

COURSE TITLE	REFRIGERATION & AIR-CONDITIONING
COURSE CODE	01ME1731
COURSE CREDITS	4

Objective:

- 1 The course is prepared to provide the detail knowledge of refrigeration and air conditioning principles, components and various refrigeration cycle, air conditioning terms, load estimation, air handling and distribution systems.

Course Outcomes: After completion of this course, student will be able to:

- 1 Determine the performance of air, vapor-compression, and vapor-absorption refrigeration cycles for given operating conditions
- 2 Select suitable refrigerants by considering their properties, environmental effects, and safety aspects.
- 3 Interpret psychrometric data and human comfort requirements to choose appropriate air-conditioning processes.
- 4 Calculate cooling and heating loads for different buildings by considering structural and environmental factors.
- 5 Select and plan suitable duct layouts, air-distribution arrangements, and system components based on performance needs.

Pre-requisite of course: Thermodynamics, Fluid mechanics, Heat and mass transfer

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Introduction to refrigeration Refrigeration, unit of refrigeration, application of refrigeration,, methods of producing cooling, ton of refrigeration, coefficient of performance	2
2	Refrigerants - Classification of refrigerants, designation system for refrigerant, properties of refrigerants, ozone depletion and Montreal protocol	2
3	Air refrigeration Difference between heat engine, refrigerator and heat pump, reversed Carnot cycle, Bell-Coleman cycle, basic air refrigeration system, bootstrap air refrigeration system, regenerative air refrigeration system, reduced ambient air refrigeration	4

Contents : Unit	Topics	Contact Hours
4	Vapour compression refrigeration system and Compound vapour compression system Concept of vapour compression refrigeration (VCR), VCR on P-h and T-s diagrams,, factors affecting the performance of the cycle, actual vapour compression cycle, - Compound compression with intercooler, flash gas removal and flash intercooler, multiple evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, cascade refrigeration system	6
5	Absorption refrigeration system Aqua-ammonia absorption system, Electrolux refrigeration system, water-lithium bromide absorption system	3
6	Refrigeration system components Classification, construction and working of compressor, condensers, expansion devices and evaporators	4
7	Psychrometric properties and processes - Gibbs-Dalton's law of partial pressure, dry bulb temperature, wet bulb temperature, relative humidity, enthalpy of moist air, specific humidity, dew point temperature, humidity and temperature measuring instruments,, psychrometric chart, by-pass factor, sensible heat factor, psychrometric processes such as sensible heating, sensible cooling, humidification and dehumidification,, heating and humidification, cooling and dehumidification, air washer, cooling and humidification, heating and dehumidification	7
8	Air conditioning and human comfort Air conditioning and it types, application of air conditioning, air conditioning system, human comfort, factors affecting thermal comfort, Effective temperature, factors governing effective temperature	4
9	Load estimation Outdoor and indoor design conditions, classification of loads, flywheel effect of building material and its use in design, effect of wall construction on cooling load, nstantaneous heat gain (IHG) and instantaneous cooling load (ICL), sensible heat gain through building structure, solar heat gain through wall and transparent surfaces, ventilation and air infiltration, heat load from occupants, heat load from lighting equipment, heat gain from power equipment, heat gain from appliances	6
10	Duct design and air distribution Duct classification, economic factors influencing duct layout, method of duct design, use of friction chart, dynamic losses and its determination, Requirements of air distribution system, air distribution, grills, outlets, application, location	4
Total Hours		42

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	To understand different component of VCR system and determine its COP To understand different component of VCR system and determine its COP	2
2	To determine dry bulb and wet bulb temperature of air using sling psychrometer To determine dry bulb and wet bulb temperature of air using sling psychrometer	2
3	To understand construction and working of window/split air conditioner and determine the TR required for particular room. To understand construction and working of window/split air conditioner and determine the TR required for particular room.	2
4	To determine different psychrometric properties of air using sling psychrometer and psychrometric chart To determine different psychrometric properties of air using sling psychrometer and psychrometric chart	2
5	To perform sensible heating and cooling & dehumidification process and analyze the same using psychrometric chart To perform sensible heating and cooling & dehumidification process and analyze the same using psychrometric chart	2
6	To perform heating and humidification process and analyze the same using psychrometric chart To perform heating and humidification process and analyze the same using psychrometric chart	2
7	To determine COP of air to air heat pump To determine COP of air to air heat pump	2
8	To determine saturation efficiency of air washer To determine saturation efficiency of air washer	2
9	To understand working of Electrolux refrigeration and determine its COP To understand working of Electrolux refrigeration and determine its COP	2
10	To determine COP and apparatus dew point of an air conditioning test rig To determine COP and apparatus dew point of an air conditioning test rig	2
11	To calculate cooling load of confined space using table and compare the same with load estimation sheet To calculate cooling load of confined space using table and compare the same with load estimation sheet	2
12	To determine and compare the cooling temperature of water with natural and artificial method. To determine and compare the cooling temperature of water with natural and artificial method.	2
Total Hours		24

Textbook :

- 1 Refrigeration and Air Conditioning, D S Kumar, S.K. Kataria & Sons, 2003
- 2 Refrigeration and Air Conditioning, C P Arora, McGraw-Hill India Publishing Ltd, 2005

References:

- 1 Refrigeration and Air Conditioning, Refrigeration and Air Conditioning, Manohar Prasad, New Age International Publisher, 2001
- 2 Refrigeration and Air Conditioning, Refrigeration and Air Conditioning, W.F. Stocker and J. W. Jones, McGraw-Hill, 1999
- 3 Refrigeration and Air-conditioning, Refrigeration and Air-conditioning, Ramesh Arora, Prentice Hall of India, 2001
- 4 Refrigeration and Air Conditioning, Refrigeration and Air Conditioning, Ameen Ahmadul, PHI India, 2010
- 5 Principles of Refrigeration, Principles of Refrigeration, Roy J. Dossat and Thomas J. Horan, Pearson, 2013

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation

Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	15.00	35.00	20.00	20.00	0.00

Instructional Method:

- 1 PPT and Video

Supplementary Resources:

- 1 <https://archive.nptel.ac.in/courses/112/105/112105129/>