INDUSTRIAL TECHNOLOGIES

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INDUSTRIAL TECHNOLOGIES DIVISION

Northwest State Community College offers a variety of degree and certificate programs in the field of Industrial Technologies. Students enrolled in an Industrial Technologies program will benefit from the small classroom sizes as they learn to analyze problems and, more importantly, how to fix them.

Students will be prepared to enter the workforce immediately after graduation. They will also have the option of transferring into a four-year degree program at a partnering college or university.

Industrial Technologies Degree and certificate programs include:

Applied Science in Industrial Technology
- Industrial Electrician
- Machining CNC Programming
- Maintenance Technician/Mechatronics
- Millwright

Certificate Programs
- HVACR (Climate Control)

Industrial Electrical
- Machining
- Millwright
- Programmable Controller (PLC)

Communications:
- ENG111 Composition I (General Studies)
- ENG113 Speech
- ENG210 Technical Communications
- ENG214 Discussion & Conference Methods

Natural Science:
- CHM101 Principles of Chemistry
- CHM201 General Chemistry I
- PHY101 Principles of Physical Science
- PHY251 Physics: Mechanics & Heat
- PHY252 Physics: Electricity & Magnetism

Technical Electives:
- Any AET, CAD, EET, IND, INT, MET, PET, PLC or QCT course

Course Sequence
The suggested sequence of courses is for full-time students. If you are a part-time student or have transferred courses in from another school, you should generally complete the courses listed under semester 1 before moving on to semester 2, 3, and then 4. Elective courses may be taken at any time. Please meet with your advisor if you need assistance to register. Your advisor can help you make any necessary changes to this recommended sequence.

General Education
For Northwest State Core Requirements for all graduates, See page 31. Unless specified on the program page, Humanities and Social Behavioral Science electives should be selected from the Core Requirements list while Communication and Natural Science electives should be selected from the following elective lists.
## INDUSTRIAL ELECTRICIAN
### ASSOCIATE OF APPLIED SCIENCE IN INDUSTRIAL TECHNOLOGY

This degree will focus on learning experiences for students that will prepare them with the technical skills to work in the Industrial Electrical field in positions such as industrial electrician, electrical technician, industrial controls technician or maintenance technician.

Students in this program will be trained not only in traditional Electrician skills, but also how to operate and troubleshoot state-of-the-art programmable controller systems, solid state motor drives, instrument systems and industrial computer systems used by maintenance personnel in manufacturing and process plants.

Students will receive hands-on training on AC/DC motors, transformers, test equipment, basic hydraulic systems, and industrial wiring practices according to the National Electrical Code. Most of the technical classes will have 50 percent of the learning experience in the classroom, and the other 50 percent in the laboratory with hands-on training. This program focuses on basic fundamentals so that graduates can also adapt to the continuous changes in this technology.

### Career Outlook
As manufacturers invest in new highly technological equipment, the demand for the Industrial Electrician is great.

### Program Learning Outcomes
Students earning an Associate degree from this program should:

1. Identify common electrical symbols and abbreviations.
2. Demonstrate safe installation of wiring and components according to the National Electrical Code.
3. Troubleshoot the various parts of a system to locate a malfunctioning part safely but promptly.
4. Troubleshoot wiring problems to identify and repair malfunctioning wiring or components.
5. Demonstrate basic knowledge of PLC control systems, analog instrumentation, and Servo robotics systems.

### First Semester

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Credits</th>
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<tr>
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<td></td>
<td>OR</td>
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<td>CIS114</td>
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<td>RTI131</td>
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<tr>
<td>+ RTI154</td>
<td>Construction Electricity I</td>
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<tr>
<td>ENG112</td>
<td>Composition II</td>
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<td>IND103</td>
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<td>+ RTI156</td>
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<tr>
<td>+ RTI172</td>
<td>Industrial Wiring (NEC)</td>
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### Third Semester

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<tr>
<td>+ PLC200</td>
<td>Programmable Controller I</td>
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<tr>
<td>+ RTI169</td>
<td>Transfer Connections</td>
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<tr>
<td>+ RTI191</td>
<td>Electronics Principles &amp; Applications</td>
<td>3</td>
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<td>Humanities Elective</td>
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<td>Natural Science Elective</td>
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### Fourth Semester

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**Total Program Hours 61**

* Prior to taking IND110, students should have basic computer literacy in Windows and at least one Windows application.

