



## PLTW Advanced Manufacturing

| <b>Standards</b>   |
|--|
| <b>International Society for Technology Literacy (ISTE) Standards</b>  |
| <b>Standards for Technological and Engineering Literacy (STEL)</b>   |
| <b>Competency Model Clearinghouse</b><br><b>Advance Manufacturing – Competency Model</b><br>Tier 4: Industry-Wide Technical Competencies |
| <b>NICE Workforce Framework for Cybersecurity</b><br>V2.1.0 TKS Statements   |
| <b>Smart Automation Certification Alliance (SACA)</b><br>1.1.1 Industry 4.0 Concepts   |
| <b>Common Core State Standards (CCSS)</b><br>High School Mathematics<br>College and Career Readiness Anchor Standards for ELA            |

## International Society for Technology Education (ISTE) Standards

| Unit 1 Introduction to Industry 4.0 |        |        |        |        |        |        |        |            |        |        |        |
|-------------------------------------|--------|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|
| Lesson 1.1                          |        |        |        |        |        |        |        | Lesson 1.2 |        |        | L 1.3  |
| A1.1.1                              | A1.1.2 | A1.1.3 | A1.1.4 | A1.1.5 | A1.1.6 | A1.1.7 | P1.1.8 | A1.2.1     | A1.2.2 | P1.2.3 | B1.3.1 |

|                              |   |   |   |   |   |   |   |   |   |   |   |   |
|------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1<br>Empowered Learner     | <b>Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.</b>                          |   |   |   |   |   |   |   |   |   |   |   |
|                              | 1.1.a Connect their learning needs, strengths and interests to their goals and use technology to help achieve them and reflect on their progress.   |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 1.3<br>Knowledge Constructor | <b>Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.</b> |   |   |   |   |   |   |   |   |   |   |   |
|                              | 1.3.a Use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.  |   |   |   |   |   |   |   | ✓ |   |   |   |
|                              | 1.3.b Evaluate the accuracy, validity, bias, origin, and relevance of digital content.  |   |   |   |   |   |   |   | ✓ |   |   |   |
|                              | 1.3.c Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.                     |   |   |   |   |   |   |   | ✓ |   |   |   |
| 1.4<br>Innovative Designer   | 1.3.d Build knowledge by exploring real-world issues and gain experience in applying their learning in authentic settings.  |   |   |   |   |   |   |   | ✓ |   |   |   |
|                              | <b>Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.</b>  |   |   |   |   |   |   |   |   |   |   |   |
|                              | 1.4.a Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.   |   |   |   |   |   |   |   | ✓ |   | ✓ | ✓ |
| 1.5<br>Computational Thinker | 1.4.c Develop, test and refine prototypes as part of a cyclical design process.   | ✓ |   |   |   |   |   |   | ✓ |   | ✓ | ✓ |
|                              | 1.4.d Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.  | ✓ |   |   |   |   |   |   | ✓ |   | ✓ | ✓ |
|                              | <b>Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.</b>                        |   |   |   |   |   |   |   |   |   |   |   |
| 1.7<br>Global Collaborator   | 1.5.a Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.                      |   |   |   |   |   |   |   |   |   | ✓ | ✓ |
|                              | 1.5.c Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.                                     |   |   |   |   |   |   |   |   |   | ✓ | ✓ |
|                              | 1.5.d Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.   |   |   |   |   |   |   |   | ✓ |   | ✓ | ✓ |
| 1.7<br>Global Collaborator   | <b>Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.</b>                       |   |   |   |   |   |   |   |   |   |   |   |
|                              | 1.7.c Contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## International Society for Technology Education (ISTE) Standards

| Unit 2 Advancing Automation in Manufacturing |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|--|---|--------|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|---|
| Lesson 2.1                                   |   |        |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |   |
| A2.1.1                                       | A2.1.2  | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6 | P2.1.7 | A2.2.1     | A2.2.2 | A2.2.3 | P2.2.4 | A2.3.1     | A2.3.2 | P2.3.3 | B2.4.1 |   |
| 1.1<br>Empowered<br>Learner                  | <b>Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.</b>                          |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|  | 1.1.a Connect their learning needs, strengths and interests to their goals and use technology to help achieve them and reflect on their progress.   | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓ |
|  | 1.1.c Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.  |        |        |        |        |        |            |        |        |        |            |        |        |        | ✓ |
| 1.3<br>Knowledge<br>Constructor              | <b>Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.</b> |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|  | 1.3.d Build knowledge by exploring real-world issues and gain experience in applying their learning in authentic settings.  |        |        |        |        |        |            |        |        |        |            | ✓      | ✓      | ✓      |   |
| 1.4<br>Innovative<br>Designer                | <b>Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.</b>  |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|  | 1.4.a Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.   |        |        |        |        |        | ✓          |        |        | ✓      | ✓          |        |        |        | ✓ |
|  | 1.4.b Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.  |        |        |        |        |        |            |        |        |        |            |        |        |        | ✓ |
|  | 1.4.c Develop, test and refine prototypes as part of a cyclical design process.   |        |        |        |        |        | ✓          | ✓      |        |        | ✓          | ✓      |        |        | ✓ |
|  | 1.4.d Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.  |        |        |        |        | ✓      | ✓          | ✓      |        |        | ✓          | ✓      |        |        | ✓ |
| 1.5<br>Computational<br>Thinker              | <b>Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.</b>                        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|  | 1.5.a Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.                      |        |        |        |        |        | ✓          |        |        |        |            | ✓      | ✓      | ✓      | ✓ |
|  | 1.5.b Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.                         |        |        |        |        |        |            |        |        |        |            | ✓      | ✓      | ✓      | ✓ |
|  | 1.5.c Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.                                     |        |        |        |        |        |            | ✓      |        |        | ✓          |        |        |        | ✓ |
|  | 1.5.d Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.   | ✓      |        | ✓      |        | ✓      | ✓          | ✓      |        |        |            |        |        |        | ✓ |
| 1.6<br>Creative<br>Communicator              | <b>Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.</b>           |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|  | 1.6.c Use digital tools to visually communicate complex ideas to others.  |        |        |        |        |        |            |        |        |        |            |        |        | ✓      |   |

## International Society for Technology Education (ISTE) Standards

| Unit 2 Advancing Automation in Manufacturing |        |        |        |        |        |        |            |        |        |        |            |        |        |        |
|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|
| Lesson 2.1                                   |        |        |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |
| A2.1.1                                       | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6 | P2.1.7 | A2.2.1     | A2.2.2 | A2.2.3 | P2.2.4 | A2.3.1     | A2.3.2 | P2.3.3 | B2.4.1 |

|  |  |   |   |   |   |   |   |   |   |   |   |  |  |  |   |
|--|--|---|---|---|---|---|---|---|---|---|---|--|--|--|---|
| <b>1.7<br/>Global<br/>Collaborator</b> | Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. |   |   |   |   |   |   |   |   |   |   |  |  |  |   |
|  | 1.7.a Use digital tools to connect with peers from a variety of backgrounds recognizing diverse viewpoints and broadening mutual understanding.                        |   |   |   |   |   |   |   |   |   |   |  |  |  | ✓ |
|  | 1.7.c Contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.                                | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |  |  |  | ✓ |

## International Society for Technology Education (ISTE) Standards

| Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |  |
|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|--|
| Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        |        | L 3.3  |  |
| A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |  |

|                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1<br>Empowered<br>Learner     | <b>Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.</b>                                |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                                 | 1.1.a Connect their learning needs, strengths and interests to their goals and use technology to help achieve them and reflect on their progress.   | ✓ |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
|                                 | 1.1.b Build networks and customize their learning environments in ways that support the learning process.   |   |   | ✓ |   |   |   |   |   |   |   | ✓ |   |   |
|                                 | 1.1.c Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.  |   |   |   |   |   |   | ✓ |   | ✓ | ✓ |   |   |   |
|                                 | 1.1.d Understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively, and are adept at thoughtfully exploring emerging technologies. | ✓ | ✓ |   | ✓ | ✓ | ✓ |   |   |   |   | ✓ |   | ✓ |
| 1.3<br>Knowledge<br>Constructor | <b>Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.</b>       |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                                 | 1.3.a Use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.  |   |   | ✓ |   |   |   |   |   |   |   | ✓ |   |   |
|                                 | 1.3.b Evaluate the accuracy, validity, bias, origin, and relevance of digital content.  |   | ✓ | ✓ |   |   |   |   |   |   |   | ✓ |   |   |
|                                 | 1.3.c Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.                           |   | ✓ | ✓ |   |   |   |   |   |   |   | ✓ |   |   |
|                                 | 1.3.d Build knowledge by exploring real-world issues and gain experience in applying their learning in authentic settings.  |   |   | ✓ |   |   |   |   |   |   |   | ✓ |   |   |
| 1.4<br>Innovative<br>Designer   | <b>Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                                 | 1.4.a Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.   |   |   |   |   |   |   |   |   |   |   | ✓ | ✓ |   |
|                                 | 1.4.b Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.  |   |   |   |   |   |   |   |   |   | ✓ | ✓ | ✓ |   |
|                                 | 1.4.c Develop, test and refine prototypes as part of a cyclical design process.   |   |   |   |   |   |   |   |   |   | ✓ | ✓ | ✓ |   |
|                                 | 1.4.d Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.  | ✓ |   |   | ✓ | ✓ |   |   |   | ✓ | ✓ | ✓ | ✓ |   |

## International Society for Technology Education (ISTE) Standards

| Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |
|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|
| Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        | L 3.3  |        |
| A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |

|                              |  |   |  |  |  |   |   |  |  |  |   |   |   |   |
|------------------------------|--|---|--|--|--|---|---|--|--|--|---|---|---|---|
| 1.5<br>Computational Thinker | Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.              |   |  |  |  |   |   |  |  |  |   |   |   |   |
|                              | 1.5.a Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.     |   |  |  |  |   |   |  |  |  |   | ✓ | ✓ |   |
|                              | 1.5.b Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.        |   |  |  |  |   |   |  |  |  | ✓ | ✓ |   |   |
|                              | 1.5.c Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.                    |   |  |  |  |   |   |  |  |  | ✓ | ✓ | ✓ |   |
|                              | 1.5.d Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.  |   |  |  |  | ✓ |   |  |  |  | ✓ | ✓ | ✓ |   |
| 1.6<br>Creative Communicator | Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. |   |  |  |  |   |   |  |  |  |   |   |   |   |
|                              | 1.6.c Use digital tools to visually communicate complex ideas to others.   |   |  |  |  | ✓ |   |  |  |  |   | ✓ | ✓ | ✓ |
| 1.7<br>Global Collaborator   | Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.             |   |  |  |  |   |   |  |  |  |   |   |   |   |
|                              | 1.7.a Use digital tools to connect with peers from a variety of backgrounds recognizing diverse viewpoints and broadening mutual understanding.                                    |   |  |  |  | ✓ |   |  |  |  |   | ✓ | ✓ |   |
|                              | 1.7.b Use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.                  | ✓ |  |  |  |   | ✓ |  |  |  |   |   | ✓ | ✓ |

