ADVANCED MANUFACTURING II

Advanced Manufacturing II continues concepts learned from *Advanced Manufacturing I*. Domains include safety and impact, drafting principles, manufacturing programming, CAD/CAM and CNC technologies, automation and robotics, and careers in advanced manufacturing. Hands-on projects and team activities will allow students to apply learning on the latest industry technologies. Students continue this course with the goal of being a skilled machine operator, repair technician, or management at any company that produces goods and services using advanced manufacturing techniques. Work-based learning experiences and industry partnerships are highly encouraged for an authentic industry experience.

- DOE Code: 5606
- Recommended Grade Level: 12
- Required Prerequisites: Advanced Manufacturing I
- Credits: 2-3 credits, maximum of 6 credits Counts as a Directed Elective or Elective for all diploma types

Career and Technical Student Organizations (CTSOs)
Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in SkillsUSA, the trade and industry CTSO.

Content Standards

Domain 1 – Safety and Impact
Core Standard 1 – Students will demonstrate safe practices and procedures with tools, machines, and equipment.

AMII-1.1	Monitor equipment operation and design parameters to determine if machine is operating safely
AMII-1.2	Make adjustments to equipment to ensure that it is operating within established safety and environmental parameters
AMII-1.3	Complete training and certification on relevant emergency and first-aid procedures
AMII-1.4	Demonstrate appropriate use of personal protective equipment
AMII-1.5	Select the best tool for the assigned job
AMII-1.6	Identify corrective actions for conditions that present a threat to healthy, safety, or the environment as related to advanced manufacturing

Domain 2- Impact and Trends
Core Standard 2 Students will analyze how advance manufacturing impacts national and global economies.

AMII-2.1	Investigate how advanced manufacturing impacts individuals, society, and the environment
AMII-2.2	Discuss new and emerging technologies related to advanced manufacturing
AMII-2.3	Apply current and emerging computer technologies utilized in industry

Domain 3 – CNC Programming
Core Standard 3 Students evaluate the fundamentals of CNC programming to perform processes and procedures.

Standards

AMII-3.1	Relate design information to manufacturing processes
AMII-3.2	Compare and contrast incremental coordinates vs. absolute coordinates
AMII-3.3	Determine positive and negative directions along axes
AMII-3.4	Identify G codes used to determine the mode of tool movement
AMII-3.5	Examine the function of four types of mill toolpaths: contour 2D, pocket, letters, drill
AMII-3.6	Describe the function of six types of chaining methods
AMII-3.7	Explain the importance of a program's cycle time
AMII-3.8	Describe the function of roughing cuts and finish passes
AMII-3.9	Locate the edge of a part
AMII-3.10	Calculate spindle speeds for machine tools
AMII-3.11	Apply proper speed and feed rates for machine tools

Domain 4 – CAD/CAM & CNC Technologies
Core Standard 4 Students create a part using CAD, CAM, & CNC programming.

Standards

AMII-4.1	Select appropriate annotation to document features within drawings using a scale
AMII-4.2	Produce a CAD Drawing using computer software
AMII-4.3	Interpret existing CAD files
AMII-4.4	Investigate the difference between machine zero and program zero on a CNC machine tool
AMII-4.5	Determine the work offsets and tool geometry offsets for a CNC program
AMII-4.6	Create programs using absolute and incremental coordinate positions
AMII-4.7	Compare and contrast Computer-Integrated Manufacturing and Flexible Manufacturing
AMII-4.8	Demonstrate how part shapes are created using CAM software
AMII-4.9	Develop two types of CNC programming languages: G&M codes, conversational
AMII-4.10	Demonstrate program verification techniques

Domain 5– Programmable Logic Controllers
Core Standard 5 Students examine the role of programmable logic controllers in manufacturing processes.

