

Course code	Course Name	L-T-P-Credits	Year of Introduction
AO463	CRYOGENICS	3-0-0-3	2016
Prerequisite : Nil			
Course Objective			
<ul style="list-style-type: none"> To introduce the functions of cryogenic engines and its applications in engineering. 			
Syllabus			
Cryogenics – Fundamentals – space applications Superconductivity - Cryo Metallurgy - Medical applications – Liquefaction – Binary mixture – Cryocoolers- Pulse Tube Refrigerators –Regenerators - Dilution refrigerators- Magnetic Refrigerators - Cryogenic Insulations –Dewar – Cryogenic instrumentation			
Expected Outcome			
<ul style="list-style-type: none"> The students will be able to understand the critical cryogenic engines, superconducting materials and their applications in space systems. 			
Text Books:			
<ol style="list-style-type: none"> Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press, New York, 1989 Randall F. Barron, Cryogenic Systems, McGraw-Hill, 1985. 			
References:			
<ol style="list-style-type: none"> Herald Weinstock, Cryogenic Technology, 1969. Robert W. Vance, Cryogenic Technology, John Wiley & Sons, Inc., New York, London. Scott R.B., Cryogenic Engineering, Van Nostrand and Co., 1962. 			
Course Plan			
Module	Contents	Hours	End Sem. Exam Marks
I	Insight on Cryogenics,	1	15%
	Properties of Cryogenic fluids,	2	
	Material properties at Cryogenic Temperatures.	2	
II	Applications of Cryogenics in Space Programs,	3	15%
	Superconductivity	2	
	Cryo Metallurgy	2	
	Medical applications.	2	
FIRST INTERNAL EXAM			
III	Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles.	2	15%
	Inversion Curve - Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle,	1	
	Claude's Cycle Dual Cycle, Ortho- Para hydrogen	3	

	conversion, Eollins cycle, Simpson cycle, Critical Components in Liquefaction Systems.	1	
IV	Binary Mixtures, T-C and H-C Diagrams	1	15%
	Principle of Rectification	2	
	Rectification Column Analysis	2	
	McCabe Thiele Method. Adsorption Systems for purification.	2	
SECOND INTERNAL EXAM			
V	J.T.Cryocoolers, Stirling Cycle Refrigerators	2	20%
	G.M.Cryocoolers, Pulse Tube Refrigerators	2	
	Regenerators used in Cryogenic Refrigerators, Dilution refrigerators,	2	
	Magnetic Refrigerators	2	
VI	Cryogenic Dewar	2	20%
	Cryogenic Transfer Lines	1	
	Insulations used in Cryogenic Systems	1	
	Instrumentation to measure Flow, Level and Temperature	2	
END SEMESTER EXAM			

Question Paper Pattern

Maximum marks: 100

Exam duration: 3 hours

The question paper shall consist of three parts

Part A

4 questions uniformly covering modules I and II. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B

4 questions uniformly covering modules III and IV. Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C

6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.