SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering Department
B. Tech. Semester VI

Course Name: **Heating, Ventilation and Air-conditioning** **Subject Code: BTME13602**

Type of course: **Professional Core Course**

Prerequisite: Fluid Mechanics, Engineering Thermodynamics, Heat Transfer

Rationale: The course is designed to provide fundamental knowledge of different refrigeration cycles, refrigerants, moist air properties and their behavior under various conditions, different air conditioning terms, heating and cooling load calculation, indoor air quality, designing of various components of air distribution system.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Vapor Compression Refrigeration System:** Concept of ton of refrigeration, air conditioning, coefficient of performance and applications of refrigeration-air condensing system. Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle. Compound compression with intercooler, flash gas removal and flash intercooler, cascade refrigeration system, bell Coleman cycle, introduction to air refrigeration systems, bootstrap air refrigeration system.	8	18%

Sr. No.	Topics	Teaching Hrs.	Module Weightage
2.	**Vapor Absorption Refrigeration System:** Practical H_2O -NH_3 cycle, LiBr – H_2O system and its working, h-x diagram and simple calculation of various processes like adiabatic mixing and mixing with heat transfer, throttling. Classification, nomenclature, desirable properties, secondary refrigerants, future industrial refrigerants.	**6**	**16%**
3.	**Psychrometry:** Dalton's law of partial pressure, Properties of moist air, temperature and humidity measuring instruments, psychrometric chart, and psychrometric processes such as sensible heating and cooling, heating and humidification cooling and dehumidification.	**5**	**10%**
4.	**Air Conditioning for Human Comfort:** Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, Effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions.	**5**	**10%**
5.	**Load analysis:** Site survey, outdoor and indoor design conditions, classification of loads, effect of wall construction on cooling load, instantaneous heat gain (IHG) and instantaneous cooling load (ICL) heat transmission through sunlit and shaded glass using tables, method of reduction of solar heat gain through glass, calculations of cooling load TETD due to sunlit and shaded roof and walls using tables, ventilation and air infiltration, load due to outside air, heat gain from occupants; electric lights; product; electric motor and appliances, load calculations for automobiles, use of load estimation sheet, introduction of CLTD method.	**8**	**18%**
6.	**Duct Design and Air Distribution:** Function; classification and economic factors influencing duct layout, equal friction method of duct design, use of friction chart, dynamic losses and its determination, Requirements of air	**8**	**18%**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	distribution system, air distribution, grills, outlets, application, location.		
7.	**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, indoor air quality, ventilation,	**5**	**10%**

Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):

Percentage Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**20**	**20**	**20**	**15**	**10**

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Refrigeration and Air Conditioning	C. P. Arora	McGraw-Hill India Publishing ltd.	2020	4th
2	Principles of Refrigeration	Roy J. Dossat	Pearson Education	2002	5th
3	A Textbook of Refrigeration and Air Conditioning	Er. R. K. Rajput	Kataria, S. K., & Sons	2013	3d
4	Refrigeration and Air Conditioning	W. F. Stocker and J. W. Jones	McGraw-Hill	--	--
5	Refrigeration and Air-Conditioning	Dr. D.S. Kumar	S. K. Kataria	2019	1st
6	Psychrometry Hand Book	--	ASHRAE	--	--

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Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Illustrate the basic concepts of refrigeration and air conditioning system.	15
CO-2	Differentiate between different types of refrigeration systems with respect to application as well as conventional and non-conventional refrigeration systems.	25
CO-3	Apply the principles of Psychometrics to design the air conditioning system.	20
CO-4	Determine cooling loads of air conditioning systems.	20
CO-5	Design of duct and components of central air conditioning system.	20

Mapping of (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO-1	1	1	1	1	1	0	1	0	0	0	1	1	1	1	1
CO-2	2	1	2	2	1	2	1	1	0	0	1	1	2	1	1
CO-3	1	2	1	1	0	0	0	0	0	0	0	0	1	1	0
CO-4	1	1	2	1	2	1	1	0	1	0	1	0	2	1	1
CO-5	0	1	1	1	0	1	1	0	1	0	1	0	1	1	0
Rationale*	**5**	**6**	**7**	**6**	**4**	**4**	**4**	**1**	**2**	**0**	**4**	**2**	**7**	**5**	**3**

Rationale - Mapping of CO's with PO's and CO's with PSO's:

It helps to understand the refrigeration and air conditioning cycles. It also helps to develop air conditioning system by evaluating cooling loads of the systems.

This course highly maps with Program outcomes 1,2,3,4,5,6,7,11 and Program Specific Outcomes 1 and 2. It states that the course will develop engineering knowledge, problem analysis, design / development of solutions, conduct investigations of complex problems, modern tool usage, the engineer and society, environment and sustainability, project management and finance and finally it will lead to convert conceptual knowledge of mechanical engineering to real life application and with the use of modern computing tools.

List of Practical:

1. To study different components of VCR system and to determine its COP.
2. To study different components of VAR system and to determine its COP.
3. To understand various tools used for refrigeration tubing and to perform various operations like flaring, swaging, bending, brazing etc.
4. To study different psychrometric processes and analyze the same using psychrometric chart.
5. To understand construction and working of window air-conditioner/ split air-conditioner and to determine its capacity.
6. To determine COP and apparatus dew point of an air conditioning test rig.
7. To calculate cooling load of a confined space using table and compare the same with load estimation sheet.
8. Prepare duct layout for a shopping mall or a large building using any one method.

Major Equipment:

1. Vapor compression test rig
2. Sectional models of compressors
3. Air cooler apparatus
4. Apparatus to study psychrometric processes
5. Tools to demonstrate various refrigeration tubing operations
6. Mechanical heat pump

List of Open learning website: https://nptel.ac.in, www.vlab.co.in

List of Open Source Software:https://www.ashrae.org/technical-resources/free-resources/software