COMPUTER INTEGRATED MANUFACTURING (non-PLTW)

Computer Integrated Manufacturing is a course that applies principles of rapid prototyping, robotics, and automation. This course builds upon the computer solid modeling skills developed in Introduction of Engineering Design. Students will use computer controlled rapid prototyping and CNC equipment to solve problems by constructing actual models of their three-dimensional designs. Students will also be introduced to the fundamentals of robotics and how this equipment is used in an automated manufacturing environment. Students will evaluate their design solutions using various techniques of analysis and make appropriate modifications before producing their prototypes.

- DOE Code: 5543
- Recommended Grade Level: Grade 11-12
- Required Prerequisites: Introduction to Engineering Design and Principles of Engineering
- Credits: 2 semester course, 2 semesters required, 1 credit per semester, maximum of 2 credits
- Fulfills a Directed Elective or Elective requirement for all diploma types
- Qualifies as a Quantitative Reasoning course

Application of Content
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.

Content Standards

Domain – Safety
Core Standard 1 Students evaluate the hazards associated with automated machines and determine appropriate safety methods and attire for working around machinery to maintain a safe working environment.

Standards

CIM-1.1 Establish a safe working routine around electrical, hydraulic and pneumatic power.

CIM-1.2 Select appropriate attire.

CIM-1.3 Integrate lock-out / tag-out procedures.

Domain – Designing/Developing for Manufacturing Production
Core Standard 2 Students integrate effective communication skills to solve a problem.

Standards

CIM-2.1 Communicate effectively using listening, speaking, reading, and writing skills.

CIM-2.2 Use quantitative analytical skills to evaluate and process numerical data.
Solve problems using critical and creative thinking skills.

CIM-2.3 Demonstrate knowledge of diverse cultures, including global and historical perspectives.

CIM-2.4 Describe how natural systems function, and recognize the impact of human beings on the environment.

CIM-2.5 Demonstrate the ability to store, retrieve, copy and output drawing files, depending upon system setup.

CIM-2.6 Incorporate various coordinate systems in the construction of 2-D geometrical shapes.

CIM-2.7 Calculate the x and y coordinates, given a radius and angle.

Core Standard 3 Students apply and adapt the design process to develop a working drawing to be used in the completion of a product.

Standards

CIM-3.1 Utilize 2-D computer sketching functions.

CIM-3.2 Apply editing techniques to produce accurate sketches.

CIM-3.3 Describe and apply sketch constraints.

CIM-3.4 Examine drawings with appropriate inquiry functions.

CIM-3.5 Define sketched objects with dimensions and geometric constraints.

CIM-3.6 Apply necessary sketched features to generate a solid model.

CIM-3.7 Demonstrate applying and modifying placed features.

CIM-3.8 Demonstrate the proper application of annotations and reference dimensions while conforming to established drafting standards.

CIM-3.9 Update model and drawing views using revision specification sheets.

CIM-3.10 Identify the fundamentals of creating assembly models.

CIM-3.11 Generate an assembly drawing, which includes views, balloons and bills of material**.**

CIM-3.12 Recognize the wide array of industry-wide prototyping methods in use.

CIM-3.13 Identify the need for rapid-prototyping.

Domain – Robotics

Core Standard 4 Students evaluate the history and principles of robotics so they can determine a need for robots.

Standards

CIM-4.1 Discuss the chronological development of automation leading to robotics.

CIM-4.2 Identify the positive impact robots have on manufacturing.

CIM-4.3 Review career opportunities in the robotics career fields.

Core Standard 5 Students establish knowledge of robotics so they can effectively select and manipulate the proper robot for the task.

Standards

CIM-5.1 Formulate a definition of a robot.

CIM-5.2 Classify different types of robots.

CIM-5.3 Compare various robotics coordinate systems, paths and work envelopes and their uses.

CIM-5.4 Anayze the various drive systems used in robotics, and discuss the advantages and disadvantages of each.

CIM-5.5 Analyze degrees freedom and Axis of motion in different types of robots.

CIM-5.6 Describe the basic components of robot and their capabilities.

CIM-5.7 Differentiate control techniques in real and in computer simulations.

CIM-5.8 Apply concepts of knowledge of robot physics in manufacturing environments.

