Computer Integrated Manufacturing

Curriculum/Content Area: Applied Technology & Engineering (ATE)	Course Length: 2 Terms
Course Title: Computer Integrated Manufacturing (CIM)	Date last reviewed: October 21, 2015
Prerequisites: Geometry Suggested: CAD I or Introduction to Engineering Design, Principles of Engineering	Board approval date: November 17, 2015

Desired Results

Course description and purpose:
Computer Integrated Manufacturing (CIM) is the study of manufacturing planning, integration, and implementation of automation. The course explores manufacturing history, individual processes, systems, and careers. In addition to technical concepts, the course incorporates finance, ethics, and engineering design. This reflects an integrated approach that leading manufacturers have adopted to improve safety, quality, and efficiency. Utilizing the activity-project-problem-based (APPB) teaching and learning pedagogy, students will analyze, design, and build manufacturing systems. While implementing these designs, students will continually hone their interpersonal skills, creative abilities, and understanding of the design process. Students apply knowledge gained throughout the course in a final open-ended problem to build a manufacturing system. Computer Integrated Manufacturing is a high school level course that is appropriate for 10th, 11th,or 12th grade students interested in manufacturing and automation.

Enduring Understandings (EUs):	**Essential Questions (EQs)**:
1. Engineering is an ongoing process. The development of every new invention and innovation is grounded in the work of people from previous generations. 2. Engineering is the profession in which the knowledge of the mathematics and natural sciences, gained by study, experience, and practice, is applied with judgment, to develop ways to utilize, the materials and forces of nature for the benefit of mankind. 3. Many manual tasks can be replicated by creating a system that utilizes multiple automation components. 4. A system is a group of related elements that work together for a specific outcome. 5. Frequently problems are too complex for a single person to solve. Teams are formed and duties shared. It is important to have a diversified team to help discover solutions that someone might miss. 6. Testing before, during, and after design & fabrication is essential to guaranteeing the reliability of a product. 7. Reliability is the ability of a product to perform	1. Why is a design process, and the documentation of said process, so important to follow when creating a solution to a problem? 2. How can an existing product be changed to incorporate different processes to make it less expensive and provide better performance? 3. What emerging technologies are or may be on the horizon that will provide energy more efficiently? 4. Why would an engineer use theory-based vs. experiment-based data interpretation in the decision-making process? 5. Why are programmable logic devices used to control machines versus monitoring and adjusting processes manually? 6. Why are engineers concerned about manufacturing processes? 7. Why do teams use consensus to make decisions? 8. Why do engineers and designers use scientific principles when creating solutions? 9. Why is it crucial for designers and engineers

its designed function, within an acceptable tolerance, for a given length of time under specific operating conditions. 8. Laws of physics exist, allowing for the prediction of actions between items within a system. These predictions are key elements in the overall design of a solution.	to utilize statistics throughout the design process?

Assessment Evidence

Performance assessments: 1. Major projects consisting of: full project documentation, complete system design with modifications and fabrication of a functioning system prototype. 2. Project presentations targeted at either informing or persuading audiences about a design solution.	Other assessments may include: ● Formative activities including group work used to introduce content and provide feedback to students. ● Summative quizzes used to determine content mastery.

Course-Long Standards

Wisconsin Standards for Technology and Engineering:

ENG1: Students will analyze and demonstrate the attributes of design.
ENG2: Students will analyze and demonstrate engineering design.
ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
ENG4: Students will develop abilities to apply the design process.
ENG5: Students will develop the abilities to use and maintain technological products and systems.
ENG6: Students will develop the abilities to assess the impact of products and systems.

