

## **SIEMENS ENGINEERING DESIGN (COURSE CODE: 57R0)**

**COURSE DESCRIPTION:** Siemens Engineering Design, the first course in the Siemens Engineering program, challenges students to work in teams to solve complex design problems. Students research, design, develop, and communicate design solutions. Teams use engineering software to prepare and evaluate designs and make extensive use of 3D printing to prepare models for presentation to authentic audiences. 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. Siemens' software and hardware are tools frequently used by industry and understanding how these tools are used in problem solving is critical.

**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:** Algebra 1 (can be taken concurrently)

**RECOMMENDED GRADE LEVELS:** 9, 10, 11

### **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.**

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 program.**

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 program.**

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 program.**

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 program 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. Create and maintain an Engineering Notebook for daily reflections, research and prototype creation documentation.
2. Apply the design and problem solving process as an iterative process incorporating sciences, mathematics and engineering to optimally convert resources to meet a stated objective.
3. Communicate solutions utilizing technical writing skills including correct spelling, proper grammar and dependent vocabulary.
4. Assume and carry out a role in the smooth running of a team working toward the solution of a problem.
5. Assemble a quantitative plan for successful completion of the project.
6. Assume responsibility for leadership roles and responsibility for actions, decisions products and policies in the governance of a project.
7. Evaluate the need for and costs of resources necessary for the completion of a project.

## **G. SKETCHING**

**Engineers demonstrate proficient skills in sketching designs. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Create sketches utilizing basic shapes such as lines, circles and ellipses.

2. Communicate ideas to a group through the use of sketches and other documentation.
3. Apply isometric and orthographic sketches to add clarity to design.
4. Create necessary sketches to communicate basic ideas during the design process.

## **H. 3D SOLID MODELING/FABRICATION AND 3-D PRINTING**

**Engineers demonstrate proficient skills designing, fabricating, and creating 3D models. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Apply geometric relationships between lines and shapes to create a mathematical database to describe design ideas.
2. Create solid models utilizing concepts of Parametric Modeling.
3. Analyze models for appropriate engineering design features needed.
4. Develop strategies for the creation of solid models for the rapid creation of design solutions.
5. Apply the concepts of digital prototyping to accelerate the time frame between ideation and completed project.
6. Access, generate, process, and transfer information using appropriate technologies.
7. Design and create a model using additive manufacturing technology sometimes called a rapid prototyping system.
8. Apply new principles of more rapid and less costly development and deployment of new materials.
9. Utilize rapid prototyping/additive manufacturing to create highly complex parts designed in a CAD system.

## **I. RENDERINGS/WORKING DRAWINGS/ DESIGN PRESENTATIONS**

**Engineers demonstrate proficient skills in renderings, drawings, and making design presentations. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Create renderings to communicate design ideas and engineering principles to the general public.
2. Generate an image from a model utilizing light, texture and shading to create a proposed final appearance of a product.
3. Apply rendering techniques to create presentations of design for a non-technical audience.

## **J. ASSEMBLY MODELING/DOCUMENTATION/EXPLODED ASSEMBLIES/BILL OF MATERIALS**

**Engineers demonstrate proficient skills in preparing model documentation. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Conduct model documentation as the process of recording details such as size, material composition, and instructions for assembling, installation and servicing, analysis, development process that describes a model for the purpose of communication of ideas.
2. Create a bill of materials to communicate materials and other information about a design.

## **K. REVERSE ENGINEERING/ENGINEERING FEATURES**

**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 the principles of design for manufacturing enabling the efficient and effective production of products.
2. Apply the green principles of design for eventual disassembly and resource recovery.
3. Investigate activities that a business conducts with the intention of making a discovery that can either lead to the development of new products or procedures, or to improvement of existing products or procedures and to know the new approaches of rapid development and deployment that saves time and is more efficient.
4. Disassemble a product into its parts, utilize precision measurement to create sketches, drawings and models of the product and identify the basic processes, systems, designs, and materials used in the manufacture of the product.

## **L. SIMPLE MACHINES**

**Engineers demonstrate proficient skills in developing solutions using simple machines. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Utilize mathematical analysis, scientific inquiry and engineering design to develop solutions to open ended problems.
2. Access, generate, process, and transfer information using appropriate technologies
3. Apply the design process in the design of a mechanical system.
4. Read and analyze detailed descriptions of machinery and provide a concise summary for documentation purposes.
5. Assign mathematical relationships to analyze mechanical advantage.
6. Apply problem solving methodology in the creation of unique solutions to mechanical motion problems.
7. Assign mathematical relationships to analyze mechanical advantage.
8. Apply problem solving methodology in the creation of unique solutions to mechanical motion problems.

## **M. MECHANICAL SYSTEMS**

**Engineers demonstrate proficient skills developing using mechanical systems. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Utilize mathematical analysis, scientific inquiry and engineering design to develop solutions to open ended problems.
2. Access, generate, process, and transfer information using appropriate technologies.
3. Apply the design process in the design of a mechanical system.
4. Read and analyze detailed descriptions of machinery and provide a concise summary for documentation purposes.
5. Assign mathematical relationships to schematics to apply forces.
6. Apply problem solving methodology in the creation of unique solutions to mechanical motion problems.
7. Apply the design process in the design of a mechanical system.
8. Design a system of elements that manage power to accomplish a task that involves defined movement.
9. Read and analyze detailed descriptions of machinery and provide a concise summary for documentation purposes.
10. Apply problem solving methodology in the creation of unique solutions to mechanical motion problems.

## **N. STRUCTURES/FORCES**

**Engineers understand how force impacts structural design. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Create models that are mathematical or physical systems set up to obey certain specified conditions whose behavior is used to understand, study or evaluate a design or system.
2. Conduct model analysis using FEA and simulations as a detailed examination of the elements, structure or behavior of a physical system under certain imposed conditions.
3. Assign mathematical relationships to schematics to apply forces.
4. Conduct a systematic study of the relationship of the material, members, and the construction of the structure when loaded to determine the resulting deflections and forces.
5. Apply knowledge of stress and strain to the design of a problem solution.
6. Analyze strength of materials to predict behavior of solid bodies subjected to various types of loading to determine the stresses, strains, and displacements caused by the loading.

7. Predict loads exerted on a product, machine, or structure during any foreseeable use to determine safety.
8. Analyze complex structures by breaking them down into components.
9. Test scale models to verify the strength predictions made from mathematical models.

## **O. ENGINEERING SYSTEMS**

**Engineers understand engineering systems. The following accountability criteria are essential for students in the Siemens Engineering program of study.**

1. Utilize mathematical analysis, scientific inquiry and engineering design to develop solutions to open ended problems.
2. Select and defend a material for use in a product, explaining material properties and characterization, based upon manufacturing processes, chemical composition, internal defects, temperature, previous loading, dimensions and other factors.

## **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](#)