Curriculum: Mechatronics II

Curricular Unit: Safety Procedures (Both Electronics and Robotics)

Instructional: A. Identify and apply workplace safety procedures

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>Standard Alignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>HECLE: HME.4.A</td>
</tr>
<tr>
<td>PEGLE: PALW.3.B</td>
</tr>
<tr>
<td>SCCLE: SC1.1.E (Chemistry I)</td>
</tr>
<tr>
<td>Knowledge: (CA) 3 (H/PE) 6,7</td>
</tr>
<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
</tr>
<tr>
<td>NETS: 1c</td>
</tr>
<tr>
<td>Performance: 3.1, 4.7</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Identify types, purposes, and operations of fire extinguishers and suppression resources
- Recognize when first aid is needed for occupational injuries and follow proper procedures
- Identify electrical hazards
- Demonstrate appropriate work place safety practices (e.g., electrical, hand tools, power tools, fall protection, PPE, lockout/tag out, and environmental hazards)
- Identify hazard of RF radiation devices
- Demonstrate safe and proper use of AC line operated equipment (e.g., isolation transformers, grounding, leakage current testing, and GFI)

**Instructional Strategies**

- IML safety curriculum – correct ways to measure current voltage and resistance
- Labs:
  - Current
  - Voltage
  - Resistance
Assessments/Evaluations:

- **Formative:**
  - IML safety worksheets from Units I, II, and III (evaluated using a scoring guide)
  - Techniques introduced in the unit are observed and monitored every day with each activity
  - End of unit questions
  - Student demonstration/performance of proper safety procedures
- **Summative:** Three practical exams evaluated using a scoring guide

Sample Assessment Questions:

- The device that opens the circuit (burns out) when the circuit is overloaded is a fuse?
  T or F

Instructional Resources/Tools:

- Instructional materials laboratory
- University of Missouri-Columbia (IML)

Cross Curricular Connections:

- **ELA:**
  - Technical reading
  - Writing
  - Discussion
- **Health:** Applying practices that preserve and enhance the safety and health of others
- **Physical Education:** Differentiating between life threatening and non-life threatening injuries and select the appropriate level of treatment
- **Science:** Identifying electrical and radiation hazards

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics II

Curricular Unit: Digital Circuits (Electronics II Portion)

Instructional: B. Digital vs. analog circuits

**Standard Alignments (Section 2)**

| SCCLE: SC7.1.A (Physical Science) |
| Knowledge: (CA) 1 (MA) 3 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1 |
| NETS: 3a,b |
| Performance: 1.6, 1.7, 3.4 |

**Unit (Section 3)**

Learning Targets:

- Identify several characteristics of digital circuits as opposed to linear (analog) circuits
- Differentiate between digital and analog signals and identify the HIGH and LOW portions of the digital waveform
- **Analyze simple logic-level indicator circuits**

Instructional Strategies:

- Chapters 1 and 2:
  - Lecture and discussion using Tokheim PowerPoints
  - Perform labs assigned from Tokheim lab book
  - Read and answer chapter:
    - self-test questions
    - review questions of Tokheim text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available

Assessments/Evaluations:

- Formative assessment of:
  - Tokheim PowerPoint quizzes
  - chapters 1 and 2:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- *Digital Electronics* textbook chapters 1 and 2 summative tests
- Summative/formative assessment of relevant live work when available
Sample Assessment Questions:

- Generally, electronics circuits are classified as either analog or _________?

Instructional Resources/Tools:

- *Digital Electronics Principles and Applications* (Roger Tolkheim):
  - textbook, and teacher resources
  - lab manual
- National Instruments Multisim computer simulation programs
- ETCAI Electronics training software
- Electronic supplies

Cross Curricular Connections:

- **ELA:**
  - Technical reading
  - Writing
  - Discussion
- **Math:** Number sense and the operation of real numbers

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Digital Logic System Components (Electronics II Portion)

Instructional: C. Analyze and interpret digital logic system components

Standard Alignments (Section 2)

| SCCLE: SC7.1.A (Physical Science) |
| Knowledge: (CA) 3 (MA) 6 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; S-CP.1 |
| NETS: 3a,b |
| Performance: 1.8, 1.10, 3.1, 3.2, 3.5, 4.1 |

Unit (Section 3)

Learning Targets:

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Basic logic gate operations
  - Clock and timing
  - Counter and controller
- Convert number systems and codes (e.g., binary, hex, ASCII and BCD)

Instructional Strategies:

- Digital textbook and lab book chapters 1-2 through reading and chapter self-test questions
- Students will:
  - construct and evaluate circuits using a variety of:
    - logic gates
    - digital IC’s
  - build labs using Multisim computer simulation software

Assessments/Evaluations:

- Formative assessment of:
  - Tokheim PowerPoint quizzes
  - chapter 1 and 2:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- Digital Electronics textbook chapters 1 and 2 summative tests
- Summative/formative assessment of relevant live work when available
Sample Assessment Questions:

- Write the Boolean expression for a two-input AND gate.

