquefiers, cryocoolers, cryogenic separation processes, cryogenic safety.

B. Cryogenic Equipment & Cooling Techniques: Design of cryostats, measurement techniques, controls, cryogenic storage and transfer devices, cooling devices for High Temperature Superconductor (HTS) cables; cooling techniques, thermal insulation, vacuum techniques, compressors, heat exchangers & turbines.

Modules	**A: Cryogenic Fundamentals:** **B: Cryogenic Equipment & Cooling Techniques:**	**June 27 – July 01, 2016** **(5 days X 7 hours each day)** **July 04 – July 08, 2016** **(5 days X 4 hours each day)**
You Should Attend If…	➢ You are a practicing cryogenic engineer or looking for working in the area of cryogenic engineering in industry, industrial or scientific research establishment or educational institute. ➢ You are a teacher who wants to pursue teaching & research in cryogenic engineering. ➢ You are an entrepreneur looking for setting up business establishment. ➢ You are a student with engineering or science background.	
Fees	Participants from abroad:	**US$ 700 for module A** **US$ 500 for module B** **(US$ 1,100 for both the modules)**
	Industry/Research Organizations within India:	**INR 35,000 for module A** **INR 25,000 for module B** **(INR 55,000 for both the modules)**
	Faculty/Staff from Academic Institutes within India:	**INR 12,000 for module A** **INR 9,000 for module B** **(INR 19,000 for both the modules)**
	Undergraduate/Graduate Students from outside IIT Kharagpur (only 10 seats)	**INR 2,000 for both the modules**
	Undergraduate/Graduate Students from within IIT Kharagpur (only 10 seats)	**INR 2,000 for both the modules**
	The above fees include service tax, if any. It will cover all instructional materials, tutorials, and 24 hrs free internet facility and computers for tutorials. The participants will be provided with **accommodation and food on payment basis. Maximum no. of participants is limited to 50(fifty) only.**	

The Faculty

Holger Neumannis the Divisional Head of the Cryogenics Department of Institute for Technical Physics (ITEP) Karlsruhe Institute of Technology (KIT), Germany. His current research interests are cryogenic cycles/cooling methods for superconductive magnets, thermal insulation concepts for different applications, and development/tests of cryogenic sensors. Dr. Neuman has been involved and has offered leadership in several projects that include Current Lead test facility Karlsruhe (CuLTKa) for test of superconductive current leads, development and construction of superconductive current leads (22 kA) for the fusion experiment JT-60, KATRIN-Karlsruher Tritium Neutrino Experiment, BMW-funded project in cooperation with Siemens on HTS generator, SUPRAPOWER –superconducting wind turbine, LIQHYSMES – Liquid Hydrogen and Superconductive Magnetic energy Storage etc. He is a vice chairman for the German Refrigeration and Air Conditioning Association. He is involved in teaching at KIT and has conducted several short term courses on Cryogenics and superconductivity.

Parthasarathi Ghosh is an Associate Professor and Head of Cryogenic Engineering Centre at IIT Kharagpur. His research experience encompasses helium liquefaction systems, cryogenic process design, cryogenic rotating equipment, cryogenic cooling and fluid machinery. Prof. Ghosh is member of design review committee of ITER (International Thermonuclear Experimental Reactor) cryogenic transfer lines and cryodistribution systems. Before joining IIT, Kharagpur, he has worked in RRCAT, Department of Atomic Energy, India where he was involved in development of helium liquefier. He has above 50 papers in international and national journals and conference proceedings. He has been involved in sponsored research and industrial consultancy in the field of cryogenic technology with organizations like ISRO, IPR, VECC etc.

Kanchan Chowdhury is a Professor of Cryogenic Engineering Centre at IIT Kharagpur. His present research interest lies in cryogenic air separation, helium liquefaction, recondensation and regasification of natural gas and safety in oxygen-rich systems. Prof. Chowdhury has conducted many short courses within and outside India for steel plants, gas industry, petroleum refineries, and hospitals as well as for the academia in his fields of expertise. He has guided doctoral and master students and published research papers. He is a reviewer of many national and international journals pertaining to cryogenics and heat transfer. He is involved with sponsored research and consultancy for relevant industries.

Course Co-ordinators

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Detailed course structure on

CRYOGENIC TECHNOLOGY: MATERIALS, PROCESSES & EQUIPMENT

Module 1

Introduction to cryogenics – history and applications

Properties of cryogenic fluids, distinctive properties of cryogens, equations of states, retrieving property data using property packages such as Allprops, Refprops etc., properties of mixtures, properties of hydrogen, properties of helium -4, superfluid helium, helium-3.

Materials properties at low temperature - thermal properties such as heat capacity heat conductivity, thermal contraction, emissivity; thermal design of cryogenic systems, mechanical properties of materials at cryogenic temperature, selection of materials examples, superconductivity and its applications.

Basic thermodynamics and heat transfer mechanisms, concepts and postulates, Laws of thermodynamics, concepts of entropy, exergy and their applications, conduction, convection and radiation heat transfer, calculations and tutorials.

Generation of low temperatures - isenthalpic, isentropic, Joule expansion, refrigerators and liquefiers, cryogenic liquefaction and refrigeration cycles, large scale helium refrigeration systems, LNG liquefaction - mixed refrigeration cycle, cascade cooling, Cryocoolers - Stirling, GM, pulse tube, reverse Brayton, JT coolers.

Cryogenic Separation- distillation, air separation, adsorption, cryogenic purification.

Safety –handling of cryogens; safety in oxygen, hydrogen and LNG systems, safety-relevant construction and handling, codes and regulations.

Module 2

Design of cryostats: planning, objective, main elements – examples, Process and instrumentation diagram (PID)

Measurement techniques – Temperature-, pressure-, mass-flow- and level-measurement; automation – cryogenic valves and their characteristics, cryogenic controls

Cryogenic storage and transfer devices, cryogenic dewars, storage of LNG, transfer lines, cooling devices for HTS cables and other cryogenic infrastructure, cryostat protection by safety valves and burst discs.

Connection elements – feed-throughs and sealing elements.

Cooling techniques – heat transfer to cryogens, bath cooling, heat transfer to cryogens, forced flow convection, superfluid heat transfer, thermosyphon cooling.

Thermal Insulation – relevance, basics, insulation techniques, multilayer insulation, application examples for different systems.

Vacuum technique – history, basics, pressure gauges, vacuum pumps, leak detection, calculation on vacuum systems, selection of equipment.

Cryogenic Equipment: compressor, heat exchanger, turbine, fundamentals, operational characteristics of different types of equipment, selection of equipment, design aspects and calculations.