

## COMMERCIAL STUDIES AND DEVELOPMENT

Interested in launching or expanding your career in the in-demand industry of commercial climate control? Take advantage of Lake Erie College's Heating, Ventilation, Air Conditioning, and Refrigeration (HVACR) Commercial Studies and Development program.

With convenient evening classes, the HVACR program can be completed in as little as one year through four unique course modules. Coursework will cover everything from electrical processes to refrigeration, air distribution, ventilation and more, affording you an innovative and sustainable perspective on installing, maintaining and repairing vital quality-of-life systems as an HVACR technician.

**In this program, you will gain extensive hands-on experience with a variety of commercial HVACR systems. Individuals who complete the program will earn learn content in preparation to take EPA License 608, EPA License 609 and the OSHA 30-Hour Safety Certificates. Students may also earn North American Technician Excellence (NATE) certification in up to 12 fields relating to various aspects of HVACR. Each NATE certification carries an additional fee, as it is not a Lake Erie College credential.**

## PROGRAM MODULES

The HVACR program at LEC consists of four 12-week modules: **ELECTRICAL THEORY AND SAFETY, THEORY OF HEAT, LOW PRESSURE BOILERS AND AIR CONDITIONING AND REFRIGERATION.** Classes will meet three times a week on Monday, Tuesday and Wednesday from 6:00 - 10:00 p.m.

Applications to the HVACR program are processed on a rolling basis. The price of the full program is \$14,700. For more information on pricing or to submit your application, visit [www.lec.edu/HVACR](http://www.lec.edu/HVACR).



## ELECTRICAL THEORY AND SAFETY

Electrical theory will explore how to identify electrical issues, what electricity is derived from and what safety practices are involved. You will earn a certificate for 30-hour OSHA Safety in this module. The topics we will cover include:

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|---|---------------------------------------|------------------------------|
| 1. Basic electricity and magnetism                      | 20. Checking capacitors               | 39. Current                  |
| 2. Troubleshooting basic controls                       | 21. Short circuit to ground           | 40. Electrical hazards       |
| 3. Pneumatics   | 22. Relays                            | 41. Three phase              |
| 4. Types of electric motors                             | 23. Magnetic overload devices         | 42. Single Phase             |
| 5. Motor controls                                       | 24. Electrical power supplies         | 43. 220 power                |
| 6. Troubleshooting electric motors                      | 25. Pictorial and line diagrams       | 44. Split phase motors       |
| 7. Electric heat  | 26. Troubleshooting voltage           | 45. Alternating current      |
| 8. Radiant heating panels                               | 27. Simple and complex circuits       | 46. Direct current           |
| 9. Electric baseboard heating                           | 28. Units of electrical measurement   | 47. Centrifugal switch       |
| 10. Automatic controls for forced air electric furnaces | 29. Ohm's law                         | 48. Inverters and converters |
| 11. Low voltage thermostat                              | 30. Sine waves                        |                              |
| 12. Unit and wall heaters                               | 31. Transformers                      |                              |
| 13. Wiring diagrams                                     | 32. Semiconductors                    |                              |
| 14. Blower motor circuits                               | 33. Insulators                        |                              |
| 15. Controlling multiple stages                         | 34. Circuit protection devices        |                              |
| 16. Contactors for controlling electric furnaces        | 35. Extensive use of electrical meter |                              |
| 17. Mechanical motor problems                           | 36. Movement of electrons             |                              |
| 18. Open windings                                       | 37. Structure of matter               |                              |
| 19. Wiring and connectors                               | 38. Wire sizes                        |                              |

**FOR MORE INFORMATION**

**VISIT:** [lec.edu/hvacr](http://lec.edu/hvacr)

**CALL:** 216.219.7907

**EMAIL:** [hdill@lec.edu](mailto:hdill@lec.edu)

## THEORY OF HEAT

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Theory of heat will focus on where heat is derived from and made in dealing with all types of heating systems. You will begin to identify components in systems and their parts in the overall operation of a system. The topics we will cover include:

