COURSE OUTLINE

Course Number	Course Title	Credits
HRA 103	**Refrigeration / Air Conditioning Electrical Controls**	**4**

Hours: Lecture/Lab/Other	Pre-requisite	Implementation Semester & Year
2 Lecture/4 Lab	**EET 130**	**Spring 2022**

Catalog description:
Examines types and application of various electromechanical devices such as motors, contractors, overload devices, thermostats, controls, and relays as well as various types of test and metering equipment.

General Education Category:
Not GenEd

Course coordinator:
Harry Bittner, 609-570-3751, bittnerh@mccc.edu

Required texts & Other materials:
Refrigeration & Air Conditioning Technology by Whitman, Johnson, Tomczyk, 5th 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 the fundamental principles of electrical motors and controls used in air conditioning and refrigeration units and systems. [ILG # 1, 3, 10; PLO # 6, 8]
2. Safely perform the electrical tasks that are basic to a career in air conditioning and refrigeration. These tasks include the installation, problem detection, repair, replacement and/or adjustment of electrical related components and interconnecting circuitry. [ILG # 10, 11; PLO # 2, 3, 4]
3. Describe the function of individual electro-mechanical components and explain how they interrelate when integrated into a refrigeration or air conditioning system. [ILG # 1, 3, 10; PLO # 6, 8]

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 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.
6. Communicate effectively by oral, written, or graphic means.
8. Understand the laws of physics as they apply to the subject field.

Units of study in detail – Unit Student Learning Outcomes:

Unit I **Basic Electricity, Electric Circuits and Power Distribution** [Supports Course SLO # 1, 2]

Learning Objectives
The student will be able to:

1. Identify the basic concepts of electrical theory
2. Describe the basic concepts of voltage, current and resistance and how they interrelate in both basic and complex circuits.
3. Explain the principles of single-phase voltage and give the advantages and limitations of same.
4. Explain the principles of three-phase voltage and give the advantages and limitation of same.
5. Describe and construct the wiring configuration of a typical three phase circuit.
6. Draw diagrams reflecting different single and three phase wiring procedures which will result in various voltage ratings.
7. Use various meters to determine the electrical condition of a circuit.

Unit II **Basic Electrical Motors and Components** [Supports Course SLOs # 1, 2, 3]

Learning Objectives
The student will be able to:

1. Describe the basic concepts of electric motors.
2. Explain the principles of single-phase motors and give the advantages and limitations of same.
3. Explain the principles of three-phrase motor and give the advantages and limitations of same.
4. Draw diagrams reflecting different single and three-phase motors.
5. Use various meters to test motor winding resistances to determine the electrical condition of the windings.

Unit III **Power Circuits** [Supports Course SLOs # 1, 2]

Learning Objectives
The student will be able to:

1. Explain the basic construction of power circuit control components.
2. Explain the principles of operations of individual power circuit control components.
3. Describe the individual function performed by the given power circuit control components.
4. Identify how primary control components are integrated into the electrical circuits of air conditioning and refrigeration systems and describe how each interacts within the circuit.

Unit IV **Primary Controls** [Supports Course SLOs # 1, 3]

Learning Objectives
The student will be able to:

1. Describe the basic construction and configuration of primary control components.
2. Explain the principles of operations of individual primary control components.
3. Identify the individual function performed by primary control components.
4. Explain how primary control components are integrated into the electrical circuits of air conditioning and refrigeration systems and describe how each interacts within the circuit.

Unit V **Secondary Controls** [Supports Course SLOs # 1, 3]

Learning Objectives
The student will be able to:

1. Explain the basic construction of secondary control components.
2. Explain the principles of operations of individual secondary control components.
3. Describe the individual function performed by secondary control components.
4. Explain how secondary control components are integrated into the electrical circuits of air conditioning and refrigeration systems and describe how each interacts within the circuit.

Evaluation of student learning: [Evaluates SLOs # 1, 2, 3]

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

- Results of a comprehensive final exam.
- Test results (a minimum of two tests, other than the final examination).
- Quiz results.
- Laboratory Performance
  - A laboratory evaluation of each student's ability to perform basic tubing, fitting and tool identifications, and basic swaging, faring, soldering and brazing procedures will be performed.
  - A performance evaluation of leak detection procedures will be conducted utilizing various methods and fluid system components.
- Attendance.

Evaluation Tools	Percentage Of Grade
Quizzes, Unit Tests and Exam	25%
Laboratory Performance	25%
Attendance	50%
Total	100%