Instructional Resources/Tools:

- *Digital Electronics Principles and Applications* (Roger Tokheim):
  - textbook
  - lab manual
- Multisim computer simulation software
- ETCAI training products
- Electronics supplies

Cross Curricular Connections:

- English:
  - Technical reading
  - Writing
  - Discussion
- Math:
  - Number sense
  - Basic logic operations

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Logic Gates (Electronics II Portion)

Instructional: D. Basic logic gates and truth table interpretation

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 3 (MA) 6</td>
</tr>
<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; S-CP.1</td>
</tr>
<tr>
<td>NETS: 3a,b</td>
</tr>
<tr>
<td>Performance: 1.8, 1.10, 3.1, 3.2, 3.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

Learning Targets:

- Identify the name, symbol, truth table, function, and Boolean expression for the seven basic logic gates:
  - AND
  - OR
  - NOT
  - NAND
  - NOR
  - XOR
  - XNOR

- Troubleshoot simple logic gate circuits

- Identify pin numbers and manufacturer’s marking on both TTL and CMOS DIP package ICs

Instructional Strategies:

- Chapter 3:
  - Lecture and discussion using Tokheim PowerPoints
  - Perform labs assigned from Tokheim lab book
  - Read and answer chapter:
    - self-test questions
    - review questions of Tokheim text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available
Assessments/Evaluations:

- Formative assessment of:
  - Tokheim PowerPoint quizzes
  - chapter 3:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- *Digital Electronics* textbook chapter 3 summative test
- Summative/formative assessment of relevant live work when available

### Sample Assessment Questions:

- The truth table for a three-input NAND gate would have ________ lines to include all the possible input combinations.

### Instructional Resources/Tools:

- *Digital Electronics Principles and Applications* (Roger Tokheim):
  - textbook and teacher resources
  - lab manual
- Multisim computer simulation software
- ETCAI computer training software

### Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math:
  - Number sense
  - Basic logic operations

### Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Combinational Logic Circuits (Electronics II Portion)

Instructional: E. Combinational logic circuits

**Standard Alignments (Section 2)**

| SCCLE: SC7.1.A (Physical Science) |
| Knowledge: (CA) 3 (MA) 6 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; S-CP.1 |
| NETS: 3a,b |
| Performance: 1.8, 1.10, 3.1, 3.2, 3.5, 4.1 |

**Unit (Section 3)**

**Learning Targets:**

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - TTL
  - CMOS
  - Encoding
  - Decoding
  - Seven-Segment Display
  - Programmable Logic Devices (PLDs)

- **Use Karnaugh Mapping to simplify Boolean expressions**

**Instructional Strategies:**

- Chapters 4-6:
  - Lecture and discussion using Tokheim PowerPoints
  - Perform labs assigned from Tokheim lab book
  - Read and answer chapter:
    - self-test questions
    - review questions of Tokheim text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available

**Assessments/Evaluations:**

- Formative assessment of:
  - Tokheim PowerPoint quizzes
  - chapter 4-6:
    - self-tests
    - review questions
    - worksheets
• Two lab evaluations:
  • One formative
  • One summative
• Digital Electronics textbook chapter 4-6 summative test
• Summative/formative assessment of relevant live work when available

Sample Assessment Questions:

• Write the keyboard version of the Boolean expression (C’)(B’)(A) +(B)(A’) = Y.

Instructional Resources/Tools:

• Digital Electronics Principles and Applications (Roger Tokheim):
  • textbook and teacher resources
  • lab manual
• Multisim computer simulation software
• ETCAI computer training software

Cross Curricular Connections:

• ELA:
  • Technical reading
  • Writing
  • Discussion
• Math:
  • Number sense
  • Basic logic operations

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Flip-Flops, Counters, and Shift Registers (Electronics II Portion)

Instructional: F. Analyze flip-flops, counters, and shift registers

### Standard Alignments (Section 2)

| SCCLE: SC7.1.A (Physical Science) |
| Knowledge: (CA) 3 (MA) 6 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; S-CP.1 |
| NETS: 3a,b |
| Performance: 1.8, 1.10, 3.1, 3.2, 3.5 |

### Unit (Section 3)

Learning Targets:

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - R-S Flip-Flops
  - Clocked R-S Flip Flop
  - D Flip-Flop
  - J-K Flip Flop
  - Schmitt Trigger
  - Ripple Counters
  - Synchronous Counters
  - Three-Digit IC Counters
  - Serial-Load Shift Registers
  - Parallel-Load Shift Registers

Instructional Strategies:

- Chapters 7-9:
  - Lecture and discussion using Tokheim PowerPoints
  - Perform labs assigned from Tokheim lab book
  - Read and answer chapter:
    - self-test questions
    - review questions of Tokheim text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available
Assessments/Evaluations:

- Formative assessment of:
  - Tokheim PowerPoint quizzes
  - chapter 7-9:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- *Digital Electronics* textbook chapter 7-9 summative test
- Summative/formative assessment of relevant live work when available

Sample Assessment Questions:

- List the mode of operation of the clocked R-S flip-flop for each input pulse shown in Fig. 7-9. Answer with the terms “set,” “reset,” “hold,” and prohibited.”

