Curriculum: Mechatronics II

Curricular Unit: Safety Procedures (Both Electronics and Robotics)

Instructional: A. Identify and apply workplace safety procedures

Standard Alignments (Section 2)

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

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 threating and non-life threating 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)

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:

- 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)

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:
  - 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
  - chapters11 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)

SCCLE: SC7.1.A (Physical Science)
Knowledge: (CA) 1 (MA) 1 (SC) 7
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
NETS: 6c
Performance: 1.8, 2.2, 3.5

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 Funtion)

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)

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

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

Standard Alignments (Section 2)

MGGLE: PS.1.C; CD.9.A
SSCLE: ECP.4.A
Knowledge: (CA) 1,4,7 (SS) 6
CCSS: 11-12.WHST.4; 11-12.WHST.5; 11-12.WHST.6
NETS: 1b; 6a,b
Performance: 1.4, 1.8, 1.10, 2.1

Unit (Section 3)

Learning Targets:

- Demonstrate an understanding of SkillsUSA, its structure, and activities
- Demonstrate an understanding of one's personal values
- Perform tasks related to effective personal management skills
- Demonstrate interpersonal skills
- Demonstrate etiquette and courtesy
- Demonstrate effectiveness in oral and written communication
- Develop and maintain a code of professional ethics
- Maintain an appropriate professional appearance
- Perform tasks related to securing and terminating employment
- Perform basic parliamentary procedures in a group meeting

Instructional Strategies:

- Students will develop leadership qualities through:
  - character building exercises
  - student organization involvement
- Leadership development will be observed by the teacher both in and out of the classroom:
  - Skills USA meetings and functions
  - Community service projects
  - Fund raising activities

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)

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

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: • *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: 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)

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 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

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?

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

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 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?

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: 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)

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:

- 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)

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:

- 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