# Air Conditioning and Refrigeration Technology Program Student Learning Outcome Mapping

**Course (CLO), Program (PLO), Institutional (ILO)**

**Program Description**: This program is designed to provide students with technical knowledge, skills, and proper work habits/attitudes necessary for employment in the field of air conditioning and refrigeration. The program prepares students to work and advance in their careers in positions such as air conditioning and refrigeration technicians, parts counter salespersons or operators of their own air conditioning and refrigeration service and repair shops.

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| **Program Learning Outcomes** | **Institutional Learning Outcomes** |
| 1. Work as sales technician or manufacturer’s representative. 2. Be employed as air conditioning and refrigeration service technician in both government and private business. 3. Manage and operate own air conditioning and refrigeration service shops. | 1. **Critical Thinking and Problem Solving**: Analyze and solve problems by using informed judgment based on evidence, sound reasoning, and/or creativity to differentiate facts from opinions and to specify solutions and their consequences. 2. **Communication**: Effectively communicate, both orally and in writing, thoughts in a clear, well-organized manner to persuade, inform and/or convey ideas in academic, work, family and community settings. 3. **Quantitative and Technological Competence**: Use mathematical skills appropriate to our technological society by analyzing and solving problems that are quantitative in nature and use technology for informational, academic, personal and professional needs. 4. **Diversity**: Understand and appreciate differences in cultures and behaviors between the self and others by demonstrating respect, honesty, fairness, and ethical principles in both personal and professional life. 5. **Civic Responsibility**: Apply the principles of civility and morality to situations in the contexts of a healthy family, work, community, environment and world. 6. **Aesthetics**: Apply numerous means of inquiry to experience and appreciate the values of arts and nature. |

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| **PLOs** | **ILOs** | | | | | |
| **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| **PLO 1** | **X** | **X** | **X** | **X** |  |  |
| **PLO 2** | **X** | **X** | **X** |  |  |  |
| **PLO 3** | **X** | **X** | **X** |  |  |  |

# AC 111 - Fundamentals of Refrigeration

This introductory course provides instruction in basic physical, chemical, and engineering principles applicable to refrigeration. This also covers the physical laws, which apply to refrigeration.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Explain the basic principles of refrigeration. | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** |  |  |
| 2. Convert from one temperature scale to another. | **X** | **X** | **X** |  | **X** |  | **X** |  |  |  |
| 3. Identify thermodynamics applied in refrigeration system. | **X** | **X** | **X** |  | **X** |  |  |  |  |  |
| 4. Identify the mechanical components of refrigeration system. | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** |  |  |
| 5. Differentiate between latent, sensible, and specific heat. | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** |  |  |

This course provides instruction in air conditioning and refrigeration shop safety and regulations, uses and care of the tools and equipment of the trade.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Cut, bend, flare, and swage copper tubes. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 2. Connect copper tubes applying soldering and brazing techniques. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 3. Select and use various hand tools. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 4. Evacuate and remove moisture in refrigeration system. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 5. Service and repair small air-conditioners and refrigeration units. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |

# AC 121 - Compressor Systems and Refrigerant Control

This course provides instruction on the different thermal laws and functions of the different components of refrigeration.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. State five thermal laws relating to refrigeration. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 2. Trace the flow of refrigerant through a complete refrigeration system. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 3. Dismantle and assemble compressor motor. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 4. Remove and replace different types of refrigerant control. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 5. Remove and replace solenoid valves of a compression system. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |

This course covers electrical symbols and electrical circuits used in air conditioning and refrigeration.

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| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Find the terminals of a motor compressor using volt ohm (VOM) meter tester and measure the current using clamp- ammeter. |  | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 2. Use various electrical testing instruments to check motor windings, shorts and grounds. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 3. Draw, read and interpret schematic and ladder wiring diagrams in refrigeration and air-conditioning units. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 4. Inspect and replace electrical components used in refrigeration and air-conditioning. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 5. Apply the test procedures in electric motors by using the actual unit. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |

# AC 123 Automotive Air-conditioning

This course helps the learner understand how the automotive air conditioning system or units vary in their design and application from stationary units. It also covers practical skills in servicing and repairing automotive air-conditioning.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Service car air-conditioning system. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 2. Service car air-con compressor unit. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 3. Service car air-con cooling unit. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 4. Service car air-con condensing unit. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 5. Service car air-con electrical system. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |

