Applied Engineering Design

Level 3: Student explored previously; second pathway specific course

Pathway(s): Engineering & Technology

Description

Applied Engineering Design is an applied course for students interested in further developing their skills as future engineers. This course covers knowledge, skills, and concepts required for postsecondary engineering and technology fields of study. Upon completion of this course, proficient students are able to explain the differences between scientists and engineers, understand the importance of ethical practices in engineering and technology, identify components of control systems, create simple free body diagrams, use measurement devices employed in engineering, conduct basic engineering economic analysis, follow the steps in the engineering design process to complete a team project, and effectively communicate design solutions to others.

NOTE: This course is still in draft form.

Student Learning Outcomes

Exploration of the STEM Field of Engineering Design

1) Identify and describe career options, working conditions, earnings, and educational requirements of various engineering disciplines
2) Recognize that engineers are guided by established condes emphasizing high ethical standards
3) Explore the differences, similarities, and interactions among engineers, scientists, and mathematicians
4) Describe how technology has evolved in the field of engineering and consider how it will continue to be a useful tool in solving engineering problems
5) Discuss the history and importance of engineering innovation on the U.S> economy and quality of life
6) Describe the importance of patents and the protection of intellectual property rights

Use of Scientific Method in Laboratory and Field Investigations

7) Know the definition of science and understand that it has limitations
8) Distinguish between scientific hypotheses and scientific theories
9) Plan and implement descriptive, comparative, and experimental investigations including asking questions, formulating testable hypotheses, and selecting equipment and technology.

Use of Scientific Method to Develop a Solution

10) Collect and organize qualitative and quantitative data and make measurements with accuracy and precision using tools.
11) Analyze, evaluate, make inferences, and predict trends from data
12) Communicate valid conclusions supported by data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and/or technology-based reports.

Safety Precautions

13) Demonstrate safe practices during engineering laboratory and field activities
14) Demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of material.

Application of Problem Solving Skills

15) Analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing
16) Communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials
17) Draw inference based on data related to promotional materials for products and services
18) Evaluate the impact of scientific research on society and the environment

Solve Engineering Design Problems

19) Apply scientific processes and concepts relevant to engineering design problems
20) Apply concepts, procedures, and functions of mathematics relevant to engineering design problems
21) Select appropriate mathematical models to develop solutions to engineering design problems
22) Integrate advanced mathematics and science skills as necessary to develop solutions to engineering design problems
23) Judge the reasonableness of mathematical models and solutions
24) Investigate and apply relevant chemical, mechanical, biological, electrical, and physical properties of materials to engineering design problems
25) Identify the inputs, processes, outputs, control, and feedback associated with open and closed systems
26) Describe the difference between open-loop and closed-loop control systems
27) Make measurements with accuracy and precision and specify tolerances
28) Use appropriate measurement systems, including customary and International System (SI) of units
29) Use conversations between measurement systems to solve real-world problems

Communication Skills in the STEM Field

30) Communicate visually by sketching and creating technical drawings using established engineering graphic tools, techniques, and standards
31) Read and comprehend technical documents including specifications and procedures
32) Prepare written documents such as emails, design proposals, procedural directions, and technical reports using the formatting and terminology conventions of technical documentation
33) Organize information for visual display and analysis using appropriate formats for various audiences, including graphs and tables
34) Evaluate the quality and relevance of sources and cite appropriately
35) Defend a design solution in a presentation

Formulating Solutions

36) Identify and define an engineering problem
37) Formulate goals, objectives, and requirements to solve an engineering problem

38) Determine the design parameters associated with an engineering problem such as materials, personnel, resources, funding, manufacturability, feasibility, and time
39) Establish and evaluate constraints pertaining to a problem, including health, safety, social, environmental, ethical, political, regulatory, and legal
40) Identify and create alternative solutions to a problem using a variety of techniques, such as brainstorming, reverse engineering, and researching engineered and natural solutions
41) Test and evaluate a proposed solution using methods, such as models, prototypes, mock-ups, simulations, critical design review, statistical analysis or experiments
42) Apply structured techniques to select and justify a preferred solution to a problem such as a decision tree, design matrix, or cost-benefit analysis
43) Predict performance, failure modes, and reliability of a design solution
44) Prepare a project report that clearly documents the designs, decisions, and activities during each phase of the engineering design process

Teamwork in STEM

45) Participate in the design and implementation of a real-world or simulated engineering project using project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project
46) Develop a plan and project schedule for completion of a project
47) Work in teams and share responsibilities
48) Compare and contrast the roles of a team leader and other team responsibilities

Extended Learning Experience

49) Identify and manage the resources needed to compete a project
50) Use a budget to determine effective strategies to meet cost constraints
51) Create a risk assessment for an engineering design project
52) Analyze and critique the results of an engineering design project
53) Maintain an engineering notebook that chronicles work such as ideas, concepts, inventions, sketches, and experiments.