Instructional Resources/Tools:

- *Digital Electronics Principles and Applications* (Roger Tokheim):
  - textbook and teacher resources
  - lab manual
- Multisim computer simulation software
- ETCAI computer training software

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math:
  - Number sense
  - Basic logic operations

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Memories and A/D, D/A converters (Electronics II Portion)

Instructional: G. Analyze memory and A/D, D/A converters

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 3 (MA) 6</td>
</tr>
<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; S-CP.1</td>
</tr>
<tr>
<td>NETS: 3a,b</td>
</tr>
<tr>
<td>Performance: 1.8, 1.10, 3.1, 3.2, 3.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

Learning Targets:

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Random-Access Memory (RAM)
  - Static RAM ICs
  - Read-Only Memory (ROM)
  - Programmable Read-Only Memory (PROM)
  - D/A (Digital to Analog) Conversion
  - A/D (Analog to Digital) Conversion
  - A/D Converter Specifications
  - A/D Converter IC
  - Digital Light Meter

Instructional Strategies:

- Chapters 11 and 14:
  - Lecture and discussion using Tokheim PowerPoints
  - Perform labs assigned from Tokheim lab book
  - Read and answer chapter:
    - self-test questions
    - review questions
    of Tokheim text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available
Assessments/Evaluations:

- Formative assessment of:
  - Tokheim PowerPoint quizzes
  - chapters 11 and 14:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
  - *Digital Electronics* textbook chapters 11 and 14 summative test
  - Summative/formative assessment of relevant live work when available

Sample Assessment Questions:

- List three general categories of bulk storage devices based on the technology each uses.

Instructional Resources/Tools:

- *Digital Electronics Principles and Applications* (Roger Tokheim):
  - textbook and teacher resources
  - lab manual
- Multisim computer simulation software
- ETCAI computer training software

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math:
  - Number sense
  - Basic logic operations

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Basic Electronic Circuits and Devices (Electronics II Portion)

Instructional: H. Test basic electronic circuits and devices

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 1  (MA) 1  (SC) 7</td>
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<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; A-CED.4</td>
</tr>
<tr>
<td>NETS: 6c</td>
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<tr>
<td>Performance: 1.8, 2.2, 3.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

Learning Targets:

- Evaluate and test sources of DC and AC signals and power
- Apply Ohm’s law
- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - DC circuits (e.g., parallel and series-parallel)
  - Bridge circuits
  - Magnetic and electromagnetic devices
  - Transformers
  - Capacitors
  - Inductors
  - Resistive devices
  - Basic circuit controls (e.g., switches, fuses, and circuit breakers)
  - AC series R/L/C (resistance, inductance, capacitance) and filter circuits
  - AC parallel R/L/C and filter circuits
  - Time constants
  - Transformers, basic circuit controls, R/L/C series and parallel circuits

Instructional Strategies:

- Chapters 3-13:
  - Lecture and discussion using Fowler PowerPoints
  - Perform labs assigned from Fowler lab book
  - Read and answer chapter:
    - self-test questions
    - review questions of Fowler text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available

**Assessments/Evaluations:**

- Formative assessment of:
  - Fowler PowerPoint quizzes
  - chapter 3-13:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- Electricity textbook chapters 3-13 summative tests
- Summative/formative assessment of relevant live work when available

**Sample Assessment Questions:**

- True or false. The resistance of a parallel resistor can be measured while the resistor is connected in the circuit.

**Instructional Resources/Tools:**

- *Electricity Principles and Applications* (Richard J. Fowler):
  - textbook, and teacher resources
  - lab manual
- National Instruments Multisim computer simulation programs
- ETCAI Electronics training software
- Electronic supplies

**Cross Curricular Connections:**

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math:
  - Number sense
  - Solve problems with formulas

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Test Equipment (Electronics II Portion)

Instructional: I. Operation of test and measurement equipment

### Standard Alignments (Section 2)

| SCCLE: SC1.1.B (Physical Science); SC7.1.A (Physical Science) |
| Knowledge: (CA) 1,3,4 (MA) 1 (CA) 3 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-RN.2; N-Q.1; A-CED.4 |
| NETS: 3b-d |
| Performance: 1.2, 1.4, 3.1, 4.1 |

### Unit (Section 3)

**Learning Targets:**

- **Measure:**
  - voltage, time, and frequency using an oscilloscope
  - voltage, current, and resistance using multimeters (e.g., VOM, EVM, and DVM)

- **Operate signal generators (e.g., audio, RF, and Function)**

**Instructional Strategies:**

- **Chapters 3-13:**
  - Lecture and discussion using Fowler and Schuler PowerPoints
  - Perform labs assigned from Fowler and Schuler lab book
  - Read and answer chapter:
    - self-test questions
    - review questions
    of Fowler and Schuler text
  - Demonstrate skills collaboratively and individually using simulation and virtual lab software
  - Complete relevant live work when available

**Assessments/Evaluations:**

- **Formative assessment of:**
  - Fowler and Schuler PowerPoint quizzes
  - Formative assessment of chapters 3-13 self-tests, review questions, and worksheets
- **Two lab evaluations:**
  - One formative
  - One summative
  - *Electricity and Electronics* textbook chapters 3-13 summative tests
  - Summative/formative assessment of relevant live work when available
Sample Assessment Questions:

- Does an iron-vane movement respond to alternating current, direct current, or both?

