Mechanical & Energy Engineering Dept.

Erbil Technical Engineering CollegeErbil

Polytechnic University

Subject: Refrigeration & Air-Conditioning Part II

Course Book:

Seventh Semester

Lecturer's name: Asst.Prof.Dr. Ranj Sirwan Abdullah

Mrs.Sally Afram Polus

Academic Year: 2022/2023

Course Book

1. Course name Part one	**Refrigeration**
2. Lecturer in charge	**Dr. Ranj Sirwan Abdullah & Mrs. Sally Afram Polus**
3. Department/ College	**Mechanical and Energy Engineering Department/ Erbil Polytechnic University**
4. Contact	**e-mail: ranj.abdullah@epu.edu.iq** **sallyafram@epu.edu.iq**
5. Time (in hours) per week	**Theory: 2** **Practical: 2**
6. Office hours	**2 hour**
7. Course code	**RAC703**
8. Teacher's academic profile	I was promoted since August 2007 as a lecturer at Erbil Polytechnic University, Erbil Technical Engineering College. Over 16 years in the academic sector, I have good knowledge in the academic field and researches, especially the Refrigeration and Air-Conditioning system, Solar system, and Renewable energy. I published many papers in international journals. Moreover, I attended many conferences and training courses during my study in Malaysia. Also, I worked on the leadership and management of the universities since 2013. Beside his Teaching in Mechanical and Energy Engineering Department, **I am acting as Director of International Office since December 2018**. I am holding Bachelor and Master degree in Mechanical Engineering/ Refrigeration and Air-conditioning Engineering from Baghdad-Technical College, and University of Technology Baghdad 2002 and 2006 respectively. He also holds PhD in Mechanical Engineering from National University of Malaysia since 2013.
9. Keywords	Refrigeration system, compressor, condenser, evaporator, expansion valve, absorption system , cooling system

10. Course overview:

a. Studying the basic principle of refrigeration systems and equipment's.
b. Studying the individual equipment of the refrigeration system such as Compressors, Condensers, Evaporators, and Expansion Valves.
c. Studying the different kind of vapor compression cycles.
d. Identify other refrigeration cycles such as absorption refrigeration

cycle, air refrigeration cycle, steam jet refrigeration cycles, and etc.

e. e. Studying the refrigeration load.

11. Course objective:

Learning about the refrigeration cycles and its components and how it is worked and then calculate the refrigeration load. So, the students able to design the main components of the refrigeration cycle. Finally, the student will be able to work in any field which is related to Refrigeration and Air-Conditioning process. This subject also focused on the Energy Management technology and how it is implemented in the Air-Conditioning system

12. Student's obligation

Student's obligation in this course is:

- Attendance in the all lectures according to the regulations of the department
- One or more quizzes in each course.
- One or more homework (assignments)

A final exam in the end of first and second course.

13. Forms of teaching

- ✓ Using data show, white board and PowerPoint, Testing in department's Laboratory.
- ✓ Publish all lecture notes in college website

Task		Weight(Marks)	Due Week
Paper Review			
Assignments	Homework	5%	3-8
	Class Activity	2%	1-12
	Report	5%	7-8
	Seminar	5%	8
	Essay		
	Project		
Quiz		8%	4 & 7
Lab.		10%	
Midterm Exam		25%	6
Final Exam		40%	12
Total		100%	

15. Student learning outcome:

The course will give the fundamental knowledge and practical abilities in the following:

- Identify the refrigeration cycles and components
- Design the main part of the refrigeration cycles
- Ability to calculate the refrigeration load for specific application
- Ability of understanding the energy management regarding the refrigeration system

16. Course Reading List and References:

17. The Topics:
18. Practical Topics (If there is any)

19. Examinations:

Q/ A refrigeration system operates by R-22. The system designed as compound system (two compressors and two evaporators). The evaporators provide cooling capacity of 10 & 20 TR at temperature -10 ℃ and 10 ℃ respectively. Both evaporators are operated by individual compressor. The condenser temperature is 35 ℃. Draw the schematic diagram and the Ph diagram then calculate the total power required by the compressors and the Coefficient of Performance of the system.

Q/ Draw the schematic diagram for two stage vapor compression refrigeration system. The system Consist of intercooling flash tank with two evaporators and two compressors.

