

SIEMENS MANUFACTURING AND AUTOMATION (COURSE CODE: 57R1)

COURSE DESCRIPTION: Siemens Manufacturing and Automation, the second course in the Siemens Engineering program, is designed to provide students with experience in the creation of a design, preparing the design for machining and designing the automation necessary to control the process. This manufacturing course will challenge students to collaboratively solve design problems by working in teams, requiring research and reporting findings, and will prepare students to obtain Siemens PLC and Solid Edge certifications. The Siemens manufacturing course will utilize the various Siemens' software as tools for problem solving and preparing solutions. The goal of the course is the application of the tools to address unique problems allowing the students to rapidly create and analyze proposed solutions.

OBJECTIVE: Given the necessary equipment, supplies, and facilities, the student will complete all of the following core standards successfully.

COURSE CREDIT: 1 (120 hours) Carnegie unit

PREREQUISITE: Siemens Engineering Design

RECOMMENDED GRADE LEVELS: 10, 11, 12

A. SAFETY

Engineers know the academic subject matter, including safety as required for proficiency within their area. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Review school safety policies and procedures.
2. Review classroom safety rules and procedures.
3. Review safety procedures for using equipment in the classroom.
4. Identify major causes of work-related accidents in office environments.
5. Demonstrate safety skills in an office/work environment.

B. STUDENT ORGANIZATIONS

Engineers know the academic subject matter, including professional development, required for proficiency within their area. The following accountability criteria are essential for students in the Siemens Engineering of study.

1. Identify the purpose and goals of a Career and Technology Student Organization (CTSO).
2. Explain how CTSOs are integral parts of specific clusters, majors, and/or courses.
3. Explain the benefits and responsibilities of being a member of a CTSO.
4. List leadership opportunities that are available to students through participation in CTSO conferences, competitions, community service, philanthropy, and other activities.

5. Explain how participation in CTSOs can promote lifelong benefits in other professional and civic organizations.

C. TECHNOLOGY KNOWLEDGE

Engineers know the academic subject matter, including the ethical use of technology. The following accountability criteria are essential for students in the Siemens Engineering of study.

1. Demonstrate proficiency and skills associated with the use of technologies that are common to a specific occupation.
2. Identify proper netiquette when using e-mail, social media, and other technologies for communication purposes.
3. Identify potential abuse and unethical uses of laptops, tablets, computers, and/or networks.
4. Explain the consequences of social, illegal, and unethical uses of technology (e.g., piracy; cyberbullying; illegal downloading; licensing infringement; inappropriate uses of software, hardware, and mobile devices in the work environment).
5. Discuss legal issues and the terms of use related to copyright laws, fair use laws, and ethics pertaining to downloading of images, Creative Commons, photographs, documents, video, sounds, music, trademarks, and other elements for personal use.
6. Describe ethical and legal practices of safeguarding the confidentiality of business-related information.
7. Describe possible threats to a laptop, tablet, computer, and/or network and methods of avoiding attacks.

D. PERSONAL QUALITIES AND EMPLOYABILITY SKILLS

Engineers know the academic subject matter, including positive work practices and interpersonal skills. The following accountability criteria are essential for students in the Siemens Engineering of study.

1. Demonstrate creativity and innovation.
2. Demonstrate critical thinking and problem-solving skills.
3. Demonstrate initiative and self-direction.
4. Demonstrate integrity.
5. Demonstrate work ethic.
6. Demonstrate conflict resolution skills.
7. Demonstrate listening and speaking skills.
8. Demonstrate respect for diversity.
9. Demonstrate customer service orientation.
10. Demonstrate teamwork.

E. PROFESSIONAL KNOWLEDGE

Engineers know the academic subject matter, including positive work practices and interpersonal skills. The following accountability criteria are essential for students in the Siemens Engineering of study.

1. Demonstrate global or “big picture” thinking.
2. Demonstrate career and life management skills and goal-making.
3. Demonstrate continuous learning and adaptability skills to changing job requirements.
4. Demonstrate time and resource management skills.
5. Demonstrates information literacy skills.
6. Demonstrates information security skills.
7. Demonstrates information technology skills.
8. Demonstrates knowledge and use of job-specific tools and technologies.
9. Demonstrate job-specific mathematics skills.
10. Demonstrates professionalism in the workplace.
11. Demonstrate reading and writing skills.
12. Demonstrates workplace safety.

F. ENGINEERING DESIGN PROCESS

Engineers demonstrate the skills for completing the engineering design process. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Maintain an Engineering Notebook for research, prototype creation, documentation, and daily reflections.
2. Apply engineering design and problem solving as an iterative process incorporating science, mathematics, and engineering to optimally convert resources to meet a design solution.
3. Communicate design solutions utilizing effective technical writing skills including correct spelling, proper grammar, and accurate technical vocabulary.
4. Prepare a quantitative plan for the successful completion of a project.
5. Assume leadership responsibility for collaborative team actions and decisions related to the successful completion of a project.
6. Evaluate the needs and costs of resources necessary for the completion of a project.
7. Prepare and communicate model documentation to include such details as product analysis, size, materials, assembly details, installation and service requirements.