Instructional Resources/Tools:

- *Electronics Principles and Applications* (Richard J. Fowler; Charles A. Schuler):
  - textbooks
  - lab manuals
- Multisim computer simulation software
- ETCAI training software

Cross Curricular Connections:

- **ELA:**
  - Technical reading
  - Writing
  - Discussion
- **Math:**
  - Number sense
  - Solving problems with formulas

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics II

Curricular Unit: Soldering, Construction of Circuits (Electronics II Portion)

Instructional: J. Construct circuits consistent with industry and safety standards

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>GLE/CLE: N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 3</td>
</tr>
<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
</tr>
<tr>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.8, 1.10, 3.1, 3.2</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Construct multistage circuits according to schematic diagrams
- Surface mount solder and desolder components (e.g., defective and replacement) to IPC standards
- Thru-Hole solder and desolder components (e.g., defective and replacement)
- Troubleshooting soldering kits the students construct

**Instructional Strategies:**

- Textbooks: *Electricity, Electronics, Digital*
- Soldering handouts
- Students will:
  - solder and desolder various electronic components in printed circuit boards
  - build functional electronic devices from soldered board work kits

**Assessments/Evaluations:**

- Formative:
  - Soldering techniques observed by the teacher of student demonstration/performance
  - Unit questions
  - Teacher created summative:
    - projects
    - practical exam
    - tests
- Lab evaluations formative/summative by the teacher – assessed using informal observation
- Summative/formative assessment of relevant live work when available
Sample Assessment Questions:

- What are the six parts of a complete circuit?

Instructional Resources/Tools:

- Electronic supplies
- YouTube videos on soldering
- Teacher created:
  - PowerPoints
  - handouts

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics II

Curricular Unit: Leadership (Both Electronics and Robotics)

Instructional: K. Demonstrate leadership skills in the classroom, industry, and society

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**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>MGGLE: PS.1.C; CD.9.A</th>
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</thead>
<tbody>
<tr>
<td>SSCLE: ECP.4.A</td>
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<tr>
<td>Knowledge: (CA) 1,4,7 (SS) 6</td>
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<tr>
<td>CCSS: 11-12.WHST.4; 11-12.WHST.5; 11-12.WHST.6</td>
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<tr>
<td>NETS: 1b; 6a,b</td>
</tr>
<tr>
<td>Performance: 1.4, 1.8, 1.10, 2.1</td>
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**Unit (Section 3)**

<table>
<thead>
<tr>
<th>Learning Targets:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Demonstrate an understanding of SkillsUSA, its structure, and activities</td>
</tr>
<tr>
<td>• Demonstrate an understanding of one’s personal values</td>
</tr>
<tr>
<td>• Perform tasks related to effective personal management skills</td>
</tr>
<tr>
<td>• Demonstrate interpersonal skills</td>
</tr>
<tr>
<td>• Demonstrate etiquette and courtesy</td>
</tr>
<tr>
<td>• Demonstrate effectiveness in oral and written communication</td>
</tr>
<tr>
<td>• Develop and maintain a code of professional ethics</td>
</tr>
<tr>
<td>• Maintain an appropriate professional appearance</td>
</tr>
<tr>
<td>• Perform tasks related to securing and terminating employment</td>
</tr>
<tr>
<td>• Perform basic parliamentary procedures in a group meeting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Strategies:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Students will develop leadership qualities through:</td>
</tr>
<tr>
<td>• character building exercises</td>
</tr>
<tr>
<td>• student organization involvement</td>
</tr>
<tr>
<td>• Leadership development will be observed by the teacher both in and out of the classroom:</td>
</tr>
<tr>
<td>• Skills USA meetings and functions</td>
</tr>
<tr>
<td>• Community service projects</td>
</tr>
<tr>
<td>• Fund raising activities</td>
</tr>
</tbody>
</table>
Assessments/Evaluations:
- Skills USA Leadership handbook – evaluated by a judge during competition
- Teacher observation

Sample Assessment Questions:
- What is the Skills USA pledge?

