Module (Air Conditioning) Catalogue

2022-2023

College	**Erbil Technical Engineering College**	
Department	**Technical Mechanical and Energy Engineering Department**	
Module Name	**Air Conditioning**	
Module Code	**AIC505**	
Degree	**Technical Diploma** ☐ **Bachler** ■ **High Diploma** ☐ **Master** ☐ **PhD** ☐	
Semester	**5**	
Qualification	**Master Degree**	
Scientific Title	**Assistant Lecturer**	
ECTS (Credits)	**5**	
Module type	**Prerequisite** ☐ **Core** ■ **Assist.** ☐	
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)	**Mr. Bashir Eskander Kareem**	
E-Mail & Mobile NO.	**Bashir.kareem@epu.edu.iq 07501134682**	
Lecturer (Practical)	**Mr. Bashir Eskander Kareem**	
E-Mail & Mobile NO.	**Bashir.kareem@epu.edu.iq 07501134682**	
Websites	**https://academicstaff.epu.edu.iq/faculty/bashir.kareem**	

Course Book

<table>
<tr><td>Course Description</td><td colspan="5">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.</td></tr>
<tr><td>Course objectives</td><td colspan="5">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.</td></tr>
<tr><td>Student's obligation</td><td colspan="5">• Attendance in the all lectures on time.
• Several quizzes and home works in each course.
• Midterm and final exams in end of the course</td></tr>
<tr><td>Required Learning Materials</td><td colspan="5">• Lecture halls using data show, white board and PowerPoint and Air conditioning laboratory.
• Publish all lectures on Moodle platform.</td></tr>
<tr><td rowspan="8">Evaluation</td><td colspan="2">Task</td><td>Weight (Marks)</td><td>Due Week</td><td>Relevant Learning Outcome</td></tr>
<tr><td rowspan="4">Assignments</td><td>Homework</td><td>5%</td><td></td><td></td></tr>
<tr><td>Class Activity</td><td>2%</td><td></td><td></td></tr>
<tr><td>Report</td><td>5%</td><td></td><td></td></tr>
<tr><td>Seminar</td><td>5%</td><td></td><td></td></tr>
<tr><td colspan="2">Quiz</td><td>8%</td><td></td><td></td></tr>
<tr><td colspan="2">Lab.</td><td>10%</td><td></td><td></td></tr>
<tr><td colspan="2">Midterm Exam</td><td colspan="3">25% Theo. (10)+ Pract. (15)</td></tr>
<tr><td colspan="2">Final Exam</td><td colspan="3">40% Theo. (20)+ Pract. (20)</td></tr>
</table>

	Total	100%		
Specific learning outcome:	The course will give the fundamental knowledge and practical abilities in the following: [1] Understanding of fundamental knowledge on heat transfer and air conditioning. [2] Understanding and have ability to use psychrometry and air properties. [3] Understanding main processes in Air conditioning systems. [4] Understanding how to prevent condensation on inner surfaces of building. [5] Estimation of heating load. [6] Understanding of solar radiation and its effects on the building. [7] Understanding how to build air conditioning cycles for year-round. [8] Understanding of coil by pass factor and be able to design indoor air condition. [9] Be able to estimate coil and room sensible heat factor. [10] Estimation of cooling load for building. Be able to design evaporative cooling system and achieve thermal comfort.			
Course References:	• Wang S.K.,"Air-condtioning 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	1st week (14th Sep. 2021)	[1]
Psychrometry and Air mixing [heat and mass balance]	2nd week (21st Sep. 2021)	[2]
Sensible cooling, sensible heating, humidification and dehumidification	3rd week (28th Sep. 2021)	[3]
Heat transfer in residential building and condensation on internal surfaces	4th week (5th Oct. 2021)	[4]
Heating load estimation, ventilation and infiltration	5th week (12th Oct. 2021)	[5]

Cooling load estimation	6th week (19th Oct. 2021)	[10]
Cooling load estimation	7th week (26th Oct. 2021)	[10]
Evaporative cooling process, cooling tower and thermal comfort	8th week (2nd Nov. 2021)	[7]
Midterm Exam		
Applied psychometrics and Sensible heat Factor (SHF)	9th week (16th Nov. 2021)	[7]
Design supply flowrate and condition, and Apparatus dew point, coil bypass factor	10th week (23rd Nov. 2021)	[9]
Practical air conditioning [Summer cycles]	11th week (30th Dec. 2021)	[8]
Practical air conditioning [Winter cycles and all year cycles]]	12th week (7th 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
Heat exchanger effectiveness	4	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:

