



Module (Air Conditioning) Catalogue 2023-2024

College	Erbil Technical Engineering College	
Department	Technical Mechanical and Energy Engineering Department	
Module Name	Air Conditioning	
Module Code	AIC505	
Degree	Technical Diploma <input type="checkbox"/> Bachler <input checked="" type="checkbox"/> High Diploma <input type="checkbox"/> Master <input type="checkbox"/> PhD <input type="checkbox"/>	
Semester	5	
Qualification	Ph.D. Degree	
Scientific Title	Lecturer	
ECTS (Credits)	5	
Module type	Prerequisite <input type="checkbox"/> Core <input checked="" type="checkbox"/> Assist. <input type="checkbox"/>	
Weekly hours	4 hours	
Weekly hours (Theory)	(2)hr Class	(27)Total hrs Workload
Weekly hours (Practical)	(2)hr Class	(26)Total hrs Workload
Number of Weeks	12 weeks	
Lecturer (Theory)	Dr. Bashir Eskander Kareem	
E-Mail & Mobile NO.	Bashir.kareem@epu.edu.iq 07501134682	
Lecturer (Practical)	Deedar Raof Mohammed	
E-Mail & Mobile NO.	deedar.mohammed@epu.edu.iq	
Websites	https://academicstaff.epu.edu.iq/faculty/bashir.kareem	

Course Book

<p>Course Description</p>	<p>This course covers air conditioning process; Heating, Ventilating, and Air Conditioning (HVAC) relates to systems that perform processes designed to regulate the air conditions within buildings for the comfort and safety of occupants or for commercial and industrial processes or for storage of goods. HVAC systems condition and move air to desired areas of an indoor environment to create and maintain desirable temperature, humidity, ventilation and air purity. Depending on geographic location and building construction, various types of interior climate control systems help ensure that interior spaces are maintained at comfortable levels year-round. With today's energy conservation concerns, buildings are constructed to be much tighter, reducing the level of natural exchange between indoor and outdoor air. As a result, more and more buildings rely on mechanical conditioning and distribution systems for managing air.</p>				
<p>Course objectives</p>	<p>Introducing students to the having knowledge about advanced Air conditioning processes. A properly operated Heating, Ventilating, and Air Conditioning (HVAC) system finds the often-delicate balance between optimizing occupant comfort while controlling operating costs. Comfort is an important issue for occupant satisfaction, which can directly affect concentration and productivity. At the same time, controlling these comfort and health parameters directly affects HVAC system operating costs in terms of energy, maintenance and equipment life.</p>				
<p>Student's obligation</p>	<ul style="list-style-type: none"> • Attendance in the all lectures on time. • Several quizzes and home works in each course. • Midterm and final exams in end of the course 				
<p>Required Learning Materials</p>	<ul style="list-style-type: none"> • Lecture halls using data show, white board and PowerPoint and Air conditioning laboratory. • Publish all lectures on Moodle platform. 				
<p>Evaluation</p>	<p>Task</p>		<p>Weight (Marks)</p>	<p>Due Week</p>	<p>Relevant Learning Outcome</p>
	<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Assignments</p>	<p>Homework</p>	<p>5%</p>		
		<p>Class Activity</p>	<p>2%</p>		
		<p>Report</p>	<p>5%</p>		
		<p>Seminar</p>	<p>5%</p>		
	<p>Quiz</p>	<p>8%</p>			
	<p>Lab. Reports</p>	<p>10%</p>			
	<p>Midterm Exam</p>	<p>25% Theo. (10)+ Pract. (15)</p>			
	<p>Final Exam</p>	<p>40% Theo. (20)+ Pract. (20)</p>			

