GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code : ME02000591

Subject Name : Advanced Air Conditioning Engineering

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Nil
Rationale:	The course is designed to give advanced knowledge and relevant technologies in the area of Air conditioning engineering which includes load calculations, component design, air distribution and handling.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Make calculation of various Psychrometric processes	Apply
2	Estimate the cooling load requirements of residential and commercial building and design the system components accordingly	Evaluate
3	Make use of tables and nomographs to design air distribution systems	Apply
4	Analyze the domestic and industrial requirement of air conditioning systems and evaporative cooling equipment	Analyze
5	Select fan for different air conditioning systems and discuss recent developments in the area of air conditioning engineering	Apply/ Create

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Applied psychometric:** Different psychrometric charts, combinations of different processes and their representation on psychrometric charts, psychrometric calculations for cooling and dehumidification, high latent	08	18

	heat load, dehumidified air quantities based on total and effective room loads, GSHF and RSHF, effective surface temperature, effect of bypass factor on GSHF, analysis for using all outside air, psychrometric of partial load control		
2.	**Design conditions and Heat load calculation:** Selection of inside design conditions for different applications, Thermal comfort, different equations governing thermal exchanges, environmental indices, AQ and its importance, Basic terminology for heat load calculation, heat transfer through walls and roofs, heat gain through glass, solar heat gain factor, shading of glass, shading devices and its selection, load due to other sources, stack effect, brief idea about other ASHRAE methods of calculating cooling load	10	22
3.	**Distribution of Air:** Terminology, outlet performance, types of outlets, location of outlets, factors affecting grill performance, selection of outlets using nomographs and tables, room air diffusions performance index (ADPI) and its use in outlet selection, types of ducts, duct materials and their accessories, duct construction, factors affecting duct construction, friction charts and other correction factors, losses, design velocity and its selection, duct heat gain or loss, duct insulation, duct layouts, duct sizing methods, noise and their isolation	09	20
4.	**Air conditioning systems:** Factors affecting the selection of the systems, classification, design procedure, system features, controls of all air, air water, all water, DX, VAV and dual duct systems, basic idea of cold air distributions systems	05	11
5.	**Evaporative cooling equipment:** Cooling tower: Types, construction, working and performance; Evaporative air cooler: Types, construction, working and performance, testing of evaporative air coolers as per IS standards, indirect evaporative cooling; Air washer: Types, construction, working, performance	06	12
6.	**Air handling systems:** Types, construction and performance characteristics of fans, fan laws, testing as per IS and AMCA standards, fan selection with the help of tables, charts and curves, fan drive arrangements and discharge from fans.	04	09
7.	**Advances in Air Conditioning:** Chilled beam, clean room concept, filtration of suspended particles, PPM control and methods, types of filters	03	07
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	**20**	**35**	**20**	**20**	**05**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Air Conditioning Engineering by W. P. Jones, Butterworth-Heinemann, Boston, Oxford
2. Refrigeration and Air conditioning by C. P. Arora, McGraw-Hill Publication
3. Hand book of Air conditioning Systems Design by Carrier Corporation
4. Air conditioning Principles and Systems by Edward G. Pita, John Wiley & Sons
5. HVAC Testing Adjusting and Balancing Manual by John Gladstone, McGraw-Hill Publication
6. ASHRAE Handbook of HVAC Systems and Equipment
7. ASHRAE Handbook of HVAC Applications
8. Fan Handbook by Frank P Bleier, McGraw-Hill Professional

(b) Open-source software and website:

Students are expected to use software related to load calculations and evaporating cooling

Suggested Course Practical List:

1. Measurement psychrometric properties using various instruments used in air conditioning.
2. Understanding the construction and working of clean room.
3. Testing of fan used in air conditioning as per IS standards or AMCA standard.
4. Performance evaluation of air conditioning system with different psychrometric conditions.
5. To carry out cooling load calculation of a residential/commercial building.
6. Design of duct system for above selected building.
7. Understand the salient features of water chilling plant.
8. To determine the capacity of window or split air conditioner.
9. To determine evaporative cooling capacity of cooling tower.
10. To determine humidifying efficiency of air cooler.

Visit of any central air-conditioning plant is desirable.

List of Laboratory/Learning Resources Required: psychrometer, hygrometer, pitot tube, anemometer, forward/backward/radial curved fan test ring as per BIS/AMCA standard, air-conditioning test rig with facility to operate with different psychrometric conditions, window/split air-conditioning test rig, cooling tower test rig, air cooler

Suggested Project List:

Suggested Activities for Students: Students are required to download 3-5 research papers from reputed international journals on the recent advancement in the areas of air-conditioning. They need to go through the same and prepare a review for the research papers. The review should have three parts: Summary, Critical Evaluation and Creative synthesize

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