    Standards

AMII-5.1	Describe the common parts of programmable controllers
AMII-5.2	Program a start/stop circuit using a PLC
AMII-5.3	Interpret programming diagrams
AMII-5.4	Create programming diagrams for real-world applications
AMII-5.5	Apply timer and counter principles to industry-related problems
AMII-5.6	Setup and test PLC's
AMII-5.7	Perform basic maintenance and troubleshooting with PLC's
AMII-5.8	Differentiate between different types of path control systems
AMII-5.9	Describe the safety precautions associated with teach pendant operation
AMII-5.10	Design programs with a minimum of 4 axis manipulators
AMII-5.11	Explain the basic work cell with I/0
AMII-5.12	Identify the basics of the I/0 electrical control
AMII-5.13	Demonstrate I/0 testing procedures from the Editor Software
AMII-5.14	Categorize the types of sensors and explain their significance
AMII-5.15	Recognize requirements for an industrial controller
AMII-5.16	Differentiate microcontrollers from PC processors

Domain 6- Automation Theory
Core Standard 6 Students evaluate theories and principles utilized within the automation and robotics industry to assess modern trends in advanced manufacturing.

    Standards

AMII-6.1	Develop machine order of operations
AMII-6.2	Examine computer logic and scanning sequence in automated controls
AMII-6.3	Convert relay logic into ladder logic diagrams
AMII-6.4	Explore the impact of cycle time and timing diagrams on manufacturing processes

Domain 7- Robotics
Core Standard 7 Students develop a working knowledge of robotics and robotic parts to classify their roles in manufacturing processes.

    Standards

AMII-7.1	Define robot coordinate systems
AMII-7.2	Identify the various types of robots
AMII-7.3	Classify robots by their power systems, coordinate systems, and path systems
AMII-7.4	Compare and contrast the advantages and disadvantages of various robot types
AMII-7.5	Identify a robot's axes of motion and determine the importance of each articulation
AMII-7.6	Determine the total number of degrees of freedom needed for a robot to perform a specific job task

AMII-7.7   Apply basic knowledge of robot physics in manufacturing environments

AMII-7.8   Demonstrate correct design, programming, troubleshooting, and editing of robot programs

AMII-7.9   Solve mathematical problems related to machine control operations

AMII-7.10   Identify the various coordinate types of industrial robots, list the advantages and disadvantages of each, and recognize the work envelope of each

AMII-7.11   Identify various end effectors (end of arm tooling) used with robots

AMII-7.12   Select appropriate end effectors for a given job task

AMII-7.13   Develop criteria to determine where, how, and with what force an end effector should grasp a part

AMII-7.14   Describe specific hazards associated with robots and determine appropriate safety methods for working around robots

AMII-7.15   Measure a robot's performance, such as speed, positioning accuracy, and repeatability, to determine if a robot meets the manufacturer's specifications

AMII-7.16   Indicate the advantages and limitations of robots in industry

AMII-7.18   Program a robot using a teach pendant

Domain 8 – Automation

Core Standard 8 Students will explore the role of automation in industry.

Standards

AMII-8.1   Describe the hazards associated with automated machines

AMII-8.2   Determine appropriate safety methods for working around automated machinery

AMII-8.3   Critique the common types of factory automation

AMII-8.4   Examine the role of software controls in manufacturing

AMII-8.5   Demonstrate a basic understanding of structured programming software

AMII-8.6   Design software utilizing programing software

AMII-8.7   Define the roles of input and output devices within automation

Domain 9 – Employability Skills and Careers in Advanced Manufacturing

Core Standard 9 Students will explore careers related skills to enhance employability in advanced manufacturing.

AMII-9.1   Investigate careers in the advanced manufacturing pathway.

AMII-9.2   Analyze education and skill requirements for careers relating to advanced manufacturing.

AMII-9.3   Report the outlook, demand, and projected wages for careers related to advanced manufacturing.

AMII-9.4   Set team goals that are specific, measurable, and achievable

AMII-9.5   Align team goals with customer and business needs

AMII-9.6   Solve problems using critical and creative thinking skills