Course Type	Course Code	Name of Course	L	T	P	Credits
DE	**NMED529**	**Advanced Refrigeration Systems**	3	0	0	3

Course Objectives
To impart knowledge of working principle and the design aspects of various conventional and non-conventional refrigeration system and its associated components. This course is essential for design of Refrigeration plant.
Learning Outcomes
Upon successful completion of this course, students will: • Be able apply the fundamentals of thermodynamics, heat transfer and fluid flow principles for design of refrigeration system as per the requirement. • Understand the requirement of multistage and cascade systems. • Understand the advantages and limitations of various non-conventional refrigeration systems. • Be able to select suitable refrigerants depending on the requirement keeping the performance and environmental impact within acceptable limits. • Understand the classification, design issues, and the selection of suitable component.

Unit No.	Topics to be Covered Lecture	Lecture Hours	Learning Outcomes
1	Introduction: Definitions, brief history, Methods of producing low temperature. Air-cycle Refrigeration: Different cycles, advantages and disadvantages, applications in aircrafts	5	Student understand the principle and requirement of using air as the refrigerant in air-craft cooling
2	Vapor Compression Refrigeration: Analysis and performance of basic cycle, cycles with Sub cooling and Superheating, Second law analysis of vapor compression system, Multi compression and multi evaporator system, Cascade system, auto cascade system	8	To understand the working principle and the various controlling parameter which decides the performance of a refrigerator and the requirement of multi-stage and cascade systems.
3	Sorption systems: Liquid and solid adsorption&absorption refrigeration systems, diffusion absorption system	6	Understand the principle of heat operated green refrigeration systems
4	Refrigerants: Classification and nomenclature, Desirable properties, ODP and GWP, TEWI, Alternative refrigerants	3	Understand the important thermophysical properties of an ideal refrigerant and also the environmental impact of synthetic refrigerants
5	Non-Conventional Refrigeration: Principle and operation of Ejector refrigeration system, Thermoelectric refrigerator, Vortex tube refrigerator, Pulse Tube refrigerator, Adiabatic demagnetization refrigerator. Themo acoustic refrigeration system	5	Students will be conversant with various non-conventional refrigeration system and their applications.
	Refrigerant Compressors: Thermodynamics of compression, reciprocating compressor, Hermetic compressor, Rotary compressor, Centrifugal compressor, capacity control, and selection	5	To understand the working principle of various types of refrigerant compressors and their design aspects

	Evaporators: Introduction, classification, natural convection coils, Flooded evaporator, direct expansion coil, Boiling heat transfer coefficient Condensers: Introduction, heat rejection ratio, water cooled and air-cooled condensers	5	Student will be conversant with design calculation of evaporator and condensers for refrigeration application
	Expansion devices: Introduction, capillary tube, automatic expansion valve, thermostatic expansion valve, Some practical problems in operation of expansion valve.	5	Working principle, design aspects and associated operational problems of expansion devices will be expounded.
	Total	42 hrs	

Text books:

1. R. C. Arora: Refrigeration and Air Conditioning, PHI, 2nd Edition, 2012.

References:

2. W. B. Gosney (1982):Principles of Refrigeration, Cambridge University Press London
3. Wilbert F. Stoecker and Jerold W. Jones, Refrigeration and air conditioning, McGraw-Hill Inc., US, 2nd Revised Edition, 1982.
4. Roy J. Dossat and Thomas J. Horan, Principles of refrigeration, Pearson, 5th Edition, 2001.
5. T.H. Kuehn, J.W. Ramsey, and J.L. Threlkeld, Thermal Environmental Engineering, Pearson 3rd Edition, 1998.