Unit #1: Computer Modeling

Major Topics:

1. Fundamentals
2. Object Construction
3. Parts Modeling
4. Creation of Working Drawings
5. Surface Modeling
6. Rapid Prototyping

Standards

Wisconsin Technology and Engineering Standards

ENG1.a.1.e: Design is a creative process.
ENG1.a.2.e: Everyone can design solutions to a problem.
ENG1.a.9.h: Examine how the design needs to continually be evaluated and the ideas of the design must be redefined and improved.
ENG2.a.2.e: Explore when designing an object, it is important to be creative and consider all ideas.

ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.
ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.
ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.
ENG4.a.3.m: Specify criteria and constraints for the design.
ENG4.b.2.e: Build or construct an object using the design process.
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.
ENG5.a.7.h: Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.
ENG5.b.2.e: Use computers and technology to access and organize information.
ENG5.b.5.m: Use computers, calculators and technology in various applications.
ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

CCSS
CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Learning Targets

I can...

- Apply knowledge of mathematics, science, and engineering.
- Work in teams to design smaller components of a larger system. The success of the entire system relies on each component to function correctly and to interact correctly with each other.
- Apply appropriate design principles to create design solutions.
- Communicate technical content effectively.

Unit #2: CNC Machining

Major Topics:

1. History of Programmable Machining
2. Characteristics
3. Programming
4. CNC Operation
5. CAM Software

Standards

Wisconsin Technology and Engineering Standards
ENG2.b.2.e: Discuss how models are used to communicate and test design ideas and processes.
ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.
ENG3.b.2.e: Describe that the process of experimentation, which is common in science, can also be used to solve technological problems.

ENG4.b.2.e: Build or construct an object using the design process.
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.
ENG5.b.2.e: Use computers and technology to access and organize information.
ENG5.b.5.m: Use computers, calculators and technology in various applications.
ENG6.a.2.m: Design and use instruments and technology to gather data.

CCSS

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Learning Targets:

I can...

- Apply concurrent engineering practices to solve problems.
- Recognize of the need for, and the ability to engage in life-long learning.
- Utilizing statics, mathematically analyze a system to determine the types and magnitude of forces required by a manufacturing process.
- Explain the effects that stress has on a material and explain how the material will react.

Unit #3: Robotics

Major Topics:

1. Introduction to Robotics
2. Robotics and Automated Systems
3. Robot Characteristics
4. Robot Controllers
5. Programming the Robot
6. End Effectors
7. Robot Applications

Standards:

Wisconsin Technology and Engineering Standards

ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.
ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.
ENG3.b.5.h: Describe how many technological problems require a multidisciplinary approach.
ENG4.b.2.e: Build or construct an object using the design process.
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.
ENG5.a.3.e: Recognize and use everyday symbols such as numbers and symbols to communicate key ideas.
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.
ENG5.a.7.h: Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

ENG5.b.2.e: Use computers and technology to access and organize information.
ENG5.b.5.m: Use computers, calculators and technology in various applications.
ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

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CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Learning Targets:

I can...

- Apply concurrent engineering practices to solve problems.
- Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.
- Identify, formulate, and solve engineering problems.
- Use the techniques, skills, and modern engineering tools necessary for engineering practice.
- Utilize technical manuals and the internet to extract the information needed to operate sophisticated equipment.
- Identify the proper sequence of tasks that need to be performed to achieve desired result.

Unit #4: Computer Integrated Manufacturing

Major Topics:

1. Rationale for CIM Manufacturing
2. Types of CIM Systems
3. Components of CIM Systems
4. CIM System Applications

Standards

Wisconsin Technology and Engineering Standards
ENG4.b.2.e: Build or construct an object using the design process.
ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.
ENG4.c.3.e: Improve the design solutions.
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.
ENG5.b.2.e: Use computers and technology to access and organize information.
ENG5.b.5.m: Use computers, calculators and technology in various applications.
ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

CCSS
CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Learning Targets:

I can . . .

- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- Apply concurrent engineering practices to solve problems.
- Understand the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- Understand that remote system design is based upon the integrated system design of mechanical, electrical, and software systems.
- Consider the wide variety of career paths available to students which require careful consideration for future professional success.