	Total	100%		
Specific learning outcome:	The course will give the fundamental knowledge and practical abilities in the following:			
	<p>[1] Understanding of fundamental knowledge on heat transfer and air conditioning.</p> <p>[2] Understanding and have ability to use psychrometry and air properties.</p> <p>[3] Understanding main processes in Air conditioning systems.</p> <p>[4] Understanding how to prevent condensation on inner surfaces of building.</p> <p>[5] Estimation of heating load.</p> <p>[6] Understanding of solar radiation and its effects on the building.</p> <p>[7] Understanding how to build air conditioning cycles for year-round.</p> <p>[8] Understanding of coil by pass factor and be able to design indoor air condition.</p> <p>[9] Be able to estimate coil and room sensible heat factor.</p> <p>[10] Estimation of cooling load for building.</p>			
Course References:	Be able to design evaporative cooling system and achieve thermal comfort.			
	<ul style="list-style-type: none"> • Wang S.K., "Air-conditioning and refrigeration mechanical engineering handbook", 1999. • Trott A.R., "refrigeration and air conditioning" 3rd edition, 2000 • Fundamental of Thermodynamics by Sonntag, Borgnakke and van Wylen. • A publication of The Trane Company—Worldwide Applied Systems Group 			
Course topics (Theory)		Week	Learning Outcome	
Properties of moist air and water vapour mixture		1 st week (14 th Sep. 2021)	[1]	
Psychrometry and Air mixing [heat and mass balance]		2 nd week (21 st Sep. 2021)	[2]	
Sensible cooling, sensible heating, humidification and dehumidification		3 rd week (28 th Sep. 2021)	[3]	
Heat transfer in residential building and condensation on internal surfaces		4 th week (5 th Oct. 2021)	[4]	
Heating load estimation, ventilation and infiltration		5 th week (12 th Oct. 2021)	[5]	

Cooling load estimation	6 th week (19 th Oct. 2021)	[10]
Cooling load estimation	7 th week (26 th Oct. 2021)	[10]
Evaporative cooling process, cooling tower and thermal comfort	8 th week (2 nd Nov. 2021)	[7]
Midterm Exam		
Applied psychometrics and Sensible heat Factor (SHF)	9 th week (16 th Nov. 2021)	[7]
Design supply flowrate and condition, and Apparatus dew point, coil bypass factor	10 th week (23 rd Nov. 2021)	[9]
Practical air conditioning [Summer cycles]	11 th week (30 th Dec. 2021)	[8]
Practical air conditioning [Winter cycles and all year cycles]]	12 th week (7 th Dec. 2021)	[11]
Final Exam		
Practical Topics	Week	Learning Outcome
Car air conditioning performance	1	1
Heating and humidification process	2	2
Cooling and dehumidification process	3	3

Questions Example Design

Q / A building has a total heating load of 80 kW. The sensible heat factor for the space is 0.8 and the space is to be maintained at 24 db and 40 percent relative humidity. Outdoor air at 5 db and 60 percent relative humidity in the amount of 1000 cfm is required. Air is supplied to the space at 48 db. Dry steam is used to humidify the air. Find (a) the conditions and amount of air supplied to the space, (b) the temperature rise of the air through the furnace, (c) the amount of water vapor required, and (d) the capacity of the furnace. Assume sea-level pressure. (1 m³/s = 2119 cfm).

Solution:

$$Q_r = 80 \text{ kW} \quad , \text{ RSHF}=0.8 \quad , V_o=1000 \text{ cfm} =0.47192\text{m}^3/\text{s} \quad , m_o = \frac{V_o}{v_o} = 0.59 \text{ kg/s}$$

Draw RSHF line pass through room condition and intersect supply condition, thus;

Supply condition 48°C db and $h = 85\text{kJ/kg}$ and $W = 0.014 \text{ kgv/kg}$

$$Q_r = m_s(h_s - h_r)$$

$$80 = m_s(85 - 43)$$

$$m_s = 1.90476 \text{ kg/s}$$

$$m_s = m_r = 1.90476$$

$$m_o/m_r = 0.59/1.90476 = 31.1\%$$

$$m_{\text{mix}} * h_{\text{mix}} = m_o * h_o + m_{\text{rec}} * h_{\text{rec}}$$

