



**MERCER**  
COUNTY COMMUNITY COLLEGE

## COURSE OUTLINE

Course Number	Course Title	Credits
HRA 205	Heavy Commercial Systems	4
Hours: Lecture/Lab/Other	Pre-requisite	Implementation Semester & Year
3 Lecture/3 Lab	HRA 104	Spring 2022

**Catalog description:**

Operation, maintenance, diagnosis, and repair of heavy commercial systems including electrical controls, mechanical components, and electrical circuitry.

**General Education Category:**

Not GenEd

**Course coordinator:**

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**Required texts & Other materials:**

Refrigeration & Air Conditioning Technology by Whitman, Johnson, Tomczyk, 5<sup>th</sup> Edition, Thompson Learning ISBN: 1-4018-3765-4.

**Course Student Learning Outcomes (SLO):**

***Upon successful completion of this course the student will be able to:***

1. Describe and explain the operation of gas-fired and oil-fired burners used in furnaces of roof top HVAC equipment. [ILG # 3, 10; PLO # 2, 6, 8, 10]
2. Read electrical symbols and ladder diagrams. [ILG # 3, 10; PLO # 2, 4, 8]
3. Discuss electric motors used for refrigeration and air conditioning systems. [ILG # 1, 3, 4, 10; PLO # 2, 6, 8]
4. Identify and explain different types of refrigeration pressure regulating valves. [ILG # 1, 3, 4, 10, 11; PLO # 2, 4, 6, 8, 10]
5. Inspect, troubleshoot and repair multistage compressors. [ILG # 3, 4, 10, 11; PLO # 2, 3, 8]
6. Perform heat load calculations on systems to determine or verify proper component sizing. [ILG # 2, 3, 4, 10, 11; PLO # 2, 5, 8, 9, 10]
7. Demonstrate good piping practices. [ILG # 2, 3, 10, 11; PLO # 2, 8]
8. Determine proper specifications and parameters of operation for system condensers. [ILG # 2, 3, 4, 10, 11; PLO # 2, 5, 8, 9, 10]
9. Identify various hot gas defrost methods and their best application. [ILG # 3, 4; PLO # 2, 8, 10]

## **Course-specific Institutional Learning Goals (ILG):**

**Institutional Learning Goal 1. Written and Oral Communication in English.** Students will communicate effectively in both speech and writing.

**Institutional Learning Goal 2. Mathematics.** Students will use appropriate mathematical and statistical concepts and operations to interpret data and to solve problems.

**Institutional Learning Goal 3. Science.** Students will use the scientific method of inquiry, through the acquisition of scientific knowledge.

**Institutional Learning Goal 4. Technology.** Students will use computer systems or other appropriate forms of technology to achieve educational and personal goals.

**Institutional Learning Goal 10. Information Literacy:** Students will recognize when information is needed and have the knowledge and skills to locate, evaluate, and effectively use information for college level work.

**Institutional Learning Goal 11. Critical Thinking:** Students will use critical thinking skills understand, analyze, or apply information or solve problems.

## **Program Learning Outcomes for Heating, Refrigeration and Air Conditioning (PLO)**

2. Service, troubleshoot, and repair domestic and commercial refrigeration and air conditioning systems and components.
3. Use electrical and mechanical test equipment and metering devices.
4. Utilize a working knowledge of control circuitry, instrumentation and ladder diagram/schematic interpretation.
5. Determine heating and air conditioning size requirements for a building of specific volume, orientation on lot, and geographic location.
6. Communicate effectively by oral, written, or graphic means.
8. Understand the laws of physics as they apply to the subject field.
9. Perform computations necessary to solve basic load sizing problems.
10. Apply the fundamental laws of thermodynamics and the basic principles of heat flow as they apply to HRAC.

## **Units of study in detail – Unit Student Learning Outcomes:**

### **Unit I      Rooftop HVAC Equipment [Supports Course SLO # 1]**

#### **Learning Objectives**

##### ***The student will be able to:***

1. Describe and explain the operation of gas-fired and oil-fired burners used in furnaces of roof top HVAC equipment.
2. Become familiar with pilot burners and fuel ignition systems.
3. Design a fuel-piping layout and select the proper fuel pipe sizes for gas and oil-fired systems.