# International Society for Technology Education (ISTE) Standards

| Unit 4 Securing Systems in Distributed Manufacturing  |   |        |        |        |        |        |            |        |        |        |        |        |       |
|---|---|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|-------|
| Lesson 4.1  |   |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3 |
| A4.1.1  | A4.1.2  | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1 | A4.2.2     | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |       |
| <b>Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.</b>                          |   |        |        |        |        |        |            |        |        |        |        |        |       |
| 1.1 Empowered Learner   | 1.1.a Connect their learning needs, strengths and interests to their goals and use technology to help achieve them and reflect on their progress.   | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          |        |        |        |        |        | ✓     |
|   | 1.1.d Understand fundamental concepts of how technology works, demonstrate the ability to choose and use current technologies effectively, and are adept at thoughtfully exploring emerging technologies. |        | ✓      | ✓      | ✓      | ✓      |            |        |        |        |        |        |       |
| <b>Students recognize the responsibilities and opportunities for contributing to their digital communities.</b>   |   |        |        |        |        |        |            |        |        |        |        |        |       |
| 1.2 Digital Citizen   | 1.2.a Manage their digital identity and understand the lasting impact of their online behaviors on themselves and others and make safe, legal and ethical decisions in the digital world.                 |        | ✓      |        |        |        |            |        |        |        |        |        |       |
|   | 1.2.b Demonstrate empathetic, inclusive interactions online and use technology to responsibly contribute to their communities.  |        | ✓      |        |        |        |            |        |        |        |        |        |       |
|   | 1.2.c Safeguard their well-being by being intentional about what they do online and how much time they spend online.  |        | ✓      |        |        |        |            |        |        |        |        |        |       |
|   | 1.2.d Take action to protect their digital privacy on devices and manage their personal data and security while online.   |        | ✓      | ✓      |        |        |            |        |        |        |        |        |       |
| <b>Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.</b> |   |        |        |        |        |        |            |        |        |        |        |        |       |
| 1.3 Knowledge Constructor   | 1.3.a Use effective research strategies to find resources that support their learning needs, personal interests and creative pursuits.  |        |        |        |        |        |            |        |        |        |        | ✓      |       |
|   | 1.3.b Evaluate the accuracy, validity, bias, origin, and relevance of digital content.  |        |        |        |        |        |            |        |        |        |        | ✓      |       |
|   | 1.3.c Curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.                           |        |        | ✓      | ✓      | ✓      |            |        |        |        |        |        |       |
|   | 1.3.d Build knowledge by exploring real-world issues and gain experience in applying their learning in authentic settings.  |        |        |        |        |        | ✓          | ✓      | ✓      | ✓      | ✓      | ✓      |       |
| <b>Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.</b>  |   |        |        |        |        |        |            |        |        |        |        |        |       |
| 1.4 Innovative Designer   | 1.4.a Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.   |        |        |        |        |        |            |        |        |        |        |        | ✓     |
|   | 1.4.b Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.  |        |        |        |        |        |            |        |        |        |        |        | ✓     |
|   | 1.4.c Develop, test and refine prototypes as part of a cyclical design process.   |        |        |        |        |        | ✓          |        |        |        |        |        | ✓     |
|   | 1.4.d Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.  |        |        |        |        |        |            |        |        |        | ✓      | ✓      | ✓     |

**Unit 4 Securing Systems in Distributed Manufacturing**

**International Society for Technology Education (ISTE) Standards**

|                                      |   | Lesson 4.1 |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |
|--------------------------------------|---|------------|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|
|                                      |   | A4.1.1     | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1     | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |
| <b>1.5<br/>Computational Thinker</b> | <b>Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.</b>              |            |        |        |        |        |        |            |        |        |        |        |        |        |
|                                      | 1.5.a Formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.            |            |        |        |        |        |        |            |        |        |        |        |        | ✓      |
|                                      | 1.5.b Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.               |            |        |        | ✓      |        | ✓      | ✓          |        |        |        |        | ✓      | ✓      |
|                                      | 1.5.c Break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.                           | ✓          |        |        | ✓      | ✓      | ✓      | ✓          |        |        |        |        | ✓      | ✓      |
|                                      | 1.5.d Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.   |            |        |        | ✓      | ✓      | ✓      |            |        |        |        |        |        | ✓      |
| <b>1.6<br/>Creative Communicator</b> | <b>Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.</b> |            |        |        |        |        |        |            |        |        |        |        |        |        |
|                                      | 1.6.a Choose the appropriate platforms and digital tools for meeting the desired objectives of their creation or communication.   |            |        | ✓      |        |        |        |            |        |        |        |        |        |        |
|                                      | 1.6.b Create original works or responsibly repurpose or remix digital resources into new creations.   |            |        | ✓      |        |        |        |            |        |        |        |        |        |        |
|                                      | 1.6.c Use digital tools to visually communicate complex ideas to others.  |            |        | ✓      |        |        |        | ✓          |        |        |        |        |        | ✓      |
|                                      | 1.6.d Publish or present content that customizes the message and medium for their intended audiences.   |            |        | ✓      |        |        |        |            |        |        |        |        |        |        |
| <b>1.7<br/>Global Collaborator</b>   | <b>Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.</b>             |            |        |        |        |        |        |            |        |        |        |        |        |        |
|                                      | 1.7.a Use digital tools to connect with peers from a variety of backgrounds recognizing diverse viewpoints and broadening mutual understanding.   |            |        | ✓      | ✓      | ✓      |        |            |        |        |        |        |        |        |
|                                      | 1.7.c Contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.   | ✓          | ✓      | ✓      | ✓      | ✓      | ✓      |            | ✓      | ✓      |        |        | ✓      | ✓      |
|                                      | 1.7.d Explore local and global issues and use collaborative technologies to work with others to investigate solutions.  |            |        |        |        |        |        |            |        |        |        | ✓      |        |        |

### Standards for Technological and Engineering Literacy (STEL)

|   |  | Unit 1 Introduction to Industry 4.0 |        |        |        |        |        |            |        |        |        |        |        |
|---|--|-------------------------------------|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|
|   |  | Lesson 1.1                          |        |        |        |        |        | Lesson 1.2 |        |        | L 1.3  |        |        |
|   |  | A1.1.1                              | A1.1.2 | A1.1.3 | A1.1.4 | A1.1.5 | A1.1.6 | A1.1.7     | P1.1.8 | A1.2.1 | A1.2.2 | P1.2.3 | B1.3.1 |
| 1 - Nature and Characteristics of Technology and Engineering                | 1R Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system. |                                     |        |        |        |        |        |            |        |        |        |        | ✓      |
| 2 - Core Concepts of Technology and Engineering                             | 2Y Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.                             |                                     |        |        |        |        |        |            | ✓      |        | ✓      | ✓      | ✓      |
|   | 2Z Use management processes in planning, organizing, and controlling work.   |                                     |        |        |        |        |        |            | ✓      |        | ✓      | ✓      | ✓      |
| 7 - Design in Technology and Engineering Education                          | 7W Determine the best approach by evaluating the purpose of the design.  |                                     |        |        |        |        |        |            | ✓      |        | ✓      | ✓      | ✓      |
|   | 7Y Optimize a design by addressing desired qualities within criteria and constraints.  |                                     |        |        |        |        |        |            | ✓      |        | ✓      | ✓      | ✓      |
|   | 7BB Implement the best possible solution to a design.  |                                     |        |        |        |        |        |            | ✓      |        | ✓      | ✓      | ✓      |
| 8 - Applying, Maintaining, and Assessing Technological Products and Systems | 8N Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.            | ✓                                   |        |        |        |        |        |            |        |        |        |        |        |

## Standards for Technological and Engineering Literacy (STEL)

|   |  | Unit 2 Advancing Automation in Manufacturing |        |        |        |        |            |        |        |        |            |        |        |        |        |        |
|---|--|--|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|--------|--------|
|   |  | Lesson 2.1                                   |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |        |        |
|   |  | A2.1.1                                       | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6     | P2.1.7 | A2.2.1 | A2.2.2 | A2.2.3     | P2.2.4 | A2.3.1 | A2.3.2 | P2.3.3 | B2.4.1 |
| <b>1 - Nature and Characteristics of Technology and Engineering</b> | 1R Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.   |  |        |        |        |        |            |        | ✓      |        |            | ✓      | ✓      | ✓      | ✓      | ✓      |
| <b>2 - Core Concepts of Technology and Engineering</b>              | 2T Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making. |  |        |        |        |        |            |        | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓      | ✓      |
|   | 2V Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.   |  |        |        |        | ✓      |            |        |        |        | ✓          | ✓      | ✓      | ✓      | ✓      | ✓      |
|   | 2W Select resources that involve tradeoffs between competing values, such as availability, cost, desirability, and waste while solving problems.   |  |        |        |        |        |            |        |        |        |            |        |        |        |        | ✓      |
|   | 2X Cite examples of the criteria and constraints of a product or system and how they affect final design.  |  |        |        |        |        |            | ✓      |        |        |            | ✓      |        |        |        | ✓      |
|   | 2Y Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.   |  |        |        |        | ✓      |            |        |        |        | ✓          | ✓      | ✓      |        | ✓      | ✓      |
|   | 2Z Use management processes in planning, organizing, and controlling work.   |  |        |        |        |        |            |        |        |        |            |        |        |        |        | ✓      |
| <b>4 - Impacts of Technology</b>                                    | 4Q Critique whether existing and proposed technologies use resources sustainably.  |  |        |        |        |        |            |        |        |        |            |        |        |        |        | ✓      |
|   | 4S Develop a solution to a technological problem that has the least negative environmental and social impact.  |  |        |        |        |        |            |        |        |        |            |        |        |        |        | ✓      |
| <b>7 - Design in Technology and Engineering Education</b>           | 7W Determine the best approach by evaluating the purpose of the design.  | ✓  | ✓      | ✓      |        | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      |        | ✓      |        | ✓      |
|   | 7X Document trade-offs in the technology and engineering design process to produce the optimal design.   |  |        |        |        |        |            |        |        |        | ✓          | ✓      |        |        |        | ✓      |
|   | 7Y Optimize a design by addressing desired qualities within criteria and constraints.  |  |        |        |        | ✓      |            | ✓      |        |        | ✓          | ✓      |        |        |        | ✓      |
|   | 7Z Apply principles of human-centered design.  |  | ✓      |        |        |        |            |        |        |        |            |        |        |        |        |        |
|   | 7AA Illustrate principles, elements and factors of design.   |  |        |        |        |        |            |        |        |        |            | ✓      |        |        |        | ✓      |
|   | 7BB Implement the best possible solution to a design.  |  |        | ✓      | ✓      | ✓      | ✓          | ✓      |        |        | ✓          | ✓      |        |        |        | ✓      |
|   | 7CC Apply a broad range of design skills to their design process.  |  |        | ✓      | ✓      | ✓      | ✓          | ✓      |        |        |            |        |        |        |        | ✓      |