Instructional Resources/Tools:
- Websites:
  - MidMoCareers.com
  - Monster.com
  - Careerbuilder.com
  - BLS Occupational Outlook Handbook (online)
- Google Drive and Docs
- Computer

Cross Curricular Connections:
- ELA:
  - Technical reading
  - Writing
  - Discussion
- Model Guidance:
  - Citizenship skills
  - Personal skills for job success

**Depth of Knowledge (Section 5)**

DOK: 2
Curriculum: Mechatronics II

Curricular Unit: Precision and Timing (Robotics III Portion)

Instructional Unit: L. Design, construct, analyze, and troubleshoot an autonomously controlled soldering robot

Standard Alignments (Section 2)

<table>
<thead>
<tr>
<th>GLE/CLE: N/A</th>
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<tbody>
<tr>
<td>Knowledge: (CA) 3</td>
</tr>
<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
</tr>
<tr>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.8, 1.10, 3.1, 3.2</td>
</tr>
</tbody>
</table>

Unit (Section 3)

Learning Targets:

- Program the robot using sensors to create precision and timing
- Execute programs utilizing shaft encoders
- Execute programs utilizing potentiometers
- Execute programs utilizing pushbuttons
- Create a list of positions that the robot will go to and return from

Instructional Strategies:

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex Curriculum: Movement, Sensors
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

Assessments/Evaluations:

- The students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Design a soldering robot
  - Program:
    - shaft encoders
    - potentiometers
    - pushbuttons
  - Build the soldering robot and perform soldering with precision and correct timing
  - Keep detailed notes in Engineering notebooks
  - Work in teams of up to 4
- Summative: Students will be able to program their robot to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:

- What real world applications do soldering robots have?

Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- ELA – Technical:
  - Reading
  - Writing
  - Discussion

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics II

Curricular Unit: Nothing but Net Challenge (Robotics III Portion)

Instructional Unit: M. Design and compete with a robot that can launch a ball into a goal

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Design a robot that meets the specifications of the game, Nothing But Net, which involves designing ball launching systems
- Program the robot to meet the specifications of the game, Nothing But Net

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, Nothing but Net Game
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

**Assessments/Evaluations:**

- The students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Design a robot that meets the Nothing but Net game specifications
  - Build a robot that meets the Nothing but Net game specifications
  - Program a robot that meets the Nothing but Net game specifications
  - Compete in the game against other students in the classroom
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher

**Sample Assessment Questions:**

- How did you decide on the method used to throw the balls into the goal?
Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- ELA – Technical:
  - Reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Tower Crane (Robotics III Portion)

Instructional Unit: N. Design and build a Tower Crane robot that utilizes a single support system

### Standard Alignments (Section 2)

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1, 3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

### Unit (Section 3)

**Learning Targets:**
- Design a tower crane using trigonometric functions to raise and lower loads while moving
- Program a tower crane using trigonometric functions to raise and lower loads while moving
- Apply basic understanding of center support systems

**Instructional Strategies:**
- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, The Game
- **Intellitek REC curriculum:**
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

**Assessments/Evaluations:**
- Formative: Teacher observation of student demonstration of activities:
  - Design a robot that lifts a minimum of 5 lbs.
  - Build a robot that is able to move loads from one spot to another without lowering or raising
  - Program a robot that can maintain the load to its furthest reach
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher
Sample Assessment Questions:

- What is the mathematical function used to keep a load steady while moving outward and inward on the crane?

Instructional Resources/Tools:

- Robote.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- **ELA – Technical:**
  - Reading
  - Writing
  - Discussion
- **Math:** Number sense and recognize the relationship of various functions
- **Science:**
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: PID Control (Proportional-Integral-Derivative) (Robotics III Portion)

Instructional Unit: O. Design, construct, analyze, and troubleshoot a Line Alignment robot that utilizes PID control

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE:</th>
<th>SC2.1.A (Physics I); SC7.1.A (Physics I)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge:</td>
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</tr>
<tr>
<td>Performance:</td>
<td>3.1, 3.4, 4.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

Learning Targets:

- Design a robot that utilizes control loop feedback mechanisms such as shaft encoders
- Program a robot that utilizes control loop feedback mechanisms
- Troubleshoot problems involved with PID control

Instructional Strategies:

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, The Game
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

Assessments/Evaluations:

- Formative: Teacher observation of student demonstration of activities:
  - Design a robot that drives until it sees a line on the floor then moves back to align itself to the line autonomously
  - Program a robot that can align itself in at full speed
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:

- What enables the robot to know how far to back up?
### Instructional Resources/Tools:
- *Robotc.net* curriculum
- *Intellitek REC* curriculum

### Cross Curricular Connections:
- **ELA – Technical:**
  - Reading
  - Writing
  - Discussion
- **Math:** Number sense and recognize the relationship of various functions
- **Science:**
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

### Depth of Knowledge (Section 5)
DOK: 4
Curriculum: Mechatronics II

Curricular Unit: Synchronization Based on Speed (Robotics III Portion)

Instructional Unit: P. Design, construct, analyze, and troubleshoot an automatic transmission

### Standard Alignments (Section 2)

- SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I)
- Knowledge: (CA) 1,3 (MA) 4 (SC) 2
- CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3
- NETS: 3c; 4b; 6a
- Performance: 3.1, 3.4, 4.5

### Unit (Section 3)

#### Learning Targets:

- Design a robot that utilizes multiple gear ratios
- Program a robot that utilizes multiple gear ratios
- Troubleshoot problems involving synchronization at set speed

#### Instructional Strategies:

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, YouTube
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
- Lectures on various parts of the videos

