

GUJARAT TECHNOLOGICAL UNIVERSITY

Mechanical Engineering (Thermal Engineering)

M.E Semester: III

Subject Name: **Cryogenic Engineering**

Sr.No	Course content
1.	Properties of engineering materials at cryogenic temperatures, mechanical properties, thermal properties, electric & magnetic properties, super conducting materials, thermo electric materials, composite materials, properties of cryogenic fluids, super fluidity of He3 & He 4.
2.	Cryogenic insulation – expanded foams, gas filled & fibrous insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multilayer insulation, comparison of performance of various insulations .
3.	Applications of cryogenic systems: Super conductive devices such as bearings, motors, cryotrons, magnets, D.C. transformers, tunnel diodes, space technology, space simulation, cryogenics in biology and medicine, food preservation and industrial applications, nuclear propulsions , chemical propulsions.
4.	Cryogenic Refrigeration System: Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled joule–Thomson refrigeration systems, expansion engine and cold gas refrigeration systems,
5.	Advanced Cryocoolers: Philips refrigerators, Importance of regenerator effectiveness for the Philips refrigerators, Gifford single volume refrigerator, Gifford double volume refrigerators analysis, COP, FOM, regenerators, pulse tube refrigerators, various types of pulse tube refrigerator.
6.	Refrigerators using solids as working media: Magnetic cooling, magnetic refrigeration systems, thermal; valves, nuclear demagnetization.
7.	Gas liquefaction systems: Introduction, thermodynamically ideal systems, Joule Thomson effect, liquefaction systems such as Linde Hampton, precooled Linde Hampson, Linde dual pressure, cascade, claudé, kapitza, heyland systems using expanders, comparison of liquefaction systems.

Reference Books:

1. Cryogenic process engineering, Thomas M Flynn, Informa Health Care, 2004
2. Miniature refrigerators for cryogenic sensors and cold electronics, Graham Walker, Clarendon Press, 1989
3. Cryogenic technology & applications, A R Jha, Butterworth-Heinemann, 2006,
4. Cryocooler, Fundamentals Part I &II, Graham Walker, Plenum Press, New York
5. Cryogenic Regenerative Heat Exchangers, R.A. Ackermann, Springer, 1997
6. Cryogenic systems, R F Barron, Oxford University Press,
7. Cryogenic heat transfer, R F Barron, Taylor & Francis Group