## Standards for Technological and Engineering Literacy (STEL)

|   |  | Unit 2 Advancing Automation in Manufacturing |        |        |        |        |            |        |        |        |            |        |        |        |        |
|---|--|--|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|--------|
|   |  | Lesson 2.1                                   |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |        |
|   |  | A2.1.1                                       | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6     | P2.1.7 | A2.2.1 | A2.2.2 | A2.2.3     | P2.2.4 | A2.3.1 | A2.3.2 | P2.3.3 |
| 8 - Applying, Maintaining, and Assessing Technological Products and Systems | 8P Apply appropriate methods to diagnose, adjust and repair systems to ensure precise, safe and proper functionality | ✓  | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          |        | ✓      |        | ✓      |
|   | 8Q Synthesize data and analyze trends to make decisions about technological products, systems or processes           |  |        |        |        |        |            |        |        |        |            |        | ✓      | ✓      | ✓      |

## Standards for Technological and Engineering Literacy (STEL)

|   |  | Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |
|---|--|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|
|   |  | Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        | L 3.3  |        |
|   |  | A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |
| <b>1 - Nature and Characteristics of Technology and Engineering</b> | 1N Explain how the world around them guides technological development and engineering design.  | ✓  |        |        | ✓      | ✓      | ✓          | ✓      | ✓      |        |        | ✓      |        | ✓      |
|   | 1Q Conduct research to inform intentional inventions and innovations that address specific needs and wants.  |  |        | ✓      | ✓      | ✓      |            |        |        |        | ✓      |        |        |        |
|   | 1R Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.   |  |        |        |        |        |            |        |        |        |        | ✓      |        |        |
| <b>2 - Core Concepts of Technology and Engineering</b>              | 2T Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making. | ✓  | ✓      |        |        | ✓      |            | ✓      | ✓      |        | ✓      | ✓      |        | ✓      |
|   | 2U Diagnose a flawed system embedded within a larger technological, social, or environmental system.   |  |        |        |        |        |            | ✓      | ✓      |        |        |        |        |        |
|   | 2V Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.   |  |        |        |        |        |            | ✓      | ✓      |        |        | ✓      |        |        |
|   | 2W Select resources that involve tradeoffs between competing values, such as availability, cost, desirability, and waste while solving problems.   | ✓  |        |        | ✓      | ✓      |            |        |        |        |        |        |        | ✓      |
|   | 2X Cite examples of the criteria and constraints of a product or system and how they affect final design.  |  |        |        | ✓      | ✓      |            |        |        |        |        | ✓      |        | ✓      |
|   | 2Z Use management processes in planning, organizing, and controlling work.   |  |        |        |        |        |            |        |        |        |        |        |        | ✓      |
| <b>3 - Integration of Knowledge, Technologies, and Practices</b>    | 3H Analyze how technology transfer occurs when a user applies an existing innovation developed for one function to a different purpose.  |  |        | ✓      |        |        | ✓          |        |        | ✓      | ✓      |        |        |        |
|   | 3J Connect technological progress to the advancement of other areas of knowledge.  |  |        |        |        |        | ✓          |        |        |        |        |        |        | ✓      |
| <b>4 - Impacts of Technology</b>                                    | 4P Evaluate ways that technology can impact individuals, society, and the environment.   | ✓  |        | ✓      | ✓      |        |            |        |        |        |        | ✓      | ✓      |        |
|   | 4R Assess a technology that minimizes resource use and resulting waste to achieve a goal.  | ✓  |        |        |        |        |            |        |        |        |        |        |        |        |
| <b>5 - Influence of Society on Technological Development</b>        | 5H Evaluate a technological innovation that arose from a specific society's unique need or want.   | ✓  |        |        |        |        |            |        |        |        |        |        |        |        |

## Standards for Technological and Engineering Literacy (STEL)

| Unit 3 Digital Simulations and Virtual Integration  |        |        |        |        |            |        |        |        |        |        |        |        |  |
|---|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|--|
| Lesson 3.1  |        |        |        |        | Lesson 3.2 |        |        |        |        |        |        | L 3.3  |  |
| A3.1.1  | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |  |
| 7W Determine the best approach by evaluating the purpose of the design.   | ✓      |        | ✓      | ✓      |            |        | ✓      |        |        | ✓      |        |        |  |
| 7X Document trade-offs in the technology and engineering design process to produce the optimal design.                                      | ✓      |        | ✓      | ✓      |            |        |        |        |        | ✓      |        |        |  |
| 7Y Optimize a design by addressing desired qualities within criteria and constraints.   | ✓      | ✓      | ✓      | ✓      |            | ✓      | ✓      |        |        | ✓      | ✓      | ✓      |  |
| 7Z Apply principles of human-centered design.   |        |        | ✓      | ✓      | ✓          |        |        |        |        | ✓      | ✓      |        |  |
| 7BB Implement the best possible solution to a design.   |        |        | ✓      | ✓      |            |        |        | ✓      | ✓      | ✓      | ✓      | ✓      |  |
| 7CC Apply a broad range of design skills to their design process.   |        |        |        |        |            |        |        |        |        |        | ✓      | ✓      |  |
| 8N Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. |        |        |        |        |            | ✓      | ✓      |        | ✓      | ✓      |        |        |  |
| 8P Apply appropriate methods to diagnose, adjust and repair systems to ensure precise, safe and proper functionality                        |        |        |        |        |            |        |        | ✓      | ✓      | ✓      | ✓      | ✓      |  |

## Standards for Technological and Engineering Literacy (STEL)

|   |  | Unit 4 Securing Systems in Distributed Manufacturing |        |        |        |        |            |        |        |        |        |        |        |        |   |
|---|--|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|---|
|   |  | Lesson 4.1   |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |        |   |
|   |  | A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6     | A4.2.1 | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |   |
| <b>1 - Nature and Characteristics of Technology and Engineering</b> | 1N Explain how the world around them guides technological development and engineering design.  |  |        |        |        |        |            |        |        |        |        | ✓      |        |        |   |
|   | 1O Assess how similarities and differences among scientific, mathematical, engineering, and technological knowledge and skills contributed to the design of a product or system.                                 |  |        |        |        |        |            |        |        |        |        | ✓      |        |        |   |
|   | 1Q Conduct research to inform intentional inventions and innovations that address specific needs and wants.  |  |        |        |        |        |            |        |        |        |        | ✓      |        |        |   |
|   | 1R Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.   |  |        |        |        |        |            |        |        |        |        | ✓      |        | ✓      |   |
| <b>2 - Core Concepts of Technology and Engineering</b>              | 2T Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making. |  |        |        |        |        |            | ✓      | ✓      |        |        |        |        | ✓      |   |
|   | 2U Diagnose a flawed system embedded within a larger technological, social, or environmental system.   | ✓  | ✓      | ✓      |        |        |            |        |        | ✓      |        |        |        | ✓      |   |
|   | 2V Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.   |  |        |        |        |        |            |        |        |        |        |        |        | ✓      |   |
|   | 2W Select resources that involve tradeoffs between competing values, such as availability, cost, desirability, and waste while solving problems.   |  |        |        |        |        |            | ✓      | ✓      | ✓      | ✓      |        |        | ✓      |   |
|   | 2X Cite examples of the criteria and constraints of a product or system and how they affect final design.  |  |        |        |        |        |            |        |        |        |        | ✓      | ✓      | ✓      |   |
|   | 2Y Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.   |  |        |        |        |        |            |        |        |        |        |        |        |        | ✓ |
|   | 2Z Use management processes in planning, organizing, and controlling work.   |  |        |        |        |        |            | ✓      | ✓      |        | ✓      | ✓      | ✓      | ✓      |   |
| <b>4 - Impacts of Technology</b>                                    | 4P Evaluate ways that technology can impact individuals, society, and the environment.   | ✓  | ✓      | ✓      |        |        |            |        |        |        |        |        |        |        |   |
| <b>6 - History of Technology</b>                                    | 6F Relate how technological development has been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.   |  |        | ✓      |        |        |            |        |        |        |        |        |        |        |   |
|   | 6H Evaluate how technology has been a powerful force in reshaping the social, cultural, political, and economic landscapes throughout history.   |  |        | ✓      |        |        |            |        |        |        |        |        |        |        |   |

## Standards for Technological and Engineering Literacy (STEL)

| Unit 4 Securing Systems in Distributed Manufacturing   |        |        |        |        |        |            |        |        |        |        |        |        |   |
|--|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|---|
| Lesson 4.1   |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |   |
| A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1     | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |   |
| 7W Determine the best approach by evaluating the purpose of the design.  |        |        |        |        |        |            |        |        |        |        |        |        | ✓ |
| 7X Document trade-offs in the technology and engineering design process to produce the optimal design.               |        |        |        |        |        |            |        |        |        | ✓      |        |        | ✓ |
| 7Y Optimize a design by addressing desired qualities within criteria and constraints.                                |        |        |        |        |        |            |        |        |        | ✓      | ✓      |        | ✓ |
| 7Z Apply principles of human-centered design.  |        | ✓      | ✓      | ✓      |        |            |        |        |        |        |        |        |   |
| 7AA Illustrate principles, elements and factors of design.   |        |        |        |        |        |            |        |        |        | ✓      |        |        |   |
| 7BB Implement the best possible solution to a design.  |        |        |        |        |        |            |        |        |        | ✓      | ✓      |        | ✓ |
| 7CC Apply a broad range of design skills to their design process.  |        |        |        |        |        |            |        |        |        |        |        |        | ✓ |
| 8 - Applying, Maintaining, and Assessing Technological Products and Systems  |        |        |        |        |        |            |        |        |        |        |        |        |   |
| 8O Develop a device or system for the marketplace.   |        |        |        |        |        |            |        |        |        | ✓      |        |        |   |
| 8P Apply appropriate methods to diagnose, adjust and repair systems to ensure precise, safe and proper functionality |        |        |        |        | ✓      | ✓          | ✓      |        |        |        |        |        | ✓ |