#### Assessments/Evaluations:

- Formative: Teacher observation of student demonstration of activities:
  - Design a robot that drives an output shaft that mimics an automatic transmission and shifts gears autonomously
  - Program a robot that can shift based on speed determined by a shaft encoder or another appropriate sensor
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher

#### Sample Assessment Questions:

- What sensor did you choose to decide when to shift?
Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- ELA – Technical:
  - Reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: FESTO Basic Level Pneumatics (Robotics III Portion)

Instructional Unit: Q. Introduction to basic level pneumatics trainers

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

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**Unit (Section 3)**

**Learning Targets:**

- Design, construct, troubleshoot, and repair:
  - manual control valves
  - relays
  - air compressors
  - industrial control switches
- Manipulate FluidSIM software for control of the Trainer System
- Set-up mode of operation of a single-acting cylinder
- Set-up mode of operation of a 3/2-way valve
- Recognize and sketch the various types of actuation for directional control valves

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - *FESTO Basic Level Pneumatics Trainer*
  - *UCANDO:*
    - *Troubleshooting Relay Logic Systems*
    - *Troubleshooting PLC’s*
  - Lectures on various parts of the videos and written material

**Assessments/Evaluations:**

- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the teacher upon completion of units
Sample Assessment Questions:

- What parts make up a single-acting cylinder?

Instructional Resources/Tools:

- **FESTO: Basic Level Pneumatics Trainer**
  - **UCANDO:**
    - *Troubleshooting Relay Logic Systems*
    - *Troubleshooting PLC’s*

Cross Curricular Connections:

- ELA – Technical:
  - Reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: FESTO Basic Level Pneumatics (Robotics III Portion)

Instructional Unit: R. Construct, utilize, analyze, and troubleshoot cylinders and 5/2-way valves

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Explain and set up direct actuation
- Set-up mode of operation of a double-acting cylinder
- Set-up mode of operation of a 5/2-way valve
- Explain and set up indirect actuation
- Set-up mode of operation of a 5/2-way valve with pneumatic actuation

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - *FESTO Basic Level Pneumatics Trainer*
  - *UCANDO:*
    - *Troubleshooting Relay Logic Systems*
    - *Troubleshooting PLC’s*
- Lectures on various parts of the videos and written material

**Assessments/Evaluations:**

- Formative: Complete practice exercises provided by *FESTO MecLab* trainer curriculum
- Summative: Comprehensive performance examination presented to the teacher upon completion of units

**Sample Assessment Questions:**

- Are sensors needed to determine actuation distance?
### Instructional Resources/Tools:

- *FESTO: Basic Level Pneumatics Curriculum*
- *UCANDO:*
  - *Troubleshooting Relay Logic Systems*
  - *Troubleshooting PLC’s*

### Cross Curricular Connections:

- **ELA – Technical:**
  - Reading
  - Writing
  - Discussion
- **Math:** Number sense and recognize the relationship of various functions
- **Science:**
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

### Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: FESTO Basic Level Pneumatics (Robotics III Portion)

Instructional Unit: S. Construct, utilize, analyze, and troubleshoot signaling elements, control elements, and flow control

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1, 3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Differentiate between a signaling element and a control element
- Measure pressure in pneumatic control systems
- Differentiate between the various types of flow control and use them in accordance with specifications
- Adjust cylinder advancing and retracting speeds
- Construct and troubleshoot one type of signal storage in pneumatic control systems

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - *FESTO Basic Level Pneumatics Trainer*
  - *UCANDO:*
    - *Troubleshooting Relay Logic Systems*
    - *Troubleshooting PLC’s*
- Lectures on various parts of the videos and written material

**Assessments/Evaluations:**

- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the teacher upon completion of units

**Sample Assessment Questions:**

- How do you measure cylinder advancing and retracting speeds?
<table>
<thead>
<tr>
<th>Instructional Resources/Tools:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <em>FESTO: Basic Level Pneumatics Curriculum</em></td>
</tr>
</tbody>
</table>
| • *UCANDO:*
|   • *Troubleshooting Relay Logic Systems* |
|   • *Troubleshooting PLC’s* |

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</tr>
<tr>
<td>• Analyze the motion of an object</td>
</tr>
</tbody>
</table>

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: FESTO Basic Level Pneumatics (Robotics III Portion)

Instructional Unit: T. Construct, utilize, analyze, and troubleshoot logic operations, latching circuits, and combinational logic operations

### Standard Alignments (Section 2)

<table>
<thead>
<tr>
<th>SCCLE:</th>
<th>SC2.1.A (Physics I); SC7.1.A (Physics I)</th>
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</thead>
<tbody>
<tr>
<td>Knowledge:</td>
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<td>NETS:</td>
<td>3c; 4b; 6a</td>
</tr>
<tr>
<td>Performance:</td>
<td>3.1, 3.4, 4.5</td>
</tr>
</tbody>
</table>

### Unit (Section 3)

#### Learning Targets:
- Explain and implement AND/OR/NOT logic operations
- Explain and set up latching circuits
- Set up and troubleshoot one option for end-position sensing in cylinders
- Combine logic operations

