**COURSE NUMBER & COURSE TITLE: ME 300 Refrigeration Theory and Equipments**

| **INSTRUCTOR:** | **Credits: 3** | **Language of instruction:** Chinese / English |
|---|---|---|
| **REQUIRED COURSE OR ELECTIVE COURSE:**<br>Required | | **TERMS OFFERED:**<br>Spring semester |
| **COURSE STRUCTURE/SCHEDULE:**<br>1. Lecture-2 days per week at 4 credits hours | | **PRE-REQUISITES:**<br>ME 300 Thermodynamics I<br>ME 300 Heat Transfer |
| **ASSESSMENT TOOLS:**<br>1. Project & discussions—30%<br>2. One comprehensive final exam—70% | | **PROFESSIONAL COMPONENT:**<br>1. Engineering Topics:<br>Engineering Science-2credits<br>Engineering Design and experiments-1credit |

**TEXTBOOK/READING LIST**

Textbook:

Ruzhu Wang, Refrigeration Theory and Technology, Beijing: China Science Press, 2005. (in Chinese)

Reference:

1. Zhiyou Zhang. Refrigeration Theory and Equipment. Beijing: China Machine Press, 1987. (in Chinese)
2. Yezheng Wu. Refrigeration Theory and Equipment. Xi'an: Xi'an Jiao Tong University Press, 1997. (in Chinese)
3. Modern Refrigeration and Air Conditioning, Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano. Qisen Yan (Interpreter). Shanghai: Shanghai Jiao Tong University, 2001. (in Chinese)
4. JARN, Japan Air Conditioning, Heating and Refrigeration News, www.jarn.co.jp.
5. Journal <Refrigeration Technology>, Shanghai Society of Refrigeration. (In Chinese)

**COURSE DESCRIPTION:** History of refrigeration, vapor compression cycle, refrigeration methods, thermodynamic calculation of simple refrigeration cycle, properties of refrigerants, equipments and components in refrigeration systems.

**COURSE OUTCOMES** [Related ME Program Outcomes in brackets]

1. Provide a thorough understanding of refrigeration methods and application characteristics. [A1]
2. Introduce and understand the process of refrigeration and analysis method of thermodynamic cycles, know the main approaches and basic principles of improving energy utilization efficiency. [A2,A3]
3. Understand and apply the common refrigerant properties equations, table and diagrams (logP-h diagram) and software to calculate the basic refrigeration thermodynamic cycle.[A2,A3]
4. Know the common refrigeration devices and equipments and operation theories and establish the general ability to solve the practical refrigeration problems. [A3]
5. Strengthen the practices and excise in real problems. [A6]

**RELATED ME PROGRAM OUTCOMES:**

A2. Engineering fundamentals

A3. Analytical skills

**PREPARED BY:** Zhaogang Qi **REVISION DATE:** Feb. 18, 2013

# ME 300 Refrigeration Theory and Equipments

## Course Syllabus

**Lectures: Spring Semester, 3 Credits/51 Credit Hours**

**COURSE INSTRUCTORS**

| | |
|---|---|
| Name: | Name: |
| Office: | Office: |
| Email: | Email: |

**COURSE DESCRIPTION**

This course will cover the basics of refrigeration theory and equipments. Specific topics will include refrigeration methods, thermodynamics cycles of refrigeration, analysis and process of refrigeration cycles, properties of refrigerants and basic devices and components in refrigeration systems. This is also a project-based course where students will work in teams to solve or complete a real practical project. The project topic will be appointed during course.

**TEXTBOOK**

Ruzhu Wang, Refrigeration Theory and Technology, Beijing: Science Press, 2005. (In Chinese)

**READING RERENCE**

1. Zhiyou Zhang. Refrigeration Theory and Equipment. Beijing: China Machine Press, 1987. (In Chinese)

2. Yezheng Wu. Refrigeration Theory and Equipment. Xi'an: Xi'an Jiao Tong University Press, 1997. (In Chinese)

3. Modern Refrigeration and Air Conditioning, Andrew D. Althouse, Carl H. Turnquist, Alfred F. Bracciano. Qisen Yan (Interpreter). Shanghai: Shanghai Jiao Tong University, 2001. (In Chinese)

4. JARN, Japan Air Conditioning, Heating and Refrigeration News, www.jarn.co.jp.

5. Journal: <Refrigeration Technology>, Shanghai Society of Refrigeration.

**COURSE PRE-REQUISITES**

ME 300 Thermodynamics I and ME 300Heat Transfer are the pre-requisties for this course. You are expected to have (i) a basic overview of thermodynamic cycle, such compression, expansion, (ii) basic knowledge in thermodynamic properties, and (iii) fundamental knowledge of heat transfer process between different heat sources.

