

**Subject Code: 01ME0731**
**Subject Name: Refrigeration & Air-conditioning**
**B.Tech. IV Year – (Sem-7) Mechanical Engineering**
**Type of course:** Program Elective

**Prerequisite:** Thermodynamics, Fluid mechanics, Heat and mass transfer

**Rationale:** 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.

**Teaching and Examination Scheme:**

Teaching Scheme( Hours)			Credits	Evaluation Scheme					Total Marks
Theory	Tutorial	Practical		Theory Marks			Practical Marks		
				ESE (E)	IA	CSE	Viva (V)	Term Work (TW)	
4	0	2	5	50	30	20	25	25	150

### COURSE OUTCOME

Students will be able to

1. Gathering basic concepts and knowledge of Refrigeration and Air-Conditioning system
2. Analyze performance parameters of Air-refrigeration system, Vapour Compression & Vapour Absorption Refrigeration by using various refrigerants.
3. Examine different terminology of psychrometry and psychrometric processes for human comfort with load calculation sheet
4. Predict the duct design method and air distribution system for analyzing duct and piping system
5. Categorize refrigeration and air-conditioning system components based on application

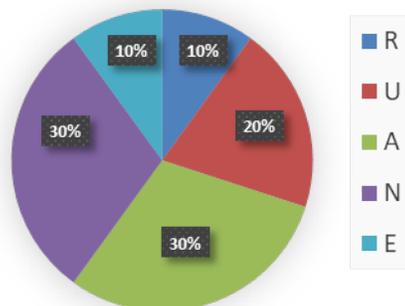
Sr no	Contents	Total hours	Weightage
1	<b>Introduction to refrigeration</b> - Refrigeration, unit of refrigeration, application of refrigeration, methods of producing cooling, ton of refrigeration, coefficient of performance	2	5
2	<b>Refrigerants</b> - Classification of refrigerants, designation system for refrigerant, properties of refrigerants, ozone depletion and Montreal protocol	2	5
3	<b>Air refrigeration</b> - Difference between heat engine, refrigerator and heat pump, reversed Carnot cycle, Bell-Coleman cycle, basic air refrigeration	4	9

	system, bootstrap air refrigeration system, regenerative air refrigeration system, reduced ambient air refrigeration		
4	<b>Vapour compression refrigeration system</b> - 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 <b>Compound vapour compression system</b> - 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, analysis of two evaporators with flash intercooler and individual expansion valve and multiple expansion valve, cascade refrigeration system	7	16
5	<b>Absorption refrigeration system</b> - Aqua-ammonia absorption system, Electrolux refrigeration system, water-lithium bromide absorption system	3	7
6	<b>Refrigeration system components</b> - Classification, construction and working of compressor, condensers, expansion devices and evaporators, evacuation and charging of refrigerant, properties and classification of thermal insulation	4	10
7	<b>Psychrometric properties and processes</b> - 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	6	14
8	<b>Air conditioning and human comfort</b> – Air conditioning and its types, application of air conditioning, air conditioning system, human comfort, factors affecting thermal comfort, Effective temperature, factors governing effective temperature	4	10
9	<b>Load estimation</b> - 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, instantaneous 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	14
10	<b>Duct design and air distribution</b> - 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	10

### Distribution of Theory Marks

R Level	U Level	A Level	N Level	E Level
10	20	30	30	10

**Legends:** R: Remembrance; U: Understanding; A: Application, N: Analyze, and E: Evaluate



### Reference Books

1. Refrigeration and Air Conditioning by D S Kumar, S.K. Kataria & Sons.
2. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.
3. Refrigeration and Air Conditioning by W.F. Stocker and J. W. Jones, McGraw-Hill
4. Refrigeration and Air-conditioning by Ramesh Arora , Prentice Hall of India
5. Refrigeration and Air Conditioning by Ameen Ahmadul, PHI India
6. Refrigeration and Air Conditioning by Manohar Prasad, New Age International Publisher
7. Principles of Refrigeration by Roy. J Dossat, Pearson Education

### List of experiment

1. To understand different components of VCR system and to determine its COP
2. To understand construction and working of reciprocating, rotary and centrifugal compressor used for R&AC.
3. To understand construction and working of window air-conditioner/split air-conditioner
4. To study packaged plant
5. To perform sensible heating and cooling & dehumidification process and analyze the same using psychrometric chart.
6. To perform heating and humidification process and analyze the same using psychrometric chart.
7. To determine COP of air to air heatpump
8. To understand working of Electrolux refrigerator and to determine its COP.
9. To determine COP and apparatus dew point of an air conditioning test rig.
10. To calculate cooling load of a confined space using table and compare the same with load estimation sheet.

### Open ended design problem

- Evaporative cooling using sand pot

### List of Open Source Software/learning website

1. <http://nptel.ac.in/>
2. [www.learnerstv.com](http://www.learnerstv.com)