

**Science, Technology, Engineering and Mathematics Career Cluster**  
**Engineering Concepts**  
**Course Number 21.47100**

**Course Description:**

Engineering Concepts is the second course in the Engineering and Technology Pathway. Students will learn to design technical solutions to engineering problems using a whole systems approach to engineering design. Students will demonstrate the application of mathematical tools, teamwork, and communications skills in solving various design challenges, while maintaining a safe work environment. The prerequisite for this course is Foundations of Engineering and Technology.

**Course Standard 1**

**STEM-EC-1**

**Demonstrate employability skills required by business and industry.**

The following elements should be integrated throughout the content of this course.

- 1.1 Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities.
- 1.2 Demonstrate creativity with multiple approaches to ask challenging questions resulting in innovative procedures, methods, and products.
- 1.3 Exhibit critical thinking and problem solving skills to locate, analyze, and apply information in career planning and employment situations.
- 1.4 Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity.
- 1.5 Apply the appropriate skill sets to be productive in a changing, technological, and diverse workplace to be able to work independently, interpret data, and apply team work skills.
- 1.6 Present a professional image through appearance, behavior, and language.

**Course Standard 2**

**STEM-EC-2**

**Demonstrate and follow safety, health, and environmental standards related to the Science, Technology, Engineering, and Math (STEM) workplaces.**

- 2.1 Implement workplace and product safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), and Underwriters Laboratories (UL).
- 2.2 Demonstrate and incorporate safe laboratory procedures in the classroom, lab, and field environments.
- 2.3 Explain the impact of safety standards such as Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), International Organization for Standardization (ISO), Good Manufacturing Practice (GMP), and Underwriters Laboratories (UL) relating to engineering fields.
- 2.4 Implement safety precautions to maintain a safe work environment.

### Course Standard 3

#### STEM-EC-3

##### **Describe the characteristics of engineering disciplines and engineered products.**

- 3.1 Explain a contemporary definition of engineering.
- 3.2 Compare and contrast engineering to other approaches for solving technological and design problems.
- 3.3 Explain the duties and responsibilities of an Engineer.
- 3.4 Analyze and evaluate the implications of ethics in the engineering field.
- 3.5 Describe the principal fields of engineering specialization and identify associated career tracks.
- 3.6 Explain the developmental and life cycle of an engineered product.
- 3.7 Understand cost and risk analysis along with market analysis that is completed when creating engineered products.

### Course Standard 4

#### STEM-EC-4

##### **Demonstrate the knowledge and skills required to pursue the full range of engineering post-secondary education and career opportunities.**

- 4.1 Explain the relationship between STEM and non-STEM Majors.
- 4.2 Identify and describe educational requirements for engineering occupations along with locations where programs of study are available.
- 4.3 Compare and contrast the differences and similarities between engineering and engineering technology degrees.
- 4.4 Analyze the need to be a life-long learner in the field of engineering.
- 4.5 Identify and explain salaries associated with the different fields of engineering, including business services, healthcare, consulting services and technical administrative support in the consideration of career segments.

### Course Standard 5

#### STEM-EC-5

##### **Explain a whole systems approach to the engineering design process to solve a technical problem.**

- 5.1 Describe the role of problem identification and definition, brainstorming, research, specifications, constraints, criteria, alternative solutions, analysis, decision making, communication, evaluation, and modification as activities comprising the engineering design process.
- 5.2 Apply the engineering design process to the solution of a technical problem.
- 5.3 Optimize and justify design solutions based on cost, time, schedule, and performance constraints.
- 5.4 Communicate design solutions to peers and potential consumers using graphical media, oral presentations, and technical writing.
- 5.5 Evaluate the design based on consumer research, peer feedback, financial and safety risk, and cost benefit analysis to optimize the design solution.

- 5.6 Demonstrate an understanding of the continuous improvement process as it applies to new designs and modifications of existing designs for new applications.

