Air-Conditioning & Refrigeration

BSc

Lecture 1

Course weekly Outline &

Ch.1 (Introduction to Air conditioning & Refrigeration)

Tikrit university\ engineering college\ mechanical dept.

Flow up of Implementation celli pass play

<table>
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<tr><td>Title</td><td colspan="5">Air-Conditioning & Refrigeration</td></tr>
<tr><td>Course Coordinator</td><td colspan="5"></td></tr>
<tr><td>Course Objective</td><td colspan="5">To Understand the basic concepts of Air-Conditioning and recognize the various types of Air-Conditioning problems encountered in practice.</td></tr>
<tr><td>Course Description</td><td colspan="5">Theoretical and experimental cores</td></tr>
<tr><td>Textbook</td><td colspan="5">(Air-Conditioning and Refrigeration, By Jones, First edition, McGraw-Hill, 1983)</td></tr>
<tr><td>References</td><td colspan="5">(Refrigeration and Air-Conditioning, By Stoecher, First edition, McGraw-Hill, 2006)</td></tr>
<tr><td rowspan="2">Course Assessment</td><td>Term Tests</td><td>Laboratory</td><td>Quizzes</td><td>Project</td><td>Final Exam</td></tr>
<tr><td>As (30%)</td><td>As (15%)</td><td>As 5%)</td><td>----</td><td>As (50%)</td></tr>
<tr><td>General Notes</td><td colspan="5">The students can be able to Model engineering problems and solve them in a systematic manner</td></tr>
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Course weekly Outline

week	Date	Topics Covered	Lab. Experiment Assignments	Notes
1	6/12/2020	Introduction to Air Conditioning		
2	13/12/2020	Calculation of relative humidity		
3	20/12/2020	Air Conditioning processes		
4	27/12/2020	humidification and dehumidification.		
5	3/1/2021	Air mixing and air supply condition		
6	19/1/2021	Overall heat transfer Coefficient calculation and wall surface temperature calculation		
7	16/1/2021	Comfortable condition		
8	23/1/2021	Design temperature and inside room temperature		
9	30/1/2021	Heating load Calculation		
10	6/2/2021	Heat loss through building structure, Infiltration and space heating		
11	13/2/2021	Cooling load Calculation, heat sources		
12	20/2/2021	Heat Gain from solar		
13	27/2/2021	Ventilation air and other sources		
14	5/3/2021	Fluid flow through ducts, duct design		
15	12/3/2021	Air distribution		
End Course Exam				
Half year Break				

Course weekly Outline

week	Date	Topics Covered	Lab. Experiment Assignments	Notes
16	11/4/2021	Duct design by Pressure drop method		
17	18/4/2021	Duct design by pressure drop and regain method		
18	25/4/2021	Duct design by velocity method		
19	2/5/2021	Fans performance		
20	9/5/2021	Fan system characteristics curves		
21	16/5/2021	Fan similarity laws		
22	23/5/2021	Friction losses in pipes		
23	30/5/2021	Pipe design		
24	6/6/2021	Pumps performance		
25	13/6/2021	Refrigeration cycle		
26	20/6/2021	heat pump cycle		
27	27/6/2021	Refrigerant systems		
28	3/7/2021	Refrigerant equipment's		
29	10/7/2021	Thermally activated absorption technology		
30	17/7/2021	Absorption cycle		
End Course Exam				

2.1- Introduction to Air Conditioning & Refrigeration

2.1.1 MOIST AIR (Psychrometry):

Psychrometry is the science of studying the thermodynamic properties of moist air and the use of these properties to analyze conditions and processes involving moist air, for example.

Air conditioning, Drying processes & Flue gas condensation

Composition of dry Air

Gas	Ratio compared to Dry Air (%)		Molecular Mass - *M* (kg/kmol)	Chemical Symbol	Boiling Point (°C)
	By volume	By weight			
Oxygen	20.95	23.20	32.00	O_2	-196
Nitrogen	78.09	75.47	28.02	N_2	-183
Carbon Dioxide	0.03	0.046	44.01	CO_2	-78.5
Hydrogen	0.00005	~ 0	2.02	H_2	-252.87
Argon	0.933	1.28	39.94	Ar	-186
Neon	0.0018	0.0012	20.18	Ne	-246
Helium	0.0005	0.00007	4.00	He	-269
Krypton	0.0001	0.0003	83.8	Kr	-153.4
Xenon	$9\ 10^{-6}$	0.00004	131.29	Xe	-108.1

2.1.2 The Ideal Gas Law:

$$\therefore p\,V = m\,R\,T \quad \text{......................................} (1)$$

Where

p = absolute pressure (Pa)

V= volume of gas (m^3)

m = mass (kg)

R = individual gas constant (J/kg, K)

T = absolute temperature (K)

This equation (1) can be modified to:

$p = \rho\, R\, T$ …………………...............................….(2)

where the density

$\rho = m / V$……………………....................................(3)

The individual gas constant can be expressed with the universal gas

constant and the molecular weight of the air as:

$R = Ru / M_{gas}$

where

M_{gas} = molecular weight of the gas

Ru = 8314.51 = universal gas constant (J/(kmol.K))

Dry air is more dense than moist air

Gas	Individual Gas Constant - *R*		Molecular Weight (kg/kmol)
		SI Units (J/kg.K)	
Dry Air		286.9	28.97
Water vapor		461	18.02

2.1.3 Pressure in Moist Air - Daltons Law

Daltons Law for moist air can be expressed as:

$$p = p_a + p_s \quad \text{..(4)}$$

where

p = total pressure of air (Pa)

p_a = partial pressure dry air (Pa)

p_s or p_w partial pressure water vapor (Pa)

2.1.4 Saturation pressure

The maximum pressure possible before vapor start to condensate at an actual temperature is called the saturation pressure p_{ws}.

can be expressed as:

p_{ws} = *(e^ (77.3450 + 0.0057 T - 7235 / T))/ T^8.2* ....(5)

where

p_{ws} = *water vapor saturation pressure (Pa)*

e = the constant 2.718.......

T = temperature of the moist air (K)

or using table (page below in document)

Temperature (^oC)	Water Vapor Saturation Pressure (Pa)
0	609.9
5	870
10	1225
15	1701
20	2333
25	3160
30	4234

Example - The Saturation Pressure of Water Vapor

The Saturation pressure of water vapor in moist air at 25°C can be calculated as:

$P_{ws} = (e\wedge (77.3450 + 0.0057 (273.15 + 25) - 7235 / (273.15 + 25)) / (273.15 + 25)\wedge 8.2 = 3160$ Pa ....(6)

Home work

1- Find the Saturation pressure of water vapor in moist air at 30°C from the above equation and compare the it with the result gain from Table 1

2- Find the Saturation pressure of water vapor in moist air at 36°C from the above equation and compare the it with the result gain from Table 1