

**DEPARTMENT OF MECHANICAL ENGINEERING**  
**NATIONAL INSTITUTE OF TECHNOLOGY TIRUCHIRAPPALLI**

COURSE PLAN – PART I			
<b>Course Title</b>	Cryogenic Engineering		
<b>Course Code</b>	MEPE17	<b>No. of Credits</b>	03
<b>Course Code of Pre-requisite subject(s)</b>	MEPE15		
<b>Session</b>	July 2019	<b>Section (if applicable)</b>	
<b>Faculty</b>	Dr. S S Harish Kruthiventi	<b>Department</b>	Mechanical Engineering
<b>E-mail</b>	harish@nitt.edu	<b>Telephone No.</b>	+91 9940404264
<b>Name of Course Coordinator (if applicable)</b>	--		
<b>Course Type</b>	<input type="checkbox"/> Core course <input checked="" type="checkbox"/> Elective course <input type="checkbox"/> Laboratory course		

**Syllabus (approved in BoS)**

Insight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of Cryogenics - Space Programs, Superconductivity, Cryo Metallurgy, Medical applications.

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve-Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claude Cycle Dual Pressure Cycle, Ortho-Para hydrogen conversion, Critical Components in Liquefaction Systems.

Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification, Rectification Column Analysis - McCabe Thiele Method , Adsorption Systems for purification.

J.T. Cryocoolers, Stirling Cycle Refrigerators, G.M. Cryocoolers, Pulse Tube Refrigerators Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators

Cryogenic Dewar Design, Cryogenic Transfer Lines. Insulations in Cryogenic Systems, Different Types of Vacuum Pumps, Instruments to measure Flow, Level and Temperature.

**Essential Readings**

1. Randall F. Barron, Cryogenic Systems, McGraw-Hill, 1985.
2. Klaus D. Timmerhaus and Thomas M. Flynn, Cryogenic Process Engineering, Plenum Press New York, 1989.
3. Randall F. Barron, Cryogenic heat transfer, CRC Press,1999.

## **COURSE OBJECTIVES**

1. To build a solid foundation in the fundamentals of cryogenics
2. To encourage a “hand’s – on” approach to solving cryogenic problems
3. To provide updated cryogenic information

## **COURSE OUTCOMES (CO)**

<b>Course Outcomes</b>	<b>Aligned Programme Outcomes (PO)</b>
Upon completion of the course, the student will be able to	
1. Introduce the working principles of basic methods to achieve low temperature by using adiabatic expansion.	PO1
2. Provide a thorough understanding of applications of classical thermodynamics to different cryogenic technologies, gas separation and purification system, and low power cryocoolers.	PO1, PO2
2. Understand the structures of different cryogenic systems and the analytical method for cryogenic thermodynamic cycle, and cryogenic gases and liquids and their mixtures	PO2, PO3

## **COURSE PLAN – PART II**

### **COURSE OVERVIEW**

The course provides a structured approach on the understanding of cryogenic systems and application of such systems to different practical scenarios and industrial aspects. The design of the course includes the introduction to the low temperatures, understanding on different kinds of thermodynamic cycles available for attaining such low temperatures and their limitations. The course further extends insight into the refrigerants used and the measurement of different flow parameters at such low temperature applications.

### **COURSE TEACHING AND LEARNING ACTIVITIES**

<b>S. No.</b>	<b>Week</b>	<b>Topic</b>	<b>Mode of Delivery</b>
1	1 <sup>st</sup> week	Introduction and applications	Chalk & Talk
2	2 <sup>nd</sup> week	Properties of cryogenic fluids and materials at cryogenic temperatures.	Chalk & Talk