# Competency Model Clearinghouse: Advanced Manufacturing Competency Model

Tier 4: Industry-Wide Technical Competencies

| Unit 1 Introduction to Industry 4.0  |  |        |        |        |        |        |        |            |        |        |        |   |   |
|--|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|---|---|
| Lesson 1.1   |  |        |        |        |        |        |        | Lesson 1.2 |        |        | L 1.3  |   |   |
| A1.1.1   | A1.1.2   | A1.1.3 | A1.1.4 | A1.1.5 | A1.1.6 | A1.1.7 | P1.1.8 | A1.2.1     | A1.2.2 | P1.2.3 | B1.3.1 |   |   |
| <b>4.1 Manufacturing Process Design / Development:</b><br>Research design, implement, and continuously improve the manufacturing process to ensure product meets customer needs. | <b>4.1.1 Critical Work Functions</b>                           |        |        |        |        |        |        |            |        |        |        |   |   |
|  | 4.1.1.1 Support manufacturing process design and development.  | ✓      |        |        |        |        |        |            |        |        |        |   |   |
|  | 4.1.1.2 Design production and production support systems.      | ✓      |        |        |        |        |        |            |        |        |        |   |   |
|  | <b>4.1.7 Testing / Troubleshooting</b>                         |        |        |        |        |        |        |            |        |        |        |   |   |
|  | 4.1.7.2 Data analysis and verification                         | ✓      |        |        |        |        |        |            |        |        |        |   |   |
|  | <b>4.1.9 Workflow Assessment</b>                               |        |        |        |        |        |        |            |        |        |        |   |   |
| 4.1.9.3 Manufacturing/processing concept planning  | ✓  |        |        |        |        |        |        |            |        |        |        |   |   |
| <b>4.2 Operations Management:</b><br>Set up, operate, monitor, control, and improve manufacturing processes and schedules to meet customer requirements.                         | <b>4.2.6 Automated Systems and Control Operations</b>          |        |        |        |        |        |        |            |        |        |        |   |   |
|  | 4.2.6.1 Automated equipment                                    |        |        | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      |        | ✓      | ✓ | ✓ |
|  | 4.2.6.2 Automated systems                                      |        |        | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      |        | ✓      | ✓ | ✓ |
|  | 4.2.6.6 Robotics   |        | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      |        | ✓      | ✓ | ✓ |
|  | <b>4.2.7 Manufacturing Process Applications and Operations</b> |        |        |        |        |        |        |            |        |        |        |   |   |
|  | 4.2.7.1 Assembly processes                                     | ✓      |        |        |        |        |        |            |        |        |        |   |   |
| <b>4.2.9 Industrial Productions</b>  |  |        |        |        |        |        |        |            |        |        |        |   |   |
| 4.2.9.3 Motion control   |  | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          |        | ✓      | ✓      | ✓ |   |
| <b>4.3 Maintenance, Installation, and Repair:</b><br>Maintain and optimize manufacturing equipment and systems.  | <b>4.3.1 Critical Work Functions</b>                           |        |        |        |        |        |        |            |        |        |        |   |   |
|  | 4.3.1.6 Maintain equipment, tools, and workstations.           |        |        |        | ✓      | ✓      | ✓      | ✓          | ✓      |        | ✓      | ✓ | ✓ |
|  | <b>4.3.2 General Skills</b>                                    |        |        |        |        |        |        |            |        |        |        |   |   |
|  | 4.3.2.1 Disassembly/assembly skills                            | ✓      | ✓      |        |        |        |        |            |        |        |        |   |   |
|  | 4.3.2.6 Use of hand tools                                      | ✓      | ✓      |        |        |        |        |            |        |        |        |   |   |
|  | 4.3.2.8 Use of hardware and software tools                     |        | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      |        | ✓      | ✓ | ✓ |
| 4.3.2.9 Technical documentation  | ✓  |        |        |        |        |        |        | ✓          |        | ✓      | ✓      | ✓ |   |

# Competency Model Clearinghouse: Advanced Manufacturing Competency Model

Tier 4: Industry-Wide Technical Competencies

| Unit 1 Introduction to Industry 4.0 |        |        |        |        |        |        |        |            |        |        |        |
|-------------------------------------|--------|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|
| Lesson 1.1                          |        |        |        |        |        |        |        | Lesson 1.2 |        |        | L 1.3  |
| A1.1.1                              | A1.1.2 | A1.1.3 | A1.1.4 | A1.1.5 | A1.1.6 | A1.1.7 | P1.1.8 | A1.2.1     | A1.2.2 | P1.2.3 | B1.3.1 |

|  |   |   |  |  |  |  |  |   |   |   |   |   |   |
|--|---|---|--|--|--|--|--|---|---|---|---|---|---|
| <b>4.4 Production in the Supply Chain / Supply Chain Logistics</b><br>Plan and monitor the movement and storage of materials and products in coordination with suppliers, internal systems, and customers. | <b>4.4.5 Executing Operations</b>                           |   |  |  |  |  |  |   |   |   |   |   |   |
|  | 4.4.5.4 Evaluating performance of operations                | ✓ |  |  |  |  |  |   | ✓ |   | ✓ | ✓ | ✓ |
|  | <b>4.4.10 Supply-chain Management</b>                       |   |  |  |  |  |  |   |   |   |   |   |   |
|  | 4.4.10.2 Just-in-time/Lean manufacturing                    |   |  |  |  |  |  | ✓ | ✓ | ✓ |   | ✓ | ✓ |
|  | <b>4.4.11 Workflow</b>                                      |   |  |  |  |  |  |   |   |   |   |   |   |
|  | 4.4.11.1 Material handling                                  | ✓ |  |  |  |  |  |   |   |   |   |   |   |
| <b>4.5 Quality Assurance and Continuous Improvement:</b><br>Ensure product and process meets quality system requirements as defined by customer specifications.  | <b>4.5.1 Critical Work Functions</b>                        |   |  |  |  |  |  |   |   |   |   |   |   |
|  | 4.5.1.3 Monitor production for product and process quality. | ✓ |  |  |  |  |  |   |   |   |   |   |   |
|  | 4.5.6 Principles of Lean Manufacturing                      |   |  |  |  |  |  | ✓ | ✓ | ✓ |   | ✓ | ✓ |

# Competency Model Clearinghouse: Advanced Manufacturing Competency Model

Tier 4: Industry-Wide Technical Competencies

| Unit 2 Advancing Automation in Manufacturing   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|--|---|--------|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|---|
| Lesson 2.1   |   |        |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |   |
| A2.1.1   | A2.1.2  | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6 | P2.1.7 | A2.2.1     | A2.2.2 | A2.2.3 | P2.2.4 | A2.3.1     | A2.3.2 | P2.3.3 | B2.4.1 |   |
| <b>4.1 Manufacturing Process Design / Development:</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| Research design, implement, and continuously improve the manufacturing process to ensure product meets customer needs. |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| <b>4.1.1 Critical Work Functions</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.1.1.1  | Support manufacturing process design and development.   |        |        |        |        |        |            |        |        |        |            | ✓      | ✓      | ✓      | ✓ |
| 4.1.1.2  | Design production and production support systems.   |        |        |        |        |        |            |        |        |        |            |        |        |        | ✓ |
| 4.1.1.4  | Develop functional specifications for the design and development of control systems.  |        |        |        |        |        |            |        |        | ✓      | ✓          | ✓      |        |        | ✓ |
| <b>4.1.5 Design Lifecycle and Concepts</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.1.5.1  | "Design for X" (design within constraints)  |        |        |        |        |        |            |        |        |        | ✓          |        |        |        |   |
| <b>4.1.7 Testing / Troubleshooting</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.1.7.2  | Data analysis and verification  |        |        |        |        |        |            |        |        |        |            | ✓      | ✓      | ✓      | ✓ |
| <b>4.1.9 Workflow Assessment</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.1.9.3  | Manufacturing/processing concept planning   |        |        |        |        |        | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓ |
| 4.1.9.5  | Plant layout planning and analysis (design optimization, walk path, workflow)   |        |        |        |        |        |            | ✓      |        |        |            |        | ✓      |        | ✓ |
| 4.1.9.10   | Process simulation tools (e.g., die press lines, manufacturing lines)   |        |        |        |        |        | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      |   |
| <b>4.2 Operations Management:</b>  |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| Set up, operate, monitor, control, and improve manufacturing processes and schedules to meet customer requirements.    |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| <b>4.2.1 Critical Work Functions</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.2.1.4  | Operate and control production/lab equipment.   |        |        |        |        |        | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓ |
| 4.2.1.5  | Perform manufacturing process applications and operations.  |        |        |        |        |        | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      |   |
| 4.2.1.8  | Monitor industrial processes and systems.   |        |        |        |        |        | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓ |
| <b>4.2.2 Systems</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.2.2.1  | Linkages among mechanical, hydraulic, pneumatic, electrical, control, computer, and other types of processes and components |        |        |        |        |        |            |        |        |        | ✓          | ✓      | ✓      |        | ✓ |
| <b>4.2.4 Precision Measurement</b>   |   |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.2.4.6  | Electrical measurement instruments and techniques (e.g., digital multimeter, voltmeter)                                     |        |        |        |        |        |            |        |        |        |            |        |        | ✓      | ✓ |