Q/ Shell and tube condenser is designed to work on R-22 refrigerant. The condenser provides a capacity of 101.6 kW for air conditioning purpose. The evaporating temperature is 5 °C and the condensing temperature is 45 °C at design condition. The system provided with cooling tower which is work in a range of 30 °C and 35 °C. A two-pass condenser with 42 tubes are arranged. The tubes are made of copper and have 14 mm ID and 16 mm OD. Assume temperature difference between vapor and tube to be 5 °C.

Calculate the length of the tube ?

Note: The specific volume and the latent heat of vaporization for R-22 at 45 °C is given

ν_f = 0.90203 L/kg

h_{fg} = 160.9 kJ/kg

While the conductivity k and viscosity μ for liquid R-22 are given

K = 0.0779 W/m.k

μ = 0.000180 Pa. s

N= 3.23 (average number of the tube in vertical row)

Fouling factor = 0.000176 m^2.k/W

Water side properties:

ρ = 995 kg/m^3, μ = 0.000773 Pa. s, C_p = 4190 J/kg. K, *k* = 0.617 W/m.K

k for copper = 390 W/m. K

20. Extra notes:

Course Book

1. Course name	**Air-Conditioning II**
2. Lecturer in charge	**Asst. Prof. Dr. Ranj Sirwan Abdullah,** **MSc. Eng. Sally Afram polus**
3. Department/ College	**Mechanical & Energy Engineering Techniques**
4. Contact	**e-mail:** ranj.abdullah@epu.edu.iq , sallyafram@epu.edu.iq
5. Time (in hours) per week	**Theory: 2** **Practical: 2**
6. Office hours	**One hour**
7. Course code	**RAC703**
8. Teacher's academic profile	Ranj Sirwan is nominated since August 2007 as lecturer at Erbil Polytechnic University, Erbil Technical Engineering College. Over 10 years in academic sector, Ranj Sirwan has a good knowledge in academic field and researches, especially the Refrigeration and Air-Conditioning system, Solar system and Renewable energy. He published many papers in international journals. Moreover, he attended many conferences and training courses during his study in Malaysia. Also, He worked on the leadership and management of the universities since 2013. Ranj Sirwan holding Bachelor and Master degree in Mechanical Engineering/ Refrigeration and Air-conditioning Engineering from Baghdad-Technical College, and University of Technology Baghdad 2002 and 2006 respectively. He also holds PhD in Mechanical Engineering from National University of Malaysia since 2013. Beside his Teaching in Mechanical and Energy Engineering Department, Ranj Sirwan acting as **Director of International office at Erbil Polytechnic University**. He is Responsible for preparation, presentation, review, and examinations of lectures delivered to undergraduates and postgraduate students through selected courses. In addition to provision of feedback to students on regular basis. Preparation of time tables by working with other professionals and teachers. Leading a team of teachers to design new projects in the department (scientific Committee and Quality assurance committee). While, at the meantime he is acting as a Director of International office at EPU
9. Keywords	Air-Condition design, All air system, Duct design, Pipe design, heat recovery, ventilation, fresh air

10. Course overview:

a. Studying the basic principle of Air Condition system design
b. Studying the individual equipment's which are used in Air- Condition system design

c. Studying the different kind of Central Air Conditioning System
d. Identify the up to date equipment's which are used in saving energy
e. Reviewing the Cooling Load Calculations

11. Course objective:

Learning about the air conditioning system and its components and how it is worked and then calculate the cooling load. So the students able to design the central cooling and heating system using Ducting and piping system. Finally, the student will be able to work in any field which is related to air-Conditioning system design.

12. Student's obligation

Student's obligation In this course is:

- Attendance in the all lectures according to the regulations of the department
- One or more quizzes in each course.
- One or more homework (assignments)
- A final exam in the end of first and second course.

13. Forms of teaching

- Using data show, white board and PowerPoint, Testing in department's Laboratory.
- Publish all lecture notes in college website.

