

**PROGRAM CONCENTRATION:** Engineering and Technology  
**CAREER PATHWAY:** Manufacturing  
**COURSE TITLE:** Robotics and Automated Systems

Upon completing this course, students will be able to apply their knowledge of computer aided design (CAD), computer numerical control (CNC), robotics, computer assisted manufacturing (CAM), programmable logic controllers, automated guided vehicles (AGV), and computer integrated manufacturing (CIM).

**ENGR-RAS-1. Students will explain the history of automated systems and the benefits of those systems to manufacturing in a global society.**

- a. Define automated manufacturing/systems.
- b. Describe the history of and early beginnings of automated manufacturing.
- c. Compare safety procedures in today's automated manufacturing environment and compare those to safety procedures in early manufacturing, including: lock outs, tag outs, tool and machine safety, OSHA, safety zones, and the impact automation has had on safety. Include analysis that is research based on dollar costs of accidents from pre-automation to automated systems and with consideration to change in the value of a dollar over time.
- d. State and discuss the components of an automated system.
- e. State and discuss the advantages and disadvantages of automating a production system on a global economy.
- f. Identify the practices, programs and systems utilized in automated manufacturing in terms of complexity, including the following: Basic Machine Controls, Materials Requirement planning (MRP II), Just-In-Time (JIT), Process Automation, Flexible Manufacturing Systems (FMS), Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM), and Artificial Intelligence (AI).

***Academic Standards:***

*SCSh7. Students will analyze how scientific knowledge is developed.*

*SCSh3. Students will identify and investigate problems scientifically.*

*SCSh6. Students will communicate scientific investigations and information clearly.*

*MM3P3. Students will communicate mathematically.*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

**ENGR-RAS-2. Students will identify and explain the major engineering tasks in organizing automated manufacturing.**

- a. List the major engineering tasks in organizing a manufacturing operation, including selecting and sequencing operations, designing tooling, preparing plant layouts, and designing material handling.
- b. Describe the purposes for operation sheets, flow process charts, and operation process charts.
- c. Define the two major handling devices, Fixed Path and Variable Path, and discuss the best application of each.
- d. Discuss the difference between process layouts and product layouts.
- e. State that plant efficiency is determined by the effective use of resource flow in terms of moving people and materials through the factory efficiently.
- f. State that process layout is used for factories that make a number of different products with each product being moved to different departments as needed for its manufacture.
- g. Discuss the various continuous process lines and patterns including: Straight, S-shaped, circular, U-shaped and random.

**Academic Standards:**

*SCSh3. Students will identify and investigate problems scientifically.*

*SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.*

*SCSh6. Students will communicate scientific investigations and information clearly.*

*MM3P1. Students will solve problems (using appropriate technology)*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

**ENGR-RAS-3. Students will discuss the systems and applications of automation including: AGV, PLC, CNC, CIM, CAD, CAM, and robotics as essential to succeeding globally in a manufacturing market.**

- a. Define AGV, PLC, CNC, CIM, CAD, CAM, and Robotics.
- b. Describe how AGV, PLC, CNC, CIM, CAD, CAM, and robotics can increase the efficiency of a manufacturing facility.
- c. Explain how industrial robots offer greater flexibility to automated production systems, specifically with reduction of labor costs and outsourcing of labor.
- d. Discuss the new approaches to automated manufacturing systems that support today's competitive environment, including: design for manufacture (DFM), design for assembly (DFA), and design for manufacture and assembly (DFMA).
- e. Identify areas in which design analysis can be accomplished or implemented for product development.
- f. Compare and contrast product quality between a product made through automation and a similar product produced through manual labor.

**Academic Standards:**

*SCSh3. Students will identify and investigate problems scientifically.*

*SCSh6. Students will communicate scientific investigations and information clearly.*

*MM3P3. Students will communicate mathematically.*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

*MM3P5. Students will represent mathematics in multiple ways.*

**ENGR-RAS-4. Students will outline the utilization of programmable control devices and data transfer.**

- a. Generate a device control flow chart or schematic for an automated manufacturing system.
- b. State the advantages and disadvantages of utilizing various control devices, including those for pressure, heat, volume control, color, weight and timing.
- c. Discuss the various architecture in developing a controlled system, including buss, PLC, and LAN.

**Academic Standards:**

*SCSh7. Students will analyze how scientific knowledge is developed.*

*SCSh3. Students will identify and investigate problems scientifically.*

*SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.*

*SCSh6. Students will communicate scientific investigations and information clearly.*

*MM3P3. Students will communicate mathematically.*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

**ENGR-RAS-5. Students will apply the principles of PLC, CIM, CAD, CAM, and robotics in the manufacturing of a product.**

- a. Design an automated system using the principles of PLC, CIM, CAD, CAM, and/or robotics to manufacture a product on a continuous basis.
- b. Analyze the products produced in their initial system and redesign the system for improved efficiency.
- c. Generate a design portfolio to track development of this system from the beginning of the project.

- d. Interact with an industry professional to develop this automated system.
- e. Prepare process flow charts and product layout plans for the development of this system.
- f. Research new emerging technologies that could improve this automated system utilized in a real-world environment.