# Competency Model Clearinghouse: Advanced Manufacturing Competency Model

Tier 4: Industry-Wide Technical Competencies

| Unit 2 Advancing Automation in Manufacturing                   |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|---|
| Lesson 2.1   |        |        |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |   |
| A2.1.1   | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6 | P2.1.7 | A2.2.1     | A2.2.2 | A2.2.3 | P2.2.4 | A2.3.1     | A2.3.2 | P2.3.3 | B2.4.1 |   |
| <b>4.2.6 Automated Systems and Control Operations</b>          |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.2.6.1 Automated equipment                                    | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          |        |        |        | ✓ |
| 4.2.6.2 Automated systems                                      | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          |        |        |        | ✓ |
| 4.2.6.3 Computer control                                       |        |        |        | ✓      | ✓      | ✓      | ✓          | ✓      |        |        |            |        |        |        |   |
| 4.2.6.5 Pneumatic systems                                      |        |        |        |        |        | ✓      | ✓          |        |        |        |            |        |        |        | ✓ |
| 4.2.6.6 Robotics   | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓ |
| <b>4.2.7 Manufacturing Process Applications and Operations</b> |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.2.7.1 Assembly processes                                     | ✓      |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| <b>4.2.9 Industrial Productions</b>                            |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.2.9.3 Motion control   |        | ✓      | ✓      |        | ✓      | ✓      | ✓          |        |        |        |            |        |        |        | ✓ |
| <b>4.2.11 Production / Process Monitoring</b>                  |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.2.11.1 Calibration   |        |        |        |        |        |        |            |        |        |        |            |        | ✓      |        | ✓ |
| 4.2.11.2 Process troubleshooting                               |        |        |        |        |        |        |            |        |        |        |            |        |        |        | ✓ |
| 4.2.11.3 Controlling process flow                              |        |        |        |        |        |        |            |        |        |        |            |        |        |        | ✓ |
| 4.2.11.5 Environmental parameters                              |        |        |        |        |        |        |            | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓ |
| <b>4.3.1 Critical Work Functions</b>                           |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.3.1.6 Maintain equipment, tools, and workstations.           |        | ✓      | ✓      |        | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          |        |        |        | ✓ |
| 4.3.1.7 Utilize predictive maintenance techniques.             |        |        |        |        |        |        |            |        |        |        |            | ✓      |        | ✓      |   |
| <b>4.3.2 General Skills</b>                                    |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |
| 4.3.2.1 Disassembly/assembly skills                            | ✓      |        |        |        | ✓      | ✓      |            | ✓      |        | ✓      | ✓          |        |        |        | ✓ |
| 4.3.2.4 Installation and calibration of instrumentation        |        |        | ✓      |        | ✓      |        |            |        |        |        |            |        |        |        |   |
| 4.3.2.6 Use of hand tools                                      | ✓      |        |        |        | ✓      | ✓      |            | ✓      |        | ✓      | ✓          |        |        |        | ✓ |
| 4.3.2.8 Use of hardware and software tools                     | ✓      | ✓      | ✓      |        | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓ |
| 4.3.2.9 Technical documentation                                | ✓      |        |        |        | ✓      | ✓      |            | ✓      | ✓      | ✓      | ✓          |        |        |        | ✓ |

# Competency Model Clearinghouse: Advanced Manufacturing Competency Model

Tier 4: Industry-Wide Technical Competencies

| Unit 2 Advancing Automation in Manufacturing |        |        |        |        |        |        |            |        |        |        |            |        |        |        |
|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|
| Lesson 2.1                                   |        |        |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |
| A2.1.1                                       | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6 | P2.1.7 | A2.2.1     | A2.2.2 | A2.2.3 | P2.2.4 | A2.3.1     | A2.3.2 | P2.3.3 | B2.4.1 |

|  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <b>4.4 Production in the Supply Chain:</b><br>Plan and monitor the movement and storage of materials and products in coordination with suppliers, internal systems, and customers. | <b>4.4.2 Automated Material Handling</b>                    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.4.2.1 Automated material handling and distributed systems |   |   | ✓ |   | ✓ | ✓ | ✓ |   |   |   | ✓ |   |   | ✓ |
|  | <b>4.4.5 Executing Operations</b>                           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.4.5.3 Executing plans and implementing controls           |   | ✓ | ✓ |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   | ✓ |
|  | 4.4.5.4 Evaluating performance of operations                |   | ✓ | ✓ |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   | ✓ |
|  | <b>4.4.10 Supply-chain Management</b>                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.4.10.2 Just-in-time/Lean manufacturing                    |   |   | ✓ |   |   | ✓ |   | ✓ |   | ✓ |   | ✓ | ✓ | ✓ |
|  | <b>4.4.11 Workflow</b>                                      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4.4.11.1 Material handling   | ✓   |   | ✓ |   | ✓ | ✓ | ✓ | ✓ |   |   | ✓ |   |   | ✓ |   |
| <b>4.5 Quality Assurance and Continuous Improvement:</b><br>Ensure product and process meets quality system requirements as defined by customer specifications.                    | <b>4.5.1 Critical Work Functions</b>                        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.5.1.3 Monitor production for product and process quality. | ✓ |   |   |   |   |   |   |   |   |   |   | ✓ | ✓ |   |
|  | 4.5.1.8 Implement controls to support quality management.   |   |   |   |   |   |   |   |   |   |   |   | ✓ | ✓ |   |
|  | <b>4.5.6 Principles of Lean Manufacturing</b>               |   |   | ✓ |   |   | ✓ |   | ✓ |   | ✓ |   | ✓ | ✓ | ✓ |
|  | <b>4.5.12 Data Analysis and Presentation</b>                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4.5.12.1 Facilitation and data visualization   |   |   |   |   |   |   |   |   | ✓ |   |   | ✓ | ✓ | ✓ |   |

# Competency Model Clearinghouse: Advanced Manufacturing Competency Model

Tier 4: Industry-Wide Technical Competencies

| Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |
|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|
| Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        |        | L 3.3  |
| A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |

|  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <b>4.1 Manufacturing Process Design / Development:</b><br>Research design, implement, and continuously improve the manufacturing process to ensure product meets customer needs. | <b>4.1.1 Critical Work Functions</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.1.1.1 Support manufacturing process design and development.   |   |   | ✓ | ✓ |   |   |   |   |   |   | ✓ | ✓ | ✓ |
|  | 4.1.1.2 Design production and production support systems.   |   |   |   |   |   |   |   |   |   |   | ✓ | ✓ |   |
|  | 4.1.1.4 Develop functional specifications for the design and development of control systems.  |   |   |   |   |   |   |   |   |   |   | ✓ | ✓ |   |
|  | <b>4.1.2 Technical Drawings and Schematics</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.1.2.1 Computer-aided design (CAD) drawing   |   | ✓ | ✓ |   |   |   |   |   |   |   |   |   |   |
|  | <b>4.1.5 Design Lifecycle and Concepts</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.1.5.1 "Design for X" (design within constraints)  |   |   | ✓ |   |   |   |   |   |   |   |   | ✓ | ✓ |
|  | <b>4.1.7 Testing / Troubleshooting</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.1.7.2 Data analysis and verification  |   | ✓ |   |   |   |   |   |   |   |   |   |   |   |
| <b>4.1.9 Workflow Assessment</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4.1.9.3 Manufacturing/processing concept planning  | ✓   |   | ✓ | ✓ | ✓ |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |
| 4.1.9.5 Plant layout planning and analysis (design optimization, walk path, workflow)  | ✓   | ✓ |   |   |   |   |   |   |   | ✓ |   | ✓ | ✓ |   |
| 4.1.9.10 Process simulation tools (e.g., die press lines, manufacturing lines)   | ✓   | ✓ | ✓ |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |
| <b>4.2 Operations Management:</b><br>Set up, operate, monitor, control, and improve manufacturing processes and schedules to meet customer requirements.                         | <b>4.2.1 Critical Work Functions</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.1.4 Operate and control production/lab equipment.   |   |   |   |   |   | ✓ |   |   | ✓ | ✓ |   | ✓ | ✓ |
|  | <b>4.2.2 Systems</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.2.1 Linkages among mechanical, hydraulic, pneumatic, electrical, control, computer, and other types of processes and components |   |   |   |   |   |   |   |   |   | ✓ |   |   |   |
|  | 4.2.2.3 Interdependence of teams, work units, departments, organizations, interorganizational systems, and the larger environment   |   |   |   |   | ✓ |   |   |   |   | ✓ | ✓ |   |   |
| <b>4.2.6 Automated Systems and Control Operations</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4.2.6.6 Robotics   | ✓   |   | ✓ | ✓ | ✓ |   |   |   |   | ✓ | ✓ | ✓ | ✓ | ✓ |

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Tier 4: Industry-Wide Technical Competencies

| Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |
|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|
| Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        |        | L 3.3  |
| A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |

|  |  |  |  |   |   |   |   |   |   |   |   |   |   |
|--|--|--|--|---|---|---|---|---|---|---|---|---|---|
| <b>4.2 Operations Management:</b><br>Set up, operate, monitor, control, and improve manufacturing processes and schedules to meet customer requirements.   | <b>4.2.7 Manufacturing Process Applications and Operations</b> |  |  |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.7.1 Assembly processes                                     |  |  |   |   |   |   |   |   |   |   |   | ✓ |
|  | 4.2.7.2 Fabrication processes                                  |  |  | ✓ |   |   |   |   |   |   |   |   |   |
|  | 4.2.7.3 Electrical/electronics manufacturing processes         |  |  |   |   |   |   |   |   |   |   | ✓ |   |
|  | <b>4.2.9 Industrial Productions</b>                            |  |  |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.9.3 Motion control   |  |  |   | ✓ |   |   |   |   |   |   |   |   |
|  | <b>4.2.11 Production / Process Monitoring</b>                  |  |  |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.11.2 Process troubleshooting                               |  |  |   |   |   |   |   |   | ✓ | ✓ | ✓ | ✓ |
| 4.2.11.3 Controlling process flow  | ✓  |  |  |   | ✓ |   |   |   | ✓ | ✓ | ✓ | ✓ |   |
| 4.2.11.5 Environmental parameters  | ✓  |  |  | ✓ | ✓ |   |   |   |   | ✓ |   |   |   |
| <b>4.3 Maintenance, Installation, and Repair:</b><br>Maintain and optimize manufacturing equipment and systems.  | <b>4.3.2 General Skills</b>                                    |  |  |   |   |   |   |   |   |   |   |   |   |
|  | 4.3.2.8 Use of hardware and software tools                     |  |  |   |   | ✓ |   |   |   |   |   | ✓ |   |
|  | 4.3.2.9 Technical documentation                                |  |  | ✓ | ✓ | ✓ |   | ✓ | ✓ |   | ✓ | ✓ | ✓ |
| <b>4.4 Production in the Supply Chain / Supply Chain Logistics</b><br>Plan and monitor the movement and storage of materials and products in coordination with suppliers, internal systems, and customers. | <b>4.4.2 Automated Material Handling</b>                       |  |  |   |   |   |   |   |   |   |   |   |   |
|  | 4.4.2.1 Automated material handling and distributed systems    |  |  |   |   |   | ✓ |   |   |   |   |   |   |
|  | <b>4.4.5 Executing Operations</b>                              |  |  |   |   |   |   |   |   |   |   |   |   |
|  | 4.4.5.4 Evaluating performance of operations                   |  |  |   |   |   |   |   |   |   |   | ✓ |   |
|  | <b>4.4.11 Workflow</b>   |  |  |   |   |   |   |   |   |   |   |   |   |
|  | 4.4.11.1 Material handling                                     |  |  |   |   |   | ✓ |   |   |   |   | ✓ |   |
| 4.4.11.2 Plant facility and capacity   | ✓  |  |  |   |   |   |   |   |   |   |   |   |   |