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.

See page 31 for a list of Humanities and Social/Behavioral Science Electives.

See page 82 for a list of Communications, Natural Science and Technical Electives.
INDUSTRIAL ELECTRICAL
CERTIFICATE

This program will focus on learning experiences that will prepare students with the technical skills to work in the industrial electrical field in positions such as Industrial Electrician, Electrical Technician, Industrial Controls Technician or Maintenance Technician. All of these courses apply toward the comparable associate degree.

Students in the program will be trained not only in traditional Electrician skills, but also how to operate and troubleshoot state-of-the-art programmable controller systems, solid state motor drives, instrument systems and industrial computer systems used by maintenance personnel in manufacturing and process plants.

Students will receive hands-on training on AC/DC motors, transformers, test equipment, basic hydraulic systems, and industrial wiring practices according to the National Electrical Code. Most of the technical classes will have 50 percent of the learning experience in the classroom, and the other 50 percent in the laboratory with hands-on training. This program focuses on basic fundamentals so that graduates can also adapt to the continuous changes in technology.

Coursework (100 level or higher) completed in this certificate directly applies toward the associate degree in Industrial Electrician.

Career Outlook
As manufacturers invest in new highly technological equipment, the demand for the Industrial Electrician is great.

Program Learning Outcomes
Students earning a certificate from this program should demonstrate:

1. Knowledge of electrical symbols and abbreviations.
2. Proficiency in basic electrical theory, motor starters, solenoid valves, various control devices, motor circuits, and variable frequency drivers.
3. Proficiency in the systematic elimination of the various parts of a system to locate a malfunctioning part safely but properly.
4. Basic knowledge of PLC control systems.
5. Knowledge of the physics of fluids, components, troubleshooting and design applications for hydraulic and pneumatic systems.

See page 82 for a list of Communications Electives.

First Semester
+ IND120 Industrial Electricity I ..................... 3
+ MTH080 Review of Beginning Algebra ........... 4

Second Semester
+ IND121 Industrial Electricity II ................. 3
+ IND110* Industrial Computing I ............... 2

Third Semester
+ IND220 Electrical Prints & Troubleshooting 3
+ IND134 Industrial Fluid Power I ............... 3

Fourth Semester
+ IND223 Motors & Motor Controls ............. 3
+ PLC200 Programmable Controller I .......... 2

Fifth Semester
+ EET277 Industrial Electronics ............... 3
+ PLC230 Servo/Robotics Systems ............. 3

Sixth Semester
+ IND221 Instrumentation & Controls I ........ 3
+ Communications Elective .................... 2

Seventh Semester
+ IND122 Industrial Wiring (NEC) ............. 3

Total Program Hours 40

For information about our graduation rates, the median debt of students who have completed the program, and other important information, visit www.NorthwestState.edu.

* Prior to taking IND110, students should have basic computer literacy in Windows and at least one Windows application.

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.
MACHINING CNC PROGRAMMING
ASSOCIATE OF APPLIED SCIENCE IN INDUSTRIAL TECHNOLOGY

This program has a diversified audience. It is naturally intended for related trades students who have completed a four-year apprenticeship program leading to a journeyman’s card. It provides the opportunity to count apprentice coursework toward an associate degree in industrial technology.

The degree/certificate program can be used by anyone as a springboard into a career as a journeyman by using the certificate as leverage into a company that has an apprenticeship/training program, since it contains more than the contact hours required for related classroom hours in an apprenticeship program.