15. Student learning outcome:

The course will give the fundamental knowledge and practical abilities in the following:

1. Identify the Air-Conditioning System and its components
2. Design the main part of the Air-Conditioning System
3. Ability to calculate the cooling and heating load for specific application
4. Ability to study the energy management of the air-conditioning system

16. Course Reading List and References:

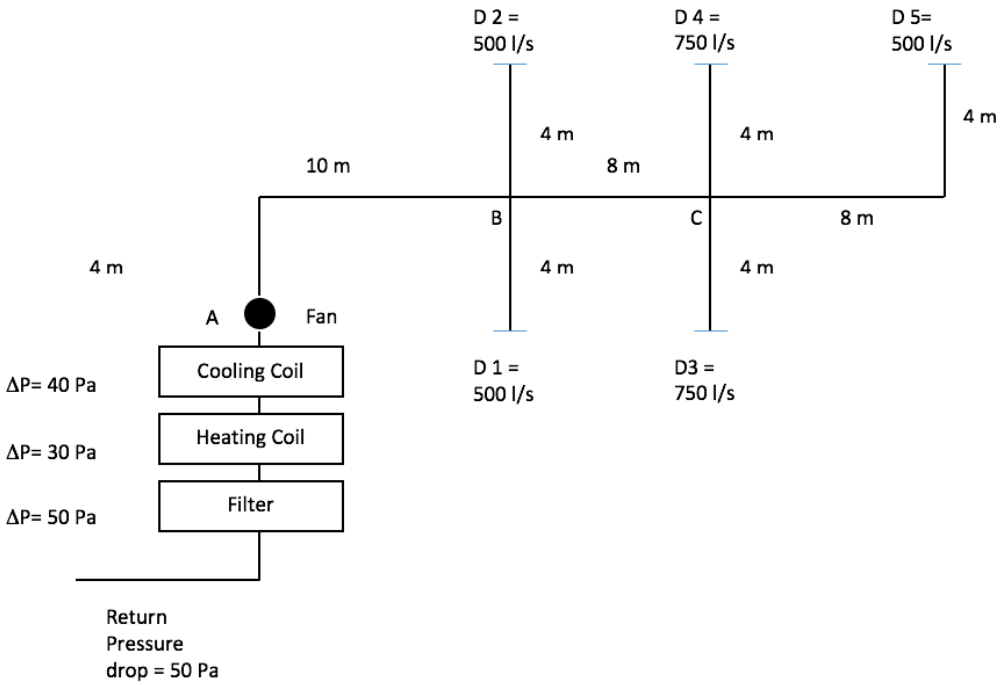
- A course in Refrigeration and Air-Conditioning by S.C ARORA & S. DOMKUNDWAR
- Refrigeration and Air-Conditioning by C P Arora
- ASHRAE Handbook

17. The Topics: Theory	
Weeks No.	**Syllabuss**
1	Psychrometric Process
2	Sensible Heating and Cooling of Air
3	Psychrometric Systems (Single Zone & Multi
4	Zone)
5	Ventilation and Infiltration Process
6	Duct Design
7	Velocity Method
9	Equal Pressure Drop Method
10	Static Region Method
11	Fan Power Calculations
12	Grills and Diffusers Selections
13	Noise and Noise Control
14	Air Conditioning Systems Classifications
15	Pipe Systems
16	Pipe System Design
17	Pump Selections
18	Pipe Length Calculations
19	Piping Layout
20	Heat Recovery Systems
21	Heat Pump System
18. Practical Topics	

19. Examinations:

Q / Figure below shows the schematic diagram for Central Air Conditioning system. Calculate the d design (rectangular duct system) using velocity method. Then select suitable diffuser for each room according to the following criteria, throw doesn't exceed 5 meter and the noise level up to 20 NC. T calculate the fan power by kW. Assume the velocity to be 10 m/s and 5 m/s for the main and branc

Giving:
1- Aspect ratio doesn't exceed 5
2- Fan efficiency 70%
3- Hight of the duct 30 cm
4- R/W 1.5

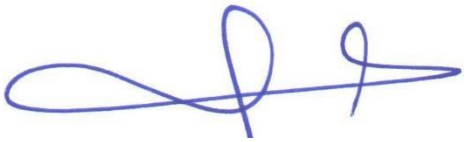


Q/ What are the advantages of the All Air System?

21. Extra notes:

22. Peer review

I hereby confirm that I have reviewed the content of the course book and found it to be sufficient and covers the learning outcomes of this course.



Assist. Prof. Dr. Ahmed Mohammed Adham
13/10/2022