

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CRYOGENIC ENGINEERING) (10)

ADVANCED AIR CONDITIONING

SUBJECT CODE: 2721003

SEMESTER: II

Type of course: Major Elective II

Prerequisite: Fundamental knowledge of thermodynamics

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			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 : ASHRE and CARRIER charts ,their differences ,application of corrections of different charts ,Applied psychrometry : 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 ESHF ,effect of fan and duct heat gain or dehumidified air quantity ,effective surface temperature ,effect of bypass factor on on GSHF ,analysis for using all outside air ,psychrometric of partial load control	6	15
2	Cooling tower: Different types ,construction working performance ,testing different types of desert coolers ,testing of desert coolers as per BIS, Air washer, different types, construction performance.	3	5
3	Heat gain calculations: choices of supply conditions. Solar heat gain: Terminology calculation different solar angles ,relation between different angles ,calculation of the intensity of direct ,diffused and ground radiation , solar air temperature ,empirical methods to evaluate heat transfer through walls, and roofs, TETD and its determination by calculation and tables ,Heat gain through glass ,Solar heat gain factor, use of equations and tables ,shading of glass ,solar chart and its use .shading of glass ,solar chart and its use, shading devices and its selection ,load due to other sources, stack effect ,different methods of calculating cooling load as per ASHRE- some brief idea(other than TETD methods)	6	15
4	Duct Design : Types of ducts ,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 ,equal friction static regains and T-method design simple idea .Noise and their isolation ,duct materials and their accessories	5	15
5	Air Distribution: Terminology ,outlet performance ,types of outlets ,location	4	5

	of outlets ,factors affecting grill performance ,selection of outlets using nomographs ,tables and line charts ,room air diffusions, performance index (ADPI)and its use in outlet selection ,use of different equations.		
6	Air conditioning systems :Factors affecting the selection of the systems ,classification ,systems ,design procedure ,system features ,psychrometric analysis ,controls of all air ,air water ,all water, DX ,VAV and dual duct systems basic idea of cold air distributions systems and dessicant cooling systems	5	15
7	Air conditioning controls : Characteristics of HVAC noise ,Acoustical rating systems and criteria ,RC ,NC, and NR criteria for noise rating ,noise control methods for VAV units ,cooling towers ,air devices roof top units ,chillers , pumps , AHU rooms, compressors. CONTROLS FOR RADIANT HEATING AND COOLING SYSTEMS A low or line voltage thermostat, single low-voltage control, over-temperature limit sensor or temperature control, supportive flow and temperature control sensors and valves that interact in response to themaster control. Slave or independent area controls zone control, outdoor reset control, interior controls, motorized mixing valves, safety controls, downstream flow control, and temperature valves of mechanical and electronic equipments.	6	10
8	Thermal effects :-Human thermo regulation, different equations governing thermal exchanges ,factors affecting comforts, environmental indices, AQ and its importance –Human comfort and health. Thermal comfort design methodology, concept of The Mean Radiant Temperature, the performance capabilities of radiant heating and cooling systems in comparison to convection. Concept of The Operative Temperature., thermal comfort, measurement techniques, calculations and procedures for thermal comfort Calculations.	2	5
9	Air handling systems : Fans ,types ,construction performance characteristics ,fan laws ,testing as per BS ,IS and AMCA standards, fan selection with the help of tables charts and curves, fan drive arrangements and discharge from fans, duct design fan selection etc. Electric radiant heating panels, high temperature heaters radiant hydronic heating systems, Radiant Heating and Cooling Hybrid Systems, Convective Systems with Radiant Panels, optimization of system combination. Ventilation with Radiant Heating and Cooling systems.	5	15

Reference Books:

1. Air Conditioning Engineering -By Jones 5th 2001
2. Thermal Environmental Engineering, Threlkeld
3. Hand book of air conditioning systems design :carrier corporation 1965
4. Air conditioning principles and systems –pita
5. HVAC testing adjusting and balancing manual :Gladstone 3 rd 1997 Ashrae Data Book, (1) Fundamentals (2001) (2) application (1999) (3)System and equipments (2000)
6. Hand book of air conditioning and refrigeration : wang 2 (1993)
7. Air conditioning application and design by jones2nd1997
8. Air conditioning system design manual : lorach1993
9. Fan handbook :bleier 1998

Course Outcome:

After learning the course the students should be able to know about

Psychrometric analysis and designing of coil, cooling load calculations, Fan selection, Air conditioning duct design, different types of control related to air conditioning system, Different types of air conditioning systems, Air distribution systems, human comfort and cooling towers

List of Experiments:

1. To study various instruments used in air conditioning
2. Study of clean room and to plot time v/s temperature curve.
3. Study of air conditioning test rig and to plot various processes.
4. Study of different types of fans used in air conditioning.
5. To find out performance characteristics of a forward curved blade fan.
6. To find out the capacity of a FCB centrifugal fan from suction side. Also determine average velocity of a fan from discharge side and calculate Cd of a given fan
7. To determine the capacity of a given fan using ten point method.
8. Study of 15 TON water chilling plant.
9. Study and testing of ductable split A / C plant of a conference hall of main building of LDCE A'bad.
10. Industrial visit of multiplex / cinema halls / auditorium / Malls etc.

Design based Problems (DP)/Open Ended Problem:

- 1 Cooling load calculation for air conditioning lab
- 2 Study of duct layout for centralized air conditioning plant
- 3 VAV system
- 4 All water Sytem
- 5 Clean room

Major Equipment:

Air conditioning test rig, Centrifugal fans, Air washer, Fan-coil unit, Air handling unit, Cooling tower, Clean room

List of Open Source Software/learning website:

Cooling load calculations, duct design , NPTEL

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