The machining CNC programmer creates machine parts. This person has a broad knowledge of tooling and its uses. Not only does he/she use manual and CNC mills, drills and lathes, but may also be trained in the use of non-traditional machining techniques, such as Electrical Discharge Machining.

Career Outlook
Based on a highly technological global market, the demand for machinists has fallen prey to a need to modernize the machinist vocation. Implementing up-to-date technology involving Computer-Numerical-Controls has become the only salvation for the trade. Contact with several regional machine shops has indicated a strong desire to bring jobs back which had already made their way to other countries.

Program Learning Outcomes
Students earning an Associate degree from this program should demonstrate:
1. Interpret and develop basic prints including dimensioning, calculations, and sketching, orthographic, isometric, sectional and auxiliary views.
2. Describe basic machining principles of lathes, mills, drills, band saw, and various hand tools.
3. Demonstrate machining and fabricating projects with an emphasis on safety, fixtureing, feeds and speeds, tooling, precision and accuracy.
4. Demonstrate welding with an emphasis on shielded metal arc (stick), oxy-acetylene, gas metal (MIG) and gas tungsten (TIG).
5. Interpret the physics of fluids, components, troubleshooting and design applications for hydraulic and pneumatic systems.

See page 31 for a list of Humanities and Social/Behavioral Science Electives.

See page 82 for a list of Communications, Natural Science and Technical Electives.

First Semester

<table>
<thead>
<tr>
<th>Course</th>
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<th>Credits</th>
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<tr>
<td>ENG111</td>
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<tr>
<td>IND110*</td>
<td>Industrial Computing I</td>
<td>3</td>
</tr>
<tr>
<td>+ MET110</td>
<td>Print Reading &amp; Sketching</td>
<td>3</td>
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<tr>
<td>+ IND140</td>
<td>Principles of Machining</td>
<td>3</td>
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<tr>
<td>+ IND132</td>
<td>Benchwork</td>
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Second Semester

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<tr>
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<td>Composition II</td>
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<tr>
<td>+ IND241</td>
<td>Tooling &amp; Fixtures</td>
<td>3</td>
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<tr>
<td>IND103</td>
<td>Applied Geometry &amp; Trigonometry</td>
<td>3</td>
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<tr>
<td>+ IND240</td>
<td>Machining Processes II</td>
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<tr>
<td>+ MET222</td>
<td>Programming CNC</td>
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Third Semester

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<tr>
<td>WLD110</td>
<td>Introduction to Applied Welding</td>
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<tr>
<td>+ IND134</td>
<td>Industrial Fluid Power I</td>
<td>3</td>
</tr>
<tr>
<td>+ MET223</td>
<td>CAM I</td>
<td>4</td>
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<tr>
<td>CAD111</td>
<td>CAD I</td>
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<tr>
<td>+ QCT141</td>
<td>Precision Measurement</td>
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Fourth Semester

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<th>Course</th>
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<tr>
<td>IND141</td>
<td>Metallurgy and Heat Treatment</td>
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<tr>
<td>+ IND105</td>
<td>Industrial Safety</td>
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<td>Social/Behavioral Science Elective</td>
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<td>Humanities Elective</td>
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</table>

Total Program Hours 69

* Prior to taking IND110, students should have basic computer literacy in Windows and at least one Windows application.

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.
The Machining Certificate is designed to meet the needs of a diverse vocational audience. Whether your interest is in computer numerical control programming, tool and die maker or patternmaker this program is designed to prepare the learner for a number of advantages as a skilled tradesman.

CNC or computer numerical control machining has literally replaced the machinist trade. You will be trained in the proper use of mills, drills and lathes, the latest in programming software as well as set-up and operational procedures of CNC equipment to produce a precision part.

As a patternmaker trainee you will learn the most up-to-date technology needed to build a pattern. To obtain this skill level the learner will become knowledgeable of the properties of metals, precision measurement and the fundamentals of repairing molds and dies.

The tool and die maker will learn how to create tools, dies and fixtures. This individual will gain a broad understanding of tooling by learning how to properly use mills, drills, lathes and other machining related equipment including non-traditional machining techniques such as the Electrical Discharge Machine.