**Academic Standards:**

*SCSh7. Students will analyze how scientific knowledge is developed.*

*SCSh3. Students will identify and investigate problems scientifically.*

*SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.*

*SCSh6. Students will communicate scientific investigations and information clearly.*

*MM3P3. Students will communicate mathematically.*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

*MM3P5. Students will represent mathematics in multiple ways.*

**STEM Standards (Common to all Engineering & Technology Courses)**

**Nature of Technology**

**ENGR-STEM-1. Students will recognize the systems, components, and processes of a technological system.**

- a. Describe the core concepts of technology.
- b. Identify the relationships among technologies along with connections to contemporary issues.
- c. Apply lifelong learning strategies necessary to understand the characteristics and scope of technology.

**Academic Standards:**

*SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.*

*SCSh7. Students analyze how scientific knowledge is developed.*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

**Technology and Society**

**ENGR-STEM-2. Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.**

- a. Describe the social, economic, and environmental impacts of a technological process, product, or system.
- b. Demonstrate ethical and professional behavior in the development and use of technology.
- c. Explain the influence of technology on history and the shaping of contemporary issues.

**Academic Standards:**

*SCSh7. Students analyze how scientific knowledge is developed.*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

**Design**

**ENGR-STEM-3. Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.**

- a. Demonstrate fundamental principles of design.
- b. Design and conduct experiments along with analysis and interpretation of data.
- c. Identify and consider realistic constraints relevant to the design of a system, component, or process.

**Academic Standards:**

*SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.*

*SCSh3. Students will identify and investigate problems scientifically.*

*SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.*

*SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.*

*SCSh8. Students will understand important features of the process of scientific inquiry.*

*MM3P1. Students will solve problems (using appropriate technology).*

*MM3P2. Students will reason and evaluate mathematical arguments.*

### **Abilities for a Technological World**

**ENGR-STEM-4. Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.**

- a. Work cooperatively in multi-disciplinary teams.
- b. Apply knowledge of mathematics, science, and engineering design.
- c. Demonstrate strategies for identifying, formulating, and solving technological problems.
- d. Demonstrate techniques, skills, and knowledge necessary to use and maintain technological products and systems.

### ***Academic Standards:***

*SCSh3. Students will identify and investigate problems scientifically.*

*SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.*

*SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.*

*SCSh6. Students will communicate scientific investigations and information clearly.*

*SCSh8. Students will understand important features of the process of scientific inquiry.*

*MM3P4. Students will make connections among mathematical ideas and to other disciplines.*

### **The Designed World**

**ENGR-STEM-5. Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.**

- a. Use common tools correctly and safely.
- b. Describe strategies for selecting materials and processes necessary for developing a technological system or artifact.
- c. Demonstrate fundamental materials processing and assembly techniques.
- d. Evaluate the interdependence of components in a technological system and identify those elements that are critical to correct functioning.
- e. Apply analytical tools to the development of optimal solutions for technological problems.

### ***Academic Standards:***

*SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.*

SCSh3. *Students will identify and investigate problems scientifically.*

SCSh4. *Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.*

SCSh5. *Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.*

MM3P1. *Students will solve problems (using appropriate technology).*

MM3P2. *Students will reason and evaluate mathematical arguments.*

MM3P4. *Students will make connections among mathematical ideas and to other disciplines.*

### **Reading**

**ENGR-STEM-6. Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.**

- a. Read in all curriculum areas.
- b. Discuss books.
- c. Build vocabulary knowledge.
- d. Establish context.

### ***Academic Standards:***

*ELAALRC2. The student participates in discussions related to curricular learning in all subject areas.*

*ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.*

*ELAALRC4. The student establishes a context for information acquired by reading across subject areas.*

### **Leadership Development**

**ENGR-STEM-7. Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.**

- a. Demonstrate effective communication skills.
- b. Participate in teamwork to accomplish specified organizational goals.
- c. Demonstrate cooperation and understanding with persons who are ethnically and culturally diverse.

### ***Academic Standards:***

*MM3P3. Students will communicate mathematically.*

*MM3P5. Students will represent mathematics in multiple ways.*

*SCSh6. Students will communicate scientific investigations and information clearly.*

### **CTAE Foundation Skills**

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

**CTAE-FS-1 Technical Skills:** Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

**CTAE-FS-2 Academic Foundations:** Learners achieve state academic standards at or above grade level.

**CTAE-FS-3 Communications:** Learners use various communication skills in expressing and interpreting information.

**CTAE-FS-4 Problem Solving and Critical Thinking:** Learners define and solve problems, and use problem-solving and improvement methods and tools.

**CTAE-FS-5 Information Technology Applications:** Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

**CTAE-FS-6 Systems:** Learners understand a variety of organizational



structures and functions.

**CTAE-FS-7 Safety, Health and Environment:** Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

**CTAE-FS-8 Leadership and Teamwork:** Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

**CTAE-FS-9 Ethics and Legal Responsibilities:** Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

**CTAE-FS-10 Career Development:** Learners plan and manage academic-career plans and employment relations.

**CTAE-FS-11 Entrepreneurship:** Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.