## COURSE LEARNING OBJECTIVES

This course is a basic major course for refrigeration engineering, cryogenics engineering, air conditioning, heat, ventilation and equipment engineering and environmental engineering student. This course will cover the basics of refrigeration theory and equipments. Specific topics will include refrigeration methods, thermodynamics cycles of refrigeration, analysis and process of refrigeration cycles, properties of refrigerants and basic devices and components in refrigeration systems.

The goal of this course is to provide each student an understanding of (a) basic principles of refrigeration cycles, (b) analysis of refrigeration thermodynamic cycles, (c) refrigerants and other working fluids, and (c) refrigeration devices and components in refrigeration systems and relate engineering knowledge to real-world engineering problems. At the end of this course, students should be able to do the following in either a team setting or individually:

1. Provide a thorough understanding of refrigeration methods and application characteristics. [A1]
2. Introduce and understand the process of refrigeration and analysis method of thermodynamic cycles, know the main approaches and basic principles of improving energy utilization efficiency. [A2, A3]
3. Understand and apply the common refrigerant properties equations, table and diagrams (logP-h diagram) and software to calculate the basic refrigeration thermodynamic cycle.[A2,A3]
4. Know the common refrigeration devices and equipments and operation theories and establish the general ability to solve the practical refrigeration problems. [A3]
5. Strengthen the practices and excise in real problems. [A6]

## GRADING FORMAT AND POLICY

The grade break-down for the course is as follows:

1, Project and in-class Discussions, 30%;

2, Final Exam (one piece of paper open), 70%.

Grading Rules:

1, Projects are team-oriented. Peer-evaluations will be considered in determining project grades for individual team members, and will be administered three times during the course of the semester.

2, Student is encouraged to discuss their grades with the instructor as frequently as needed. The student is always given the benefit of the doubt in all grade discussions and every effort will be made to find ways to help a student improve his/her grade throughout the semester.

## DESIGN PROJEXTS

Example: Small-scaled dehumidifier/Water heater (The project topic will be appointed in the first lecture and changed in different semester) as the following steps:

1，Literature review and survey;
2， Conceptual design;
3，Manufacturing;
4，Performance test;
5，Final report and defense;

## TEAM-WORK

Success in the project depends heavily on teamwork. Students will be assigned to groups of four that will work together the entire semester. It is expected that the students within a team will work together on in-class discussions, activities and projects. It is not unusual for teat's to experience some conflict during the semester. What is important is that the teams deal with this in a positive and constructive manner. Teams having problems working together should make every effort to resolve them by themselves. The course instructors and GSIs will be available to help and facilitate smooth team operation, but the end responsibility lies with the team.

## COURSE ROAD-MAP AND SCHEDULE

| Week# | Lecture# | Lecture Topic | Lecturer | Reference | Homework | Lab/Recitation Topics |
|---|---|---|---|---|---|---|
| 1 | 1 | Course start: course overview, introduction of this course, project topic assignment | | Lecture notes and textbook | | |
| | 2 | Basic applications of refrigeration, history of refrigeration | | Lecture notes and textbook | | |
| 2 | 3 | Carnot cycle and theoretical refrigeration cycles | | Lecture notes and textbook | | |
| | 4 | Refrigeration cycle, Analysis in LogP-h and T-s Diagram | | Lecture notes and textbook | | |
| 3 | 5 | Real refrigeration cycle and calculation, two-stage and cascade refrigeration systems | | Lecture notes and textbook | | |
| | 6 | Project Review #1 | | | | |
| 4 | 7 | Refrigerants and properties | | Lecture notes and textbook | | |
| | 8 | Refrigerants and properties | | Lecture notes and textbook | | |
| 5 | 9 | Coolant and lubricants in refrigeration system | | Lecture notes and textbook | | |
| | 10 | Refrigeration devices: Compressors | | Lecture notes and textbook | | |
| 6 | 11 | Refrigeration devices: Expansion devices | | Lecture notes and textbook | | |
| | 12 | Refrigeration devices: Evaporators | | Lecture notes and textbook | | |
| 7 | 13 | Refrigeration devices: Condensers | | Lecture notes and textbook | | |
| | 14 | Project Review #2 | | | | |
| 8 | 15 | Refrigeration devices: Auxiliary components | | Lecture notes and textbook | | |

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| | 16 | Refrigeration systems: Refrigerator | | Lecture notes and textbook | | |
| 9 | 17 | Refrigeration systems: Residential air conditioner and heat pump | | Lecture notes and textbook | | |
| | 18 | Refrigeration systems: Mobile air conditioning system | | Lecture notes and textbook | | |
| 10 | 19 | Refrigeration systems: Chiller | | Lecture notes and textbook | | |
| | 20 | Adsorption and Absorption refrigeration systems | | Lecture notes and textbook | | |
| 11 | 21 | Refrigeration devices: Auxiliary components | | Lecture notes and textbook | | |
| | 22 | Project Review #3 | | | | |
| 12 | 23 | Course Review | | | | |
| | 24 | Final Exam | | | | |