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|---|--------------------------------------|---|
| 1. Heat, temperature and pressure         | 16. Evaporator                       | 31. Functions and sizings of duct work  |
| 2. Conduction                             | 17. Compressor                       | 32. Different types of Duct material    |
| 3. Convection                             | 18. Condenser                        | 33. Different types of heat             |
| 4. Radiation                              | 19. Metering device                  | 34. Cooling in relation to heat balance |
| 5. Sensible heat                          | 20. Refrigerants                     | 35. Tubing                              |
| 6. Latent heat                            | 21. Boiling point of the refrigerant | 36. Brazing pipes                       |
| 7. Specific heat                          | 22. Refrigerant cylinder color codes | 37. Sweating pipes                      |
| 8. Sizing heating equipment               | 23. Energy used as work              | 38. Heat pumps                          |
| 9. Pressure gauges                        | 24. Forced air heating               | 39. Fluxing                             |
| 10. Matter                                | 25. Oil burners                      |   |
| 11. Mass and weight                       | 26. Oil furnaces                     |   |
| 12. Density                               | 27. Blower motors                    |   |
| 13. Energy                                | 28. Filters                          |   |
| 14. Gas laws                              | 29. Heating elements and types       |   |
| 15. Temperature and pressure relationship | 30. Inducer motor                    |   |

## LOW PRESSURE BOILERS

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This module will focus on water and steam boilers with system functions and applications. You will get an enormous amount of hands-on experience and installation throughout this module. The topics we will cover include:

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|---|------------------------------------|-------------------------|
| 1. Low pressure steam boilers           | 16. Heat exchangers                | 31. In line filtration  |
| 2. Water boilers                        | 17. Limit switch                   | 32. Water softeners     |
| 3. Radiators                            | 18. Venting                        | 33. PH levels           |
| 4. Fin tubes                            | 19. Gas piping                     | 34. Controls            |
| 5. Tank less domestic hot water heaters | 20. Pro press use                  | 35. Pumps               |
| 6. Pilot and spark ignition systems     | 21. Mega Press use                 | 36. Rebuild of Pumps    |
| 7. Gas fuels                            | 22. Pipe threading                 | 37. Overflow preventers |
| 8. Gas combustion                       | 23. Dampers                        | 38. Tubing              |
| 9. Gas valve                            | 24. Actuators                      | 39. Installation        |
| 10. Gas regulators                      | 25. Chemicals for cleaning systems | 40. Roof top units      |
| 11. Solenoid valve                      | 26. Water make up                  |                         |
| 12. Diaphragm valve                     | 27. Expansion tanks                |                         |
| 13. Manifold                            | 28. Laying out a system            |                         |
| 14. Orifice                             | 29. Check valves                   |                         |
| 15. Burners                             | 30. Blow downs                     |                         |

## AIR CONDITIONING AND REFRIGERATION

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In this module you will learn about the various components of a cooling system and how the system works. There will be heavy hands-on and field experience during this module. You will finish with two certificates in refrigeration which are the 608 and 609. The topics we will cover include:

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|---|---|---------------------------------------|
| 1. Conditioning equipment                     | 16. Types of bulb charge                  | 31. Installation                      |
| 2. Chillers                                   | 17. The four basic components of a system | 32. Brazing coils and lines           |
| 3. Compressors (all types)                    | 18. Mechanical controls                   | 33. Defrost cycle                     |
| 4. Cooling tower function                     | 19. Crank case pressure regulator         | 34. Safety with refrigeration         |
| 5. Scroll and reciprocating chiller operation | 20. Use of gauges and hoses               | 35. Trouble shooting all system types |
| 6. Centrifugal chiller operation              | 21. Pressure switches                     |                                       |
| 7. General maintenance for all chillers       | 22. Ice machines                          |                                       |
| 8. Evaporators                                | 23. Walk in coolers                       |                                       |
| 9. Condensers                                 | 24. King valve                            |                                       |
| 10. Tube within a tube condensers             | 25. Recovery of refrigerant               |                                       |
| 11. Shell and coil condensers                 | 26. Charging a system                     |                                       |
| 12. Superheat                                 | 27. Liquid in the compressor cylinder     |                                       |
| 13. Sub-cooling                               | 28. Fan-cycling head pressure controls    |                                       |
| 14. Head pressure controls                    | 29. Low, medium and high temp. set ups    |                                       |
| 15. Expansion devices                         | 30. TXV valve                             |                                       |