Coursework (100 level or higher) completed in this certificate directly applies toward the associate degree in machining CNC programming.

Program Learning Outcomes
Students earning a certificate from this program should demonstrate:

1. Knowledge of basic print reading skills including dimensioning practices and calculations, sketching including orthographic, isometric, sectional and auxiliary views.
2. Knowledge of basic machining principles using lathes, mills, drills, band saw, and various hand tools.
3. Proficiency in machining and fabricating projects with an emphasis on safety, fixturing, feeds and speeds, tooling, precision, and accuracy.
4. Proficiency in welding with an emphasis on shielded metal arc (stick), oxy-acetylene, gas metal (MIG) and gas tungsten (TIG).

See page 82 for a list of Communications Electives.

For information about our graduation rates, the median debt of students who have completed the program, and other important information, visit www.NorthwestState.edu.

* Prior to taking IND110, students should have basic computer literacy in Windows and at least one Windows application.

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.
The industrial maintenance technician not only troubleshoots and repairs the most highly advanced industrial equipment, but is responsible for the layout and installation. This individual will be versed in electrical, hydraulics, pneumatics, pipefitting, welding, machine repair and installation as well as motor control systems, PLC control systems and instrumentation control networking.

**Career Outlook**

Employers trying to stay competitive with an international marketplace are hard pressed to find a multi-crafted maintenance employee who can accomplish a multitude of vocational qualities (electrician, plumber, pipefitter, hydraulics and pneumatics specialists, HVACR, machine set-up, machine installer, welder, systems troubleshooter and control systems programming). This program will provide those employers with such a skilled professional.

**Program Learning Outcomes**

Students earning an Associate degree from this program will:

1. Demonstrate a knowledge of fluid power and electrical symbols per ISO and JIC standards.
2. Read and interpret fluid power schematics.
3. Analyze electrical and PLC controls within fluid power circuits and systems.
4. Specify components, hoses, pipes and tubing, in the design, construction, and sizing of fluid power systems.
5. Apply principles of electrical controls and fluid power applications to industrial situations.

See page 31 for a list of Humanities and Social/Behavioral Science Electives.

See page 82 for a list of Communications Electives.

<table>
<thead>
<tr>
<th>First Semester</th>
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<tr>
<td>ENG111</td>
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<td>Intro to Engineering Technology .... 2</td>
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<td>+ IND120</td>
<td>Industrial Electricity I ............. 3</td>
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<tr>
<td>+ IND140</td>
<td>Principles of Machining ............. 3</td>
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<td>+ MTH109</td>
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<tr>
<td>PHY101</td>
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<td>+ IND223</td>
<td>Motors &amp; Motor Controls ............ 3</td>
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<td>+ PLC200</td>
<td>Programmable Controller I .......... 3</td>
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<td>+ IND131</td>
<td>Industrial Pipefitting ............. 3</td>
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<td>+ IND232</td>
<td>Machine Repair ..................... 3</td>
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<td>Systems Integration ............... 3</td>
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**Total Program Hours**

70

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.
INDUSTRIAL MAINTENANCE
CERTIFICATE

The industrial maintenance technician not only troubleshoots and repairs advanced industrial equipment, but is responsible for the layout and installation. This individual will be versed in electrical, hydraulics, pneumatics, pipefitting, welding, machine repair and installation as well as motor control systems and PLC control systems.

Coursework (100 level or higher) completed in this certificate directly applies toward the associate degree in maintenance technician/mechatronics.

Career Outlook
Many manufacturing companies across the country no longer employ segregated trades (electrician, millwright, machinist, etc.) Instead, they are moving to a multi-craft classification that will perform electrical, mechanics, machining, welding, etc. Therefore, positions for general maintenance and industrial maintenance are currently in great demand.