CIM-5.9 Describe the necessity for specialty tooling applications in robotics.

CIM-5.10 Identify and demonstrate correct design, programming, troubleshooting, and edition of robotics programs.

Domain – CNC

Core Standard 6 Students evaluate the history and principles of computer numeric control so they can determine a need for CNC

Standards

CIM-6.1 Explain the history of computer controlled machines charting the growth of numerical control (NC) and how it has been implemented into private industry.

CIM-6.2 Explain how the application of CNC machines has impacted manufacturing.

CIM-6.3 Explain the advantages and disadvantages of CNC machining.

CIM-6.4 Explore career opportunities and educational requirements within the field of programmable machines.

Core Standard 7 Students evaluate proper methods for the setup and execution of CNC machining.

Standards

CIM-7.1 Examine different types of tool holding devices used in CNC machine tools.

CIM-7.2 Describe the difference between reference and position points.

CIM-7.3 Plot points using absolute, relative (incremental) and polar coordinates.

CIM-7.4 Identify the optimum location for the PRZ point.

CIM-7.5 Complete a preliminary planning sheet to identify necessary work holding devices, cutting tools, reference points, machining sequences and safe operation.

CIM-7.6 Explore the advantages and disadvantages of shop floor programming as well as offline programming.

CIM-7.7 Demonstrate the ability to safely set up, maintain and operate a CNC machine center using appropriate documentation and procedures.

CIM-7.8 Examine part geometry to select appropriate cutting tools and fixturing devices needed to create the part using a CNC machine.

CIM-7.9 Set up and edit the tool library of a CNC control program, providing offset values and tool geometry.

CIM-7.10 Calculate and verify appropriate spindle speeds and feed rates specific to each cutting tool utilized in an NC part program.

CIM-7.11 Verify NC part programs using simulation software before machining the part on a CNC device.

CIM-7.12 Follow a safety checklist before running an NC part program on a CNC machine.

CIM-7.13 Perform a dry run to verify the machine setup and program operation.

Core Standard 8 Students integrate computer aided manufacturing software to develop alpha numeric codes.

Standards

CIM-8.1 Demonstrate the ability to operate the user interface with a CAM package and to access help using appropriate documentation and help screens.

CIM-8.2 Perform basic file operations using a CAM package, such as saving, opening, printing and editing part program files.

CIM-8.3 Demonstrate the ability to import and export CAD files using a CAM package.

CIM-8.4 Setup a CAM package by editing the material and tool libraries, defining stock sizes, selecting the appropriate post processor and defining the units of measure to be used.

CIM-8.5 Define and apply the fundamental and advanced milling and turning procedures used in.

Domain – Automation

Core Standard 9 Students evaluate the benefit of automated manufacturing so they can utilize manufacturing system.

Standards

CIM-9.1 Describe how the individual components of a flexible manufacturing system (FMS) are interrelated.

CIM-9.2 Recognize the benefits and problems associated with CIM technology and how they affect the manufacturing process.

CIM-9.3 Identify some basic characteristics of a manufacturing operation that lend themselves to computer integrated manufacturing.

CIM-9.4 Identify some of the typical components and sub systems that make up an automated machining, assembly and process-type manufacturing operation.

CIM-9.5 Identify the three categories of CIM systems.

CIM-9.6 Compare and contrast the benefits and drawbacks of the three categories of CIM systems.

Core Standard 10 Students apply concepts of machine communication to develop manufacturing processes.

Standards

CIM-10.1 Develop machine order of operations.

CIM-10.2 Examine computer logic and scanning sequence in automated controls.

CIM-10.3 Describe the common parts of programmable controllers.

CIM-10.4 Convert relay logic into ladder logic diagrams.

CIM-10.5 Program a start/stop circuit using a PLC.

CIM-10.6 Program timer and counter programs on a PLC system.

CIM-10.7 Troubleshoot PLC programs and systems.

CIM-10.8 Recognize the working relationship between the CNC mill and the robot.

CIM-10.9 Identify the components of an FMS.

CIM-10.10 Recognize the necessary safety precautions associated with a fully automated CIM system.

CIM-10.11 Demonstrate how individual components work together to form a complete CIM system.

Career and Technical Student Organizations

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 a Career and Technical Student Organization, such as the **Technology Student Association (TSA).**