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

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

Supply condition 48℃ db and h= 85kj/kg and W=0.014 kgv/kga

$Q_r = m_s(h_s - h_r)$

$80 = m_s(85 - 43)$

$m_s = 1.90476\ kg/s$

ms=mr=1.90476

mo/mr=0.59/1.90476 = 31.1%

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

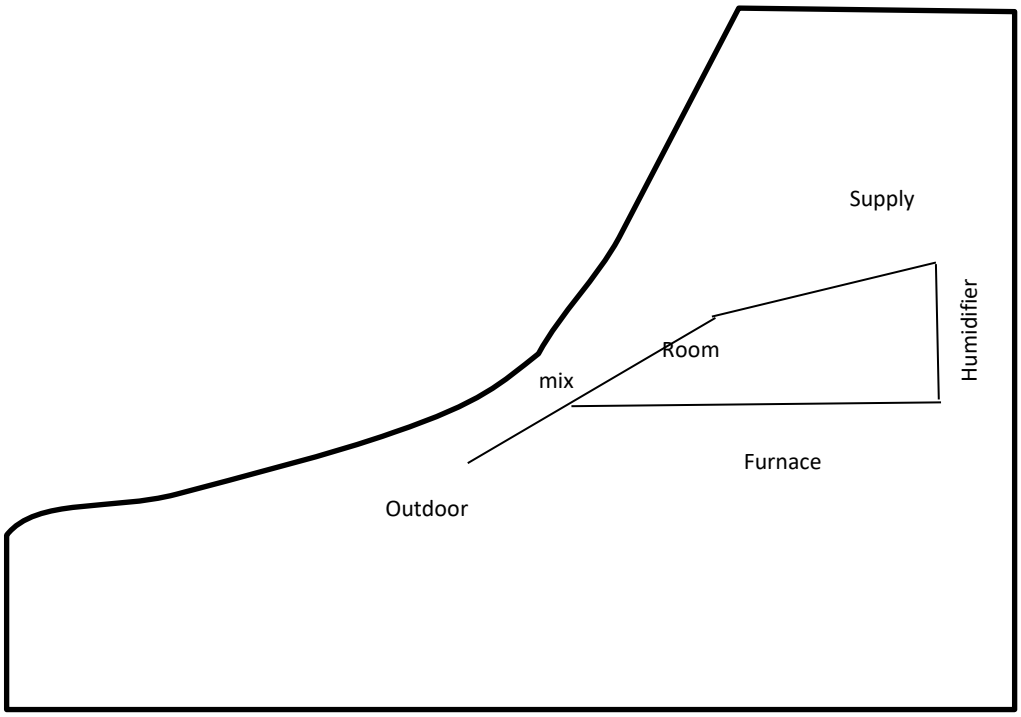
h_{mix}=33.65 kj/kg and T_{mix}=17.5℃

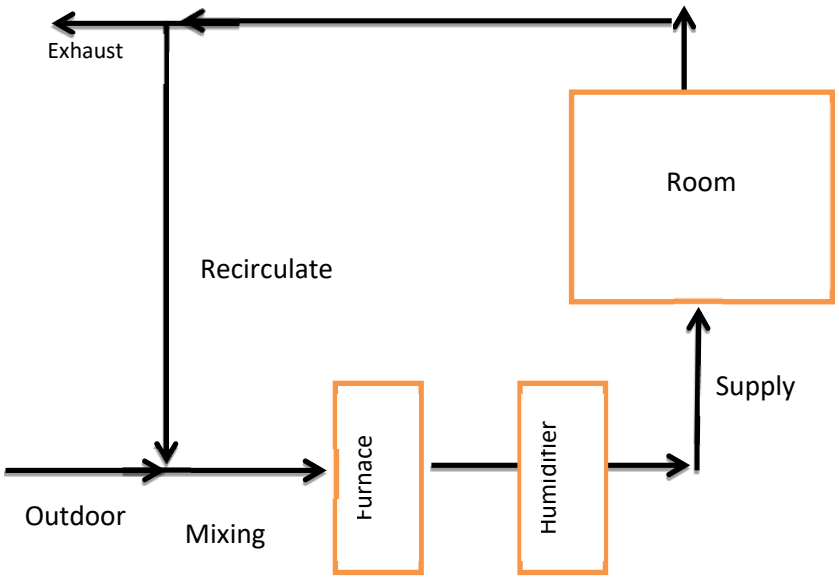
Temperature rise in furnace = 48-17.5=30.5℃

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

$m_w = 0.020514\ kg_v/s$

$capacity\ of\ furance = m\ cp\ \Delta T = 1.90476 * 1.005(30.5) = 58.4kW$





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.

Dr. Banipal N. Yaqob

12/9/2022