

Subject Code: 01ME0731

Subject Name: Refrigeration and Air-conditioning

B. Tech. Year - III (Semester - 7)

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.

Course Outcome :

After learning the course, the students will be competent

1. Gathering basic concepts and knowledge of Refrigeration and Air-Conditioning system.
2. Analyze performance parameters of Air-refrigeration system, vapor Compression & vapor absorption refrigeration by using various refrigerants.
3. Examine different terminology of psychometric and psychometric 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.

Teaching and Examination Scheme :

Teaching Scheme			Credits C	Examination Marks					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

Content :

Sr. No.	Content	Total Hrs
1	INTRODUCTION TO REFRIGERATION: Refrigeration, unit of refrigeration, application of refrigeration, methods of producing cooling, ton of refrigeration, coefficient of performance	05
2	REFRIGERANTS: Classification of refrigerants, designation system for refrigerant, properties of refrigerants, ozone depletion and Montreal protocol	05
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	09

4	<p>VAPOUR COMPRESSION REFRIGERATION 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.</p> <p>COMPOUND VAPOUR COMPRESSION SYSTEM: 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.</p>	16
5	<p>ABSORPTION REFRIGERATION SYSTEM: Aqua-ammonia absorption system, Electrolux refrigeration system, water-lithium bromide absorption system.</p>	07
6	<p>REFRIGERATION SYSTEM COMPONENTS: Classification, construction and working of compressor, condensers, expansion devices and evaporators, evacuation and charging of refrigerant, properties and classification of thermal insulation</p>	10
7	<p>PSYCHROMETRY 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.</p>	14
8	<p>AIR CONDITIONING AND HUMAN COMFORT: Air conditioning and its types, application of air conditioning, air conditioning system, human comfort, factors affecting thermal comfort, Effective temperature, factors governing effective temperature</p>	10
9	<p>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, 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</p>	14
10	<p>DUCT DESIGN AND 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</p>	10

Distribution of Theory Marks

R Level	U Level	A Level	N Level	E` Level	C Level
10	20	25	25	10	10

Legends: R: Remember; **U:** Understand; **A:** Apply; **N:** Analyze; **E:** Evaluate; **C:** Create

List of Experiments :

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 psychometric chart.
6. To perform heating and humidification process and analyze the same using psychometric chart.
7. To determine COP of air-to-air heat pump
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.

List of Assignments :

Assignment should be designed to include chapter no 3, 4, 7, 9 & 10 Refrigeration and Air-conditioning

1. Theory and Example on Air refrigeration
2. Theory and Example on VCRS
3. Theory and Example on Psychrometry properties and process
4. Theory and Example on Load analysis
5. Theory and Example on Duct design and distribution

Major Equipment :

1. VCRS apparatus
2. Heat pump apparatus
3. Air-conditioner test rig
4. Air- washer test rig
5. Electrolux system

Design based Examples (DE)/ Open Ended Example :

1. Evaporative cooling using sand pot

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 AmeenAhmadul, 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 Open Base Software/learning website :

1. <http://nptel.ac.in>
2. www.learnerstv.com