This course provides instruction in refrigerant protection, service and repair of refrigerators and freezers, using the latest computer refrigeration simulator.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Correctly classify and identify different types of refrigerant using numbers and color code. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 2. Demonstrate proper handling of refrigerant cylinders. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 3. Describe the refrigeration mechanical components and cabinets for different types of refrigerators and freezers. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 4. Read, draw, and interpret circuits for manual defrost and automatic defrost systems. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 5. Diagnose and repair refrigerators and freezers using actual units. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |

This course provides the students practical knowledge and skills necessary to service and repair air conditioning systems using the latest computer air conditioner simulator.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Explain the principals of air conditioning. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 2. Install properly window-type air conditioning units following the manufacturer’s specifications. |  | **X** | **X** |  | **X** | **IX** |  |  |  |  |
| 3. Install split-type . air conditioning units following the manufacturer’s specifications |  | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 4. Perform preventive maintenance in air-conditioning units. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 5. Diagnose and repair common customer complaints encountered by technicians in the field using actual units. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |

This course covers the chemistry of air, air and human comfort, psychrometric properties of air, the psychrometric chart, problems for the conditioned air supply, conduction, solar transmission, occupancy and equipment heat gains and losses, coil load, and total air supply.

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| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Explain how temperature, humidity and air movement affect human comfort. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 2. Use various instruments, such as psychrometers, dry bulb thermometers, hygrometers, pilot tubes, recorders, manometers and barometers. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 3. Read and interpret psychrometric chart and scales. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 4. Define heat load and identify its sources for both heating and cooling of space. | **X** | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 5. Calculate the heat load using U-valves or R-Valves, square footage and design temperature charts. |  | **X** | **X** |  | **X** |  | **X** |  |  |  |

# AC 221 - Refrigerant Recovery and Recycling

This course enables the learner to understand the effects of CFC’s (Chloroflourocarbon) in the Ozone layer and to apply the EPA rules and regulations in the handling of refrigerants.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Follow the Environmental Protection Agency (EPA) rules governing fully halogenated refrigerants (CFCs). | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 2. Use recovery and recycling equipment. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 3. Perform appropriate procedures in recovery of refrigerants. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 4. Perform appropriate procedures in recycling of refrigerants. | **X** | **X** | **X** |  | **X** | **X** |  |  |  |  |
| 5. Maintain recovery instruments and equipment in accordance to the manufacturer’s recommendations. |  | **X** | **X** |  | **X** | **X** |  |  |  |  |

# AC 223 - Internship

This course provides the student practical training in the field of air conditioning and refrigeration. With the assistance of an instructor-coordinator, the student is assigned to work under a supervisor in a governmental department or a private firm in order to learn through an actual work experience.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Demonstrate proper employee behaviors and work habits. | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** | **X** |
| 2. Perform air conditioning and refrigeration tasks as assigned  by site supervisor. | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** | **X** |

# WE 110 - Gas Welding and Cutting

This course provides an introduction to the safe operation of gas welding equipment and instruction in the fundamentals of fusion welding of ferrous metals in various positions.

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| **CLO**  Students will be able to: | **PLO** | | |  | **ILO** | | | | | |
| **PLO 1** | **PLO 2** | **PLO 3** |  | **ILO 1** | **ILO 2** | **ILO 3** | **ILO 4** | **ILO 5** | **ILO 6** |
| 1. Students will be able to set up gas welding equipment and  accessories. |  | **X** | **X** |  | **X** | **X** | **X** |  |  |  |
| 2. Students will be able to weld sheet metal butt joints in flat,  horizontal and vertical positions. |  | **X** | **X** |  | **X** | **X** | **X** |  |  | **X** |
| 3. Students will be able to perform brazing and torch soldering. |  | **X** | **X** |  | **X** | **X** | **X** |  |  | **X** |
| 4. Students will be able to cut a steel plate manually using the  cutting torch. |  | **X** | **X** |  | **X** | **X** | **X** |  |  | **X** |
| 5. Students will be able to interpret welding symbols on a  blueprint. |  | **X** | **X** |  | **X** | **X** | **X** |  |  |  |