G. REVERSE ENGINEERING

Engineers demonstrate proficient skills applying the principles of design in reverse engineering. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Apply design principles which include the accommodation for disassembly and resource recovery.
2. Research and apply current business practices that lead to new product development or improvement of products or procedures including the use of rapid development and deployment to be faster to market.
3. Analyze the design attributes of an existing product by disassembling it into its parts, use precision measurement tools to create sketches & drawings of the parts, identify the materials and processes used in manufacturing, and create a new and improved design.
4. Utilize convergent modeling to capture data and rapidly create new parts to fit existing scans.
5. Collaborate with teams to combine models and parametrically create solutions.
6. Utilize rapid prototyping/additive manufacturing to create highly complex parts designed in a CAD system.

H. DESIGN FOR MANUFACTURING

Engineers demonstrate proficient skills necessary for manufacturing design. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Apply the principles of design for manufacturing, enabling the efficient and effective production of products.
2. Develop a logical argument for selecting the tools, machines and labor necessary to produce finished goods from raw materials.
3. Create a strategy to increase efficiency and decrease waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs and reducing the impact of water and other natural resource consumption.
4. Create a plan for protecting the safety, health and welfare of people engaged in the manufacturing environment.
5. Create technical drawings having proper dimensional tolerances and limits necessary for components to fit as designed.
6. Use appropriate instruments accurately to make precision measurements required by plan specification to achieve required dimensions, shapes, location of centers, parallel surfaces and other component attributes.
7. Understand and apply Statistical Process Control (SPC) to acquire quality control.
8. Research and apply knowledge of material properties to product design and development.

I. DESIGN FOR ASSEMBLY

Engineers demonstrate proficient skills necessary for assembly design. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Apply engineering design of components to assure alignment for assembly.
2. Create a management plan that includes quality planning, quality control, quality assurance, and quality improvement for an advanced manufacturing environment.

3. Research, construct, and evaluate a plan for an assembly line or work cell.

J. COMPUTER NUMERIC CONTROL (CNC) OF MACHINES

Engineers demonstrate proficient skills for programming and using numeric controls. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Apply Cartesian Coordinates to create toolpaths for machine tools.
2. Research and apply proper cutting tool speeds, feeds, and directions for manufacturing.
3. Create simple Numeric Control (NC) part programs using a text editor or a CAM package.
4. Analyze NC part program files to identify and correct errors.
5. Analyze part geometry to select appropriate cutting tools and fixturing devices needed to create a part using a CNC machine.
6. Edit the tool library of a CNC machine program to establish tool offset values.

K. APPLYING CAM SOFTWARE TO PROBLEM SOLUTIONS

Engineers demonstrate proficient skills for programming and applying CAM software to solve problems. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Design and prepare 3D models with appropriate units for use in toolpath generation.
2. Setup a CAM package by editing the material and tool libraries.
3. Generate tool paths from a CAD program and edit NC part program files to identify and correct errors.

L. AUTOMATION WITH PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

Engineers demonstrate proficient skills for programming and using programmable logic controllers. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Design and analyze an electrical system to efficiently convert, transform, and transmit electricity to where it is needed.
2. Research and specify electrical devices necessary to provide needed power.
3. Apply machine control systems, sensory feedback, and information processing to increase productivity in manufacturing.
4. Use flow charts and diagrams to apply logic in the design of control programs.

M. APPLYING LOGIC SOFTWARE (TIA PORTAL) TO CREATE PROBLEM SOLUTIONS

Engineers demonstrate proficient skills for applying logic software to solve problems. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Design a system of elements that manages power to accomplish a task involving defined movement.
2. Design a control system to vary the speed and performance of a motor by utilizing feedback from the system to gain the most efficiency possible.
3. Formulate a system to utilize data collection and analysis to maintain and improve product quality and provide adequate confidence that the product will satisfy design requirements.
4. Design and analyze the application of machine control systems, sensory feedback, and information processing to increase productivity in manufacturing.

N. PNEUMATICS DESIGN AND CONTROL

Engineers demonstrate proficient skills for constructing and operating pneumatics systems. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Construct systems that efficiently utilize a fluid (liquid or gas) under pressure to generate, transmit, and control power.
2. Design an integrated system of machines, machine tools, jigs, fixtures, instruments, and control programs to produce needed parts.
3. Utilize jigs, fixtures, drill guides, gauges, and other manufacturing and assembly tools.
4. Research, construct and evaluate a plan for an assembly line or work cell.
5. Identify systems, sub-systems and typical components of an automated manufacturing operation.
6. Apply the necessary safety precautions associated with a fully automated system.

O. BUSINESS OF MANUFACTURING

Engineers understand and apply the business principles of engineering. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Research and categorize the activities that a business conducts to make discoveries that can either lead to the development of new products or procedures, or to improve existing products or procedures.
2. Research and evaluate the new approaches of rapid development and deployment of products that saves time and is more efficient.
3. Review and evaluate the benefits of a plan for an assembly line or work cell.

4. Create a strategy to increase efficiency and decrease waste by receiving inventory just in time for the production process to reduce costs and reduce use of natural resources.
5. Evaluate the use of production organization, planning, and resources, both human and capital, as well as regulatory requirements, to successfully and efficiently bring a product to market.
6. Create a management plan including quality planning, quality control, quality assurance, and quality improvement for an advanced manufacturing environment.
7. Create a plan for protecting the health and safety of the people engaged in a manufacturing environment.

P. CAREER AWARENESS AND DEVELOPMENT

Engineers acquire the career development skills necessary for success. The following accountability criteria are essential for students in the Siemens Engineering program of study.

1. Develop awareness of career opportunities related to each curriculum project.
2. Critique career connections described in each curriculum project engagement scenario.

[Academic Standards and Indicators](#)