## Competency Model Clearinghouse: Advanced Manufacturing

### Competency Model

Tier 4: Industry-Wide Technical Competencies

| Unit 4 Securing Systems in Distributed Manufacturing |        |        |        |        |        |            |        |        |        |        |        |        |
|--|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|
| Lesson 4.1   |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |
| A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1     | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |

|  |   |  |   |   |   |   |   |   |   |   |   |   |   |
|--|---|--|---|---|---|---|---|---|---|---|---|---|---|
| <b>4.1 Manufacturing Process Design / Development:</b><br>Research design, implement, and continuously improve the manufacturing process to ensure product meets customer needs. | <b>4.1.1 Critical Work Functions</b>  |  |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.1.1.1 Support manufacturing process design and development.   |  |   |   |   |   |   |   |   |   |   |   | ✓ |
|  | 4.1.1.4 Develop functional specifications for the design and development of control systems.                                      |  |   |   |   |   |   |   |   |   |   |   | ✓ |
|  | <b>4.1.7 Testing / Troubleshooting</b>  |  |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.1.7.2 Data analysis and verification  |  |   |   | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   | ✓ |
|  | <b>4.1.9 Workflow Assessment</b>  |  |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.1.9.3 Manufacturing/processing concept planning   |  |   |   |   |   |   | ✓ | ✓ | ✓ | ✓ |   | ✓ |
|  | 4.1.9.5 Plant layout planning and analysis (design optimization, walk path, workflow)   |  |   |   |   |   |   |   |   |   |   |   | ✓ |
| 4.1.9.10 Process simulation tools (e.g., die press lines, manufacturing lines)   |   |  |   | ✓ | ✓ | ✓ |   |   |   |   |   | ✓ |   |
| <b>4.2 Operations Management:</b><br>Set up, operate, monitor, control, and improve manufacturing processes and schedules to meet customer requirements.                         | <b>4.2.1 Critical Work Functions</b>  |  |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.1.4 Operate and control production/lab equipment.   |  | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   | ✓ |
|  | 4.2.1.5 Perform manufacturing process applications and operations.  |  |   |   |   |   |   |   |   |   |   |   | ✓ |
|  | 4.2.1.7 Support the operation and control of production/process equipment.  |  |   |   |   |   |   |   |   |   |   |   | ✓ |
|  | 4.2.1.8 Monitor industrial processes and systems.   |  |   |   |   |   | ✓ |   |   |   |   |   | ✓ |
|  | <b>4.2.2 Systems</b>  |  |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.2.3 Interdependence of teams, work units, departments, organizations, interorganizational systems, and the larger environment |  |   |   |   |   |   | ✓ | ✓ | ✓ | ✓ |   | ✓ |
|  | <b>4.2.6 Automated Systems and Control Operations</b>   |  |   |   |   |   |   |   |   |   |   |   |   |
|  | 4.2.6.1 Automated equipment   |  |   |   |   |   |   |   |   |   |   |   | ✓ |
|  | 4.2.6.2 Automated systems   |  |   |   |   |   |   |   |   |   |   |   | ✓ |
| 4.2.6.3 Computer control   |   |  |   |   |   |   |   |   |   |   |   | ✓ |   |
| 4.2.6.5 Pneumatic systems  |   |  |   |   |   |   |   |   |   |   |   | ✓ |   |
| 4.2.6.6 Robotics   |   |  |   |   |   |   |   |   |   |   |   | ✓ |   |

**Competency Model Clearinghouse: Advanced Manufacturing  
Competency Model**

**Tier 4: Industry-Wide Technical Competencies**

| Unit 4 Securing Systems in Distributed Manufacturing |        |        |        |        |        |            |        |        |        |        |        |        |
|--|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|
| Lesson 4.1   |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |
| A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1     | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |

|  |   |   |   |  |   |  |   |   |   |   |   |   |   |
|--|---|---|---|--|---|--|---|---|---|---|---|---|---|
| <b>4.2 Operations Management:</b><br>Set up, operate, monitor, control, and improve manufacturing processes and schedules to meet customer requirements.   | <b>4.2.11 Production / Process Monitoring</b>               |   |   |  |   |  |   |   |   |   |   |   |   |
|  | 4.2.11.2 Process troubleshooting                            |   |   |  |   |  |   |   |   |   |   |   | ✓ |
|  | 4.2.11.3 Controlling process flow                           |   |   |  |   |  |   |   |   |   |   |   | ✓ |
|  | 4.2.11.5 Environmental parameters                           |   |   |  |   |  |   | ✓ | ✓ |   |   |   |   |
| <b>4.3 Maintenance, Installation, and Repair:</b><br>Maintain and optimize manufacturing equipment and systems.  | <b>4.3.1 Critical Work Functions</b>                        |   |   |  |   |  |   |   |   |   |   |   |   |
|  | 4.3.1.6 Maintain equipment, tools, and workstations.        |   |   |  |   |  |   |   |   |   |   |   | ✓ |
|  | <b>4.3.2 General Skills</b>                                 |   |   |  |   |  |   |   |   |   |   |   |   |
|  | 4.3.2.6 Use of hand tools                                   |   |   |  |   |  |   |   |   |   |   | ✓ |   |
|  | 4.3.2.8 Use of hardware and software tools                  |   |   |  |   |  |   |   |   |   |   |   | ✓ |
| 4.3.2.9 Technical documentation  |   |   | ✓ |  |   |  |   |   |   |   |   | ✓ |   |
| <b>4.4 Production in the Supply Chain / Supply Chain Logistics</b><br>Plan and monitor the movement and storage of materials and products in coordination with suppliers, internal systems, and customers. | <b>4.4.2 Automated Material Handling</b>                    |   |   |  |   |  |   |   |   |   |   |   |   |
|  | 4.4.2.2 Integrated supply chain information technology      |   |   |  |   |  | ✓ | ✓ | ✓ | ✓ |   | ✓ | ✓ |
|  | <b>4.4.10 Supply-chain Management</b>                       |   |   |  |   |  |   |   |   |   |   |   |   |
|  | 4.4.10.2 Just-in-time/Lean manufacturing                    | ✓ |   |  | ✓ |  | ✓ | ✓ |   |   | ✓ | ✓ |   |
|  | <b>4.4.11 Workflow</b>                                      |   |   |  |   |  |   |   |   |   |   |   |   |
| 4.4.11.1 Material handling   |   |   |   |  |   |  |   |   |   | ✓ |   | ✓ | ✓ |
| <b>4.5 Quality Assurance and Continuous Improvement:</b><br>Ensure product and process meets quality system requirements as defined by customer specifications.  | <b>4.5.1 Critical Work Functions</b>                        |   |   |  |   |  |   |   |   |   |   |   |   |
|  | 4.5.1.3 Monitor production for product and process quality. |   |   |  |   |  |   |   |   |   |   |   | ✓ |
|  | 4.5.6 Principles of Lean Manufacturing                      | ✓ |   |  | ✓ |  | ✓ | ✓ |   |   | ✓ | ✓ | ✓ |
|  | <b>4.5.12 Data Analysis and Presentation</b>                |   |   |  |   |  |   |   |   |   |   |   |   |
|  | 4.5.12.1 Facilitation and data visualization                |   |   |  | ✓ |  |   |   |   |   |   |   |   |
| 4.5.12.2 Query-based computer skills   |   |   |   |  |   |  | ✓ |   |   |   |   |   |   |

# NICE Workforce Framework for Cybersecurity

V2.1.0 TKS Statements

|           |   | Unit 4 Securing Systems in Distributed Manufacturing |        |        |        |        |        |            |        |        |        |        |        |        |
|-----------|---|--|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|
|           |   | Lesson 4.1   |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |
|           |   | A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1     | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |
| Knowledge | K0728 Knowledge of Confidentiality, Integrity and Availability (CIA) principles and practices | ✓  |        |        |        |        |        |            |        |        |        |        |        |        |
|           | K1173 Knowledge of multilevel security requirements   | ✓  |        |        |        |        |        |            |        |        |        |        |        |        |
|           | K1087 Knowledge of social engineering tools and techniques                                    |  | ✓      |        |        |        |        |            |        |        |        |        |        |        |
|           | K0807 Knowledge of web mail tools and techniques  |  | ✓      |        |        |        |        |            |        |        |        |        |        |        |
|           | K0830 Knowledge of password policies and procedures   |  | ✓      |        |        |        |        |            |        |        |        |        |        |        |
|           | K0857 Knowledge of malware analysis tools and techniques                                      |  |        | ✓      |        |        |        |            |        |        |        |        |        |        |
|           | K1248 Knowledge of digital and physical security vulnerabilities                              |  |        | ✓      |        |        |        |            |        |        |        |        |        |        |
|           | K1096 Knowledge of data analysis tools and techniques   |  |        |        | ✓      |        |        |            |        |        |        |        |        |        |
|           | K1145 Knowledge of data encryption practices and principles                                   |  |        |        |        | ✓      |        |            |        |        |        |        |        |        |
|           | K1167 Knowledge of data sanitization methods  |  |        |        | ✓      |        |        |            |        |        |        |        |        |        |
|           | K0723 Knowledge of vulnerability data sources   |  |        |        |        | ✓      |        |            |        |        |        |        |        |        |
| Skills    | S0854 Skill in performing data analysis   |  |        |        | ✓      |        |        |            |        |        |        |        |        |        |
|           | S0402 Skill in verifying data   |  |        |        | ✓      |        |        |            |        |        |        |        |        |        |
|           | S0403 Skill in validating data  |  |        |        | ✓      |        |        |            |        |        |        |        |        |        |
|           | S0494 Skill in performing operational environment analysis                                    |  |        |        | ✓      |        |        |            |        |        |        |        |        |        |
| Tasks     | T0513 Perform operational testing   |  |        |        |        |        |        |            |        |        |        |        |        |        |
|           | T1830 Test internally developed software  |  |        |        |        | ✓      |        |            |        |        |        |        |        |        |
|           | T1309 Analyze system capabilities and requirements  |  |        |        |        |        | ✓      |            |        |        |        |        |        |        |
|           | T1506 Analyze software and hardware testing results   |  |        |        |        |        | ✓      |            |        |        |        |        |        |        |
|           | T1513 Conduct trial runs of programs and software applications                                |  |        |        |        | ✓      | ✓      |            |        |        |        |        |        | ✓      |
|           | T1708 Prepare operational assessment reports  |  |        |        |        |        | ✓      |            |        |        |        |        |        |        |