Program Learning Outcomes
Students earning a certificate from this program should demonstrate:

1. Knowledge of electrical symbols and abbreviations.
2. Proficiency in basic electrical theory, motor starters, solenoid valves, various control devices, motor circuits, and variable frequency drivers.
3. Proficiency in the systematic elimination of the various parts of a system to locate a malfunctioning part safely but promptly.
4. Basic knowledge of PLC control systems.
5. Knowledge of the physics of fluids, components, troubleshooting and design applications for hydraulic and pneumatic systems.

See page 82 for a list of Communications Electives.

For information about our graduation rates, the median debt of students who have completed the program, and other important information, visit www.NorthwestState.edu.

* Prior to taking IND110, students should have basic computer literacy in Windows and at least one Windows application.

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.
The millwright is trained to install, dismantle or move machinery and heavy equipment according to engineered plans, blueprints or other drawings. The skill level of the millwright ranges from rigger, welder and machine repairman to fabricator, pipefitter and machine reconditioner.

Career Outlook
Openings for millwrights will be found in areas where manufacturing is high. Related vocations are also a possibility with pipefitters and riggers, machine repairmen, structural iron and steel workers being in high demand.

Program Learning Outcomes
Students earning an Associate degree from this program should demonstrate:
1. Knowledge of basic print reading skills including dimensioning practices and calculations, sketching including orthographic, isometric, sectional and auxiliary views.
2. Knowledge of basic machining principles using lathes, mills, drills, band saw, and various hand tools.
3. Proficiency in machining and fabricating projects with an emphasis on safety, fixturing, feeds and speeds, tooling, precision, and accuracy.
4. Proficiency in welding with an emphasis on shielded metal arc (stick), oxy-acetylene, gas metal (MIG) and gas tungsten (TIG).
5. Knowledge of the physics of fluids, components, troubleshooting and design applications for hydraulic and pneumatic systems.

See page 31 for a list of Humanities and Social/Behavioral Science Electives.

See page 82 for a list of Communications, Natural Science and Technical Electives.
MILLWRIGHT
CERTIFICATE

The millwright is trained to install, dismantle or move machinery and heavy equipment according to engineered plans, blueprints or other drawings. The skill level of the millwright ranges from rigger, welder and machine repairman to fabricator, pipefitter and machine reconditioner.

Coursework (100 level or higher) completed in this certificate directly applies toward the associate degree in millwright.

Career Outlook
Openings for millwrights will be found in areas where manufacturing is high. Related vocations are also a possibility with pipefitters and riggers, machine repairmen, structural iron and steel workers being in high demand.

Program Learning Outcomes
Students earning a certificate from this program should demonstrate:

1. Knowledge of basic print reading skills including dimensioning practices and calculations, sketching including orthographic, isometric, sectional and auxiliary views.
2. Knowledge of basic machining principles using lathes, mills, drills, band saw, and various hand tools.
3. Proficiency in machining and fabricating projects with an emphasis on safety, fixturing, feeds and speeds, tooling, precision, and accuracy.
4. Proficiency in welding with an emphasis on shielded metal arc (stick), oxy-acetylene, gas metal (MIG) and gas tungsten (TIG).
5. Knowledge of the physics of fluids, components, troubleshooting and design applications for hydraulic and pneumatic systems.

See page 82 for a list of Communications Electives.

For information about our graduation rates, the median debt of students who have completed the program, and other important information, visit www.NorthwestState.edu.

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.
A Programmable Logic Controller (PLC) Certificate prepares the individual to install, maintain and troubleshoot industrial grade Programmable Logic Controllers (PLC) systems. Typically these technicians will work closely with maintenance supervisors and electrical engineers, sometimes receiving objectives and technical advice from them. Technicians conduct extensive self study (reading, research and practice) to improve and maintain technical proficiency, due to new and improved electrical control devices.

Typically technicians work on assignments and tasks with minimum supervision and guidance, often requiring the technician to interface and pass down information between cross function personnel of incoming and outgoing shifts. It is expected by employers that technicians demonstrate excellent verbal, written and interpersonal communication skills.