## Course Standard 6

### STEM-EC-6

**Employ critical thinking skills and teamwork skills when working in groups to solve problems, to make decisions, achieve group goals and use team members' talents effectively.**

- 6.1 Identify and describe common tasks that require employees to use problem-solving skills.
- 6.2 Analyze elements of a problem to develop creative solutions.
- 6.3 Describe the value of using problem-solving and critical thinking skills to improve a situation or process.
- 6.4 Create ideas, proposals, and solutions to problems.
- 6.5 Work with others to achieve objectives in a timely manner.
- 6.6 Promote the full involvement and use of team members' individual talents and skills.
- 6.7 Demonstrate teamwork processes that provide team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution.
- 6.8 Take responsibility for shared group and individual work tasks.
- 6.9 Demonstrate sensitivity to and value for diversity.
- 6.10 Apply peer evaluation techniques to critique group members.
- 6.11 Integrate business principles when working as a team.

## Course Standard 7

### STEM-EC-7

**Summarize and apply engineering solutions through the audience appropriate application of engineering graphics and technical writing.**

- 7.1 Communicate design specifications through Engineering drawings and multiple medias.
- 7.2 Apply tools to mathematically analyze engineering design problems.
- 7.3 Apply accurate dimensions to a technical drawing, including size and geometric tolerances.
- 7.4 Prepare a persuasive proposal for an engineering solution.
- 7.5 Document engineering design processes using an engineering design notebook.
- 7.6 Prepare a report of engineering design activities including a description of analysis, optimization, and selection of a final solution.
- 7.7 Research and benchmark a technological problem or idea.
- 7.8 Use oral and visual communication skills to deliver an engineering design presentation.

## Course Standard 8

### STEM-EC-8

#### Apply basic engineering tools and resources to aid in data collection and problem solution sets.

- 8.1 Demonstrate understanding and application of various measurement systems.
- 8.2 Demonstrate understanding and application of various base units in both English and international systems (SI).
- 8.3 Demonstrate an understanding of the importance of tool calibration and precision measurement instruments.
- 8.4 Demonstrate the use of precision measuring instruments to measure and inspect parts to optimize the solution to a problem.
- 8.5 Use appropriate technologies or applications to generate data to optimize solutions to a problem.
- 8.6 Graphically display the collection of data.
- 8.7 Use laboratory tools, equipment, and technologies to demonstrate the properties of materials.

## Course Standard 9

### STEM-EC-9

#### Cite evidence for the role of troubleshooting, research and development, inventions, and innovations in problem solving.

- 9.1 Demonstrate an understanding of the difference between an invention and an innovation and the importance in developing solutions.
- 9.2 Use appropriate evaluation tools while troubleshooting during the design process.
- 9.3 Examine business and industry research to prepare devices and systems for the marketplace.
- 9.4 Use an interdisciplinary approach to problem solve.

## Course Standard 10

### STEM-EC-10

#### Explore the use of social media and other 21<sup>st</sup> century technologies and their impact(s) on the fields of engineering and technology.

- 10.1 Demonstrate an understanding of the different types of social media utilized in market products.
- 10.2 Evaluate positive and appropriate utilization of social media in the workplace.
- 10.3 Employ open communication through social media applications as a medium across multiple platforms.
- 10.4 Investigate the impact(s) of various uses of social media (e.g., positive, negative, intended, unintended, etc.).
- 10.5 Explain aggregate data collected from researched social media platforms.

## Course Standard 11

### STEM-EC-11

**Critique and synthesize how related career and technology student organizations are integral parts of career and technology education courses. Students will develop leadership, interpersonal, and problem-solving skills through participation in co-curricular activities associated with the Technology Student Association (TSA).**

- 11.1 Explain the goals, mission and objectives of Career Technical Student Organizations (CTSOs).
- 11.2 Explore the impact and opportunities a student organization (TSA) can develop to bring business and education together in a positive working relationship through innovative leadership and career development programs.
- 11.3 Explore the local, state, and national opportunities available to students through participation in related student organization (TSA) including but not limited to conferences, competitions, community service, philanthropy, and other (TSA) activities.
- 11.4 Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development.
- 11.5 Demonstrate teamwork, leadership, interpersonal relations, and project management.
- 11.6 Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned.
- 11.7 Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.
- 11.8 Through teamwork, apply the skills in quality assurance as well as those in process management and development for appropriate applications of systems integration techniques to an assigned project.
- 11.9 Effectively use project management techniques (e.g., teamwork, appropriate time management practices, effective organizational skills, conduct analysis of cost, resources, and production capacity, and quality practices with continuous improvement).
- 11.10 Understand and demonstrate proper work ethics when working with plans, processes, and projects, as assigned.