#### Instructional Strategies:
- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - FESTO Basic Level Pneumatics Trainer
  - UCANDO:
    - Troubleshooting Relay Logic Systems
    - Troubleshooting PLC’s
- Lectures on various parts of the videos and written material

#### Assessments/Evaluations:
- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the teacher upon completion of units

#### Sample Assessment Questions:
- What types of sensors are used for end-position sensing?
<table>
<thead>
<tr>
<th>Instructional Resources/Tools:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>FESTO: Basic Level Pneumatics Curriculum</strong></td>
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<table>
<thead>
<tr>
<th>Cross Curricular Connections:</th>
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<tbody>
<tr>
<td>• ELA – Technical:</td>
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<td>• Critical thinking</td>
</tr>
<tr>
<td>• Analyze the motion of an object</td>
</tr>
</tbody>
</table>

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: FESTO Basic Level Pneumatics (Robotics III Portion)

Instructional Unit: U. Construct, utilize, analyze, and troubleshoot magnetic proximity switches, pressure sequence valves, and pressure-dependent control systems

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Set-up mode of operation of a magnetic proximity switch
- Differentiate between 5/2-way valves and select and use them in accordance with specifications
- Develop and troubleshoot existing circuits
- Set-up mode of operation of a pressure sequence valve
- Set up pressure-dependent control systems
- Set-up mode of operation of a pressure regulator

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - *FESTO Basic Level Pneumatics Trainer*
  - *UCANDO:*
    - *Troubleshooting Relay Logic Systems*
    - *Troubleshooting PLC’s*
- Lectures on various parts of the videos and written material

**Assessments/Evaluations:**

- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the teacher upon completion of units
Sample Assessment Questions:

- How do magnetic proximity switches work?

Instructional Resources/Tools:

- *FESTO: Basic Level Pneumatics Curriculum*
- *UCANDO:*
  - Troubleshooting Relay Logic Systems
  - Troubleshooting PLC’s

Cross Curricular Connections:

- ELA – Technical:
  - Reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics II

Curricular Unit: FESTO Basic Level Pneumatics (Robotics III Portion)

Instructional Unit: V. Construct, utilize, analyze, and troubleshoot time delay valves, oscillating motion, and multiple cylinders

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I)</th>
</tr>
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<tbody>
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</tr>
<tr>
<td>Performance: 3.1, 3.4, 4.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Analyze existing circuits and optimize them in accordance with specifications
- Set up mode of operation of a time-delay valve
- Set up circuits with oscillating motion
- Set up time delay valves in accordance with specific constraints
- Analyze and construct circuits with two cylinders

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - *FESTO Basic Level Pneumatics Trainer*
  - *UCANDO:*
    - *Troubleshooting Relay Logic Systems*
    - *Troubleshooting PLC’s*
  - Lectures on various parts of the videos and written material

**Assessments/Evaluations:**

- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the teacher upon completion of units

**Sample Assessment Questions:**

- Do time-delay valves have fail-safe measures?
Instructional Resources/Tools:

- *FESTO: Basic Level Pneumatics Curriculum*
- *UCANDO:*
  - Troubleshooting Relay Logic Systems
  - Troubleshooting PLC’s

Cross Curricular Connections:

- ELA – Technical:
  - Reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Robotics IV

Curricular Unit: FESTO MecLab Mechatronics Training System (Part A) (Robotics IV Portion)

Instructional Unit: W. Create a program that enables students to analyze, operate, and troubleshoot industrial machines and components

### Standard Alignments (Section 2)

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

### Unit (Section 3)

#### Learning Targets:
- Identify machines and their function in a process
- Identify, connect, and troubleshoot industrial components
- Design circuits using FluidSIM software and its tools
- Identify, connect, and troubleshoot industrial component symbols and designations

#### Instructional Strategies:
- The instructor will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - FESTO MecLab Mechatronics Training System
  - UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
- Lectures on various parts of the videos and written material

#### Assessments/Evaluations:
- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the instructor upon completion of units

#### Sample Assessment Questions:
- Where are the actuators located in FluidSIM?

#### Instructional Resources/Tools:
- FESTO: Basic level Pneumatics curriculum
- UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
Cross Curricular Connections:

- **ELA:**
  - Technical reading
  - Writing
  - Discussion
- **Math:** Number sense and recognize the relationship of various functions
- **Science:**
  - Investigate, reason, and critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Robotics IV

Curricular Unit: FESTO MecLab Mechatronics Training System (Part B) (Robotics IV Portion)

Instructional Unit: X. Create a program that enables students to analyze, operate, and troubleshoot sequence of operations as well as pneumatic and electrical schematics

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

Learning Targets:

- Design, create, and analyze sequence of operations
- Analyze pneumatic and electrical schematics

Instructional Strategies:

- The instructor will help if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - FESTO MecLab Mechatronics Training System
  - UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
  - Lectures on various parts of the videos and written material

Assessments/Evaluations:

- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the instructor upon completion of the units

Sample Assessment Questions:

- Can you use a flowchart to display a sequence of operation?