Coursework (100 level or higher) completed in this certificate directly applies toward the associate degree in Automation and Controls.

**Career Outlook**

Graduates of this program may find employment as entry-level control technicians, electrical technicians or as service technicians working under the direction of the maintenance or engineering department. Some of the typical duties of these technicians will include: troubleshooting and programming of PLC control systems; variable frequency drives; 480 volt 3 phase motor wiring; reading blueprints and electrical schematics; installing conduit and wiring; testing wiring connections; working closely with electrical engineers and / or general contractors.

**Program Learning Outcomes**

Students earning a certificate from this program should demonstrate:

1. Knowledge of electrical symbols and abbreviations.
2. Basic knowledge of operating systems, networking, and computer hardware.
3. Proficiency in design concepts, orthographic projection, dimensioning practices, and blueprint reading.
4. Basic ladder logic programming, addressing, editing, and troubleshooting.

See page 82 for a list of Communications Electives.

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### First Semester

- **IND120** Industrial Electricity I ..................... 3
- **MTH080** Review of Beginning Algebra............. 4

### Second Semester

- **IND121** Industrial Electricity II ..................... 3
- **IND110*** Industrial Computing I ..................... 2

### Third Semester

- **CAD111** CAD I........................................... 4
- **IND223** Motors & Motor Controls .................. 3

### Fourth Semester

- **PLC200** Programmable Controller I ............. 3
- **Communications Elective** ......................... 2

### Fifth Semester

- **IND221** Instrumentation & Controls............. 3
- **PLC210** Programmable Controller II .......... 3

### Sixth Semester

- **EET240** Engineering Programming................ 3
- **PLC220** Programmable Controller III........... 3

**Total Program Hours** 38

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For information about our graduation rates, the median debt of students who have completed the program, and other important information, visit www.NorthwestState.edu.

* Prior to taking IND110, students should have basic computer literacy in Windows and at least one Windows application.

* Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.
HVAC-R (CLIMATE CONTROL) CERTIFICATE

Heating, Ventilating, Air Conditioning, and Refrigeration, as a technical discipline, has made its transition to the “high-tech” field. Modern environmental control equipment use advanced controls involving pneumatic, electro-mechanical and direct digital control technologies. Today, common HVAC-R applications include the use of computers and computer network interfaces to facilitate building/space climate control and monitoring. Presently, manpower shortages exist for qualified personnel (see http://www.mepatwork.com for additional information). Men and women wanting to enter this field must understand these advanced technologies, their controls and communications networks if they are to be successful in this changing field.

Career Outlook
A wide variety of employment possibilities exist for those individuals who have training in the Climate Control field. HVAC-R Installers and Service Technicians are always needed to support companies involved in product sales and service. These skilled tradespersons work in residential, commercial and industrial settings keeping related equipment operational throughout the climate seasons. Refrigeration journeymen work in commercial and industrial settings providing support for the food industry. Air balance specialists work with environmental engineers to test and adjust newly installed and existing HVAC-R systems. Systems integrators unify various sub-systems involving the HVAC-R and fire control-life safety technologies under one common control.

Upgrade to an Associate Degree
Coursework (100 level or higher) completed in this certificate directly applies toward the Associate Degree in Alternative Energy Technology.

Program Learning Outcomes
Students earning a certificate from this program should demonstrate:

1. Knowledge of electrical symbols and abbreviations.
2. Basic knowledge of operating systems, networking, and computer hardware.
3. Proficiency in design concepts, orthographic projection, dimensioning practices, and blueprint reading.
4. Knowledge of the physics of fluids, components, troubleshooting and design applications for hydraulic and pneumatic systems.

See page 82 for a list of Communications Electives.

For information about our graduation rates, the median debt of students who have completed the program, and other important information, visit www.NorthwestState.edu under Math, Science & Engineering Technologies.

Must be proficient in MTH080.

+ Students must attain a minimum grade of “C” in all courses with a ‘+’ to progress in the program and to graduate.