

## Signature Page


The College and CTC will agree not to discriminate in their educational programs, activities or employment practices based on race, color, national origin, sex, sexual orientation, disability, age, religion, ancestry, union membership or any other legally protected classification.

Announcement of this policy is in accordance with state law, including the Pennsylvania Human Relations Act, and with federal law, including Titles VI and VII of the Civil Rights Act of 1964, Title IX of the Educational Amendments of 1972, Section 503 and 504 of the Rehabilitation Act of 1973, the Age Discrimination Act of 1975, and the Americans with Disabilities Act of 1990. Inquiries should be directed to the Affirmative Action Officer (presently Sylvia Detar) at 724-925-4190 or in Room 4100D, Westmoreland Business & Industry Center, Youngwood, PA 15697.

### For the CTC:

 03/24/21  
\_\_\_\_\_  
Director Date

### For the College:

 3/25/21  
\_\_\_\_\_  
Kristy A. Bishop, Ph.D. Date  
Vice-President of Academic Affairs

**Appendix I**  
Articulated Courses

Guide for Local Articulation

Curriculum Guide for the articulation of HVAC Technology college coursework and credit  
between WCCC and ICTC

WCCC

HAC 290 EPA Refrigerant Exam Prep.

HAC 101 Heating and Cooling Fundamentals

HAC 170 H, AC and R Control Systems

ICTC

CIP 47.0201

## COURSE OUTLINE

### Course Information

- A. Course Title: **EPA Refrigerant Exam Preparation**
- B. Course Number: **HAC 290**
- C. Lecture, Lab and Credit Breakdown: **3-0-3**
- D. Course Prerequisite(s): **None**
- E. Course Co-requisite(s): **None**

### Catalog Description

This course is designed to prepare HVAC students to take and pass the EPA Refrigerant Certification Examination. Students will learn and demonstrate proper refrigerant handling techniques that include recovery, recycling and storage. Students will use refrigeration gauges, vacuum pumps, recovery machines and recovery cylinders to properly charge and recover refrigerants. EPA regulations, refrigerant chemistry, refrigerant lubricants, transportation and disposal are presented in this course

### Learning Objectives

The purpose of this course is to:

- To prepare the student to pass the Mainstream EPA Refrigerant Certification Exam.
- To develop skills in refrigeration containment and recovery.
- To develop safety skills needed in refrigeration handling.
- To demonstrate awareness of refrigerant toxicity and first aid procedures.
- To evaluate recovery and recycling equipment features and their performance.
- To develop skills in leak detection and repair.
- To demonstrate an understanding of proper labeling and transportation requirements for used refrigerants.
- To use proper refrigerants and lubricants for various applications.

### Course Outcomes

Upon successfully completing this course, students will be able to:

- Draw a diagram of the refrigeration cycle.
- Name and explain the operation of the following compressors: reciprocating, scroll, screw, rotary, centrifugal.
- Identify and explain the function of the metering devices.
- Explain the causes of high and low superheat and subcooling and what can result from it.
- Discuss charging and removal of refrigerant.
- Discuss changing vacuum pump oil in a vacuum pump.
- Identify various oil types and the refrigerants they are used with.
- Discuss use of pressure temperature charts.
- Define a zeotrope, azeotrope, near-azeotrope and pure compounds.
- Explain the procedures for handling the byproducts of refrigerant recycling.

## Topical Course Outline

1. Refrigerant Chemistry
2. Refrigeration Lubricants
3. Alternative Refrigerants
4. Environmental Effects of Refrigerants
5. Clean Air Act, Section 608
6. Recovery, Recycle, and Reclaim
7. Transportation and Handling
8. Leak Detection
9. Proper Fabrication Techniques
10. Industry Standards for Mechanical Rooms
11. Low Pressure Chillers

## References, Resources, and Learning Materials Text:

Instructor Handouts

Reviewed and Approved by:

---

Division Dean

Date



## COURSE OUTLINE

### Course Information

- A. Course Title: **Introduction to Refrigeration/ Air Conditioning**
- B. Course Number: **HAC 101**
- C. Lecture, Lab and Credit Breakdown: **2-4-4**
- D. Course Prerequisite(s): **None**
- E. Course Co-requisite(s): **None**

### Catalog Description

This course is designed to introduce students to refrigeration and air-conditioning systems. Individual components and controls found in refrigeration and air-conditioning are evaluated and tested in the classroom and the HVAC lab. Students will learn to use and apply meters, gauges, hand tools, power tools to troubleshoot and repair refrigeration equipment.