3	3 <sup>rd</sup> week	Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles	Chalk & Talk
4	4 <sup>th</sup> week	Inversion Curve-Joule Thomson Effect. Linde Hampson Cycle	Chalk & Talk
5	5 <sup>th</sup> week	Precooled Linde Hampson Cycle, Claude Cycle Dual Pressure Cycle, Ortho-Para hydrogen conversion	Chalk & Talk
6	6 <sup>th</sup> week	Critical Components in Liquefaction Systems.	Chalk & Talk
7	7 <sup>th</sup> week	J.T. Cryocoolers	Chalk & Talk
8	8 <sup>th</sup> week	Stirling Cycle Refrigerators, G.M. Cryocoolers, Pulse Tube Refrigerators	Chalk & Talk
9	9 <sup>th</sup> week	Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators	Chalk & Talk
10	10 <sup>th</sup> week	Cryogenic Dewar Design, Cryogenic Transfer Lines	Chalk & Talk
11	11 <sup>th</sup> week	Insulations in Cryogenic Systems, Different Types of Vacuum Pumps	Chalk & Talk
12	12 <sup>th</sup> week	Instruments to measure Flow and Level	Chalk & Talk
13	13 <sup>th</sup> week	Instruments to measure Temperature	Chalk & Talk
14	14 <sup>th</sup> week	Revision	Chalk & Talk

**COURSE ASSESSMENT METHODS (Shall range from 4 to 6)**

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Mid exam (1 <sup>st</sup> and 2 <sup>nd</sup> and 3 <sup>rd</sup> units)	Sep 2019	1.5 hour	30%
2.	Quiz (Multiple Choice Questions) (4 <sup>th</sup> unit)	Oct 2019	30 mins	10%
3.	Quiz (Multiple Choice Questions) (5 <sup>th</sup> unit)	Oct 2019	30 mins	10%
CPA	Compensation test (first four units)	Nov 2019	1.5 hour	30%
4.	End Semester Examination (Descriptive)	Nov 2019	2 hours	50%

**COURSE EXIT SURVEY**

1. Students feedback through class committee meetings
2. Feedback questionnaire from students – twice during the semester
3. Feedback from students on the course outcomes shall be obtained at the end of the course

**COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, academic honesty and plagiarism etc.)**

### Mode of Correspondence

1. The Faculty is available for consultation during the time intimated to the students then and there.
2. All correspondence will be sent to the webmail id of the students, if required.
3. The students will be communicated through the email id: harish@nitt.edu for any academic related issues (including sharing of study materials) with respect to this course.

### Attendance

1. All the students are expected to attend all the contact hours. Students should maintain 75% minimum physical attendance by the end of the course to attend the end semester examination.
2. Students fall short of 75% attendance at the end of the course will have to appear the compensation assessment (CPA). Students with attendance in the range between 50% to 75% have to score at least 40% marks in the CPA to make themselves eligible for appearing the end semester exam. The students with attendance < 50% have to score 60% in the CPA to make themselves eligible for appearing the end semester exam.
3. Students not having 75 % minimum attendance at the end of the semester and also scores less than recommended marks in the CPA will be awarded 'V' Grade and have to REDO the course.
4. Marks obtained in the CPA will not be considered for cumulative marks for the students, who appeared due to attendance shortage.


### Compensation Assessment


1. Attending all the assessments (2, 3, 4, 5) are mandatory for every student. Flexibility is given to the students to fix the date for each mode of evaluation convenient to majority of the students.
2. If any student fails to attend the cycle test 1 and 2 due to genuine reason like medical emergency, the student may be permitted to appear the compensation assessment (CPA) on submission of appropriate documents as proof. (Not valid for students having attendance lag).
3. Students not having 75 % minimum attendance at the end of the semester and also didn't the cycle test 1 and 2 will be awarded 'V' Grade and have to REDO the course.
4. In any case, compensation assessment (CPA) is not considered as an improvement test.
5. The minimum marks for passing this course and grading pattern will adhere to the regulations of the institute.

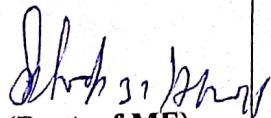
### Academic Honesty & Plagiarism

1. In case if any student found guilty, indulging in any mal practice, the student will be awarded ZERO marks in that particular assessment. If found using mobile phones or any other gadgets for any mal-practice during the examination, the answer sheet of the student will not be evaluated and will be awarded ZERO marks for that assessment.

### **FOR APPROVAL**

  
[Dr. K S S Harish, AP/ME]  
Course Faculty

  
CC Chairperson  
3/7/2019

  
HoD (Dept. of ME)