

**Subject Code: 01AE0604**
**Subject Name: Automobile Refrigeration & Air conditioning**
**B.Tech. III Year – (Sem-6) Automobile Engineering**
**Type of Course:** Engineering

**Pre-requisite of course:** Engineering Thermodynamics

**Rationale:** The course is designed to give fundamental knowledge of types of refrigeration, refrigeration cycles, refrigerants and behavior under various conditions, different air conditioning terms and load calculation, designing of components of air distribution system.

**Course Outcomes:**

After learning the course the students should be able to:

1. Understand the basic concepts of refrigeration and air conditioning systems
2. Understand and analysis of various refrigeration cycles
3. Make basic calculation of psychometric properties and process
4. Do basic calculations of heating and cooling load requirements of a room.
5. Apply scientific and engineering principles to analyze and design aspects of engineering systems that relate to refrigeration and air conditioning

**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term work (TW)	
3	2	0	4	50	30	20	25	25	150

Sr.No	Contents	Duration	Weightage
1	<b>Introduction:</b> Brief history, refrigeration and air conditioning needs, refrigeration and air condensing systems – types and applications, cooling methods, ton of refrigeration, coefficient of performance,.	2	3
2	<b>Refrigerants:</b> Classification, terminology, required properties, secondary refrigerants, upcoming industrialized refrigerants	2	4

3	<b>Air refrigeration:</b> Reversed Carnot cycle. Restrictions of Reverse Carnot cycle, Bell-Coleman cycle, working and examination of air refrigeration systems (Simple; Bootstrap; Regenerative and Reduced ambient, refrigeration inside Aircraft,	4	8
4	<b>Vapour Compression system:</b> Simple system on P-h and T-s diagrams, simple cycle analysis, elements affecting the performance of the cycle, actual cycle  <b>Compound Compression System:</b> Compound compression by means of intercooler (flash gas abstraction and flash intercooler), analysis of two evaporators with flash intercooler and individual expansion valve and multiple expansion valve, multiple evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, , cascade refrigeration system	7	16
6	<b>Absorption refrigeration system:</b> Desired characteristics of refrigerant, selection of pair, practical H <sub>2</sub> O - NH <sub>3</sub> cycle, LiBr – H <sub>2</sub> O system and its functioning, h-x diagram and simple calculation of several process alike adiabatic mixing and mixing with heat transfer, throttling, Electrolux refrigeration system	3	8
7	<b>Refrigeration system components:</b> Types; compressors construction; working; comparison and selection ,condensers; expansion devices; and evaporators, refrigeration piping accessories*, evacuation and charging of refrigerant*, properties and classification of thermal insulation	5	12
8	<b>Psychrometry:</b> Dalton’s law of partial pressure, Properties of moist air, temperature and humidity measuring instruments, psychrometric chart, psychrometric processes such as sensible heating and cooling, heating and humidification cooling and dehumidification, , adiabatic saturation, chemical dehumidification.	5	13
9	<b>Human comfort:</b> Assortment of inside design conditions, thermal relaxation, heat balance equation for user(human being), elements affecting thermal comfort, Operative temperature, comfort chart and factors governing effective temperature, selection of outside design conditions	1	3

11	<b>Load analysis:</b> Site survey, outdoor and indoor design conditions, classification of loads, flywheel effect of building material and its use in design, effect of wall structure on cooling capacity, calculations of cooling capacity, instantaneous heat gain and instantaneous cooling load heat transmission through sunlit and shaded glass using tables, TETD due to sunlit and shaded roof and walls using tables, method of reduction of solar heat gain through glass, ventilation and air infiltration, load due to outside air, heat gain from occupants; electric lights; product; electric motor and appliances, , use of load estimation sheet, introduction of CLTD method ,load calculations for automobiles	6	15
12	<b>Duct design and air distribution:</b> Purpose; classification and economic factors influencing duct layout, equal friction technique of duct design, usage of friction chart, dynamic losses and its determination, Requirements of air distribution arrangement, air distribution, grills, outlets, application, location	4	10
13	<b>Air-conditioning systems:</b> Classification, system components, all air; all water; and air-water systems, room midair conditioners, packaged air conditioning plant, centralized air conditioning systems, split air conditioning systems	3	8

Remember	Understand	Apply	Analyze	Evaluate	Create
20	20	15	15	20	10

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

**Reference Books:**

1. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.
2. Refrigeration and Air-conditioning by Ramesh Arora , Prentice Hall of India
3. Refrigeration and Air Conditioning by Manohar Prasad, New Age International Publisher
4. Principles of Refrigeration by Roy. J Dossat, Pearson Education
5. Refrigeration and Air Conditioning by Jordon and Prister, Prentice Hall of India Pvt. Ltd.
6. Refrigeration and Air Conditioning by W.F. Stocker and J. W. Jones, McGraw-Hill
7. Refrigeration and Air Conditioning by Ameen Ahmadul, PHI India
8. Automobile Air conditioning by Crouse and Anglin, McGraw Hill Publications

**List of laboratory experiments (Any Ten)**

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 and to perform various operations like flaring, swaging, bending, brazing etc.
5. To perform different psychrometric processes and analyze the same using psychrometric chart.
6. To understand construction and working of window air-conditioner/ split air-conditioner and to determine its capacity.
7. To determine COP and apparatus dew point of an air conditioning test rig.
8. To calculate cooling load of a confined space using table and compare the same with load estimation sheet.
9. Study of domestic refrigerator and to determine % running time at different thermostat settings.
10. To determine (COP)<sub>C</sub> and (COP)<sub>H</sub> of heat pump
11. To determine saturation efficiency of air cooler/air washer
12. Study of packaged plant