ADVANCED MANUFACTURING II

Advanced Manufacturing II introduces basic blueprint reading, Computer Numerical Control (CNC) operation and the skills commonly used in the manufacturing industry. Areas of study will include: interpretation of drawing dimensions and notes to ANSI standards for machining including; Geometric Dimensioning and Tolerancing (GDT), welding, fabrication applications and inspection techniques. Students will be able to use Computer Aided Design software (CAD) to create 3D models and working drawings. Skills in the setup and operation of a CNC mill and lathe will also be acquired using multiple machine tool controllers. Other more general topics will include coordinate systems, dimensioning, line precedence, multiview drawings, safe dress, tool paths, speed and feed calculations, and tool selection. The course also introduces robotics, automation, and Computer Integrated Manufacturing Technology (CIMT). Common types of factory automation will be identified. The course will focus on three main types of manufacturing automation including; Programmable Logic Controllers (PLC), Computer Numerically Controlled Machines (CNC), and Robotics. Topics cover robotic principles including basic theory, robot safety, robotic classifications, applications, socioeconomic impact, work cell design, robot programming (Pendant and Software Language), and sensor and actuator interfacing. Students will be required to design, program and troubleshoot computer controlled machine logic and production processes in a project oriented learning environment.

DOE Code: 5606

Recommended Grade Level: Grade 12

Recommended Prerequisites: Advanced Manufacturing I

Credits: 2-3 credits, maximum of 6 credits

Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas

This course is aligned with the following Post-Secondary courses for Dual Credit:

Ivy Tech

ADMF 116- Automation and Robotics in Manufacturing

ADMF 103- Graphic Communications for Manufacturing

Vincennes University

CIMT 125/L- Intro to Robotics and Automation

PMTD 110/L- Manufacturing Processes

Dual Credit
This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

Application of Content and Multiple Hour Offerings
Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences. When a course is offered for multiple hours per semester, the amount of laboratory application or work-based learning needs to be increased proportionally.

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 CTSO for this area.

Content Standards

Domain – Drafting Principles
Core Standard 1 Students formulate an understanding of the rules and principles of drafting and drawing to assess their role in manufacturing processes.

Standards

AMII-1.1	Utilize conventional drafting practices using CAD
AMII-1.2	Describe three methods of creating a technical drawing
AMII-1.3	Understand advanced dimensioning, sectional drawings, fasteners, and assembly drawings
AMII-1.4	Explain how views are arranged in a multiview drawing
AMII-1.5	Describe a method used to visualize the views of an object in a multiview drawing
AMII-1.6	Describe the function of three line types used in a multiview drawing: Object, hidden, and center
AMII-1.7	Describe the function of line precedence
AMII-1.8	Describe the function of a drawing scale
AMII-1.9	Identify appropriate welding symbols in a drawing
AMII-1.10	Utilize dimensions, symbols, and notations as related to ANSI standards
AMII-1.11	Create proper geometric dimensioning and tolerance
AMII-1.12	Describe six rules for dimensioning a multiview drawing
AMII-1.13	Describe two methods of dimensioning drawings: unidirectional and aligned

Domain – Essentials of Manufacturing Programming
Core Standard 2 Students evaluate the fundamentals of manufacturing programming to perform

processes and procedures.

Standards

AMII-2.1 Relate design information to manufacturing processes

AMII-2.2 Solve problems using critical and creative thinking skills

AMII-2.3 Identify the three axes of the Cartesian coordinate system

AMII-2.4 Define incremental coordinates vs. absolute coordinates

AMII-2.5 Determine positive and negative directions along axes

AMII-2.6 Identify G codes used to determine the mode of tool movement

AMII-2.7 Describe the function of four types of mill toolpaths: contour 2D, pocket, letters, drill

AMII-2.8 Describe the function of six types of chaining methods

AMII-2.9 Explain the importance of a program's cycle time

AMII-2.10 Describe the function of roughing cuts and finish passes

AMII-2.11 Explain five main factors that influence tool selection

AMII-2.12 Describe three different techniques for locating the edge of a part

AMII-2.13 Describe how to calculate spindle speeds for machine tools

AMII-2.14 Explain the importance of using proper feed rates

AMII-2.15 Describe how to select speed and feed rates for machine tools

Domain – Details of CAD/CAM & CNC

Core Standard 3 Students apply and adapt CAD/CAM & CNC technologies to complete manufacturing tasks.