## Smart Automation Certification Alliance (SACA)

### 1.1.1 Industry 4.0 Concepts

|  |   | Unit 1 Introduction to Industry 4.0 |        |        |        |        |        |        |            |        |        |        |        |
|--|---|-------------------------------------|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|
|  |   | Lesson 1.1                          |        |        |        |        |        |        | Lesson 1.2 |        |        | L 1.3  |        |
|  |   | A1.1.1                              | A1.1.2 | A1.1.3 | A1.1.4 | A1.1.5 | A1.1.6 | A1.1.7 | P1.1.8     | A1.2.1 | A1.2.2 | P1.2.3 | B1.3.1 |
|  | 101.1.1 Identify Industry 4.0 components and their functions. |                                     |        |        |        |        |        |        |            | ✓      |        |        |        |
|  | 101.1.5 Identify basic robot elements.                        |                                     | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      | ✓          | ✓      | ✓      | ✓      | ✓      |

|  |  | Unit 2 Advancing Automation in Manufacturing |        |        |        |        |            |        |        |        |            |        |        |        |        |
|--|--|--|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|--------|
|  |  | Lesson 2.1                                   |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |        |
|  |  | A2.1.1                                       | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6     | P2.1.7 | A2.2.1 | A2.2.2 | A2.2.3     | P2.2.4 | A2.3.1 | A2.3.2 | P2.3.3 |
|  | 101.1.5 Identify basic robot elements. |  | ✓      | ✓      |        | ✓      | ✓          |        |        |        |            |        |        |        |        |

|  |   | Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |
|--|---|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|
|  |   | Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        | L 3.3  |        |
|  |   | A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |
|  | 101.1.1 Identify Industry 4.0 components and their functions. | ✓  |        |        | ✓      | ✓      | ✓          |        |        |        |        | ✓      |        | ✓      |
|  | 101.1.2 Identify types of automation and their functions.     |  |        | ✓      | ✓      | ✓      |            |        |        | ✓      | ✓      | ✓      | ✓      | ✓      |
|  | 101.1.4 Perform basic lean manufacturing functions.           | ✓  |        |        |        |        |            |        |        |        |        |        |        |        |
|  | 101.1.5 Identify basic robot elements.                        | ✓  |        | ✓      | ✓      | ✓      | ✓          |        |        | ✓      | ✓      | ✓      | ✓      |        |

# Common Core State Standards (CCSS)

## High School Mathematics

| Unit 2 Advancing Automation in Manufacturing   |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |   |   |   |
|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|---|---|---|---|
| Lesson 2.1   |        |        |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |   |   |   |   |
| A2.1.1   | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6 | P2.1.7 | A2.2.1     | A2.2.2 | A2.2.3 | P2.2.4 | A2.3.1     | A2.3.2 | P2.3.3 | B2.4.1 |   |   |   |   |
| <b>Quantities</b><br>Reason quantitatively and use units to solve problems.  |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |   |   |   |
| CCSS.Math.Content.HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.                             |        |        |        |        |        |        |            |        |        |        |            |        |        | ✓      | ✓ | ✓ |   |   |
| CCSS.Math.Content.HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.   |        |        |        |        |        |        |            |        |        |        | ✓          |        |        |        |   |   |   |   |
| CCSS.Math.Content.HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.  |        |        |        |        |        |        |            |        |        |        | ✓          | ✓      | ✓      | ✓      |   |   | ✓ |   |
| <b>Creating Equations</b><br>Create equations that describe numbers or relationships   |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |   |   |   |
| CCSS.Math.Content.HSA.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.  |        |        |        |        |        |        |            |        |        |        |            | ✓      |        |        | ✓ |   | ✓ |   |
| CCSS.Math.Content.HSA.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.   |        |        |        |        |        |        |            |        |        | ✓      | ✓          | ✓      | ✓      |        | ✓ |   | ✓ |   |
| CCSS.Math.Content.HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.  |        |        |        |        |        |        |            |        |        |        |            | ✓      |        |        | ✓ |   | ✓ |   |
| <b>Linear, Quadratic, &amp; Exponential Models</b><br>Construct and compare linear, quadratic, and exponential models and solve problems.<br>CCSS.Math.Content.HSF.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. |        |        |        |        |        |        |            |        |        |        |            |        |        |        |   |   |   |   |
| CCSS.Math.Content.HSF.LE.A.1.b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.  |        |        |        |        |        |        |            |        |        |        |            |        | ✓      |        |   | ✓ |   | ✓ |

# Common Core State Standards (CCSS)

## High School Mathematics

| Unit 3 Digital Simulations and Virtual Integration   |        |        |        |        |            |        |        |        |        |        |        |        |  |
|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|--|
| Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        |        | L 3.3  |  |
| A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |  |
| <b>Number and Quantities</b><br>Reason quantitatively and use units to solve problems.   |        |        |        |        |            |        |        |        |        |        |        |        |  |
| CCSS.Math.Content.HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. |        |        |        |        |            |        |        |        |        |        |        |        |  |
| ✓  |        |        |        |        |            |        |        |        |        |        | ✓      |        |  |
| CCSS.Math.Content.HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.  |        |        |        |        |            |        |        |        |        |        |        |        |  |
| ✓  |        | ✓      | ✓      | ✓      |            |        |        |        |        |        | ✓      | ✓      |  |
| <b>Algebra</b><br><b>Seeing Structure in Expressions</b><br>Interpret the structure of expressions.  |        |        |        |        |            |        |        |        |        |        |        |        |  |
| CCSS.Math.Content.HSA.SSE.A.1 Interpret expressions that represent a quantity in terms of its context.   |        |        |        |        |            |        |        |        |        |        |        |        |  |
| CCSS.Math.Content.HSA.SSE.A.1.b Interpret complicated expressions by viewing one or more of their parts as a single entity.  |        |        |        |        |            |        |        |        |        |        |        |        |  |
|  |        |        |        |        |            |        |        |        |        |        | ✓      |        |  |

**Common Core State Standards (CCSS)**  
High School Mathematics

| Unit 4 Securing Systems in Distributed Manufacturing |        |        |        |        |        |            |        |        |        |        |        |        |  |
|--|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--|
| Lesson 4.1   |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |  |
| A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1     | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |  |

|                          |  |  |  |  |   |   |  |   |   |   |   |  |   |   |
|--------------------------|--|--|--|--|---|---|--|---|---|---|---|--|---|---|
| Number and Quantities    | <b>Quantities</b><br>Reason quantitatively and use units to solve problems.  |  |  |  |   |   |  |   |   |   |   |  |   |   |
|                          | CCSS.Math.Content.HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. |  |  |  | ✓ | ✓ |  | ✓ | ✓ | ✓ | ✓ |  | ✓ | ✓ |
|                          | CCSS.Math.Content.HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.  |  |  |  | ✓ | ✓ |  | ✓ | ✓ |   | ✓ |  | ✓ | ✓ |
| Algebra                  | <b>Seeing Structure in Expressions</b><br>Interpret the structure of expressions.<br>CCSS.Math.Content.HSA.SSE.A.1 Interpret expressions that represent a quantity in terms of its context.  |  |  |  |   |   |  |   |   |   |   |  |   |   |
|                          | CCSS.Math.Content.HSA.SSE.A.1.a Interpret parts of an expression, such as terms, factors, and coefficients.  |  |  |  |   |   |  | ✓ | ✓ |   | ✓ |  | ✓ | ✓ |
|                          | CCSS.Math.Content.HSA.SSE.A.1.b Interpret complicated expressions by viewing one or more of their parts as a single entity.  |  |  |  | ✓ | ✓ |  |   |   |   |   |  |   |   |
|                          | <b>Creating Equations</b><br>Create equations that describe numbers or relationships   |  |  |  |   |   |  |   |   |   |   |  |   |   |
|                          | CCSS.Math.Content.HSA.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.                                       |  |  |  | ✓ | ✓ |  |   |   |   |   |  |   |   |
| Statistics & Probability | <b>Interpreting Categorical &amp; Quantitative Data</b><br>Summarize, represent, and interpret data on a single count or measurement variable  |  |  |  |   |   |  |   |   |   |   |  |   |   |
|                          | CCSS.Math.Content.HSS.ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.                                |  |  |  | ✓ | ✓ |  |   |   |   |   |  |   |   |

# Common Core State Standards (CCSS)

College and Career Readiness Anchor Standards for ELA

| Unit 1 Introduction to Industry 4.0 |        |        |        |        |        |        |        |            |        |        |        |
|-------------------------------------|--------|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|
| Lesson 1.1                          |        |        |        |        |        |        |        | Lesson 1.2 |        |        | L 1.3  |
| A1.1.1                              | A1.1.2 | A1.1.3 | A1.1.4 | A1.1.5 | A1.1.6 | A1.1.7 | P1.1.8 | A1.2.1     | A1.2.2 | P1.2.3 | B1.3.1 |

|                        |  |   |   |   |   |   |   |   |   |   |   |   |   |
|------------------------|--|---|---|---|---|---|---|---|---|---|---|---|---|
| Reading                | <b>Integration of Knowledge and Ideas</b>  |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |
|                        | CCSS.ELA-Literacy.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.  |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |
|                        | CCSS.ELA-Literacy.CCRA.R.8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.                                      |   |   |   |   |   |   | ✓ |   |   |   |   |   |
| Writing                | <b>Text Types and Purposes</b>   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.                    | ✓ |   |   |   |   |   |   |   |   |   | ✓ |   |
|                        | <b>Production and Distribution of Writing</b>  |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  | ✓ |   |   |   |   |   |   |   |   |   |   | ✓ |
|                        | <b>Research to Build and Present Knowledge</b>   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.   |   |   |   |   |   |   |   | ✓ |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.                         |   |   |   |   |   |   | ✓ |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.   |   |   |   |   |   |   | ✓ |   |   |   |   |   |
| Speaking and Listening | <b>Comprehension and Collaboration</b>   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively                | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.   |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |
|                        | <b>Presentation of Knowledge and Ideas</b>   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience. |   |   |   |   |   |   |   | ✓ |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.   | ✓ |   |   |   |   |   |   | ✓ |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.  |   |   |   |   |   |   | ✓ |   |   |   |   |   |

