Faculty of Engineering and Technology
Bachelor of Technology
Effective from Academic Year: 2019-20

Branch Name:	Mechanical Engineering
Semester/Year:	Semester VII / Forth Year
Subject Title:	Refrigeration and Air - Conditioning
Subject Code:	1ET1010703
Pre-requisite:	Engineering Thermodynamics, Fluid Mechanics and Heat Transfer

Course Objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
3. Study of various refrigeration cycles and evaluate performance using refrigerant property tables.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
				Theory (Marks)		Practical (Marks)		
Lecture (L)	Tutorial (T)	Practical (P)	Credit	University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Total (Marks)
03	00	02	04	70	30	30	20	150

Subject Contents			
Sr. No	**Topic**	**Total Hours**	**Weightage (%)**
1	**Introduction to Refrigeration:** Methods of refrigeration, Carnot refrigerator, Carnot heat pump, unit of refrigeration, Co-efficient of Performance, Energy Efficiency Ratio (EER), BEE star rating. **Refrigerants**: Designation of refrigerant, selection of refrigerant, chemical, physical and thermodynamic requirements of refrigerants, secondary refrigerant, azeotropes and its uses, ODP and GWP, Montreal protocol and India's commitment, Recent substitutes for refrigerants. **Air refrigeration systems:** Bell Colemon cycle, applications. **Aircraft air refrigeration systems:** Need for aircraft refrigeration, Simple, Bootstrap including evaporative cooling, Reduced ambient, Regenerative air cooling system, Comparison of these systems based on DART rating.	8	19
2	**Vapour Compression Refrigeration System:** Study of theoretical and actual vapour compression cycle, use of p-h & T-s charts, effect of evaporator and condenser pressure, effect of sub cooling and super heating, Two stage VCR cycle with Water intercooler, flash intercooler & liquid sub-cooler, multi-evaporators at different temperatures with individual/compound compressors and individual/multiple expansion valves, Cascade refrigeration systems. **Components:** Types, construction, working, and selection of compressors,	9	21

	condensers, expansion devices, and evaporators.		
3	**Vapour absorption refrigeration systems: S**imple & modified vapour absorption refrigeration systems, Li-Br-water VAR system, Electrolux refrigerator, Desirable properties of solvent, absorbent & refrigerant combinations, applications of VAS, comparison between VCR and VAR.	4	10
4	**Psychrometry:** Properties of moist air, psychometric chart and process, mixing of air stream, bypass factor, sensible heat factor, room sensible heat factor, Gross sensible heat factor, humidifying efficiency, air washer. **Human comfort:** Introduction to industrial and comfort air conditioning, human requirements of comfort, effective temperature and comfort chart.	8	19
5	**Air conditioning load calculations:** Inside and outside design conditions, Building cooling & heating load calculation, ventilation and air infiltration, load due to outside air, heat gain from occupants, electric lights and other appliances, Effective sensible heat factor, Cooling Load estimation. **Air Distribution Systems:** Air handling unit, Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, methods of duct system design: equal friction, velocity reduction, static regain method, Fan coil unit, types of fans used in air conditioning systems.	9	21
6	**Air-conditioning systems:** Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems, Variable Refrigerant Flow systems, VAV control systems, Inverter Units.	4	10

Course Outcomes:

The student will be able to

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system.
2. Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems.
3. Present the properties, applications and environmental issues of different refrigerants.
4. Calculate cooling load for air conditioning systems used for various applications
5. Operate and analyze the refrigeration and air conditioning systems.

List of Reference Books:

1. Arora C. P., "Refrigeration and air conditioning", TMH, New Delhi.
2. Monohar Prasad, "Refrigeration and air conditioning", New Age Publishers, New Delhi.
3. Stocker W. F. and Jones, "Refrigeration and air conditioning", McGraw Hill.
4. Dossat, "Principles of Refrigeration", John Wiley Inc.
5. Arora and Domkundawar, "Refrigeration and air conditioning", Dhanpatrai and sons, New Delhi.
6. Rajput R. K., "Refrigeration and air conditioning", S. K. Kataria & Sons.

List of Practical:

1. To understand different components of VCR system and to determine its COP.
2. To understand working of Electrolux refrigerator and to determine its COP.
3. To understand construction and working of reciprocating, rotary and centrifugal compressor used for R&AC.
4. To understand various tools used for refrigeration tubing and to perform various operations like flaring, swaging, bending, brazing etc.
5. To determine COP of heat pump.
6. Study of domestic refrigerator.
7. To study different psychrometric processes and analyze the same using psychrometric chart.
8. To determine COP and apparatus dew point of an air conditioning test rig.

9. To determine cooling capacity of the window air conditioner.
10. Performance on Ice Plant Tutor.

E-Resources:

1. https://nptel.ac.in/courses/112105128/
2. https://nptel.ac.in/courses/112107208/