### Learning Objectives

The purpose of this course is to:

- Demonstrate an understanding of the basic refrigeration cycle and components.
- Demonstrate using a P/T chart to find boiling points and equivalent temperatures of refrigerants.
- Demonstrate proper usage of refrigerant hand tools, such as gages, recovery equipment and vacuum pumps.
- List safety rules for using oxygen and acetylene torches.
- List safety rules for nitrogen pressurization
- Demonstrate proper refrigerant system charging and evacuation.
- Demonstrate the ability to solder and braze copper tubing.
- Use a Pressure Enthalpy chart to plot the refrigeration cycle.
- Follow industry accepted safety practices.

### Course Outcomes

Upon successfully completing this course, students will be able to:

- Demonstrate a working knowledge of the basic refrigeration cycle.
- Define and discuss heat, temperature and pressure relationships.
- Define refrigeration and state the different common refrigerants.
- Utilize the different tools and equipment used in the industry.
- Demonstrate use of gauges and thermometers to acquire superheat and sub-cooling readings.
- Discuss matter and energy for electricity and heat transfer.
- Discuss temperature/ pressure relationships.
- Identify the most common refrigerants.
- Identify the various oils used with refrigerants.
- Explain the relationships between the use of refrigerants and global warming.
- Learn to perform refrigerant recovery charge refrigerant to a system.

## Topical Course Outline

1. Refrigeration System and Operation
  - a. Introduction to the Refrigeration Cycle
    - i. Refrigeration components
    - ii. Operation
  - b. Matter and Energy
    - i. Gas Laws
    - ii. Types of Heat
    - iii. Pressures
  - c. Refrigeration and Refrigerants
    - i. P/T Relationships
    - ii. Process
    - iii. Components
    - iv. Characteristics
    - v. Cycles
  - d. Safety Practices
    - i. Pressure Vessels and Piping
    - ii. Electrical Hazards
    - iii. Mechanical Equipment
    - iv. Chemical Handling
  - e. Tools and Equipment
    - i. Refrigeration Tools
    - ii. Electrical Tools
    - iii. Piping Tools
2. Refrigerant Handling and Recovery
  - a. Environmental Concerns
    - i. Ozone Depletion
    - ii. Global Warming
  - b. Regulations

## References, Resources, and Learning Materials Text:

**Refrigeration and Air Conditioning Technology - Whitman, Thompson, Tomzack & Silverstein**

**MindTap HVAC (Refrigeration and Air Conditioning Technology - Tomczyk, Silverstein, Whitman & Johnson's**

Reviewed and Approved by:

---

Division Dean

Date



## COURSE OUTLINE

### Course Information

- A. Course Title: **HVACR Control Systems**
- B. Course Number: **HAC 170**
- C. Lecture, Lab and Credit Breakdown: **1-2-2**
- D. Course Prerequisite(s): **None**
- E. Course Co-requisite(s): **None**

### Catalog Description

Provides a fundamental understanding of electrical and mechanical control circuits as applied to refrigeration, heating and air-conditioning systems. Reading and understanding ladder and schematic diagrams are covered in detail. Troubleshooting circuits using electrical meters and pressure gauges are emphasized in labs. Installation and replacement of controls are covered.

### Learning Objectives

The purpose of this course is to:

Upon completion of this course, the student should be able to electrically troubleshoot and repair refrigeration, heating and air conditioning equipment in residential and light commercial applications.

### Course Outcomes

Upon successfully completing this course, students will be able to:

- List safety procedures used when working with electricity.
- Identify electrical schematic symbols used in RHVAC.
- Identify electrical flow in control systems.
- Identify available electrical readings in DC and AC circuits.
- Identify motor types and starting devices used in HVAC&R circuits. Explain their characteristics and their function.
- Differentiate between safety devices, loads, conductors, switches and controls.
- Demonstrate the installation and adjustment of HVAC&R controls.
- Demonstrate the use of digital and analog meters to check power, voltage, current capacitance, and continuity.
- Identify, mount and wire thermostat types such as line voltage and low voltage thermostats.
- Troubleshoot faulty controls and motors with meters.

### Topical Course Outline

1. Define bimetal, rod and tube, and fluid filled controls
2. Make general comparisons between different bimetal applications.
3. Discuss the thermocouple, a thermistor, and space temperature control.
4. Describe a high pressure and low pressure control.
5. Describe pressure transducers.

6. Describe the functions of mechanical and electromechanical controls.
7. Describe how to use a multimeter to troubleshoot a circuit.
8. Recognize the components in a heat-cool electrical circuit.
9. Follow the sequence of operations for a heat-cool electrical circuit.
10. Differentiate between a pictorial and a line-type electrical wiring diagram.

References, Resources, and Learning Materials Text:

**Refrigeration and Air Conditioning Technology - Whitman, Johnson, Tomczyk & Silberstein**

**MindTap HVAC-R for Whitman/ Johnson/ Tomczyk & Silberstein Refrigeration and Air Conditioning Technology**

Reviewed and Approved by:

---

Division Dean

Date