GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (THERMAL ENGINEERING) (21)
ADVANCED AIR CONDITIONING TECHNOLOGY
SUBJECT CODE: 2732105
M.E. 3rd SEMESTER

Type of Course: Applied Engineering (Advanced)

Prerequisite: Fundamental knowledge of air-conditioning

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

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Psychometric charts and applied psychometric :** ASHRAE and Carrier charts, their differences, combinations of different processes and their representation on psychrometric charts, psychrometric calculations for cooling and dehumidification, high latent 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	**5**	13
2	**Heat load calculation :** Basic terminology, sole air temperature, TETD method to evaluate 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.	**7**	16
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.	**10**	23
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	**5**	13

5	**Evaporative cooling equipments :** 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	**5**	12
6	**Thermal effects :** Human thermo regulation, different equations governing thermal exchanges, factors affecting comforts, environmental indices, AQ and its importance, human comfort and health.	**3**	7
7	**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.	**4**	9
8	**Advances in Air Conditioning :** Chilled beam, clean room concept, filtration of suspended particles, PPM control and methods, types of filters.	**3**	7

Reference 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 Australia Limited
5. HVAC Testing Adjusting and Balancing Manual by John Gladstone 3rd, McGraw-Hill Publication
6. ASHRAE Handbook of HVAC Systems and Equipment (2012)
7. ASHRAE Handbook of HVAC Applications (2011)
8. Fan Handbook by Frank P Bleier, McGraw-Hill Professional

Course Outcome:

After learning the course the students should be able to:

1. Acquire a thorough understanding of common air conditioning systems.
2. Estimate the cooling load requirements of residential and commercial building and design the system components accordingly
3. Develop the skills to analyze the domestic and industrial requirement of air conditioning systems

List of Experiments: (any 10 to be perform)

1. To study various instruments used in air conditioning.
2. Study of advanced air conditioning systems.
3. Study of air conditioning test rig.
4. Study of clean room.
5. Testing of fan used in air conditioning as per IS standards or AMCA standard.
6. Performance evaluation of air conditioning system with different psychrometric conditions.
7. Load calculation of a residential/commercial building.
8. Design of duct system for above selected building.
9. Understand the salient features of water chilling plant.
10. To determine the capacity of window or split air conditioner.
11. To determine evaporative cooling capacity of cooling tower.
12. To determine humidifying efficiency of air cooler.

Design based Problems (DP)/Open Ended Problem:

1. Calculation of cooling load of any residential or commercial building and compare the same with load calculation sheet of a consultant.
2. Design a duct layout for a central air conditioning system of a large building. Necessary input data may be obtain for a particular site.
3. Calculation of cooling load of any residential or commercial building using any of the ASHARE methods other than TETD and compare the same with load calculation sheet of a consultant.

Major Equipment: Duct type air conditioning trainer, cooling tower experimental test rig, window air conditioning test rig, spit air conditioner, evaporative air cooler, centrifugal fans, air washer, models of AHU, FCU etc., pitot tube, anemometer, hygrometer, sling psychrometer,

List of Open Source Software/learning website:

1. Students can refer to video lectures available on the websites including NPTEL.
2. Students can refer to the CDs which are available with some reference books for the solution of problems using software/spreadsheets. Students can develop their own programs/ spreadsheets for the solutions of problems.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.