Standards

AMII-3.1 Interpret existing CAD files

AMII-3.2 Identify the difference between machine zero and program zero on a CNC machine tool

AMII-3.3 Determine the work offsets and tool geometry offsets for a CNC program

AMII-3.4 Create programs using absolute and incremental coordinate positions

AMII-3.5 Compare and contrast Computer-Integrated Manufacturing and Flexible Manufacturing

AMII-3.6 Demonstrate how part shapes are created using CAM software

AMII-3.7 Develop two types of CNC programming languages: G&M codes, conversational

AMII-3.8 Demonstrate program verification techniques

AMII-3.9 Create a part using CAD, CAM, & CNC programming

Domain – History and Fundamentals in Automation and Robotics

Core Standard 4 Students establish an understanding of the history and fundamentals of automation and robotics to assess their role in manufacturing processes.

Standards

AMII-4.1 Describe the history and relevance of computer controlled machines

AMII-4.2 Describe the common parts of programmable controllers

AMII-4.3 Program a start/stop circuit using a PLC

AMII-4.4 Program timer and counter programs on a PLC system

AMII-4.5 Troubleshoot PLC programs and systems

AMII-4.6 Verbally describe and interpret data obtained from engineering drawings

AMII-4.7 Differentiate between different types of path control systems

AMII-4.8 Describe the safety precautions associated with teach pendant operation

AMII-4.9 Understand how to read and design complex programs with the Microbot

AMII-4.10 Understand the basic workcell with I/O

AMII-4.11 Identify the basics of the EMIA board schematic

AMII-4.12 Demonstrate I\O testing procedures from the Editor Software

AMII-4.13 Categorize the types of sensors and explain their significance

AMII-4.14 Recognize requirements for an industrial controller

AMII-4.15 Differentiate microcontrollers from PC processors

AMII-4.16 Describe the history of robotics

Domain – Theories and Principles of Automation and Robotics

Core Standard 5 Students evaluate theories and principles utilized within the automation and robotics industry to assess modern trends in advanced manufacturing.

Standards

AMII-5.1 Develop machine order of operations

AMII-5.2 Examine computer logic and scanning sequence in automated controls

AMII-5.3 Convert relay logic into ladder logic diagrams

Domain – Robotics

Core Standard 6 Students develop a working knowledge of robotics and robotic parts to classify their role in manufacturing processes.

Standards

AMII-6.1 Classify robots by their power systems, coordinate systems, and path systems

AMII-6.2 Describe the advantages and disadvantages of various robot types

AMII-6.3 Identify a robot's axes of motion, determine importance of each articulation

AMII-6.4 Determine the total number of degrees of freedom needed for a robot to perform a specific job task

AMII-6.5 Apply basic knowledge of robot physics in manufacturing environments

AMII-6.6 Demonstrate correct design, programming, troubleshooting, and editing of robot programs

AMII-6.7 Solve mathematical problems related to machine control operations

AMII-6.8 Identify the various coordinate types of industrial robots, list the advantages and disadvantages of each, and recognize the work envelope of each

AMII-6.9 Classify robots by their power system

AMII-6.10 Identify a robot's axes of motion, determine importance of each articulation, and determine the total number of degrees of freedom needed to perform a specific job task

AMII-6.11 Identify various end effectors (end of arm tooling) used with robots

AMII-6.12 Select appropriate end effectors for a given job task

AMII-6.13 Develop criteria to determine where, how and with what force an end effector should grasp a part

AMII-6.14 Describe the hazards associated with robots and determine appropriate safety methods for working around robots

AMII-6.15 Measure a robot's performance, such as speed, positioning accuracy, and repeatability, to determine if a robot meets the manufacturer's specifications

AMII-6.16 Define robot coordinate systems

AMII-6.17 Indentify the various types of robots

AMII-6.18 Indicate the advantages of robots in industry

AMII-6.19 Assess the limitations of robots

AMII-6.20 Program a robot using a teach pendant

Domain – Automation

Core Standard 7 Students develop a working knowledge of automation to explore its role in industry.

Standards

AMII-7.1 Describe the hazards associated with automated machines

AMII-7.2 Determine appropriate safety methods for working around computer controlled machinery

AMII-7.2 Define the common types of factory automation

AMII-7.3 Describe the role of software controls in manufacturing

AMII-7.4 Demonstrate a basic understanding of QBasic and Visual Basic Software and be able to read and design complex software programs utilizing the software

AMII-7.5 Explain the difference between robotics and automation

AMII-7.6 Define the roles of input and output devices within automation

AMII-7.7 Indicate that there is still a need for automation professionals throughout the life span of an automated system

AMII-7.8 Design and build a functional multi-step automated system