## Common Core State Standards (CCSS)

College and Career Readiness Anchor Standards for ELA

| Unit 1 Introduction to Industry 4.0   |  |        |        |        |        |        |        |            |        |        |        |  |
|---|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|--|
| Lesson 1.1  |  |        |        |        |        |        |        | Lesson 1.2 |        |        | L 1.3  |  |
| A1.1.1  | A1.1.2   | A1.1.3 | A1.1.4 | A1.1.5 | A1.1.6 | A1.1.7 | P1.1.8 | A1.2.1     | A1.2.2 | P1.2.3 | B1.3.1 |  |
| Language  | <b>Conventions of Standard English</b>   |        |        |        |        |        |        |            |        |        |        |  |
|   | CCSS.ELA-Literacy.CCRA.L1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.             |        |        |        |        |        |        |            |        |        |        |  |
|   | CCSS.ELA-Literacy.CCRA.L2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. |        |        |        |        |        |        |            |        |        |        |  |
|   | <b>Vocabulary Acquisition and Use</b>  |        |        |        |        |        |        |            |        |        |        |  |
| CCSS.ELA-Literacy.CCRA.L6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression. |  |        |        |        |        |        |        |            |        |        |        |  |

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College and Career Readiness Anchor Standards for ELA

| Unit 2 Advancing Automation in Manufacturing |        |        |        |        |        |        |            |        |        |        |            |        |        |        |  |
|--|--------|--------|--------|--------|--------|--------|------------|--------|--------|--------|------------|--------|--------|--------|--|
| Lesson 2.1                                   |        |        |        |        |        |        | Lesson 2.2 |        |        |        | Lesson 2.3 |        |        | L 2.4  |  |
| A2.1.1                                       | A2.1.2 | A2.1.3 | A2.1.4 | A2.1.5 | A2.1.6 | P2.1.7 | A2.2.1     | A2.2.2 | A2.2.3 | P2.2.4 | A2.3.1     | A2.3.2 | P2.3.3 | B2.4.1 |  |

|                        |  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------------------|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reading                | <b>Key Ideas and Details</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.   |   |   |   |   |   |   |   |   | ✓ | ✓ |   |   |   | ✓ |
| Writing                | <b>Integration of Knowledge and Ideas</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Writing                | <b>Text Types and Purposes</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.   |   |   |   |   |   |   |   |   |   |   | ✓ | ✓ | ✓ |   |
| Speaking and Listening | <b>Production and Distribution of Writing</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  |   |   |   |   |   |   |   |   |   |   |   |   |   | ✓ |
| Speaking and Listening | <b>Comprehension and Collaboration</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively  | ✓ |   | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   | ✓ |   |   | ✓ |
| Speaking and Listening | <b>Presentation of Knowledge and Ideas</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Language               | <b>Conventions of Standard English</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.  |   |   |   |   |   |   |   |   |   |   | ✓ |   |   | ✓ |
| Language               | <b>Vocabulary Acquisition and Use</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.  | ✓ |   |   |   |   |   |   |   |   |   | ✓ |   |   | ✓ |
| Language               | <b>Conventions of Standard English</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.L.6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression. |   |   |   |   |   |   |   |   |   | ✓ | ✓ | ✓ | ✓ | ✓ |

# Common Core State Standards (CCSS)

College and Career Readiness Anchor Standards for ELA

| Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |
|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|
| Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        | L 3.3  |        |
| A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |

|                        |  |   |  |   |   |   |  |  |  |   |   |   |
|------------------------|--|---|--|---|---|---|--|--|--|---|---|---|
| Reading                | <b>Key Ideas and Details</b>   |   |  |   |   |   |  |  |  |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. |   |  | ✓ | ✓ | ✓ |  |  |  |   | ✓ | ✓ |
|                        | CCSS.ELA-Literacy.CCRA.R.2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.  |   |  | ✓ | ✓ |   |  |  |  |   | ✓ | ✓ |
|                        | <b>Integration of Knowledge and Ideas</b>  |   |  |   |   |   |  |  |  |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.  | ✓ |  | ✓ | ✓ |   |  |  |  |   | ✓ | ✓ |
| Writing                | CCSS.ELA-Literacy.CCRA.R.8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.                                |   |  | ✓ | ✓ |   |  |  |  |   | ✓ | ✓ |
|                        | <b>Text Types and Purposes</b>   |   |  |   |   |   |  |  |  |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.   |   |  | ✓ | ✓ |   |  |  |  |   | ✓ | ✓ |
|                        | CCSS.ELA-Literacy.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.              |   |  | ✓ | ✓ |   |  |  |  |   | ✓ | ✓ |
|                        | <b>Production and Distribution of Writing</b>  |   |  |   |   |   |  |  |  |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  | ✓ |  |   | ✓ |   |  |  |  |   | ✓ |   |
|                        | <b>Research to Build and Present Knowledge</b>   |   |  |   |   |   |  |  |  |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.   |   |  |   |   | ✓ |  |  |  |   | ✓ |   |
| Speaking and Listening | CCSS.ELA-Literacy.CCRA.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.                   |   |  |   |   | ✓ |  |  |  |   |   |   |
|                        | CCSS.ELA-Literacy.CCRA.W.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.   |   |  |   | ✓ | ✓ |  |  |  |   |   |   |
|                        | <b>Comprehension and Collaboration</b>   |   |  |   |   |   |  |  |  |   |   |   |
| Speaking and Listening | CCSS.ELA-Literacy.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively          | ✓ |  |   | ✓ | ✓ |  |  |  |   | ✓ |   |
|                        | CCSS.ELA-Literacy.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.   | ✓ |  | ✓ | ✓ |   |  |  |  | ✓ | ✓ |   |

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College and Career Readiness Anchor Standards for ELA

| Unit 3 Digital Simulations and Virtual Integration |        |        |        |        |            |        |        |        |        |        |        |        |  |
|--|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--------|--|
| Lesson 3.1   |        |        |        |        | Lesson 3.2 |        |        |        |        |        |        | L 3.3  |  |
| A3.1.1   | A3.1.2 | A3.1.3 | A3.1.4 | P3.1.5 | A3.2.1     | A3.2.2 | A3.2.3 | A3.2.4 | A3.2.5 | A3.2.6 | P3.2.7 | B3.3.1 |  |

|          |  |   |  |  |   |   |   |  |  |  |   |   |   |
|----------|--|---|--|--|---|---|---|--|--|--|---|---|---|
| Language | <b>Conventions of Standard English</b>   |   |  |  |   |   |   |  |  |  |   |   |   |
|          | CCSS.ELA-Literacy.CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.  | ✓ |  |  | ✓ | ✓ |   |  |  |  |   | ✓ | ✓ |
|          | CCSS.ELA-Literacy.CCRA.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.  | ✓ |  |  | ✓ | ✓ |   |  |  |  |   | ✓ |   |
|          | <b>Vocabulary Acquisition and Use</b>  |   |  |  |   |   |   |  |  |  |   |   |   |
|          | CCSS.ELA-Literacy.CCRA.L.6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression. | ✓ |  |  | ✓ |   | ✓ |  |  |  | ✓ | ✓ | ✓ |

# Common Core State Standards (CCSS)

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| Unit 4 Securing Systems in Distributed Manufacturing |        |        |        |        |        |            |        |        |        |        |        |        |  |
|--|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|--------|--|
| Lesson 4.1   |        |        |        |        |        | Lesson 4.2 |        |        |        |        |        | L 4.3  |  |
| A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1     | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |  |

|  |  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reading  | <b>Key Ideas and Details</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | CCSS.ELA-Literacy.CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. |   |   | ✓ |   |   |   |   |   |   |   |   |   |   |
|  | CCSS.ELA-Literacy.CCRA.R.2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.  |   |   | ✓ |   |   |   |   |   |   |   |   |   |   |
|  | <b>Integration of Knowledge and Ideas</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | CCSS.ELA-Literacy.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   | ✓ |
| CCSS.ELA-Literacy.CCRA.R.8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.              |  | ✓ | ✓ |   |   |   |   |   |   |   |   |   |   |   |
| Writing  | <b>Text Types and Purposes</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | CCSS.ELA-Literacy.CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.   |   |   |   |   |   |   |   | ✓ |   |   | ✓ | ✓ |   |
|  | CCSS.ELA-Literacy.CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.              |   |   |   |   |   |   |   | ✓ |   |   | ✓ | ✓ |   |
|  | <b>Production and Distribution of Writing</b>  |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | CCSS.ELA-Literacy.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.  |   |   | ✓ |   |   |   |   | ✓ |   |   | ✓ | ✓ | ✓ |
|  | <b>Research to Build and Present Knowledge</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | CCSS.ELA-Literacy.CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.   |   |   | ✓ |   |   |   |   |   |   |   |   | ✓ |   |
| CCSS.ELA-Literacy.CCRA.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. |  |   |   |   |   |   |   |   |   |   | ✓ |   |   |   |
| Speaking and Listening   | <b>Comprehension and Collaboration</b>   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|  | CCSS.ELA-Literacy.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively          | ✓ | ✓ | ✓ | ✓ | ✓ |   |   | ✓ | ✓ |   |   |   |   |
| CCSS.ELA-Literacy.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.   | ✓  | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   | ✓ |   |

**Unit 4 Securing Systems in Distributed Manufacturing**

**Lesson 4.1**

**Lesson 4.2**

**L 4.3**

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|                               | A4.1.1   | A4.1.2 | A4.1.3 | A4.1.4 | A4.1.5 | P4.1.6 | A4.2.1 | A4.2.2 | A4.2.3 | A4.2.4 | A4.2.5 | P4.2.6 | B4.3.1 |   |
|-------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---|
| <b>Speaking and Listening</b> | <b>Presentation of Knowledge and Ideas</b>   |        |        |        |        |        |        |        |        |        |        |        |        |   |
|                               | CCSS.ELA-Literacy.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.   | ✓      |        | ✓      |        |        |        |        |        |        |        |        |        | ✓ |
|                               | CCSS.ELA-Literacy.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.   |        |        | ✓      |        |        |        |        |        |        |        |        |        |   |
|                               | CCSS.ELA-Literacy.CCRA.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.  |        |        | ✓      |        |        |        |        |        |        |        |        |        |   |
| <b>Language</b>               | <b>Conventions of Standard English</b>   |        |        |        |        |        |        |        |        |        |        |        |        |   |
|                               | CCSS.ELA-Literacy.CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.  | ✓      |        | ✓      |        |        |        |        |        |        |        |        | ✓      | ✓ |
|                               | CCSS.ELA-Literacy.CCRA.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.  |        |        | ✓      |        |        |        |        |        |        |        |        | ✓      | ✓ |
|                               | <b>Vocabulary Acquisition and Use</b>  |        |        |        |        |        |        |        |        |        |        |        |        |   |
|                               | CCSS.ELA-Literacy.CCRA.L.6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression. |        |        | ✓      |        |        |        | ✓      | ✓      | ✓      | ✓      | ✓      | ✓      | ✓ |