Instructional Resources/Tools:

- FESTO: Basic Level Pneumatics curriculum
- UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate, reason, and critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Robotics IV

Curricular Unit: FESTO MecLab Mechatronics Training System (Part C) (Robotics IV Portion)

Instructional Unit: Y. Create a program that enables students to analyze, operate, and troubleshoot linear actuators, relays, limit switches, and cylinders

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

Learning Targets:

- Demonstrate control of linear actuators
- Demonstrate control of relays
- Demonstrate control of limit switches
- Demonstrate structure, function and application of single-acting and double-acting cylinders

Instructional Strategies:

- The instructor will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - *FESTO MecLab Mechatronics Training System*
  - *UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s*
- Lectures on various parts of the videos and written material

Assessments/Evaluations:

- Formative: Complete practice exercises provided by *FESTO MecLab* trainer curriculum
- Summative: Comprehensive performance examination presented to the instructor upon completion of the units

Sample Assessment Questions:

- What is the difference between solid-state relays and mechanical relays?
Instructional Resources/Tools:

- *FESTO:* Basic level *Pneumatics* curriculum
- *UCANDO:* Troubleshooting Relay Logic Systems, Troubleshooting PLC’s

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate, reason, and critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Robotics IV

Curricular Unit: FESTO MecLab Mechatronics Training System (Part D) (Robotics IV Portion)

Instructional Unit: Z01. Calculate parameters, actuation, valves, and circuits

### Standard Alignments (Section 2)

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

### Unit (Section 3)

#### Learning Targets:
- Demonstrate calculating basic parameters
- Demonstrate direct and indirect actuation
- Demonstrate application and function of 3/2 and 5/2-way valves
- Demonstrate the methods of actuation of directional control valves
- Analyze circuits

#### Instructional Strategies:
- The instructor will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - FESTO MecLab Mechatronics Training System
  - UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
- Lectures on various parts of the videos and written material

#### Assessments/Evaluations:
- Formative: Complete practice exercises provided by FESTO MecLab trainer curriculum
- Summative: Comprehensive performance examination presented to the instructor upon completion of the units

#### Sample Assessment Questions:
- Does indirect actuation have limits?

#### Instructional Resources/Tools:
- FESTO: Basic level Pneumatics curriculum
- UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
Cross Curricular Connections:

- **ELA:**
  - Technical reading
  - Writing
  - Discussion
- **Math:** Number sense and recognize the relationship of various functions
- **Science:**
  - Investigate, reason, and critical thinking
  - Analyze the motion of an object

### Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Robotics IV

Curricular Unit: FESTO MecLab Mechatronics Training System (Part E) (Robotics IV Portion)

Instructional Unit: Z02. Create a program that enables students to analyze, operate, and troubleshoot pressure measurement, pressure control systems, flow control, and latching circuits

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Demonstrate the options for pressure measurement
- Demonstrate pressure-dependent control systems
- Distinguish between different flow control methods and how to use them as intended
- Build latching circuits

**Instructional Strategies:**

- The instructor will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - *FESTO MecLab Mechatronics Training System*
  - *UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s*
- Lectures on various parts of the videos and written material

**Assessments/Evaluations:**

- Formative: Complete practice exercises provided by *FESTO MecLab* trainer curriculum
- Summative: Comprehensive performance examination presented to the instructor upon completion of the units

**Sample Assessment Questions:**

- Are there anti-backflow control valves in pneumatics?

**Instructional Resources/Tools:**

- *FESTO: Basic level Pneumatics* curriculum
- *UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s*
Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate, reason, and critical thinking
  - Analyze the motion of an object

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Robotics IV

Curricular Unit: SkillsUSA Competition (Robotics IV Portion)

Instructional Unit: Z03. Utilize electronic and/or robotic knowledge and skills to perform to competition specifications

**Standard Alignments (Section 2)**

<table>
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<tr>
<th>SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I)</th>
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</tr>
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<td>Performance: 3.1, 3.4, 4.5</td>
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</tr>
</tbody>
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**Unit (Section 3)**

**Learning Targets:**

- Interpret instructions as presented by SkillsUSA competition
- Design, create, and troubleshoot the given competition

**Instructional Strategies:**

- The instructor will help, if needed, while trying to implement troubleshooting skills
- Instructional videos and written material from:
  - FESTO MecLab Mechatronics Training System
  - UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
  - Robotc.net Vex Cortex Curriculum
  - Intellitek REC Curriculum

**Assessments/Evaluations:**

- Formative: Complete practice exercises provided by instructor per competition guidelines
- Summative: Comprehensive performance examination presented to the instructor upon completion of the units and/or competition results

**Sample Assessment Questions:**

- What would you have done differently in order to better achieve your desired results?

**Instructional Resources/Tools:**

- FESTO: Basic level Pneumatics curriculum
- UCANDO: Troubleshooting Relay Logic Systems, Troubleshooting PLC’s
- Robotc.net Vex Cortex curriculum
- Intellitek REC curriculum
Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math: Number sense and recognize the relationship of various functions
- Science:
  - Investigate, reason, and critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4