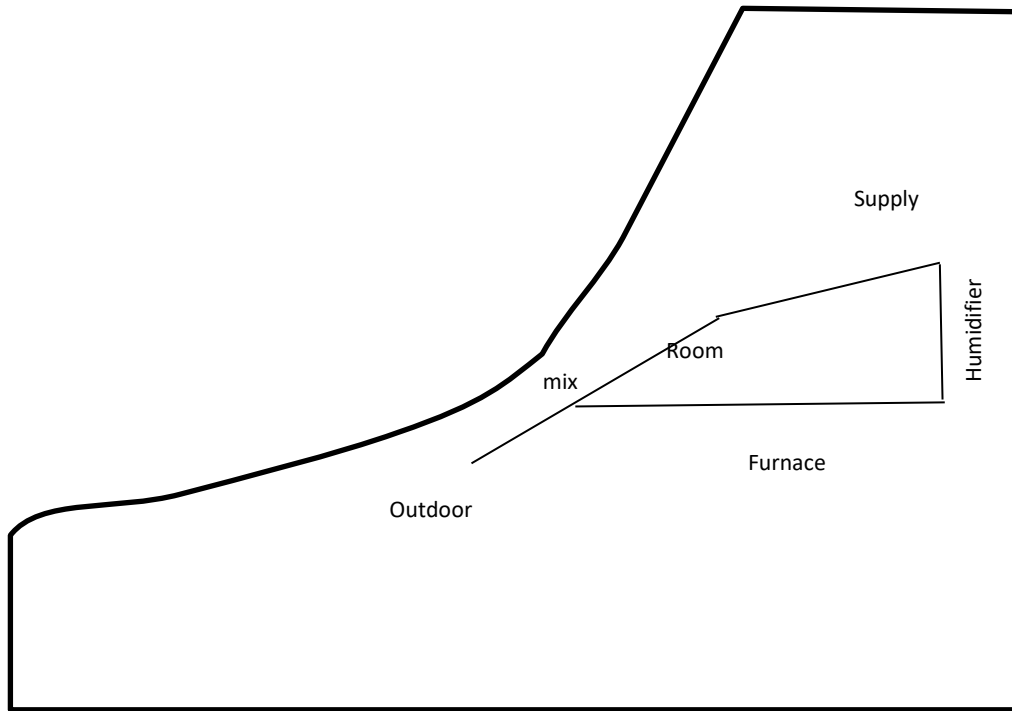
$$h_{\text{mix}} = 33.65 \text{ kJ/kg} \text{ and } T_{\text{mix}} = 17.5^\circ\text{C}$$

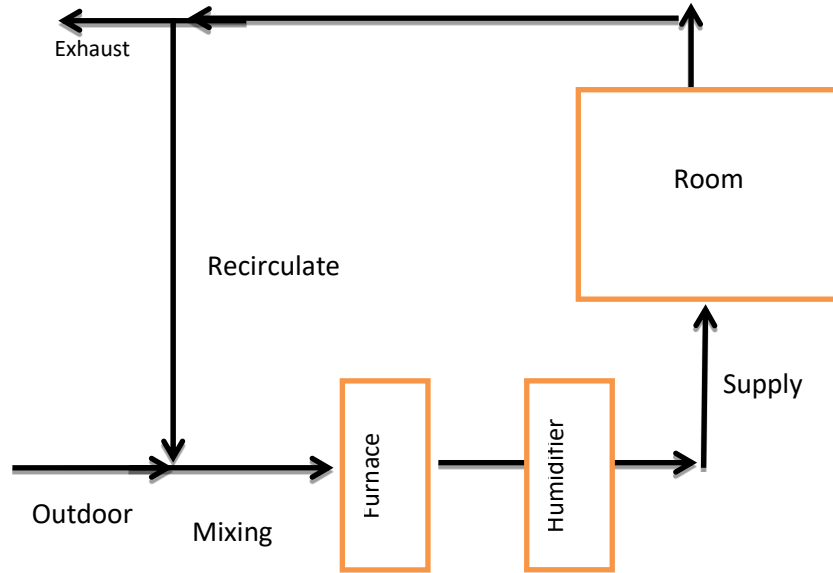
Temperature rise in furnace = $48 - 17.5 = 30.5^\circ\text{C}$

$$m_w = m_{\text{mix}}(w_s - w_o) = 1.90476(0.014 - 0.00323)$$

$$m_w = 0.020514 \text{ kgv/s}$$

$$\text{capacity of furnace} = m c_p \Delta T = 1.90476 * 1.005(30.5) = 58.4 \text{ kW}$$





Q2/ What process is required to achieve thermal comfort?

Answer

Air condition processes to achieve thermal comfort are; heating, cooling, humidifying, and dehumidifying process on need.

Extra notes:

External Evaluator

I confirm that the contents of this syllabus are sufficient and cover all the requirements of Air Conditioning subject.

Assist. Prof. Dr. Banipal N. Yaqob

12/9/2023