### **Unit II      Reading Electrical Symbols and Ladder Diagrams [Supports Course SLO # 2]**

#### **Learning Objectives**

##### ***The student will be able to:***

1. Explain the meaning of common symbols used in ladder diagrams of today's major HVAC manufacturers.
2. Read and understand the logic of ladder diagrams and schematics.
3. Use ladder diagrams as a means to analyze mechanical and electrical problems in a malfunctioning system.

**Unit III**      **Electric Motors for Refrigeration and Air Conditioning Systems** [Supports Course SLO # 3]

**Learning Objectives**

***The student will be able to:***

1. Identify common types of motors and their various unique characteristics and uses.
2. Select the proper horsepower and speed required for individual applications.
3. Know how to test and troubleshoot motor starting and running problems.
4. Become familiar with motor protection devices and how to identify problems with these devices.
5. Identify various electrical service power supplies for residential and commercial buildings and become aware of their voltage and ampacity.

**Unit IV**      **Refrigeration Pressure Regulating Valves I Electronic Pressure Regulating Valves** [Supports Course SLO # 4]

**Learning Objectives**

***The student will be able to:***

1. Identify and describe the selection, installation and adjustment of suction pressure regulating valves.
2. Know how to select, install and adjust valves that are designed to control the discharge pressure of refrigeration system.
3. Understand the function of a valve that reduces compressor capacity and thereby reduces system capacity.
4. To identify and understand the operation and adjustment of compressor unloaders.
5. Identify and understand step motor valves.

**Unit V**      **Multistage Compressors** [Supports Course SLO # 5]

**Learning Objectives**

***The student will be able to:***

1. Identify the causes of compressor overheating and make repairs or changes to a refrigeration system to reduce compressor failures caused by overheating.
2. Understand the principles for two and three stage compressors and how and why to use these for low temperature applications.
3. Become familiar with liquid sub-cooling and recognize the benefits of additional efficiency that it provides.
4. Identify and describe the operation of a cascade refrigeration system.

**Unit VI**      **Refrigeration Heat Load Calculation** [Supports Course SLO # 6]

**Learning Objectives**

***The student will be able to:***

1. Do refrigeration heat load calculations and subsequent sizing and selection of compressors, condensers, evaporators, and expansion valves.
2. Use a heat load calculation as a means to verify the required sizing and the possible overloading of an existing refrigeration system.

**Unit VII**      **Good Piping Practice** [Supports Course SLO # 7]

**Learning Objectives**

***The student will be able to:***

1. Recognize a properly piped refrigeration system and be able to describe the necessity for good piping and the resulting return of oil to the compressor.
2. Become familiar with pipe sizing tables and charts in order to do a piping and sizing layout for the earlier heat load calculations.

**Unit VIII**      **Air- and Water-Cooled Condensers** [Supports Course SLO # 8]

**Learning Objectives**

***The student will be able to:***

1. Describe normal operating conditions and pressures.
2. Select the proper size condenser for a given application.
3. Make necessary corrections and adjustments to achieve efficient operation.
4. Become familiar with water-cooling tower operation and maintenance.

**Unit IX**      **Hot Gas Defrost Systems** [Supports Course SLO # 9]

**Learning Objectives**

***The student will be able to:***

1. Identify various hot gas defrost methods and describe where each is used to its best advantage.

**Unit X**      **Class Trip** [Supports Course SLO # 1 - 9]

**Learning Objectives**

***The student will be able to:***

1. Survey commercial RHWAC equipment not available on the MCTS campus.
2. Apply classroom training and experience on functioning refrigeration equipment.

**Evaluation of student learning:** [Evaluates SLOs # 1 - 9]

Students' achievement of the course objectives will be evaluated through the use of the following:

- Results of a comprehensive final exam.
- Test and quiz results (a minimum of two tests, other than the final examination).
- Attendance.

<b>Evaluation Tools</b>	<b>Percentage Of Grade</b>
Quizzes, Tests and Exam	50%
Attendance	50%
<b>Total</b>	<b>100%</b>