

Science, Technology, Engineering and Mathematics Career Cluster
Engineering Applications
Course Number 21.47200

Course Description:

Engineering Applications is the third course in the Engineering and Technology Pathway. Students will apply their knowledge of Science, Technology, Engineering, and Math (STEM) to develop solutions to technological problems. Solutions will be developed using a combination of engineering software and prototype production processes. Students will use market research, cost benefit analysis, and an understanding of the design cycle to create and present design, marketing, and business plans for their solutions. A capstone project will allow students to demonstrate their depth of knowledge of the engineering design process and prepare them for future opportunities in the field of engineering. The prerequisite for this course is Engineering Concepts.

Course Standard 1

STEM-EA-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-EA-2

Demonstrate and follow safety, health, and environmental standards related to the STEM workplace and apply specific engineering tools, machines, materials and processes in a safe and orderly manner to formulate, analyze, and verify engineering practices and solutions.

- 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), American Disabilities Association (ADA), 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),

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American Disabilities Association (ADA), and Underwriters Laboratories (UL) related to engineering fields.

- 2.4 Understand the environmental impact of engineering designs and processes.
- 2.5 Explain the criteria for selection of appropriate materials, tools, and processes.
- 2.6 Safely and effectively manipulate materials, tools, and processes.
- 2.7 Apply appropriate care and maintenance in the use of tools and machines.

Course Standard 3

STEM-EA-3

Identify and explore career opportunities in one or more engineering career pathways to build an understanding of the opportunities available in the STEM workplace.

- 3.1 Locate and identify career opportunities that appeal to personal career goals.
- 3.2 Match personal interests and aptitudes to selected careers.
- 3.3 Participate in career related field trips and/or career related presentations by professionals in STEM.

Course Standard 4

STEM-EA-4

Apply knowledge of the engineering design process to solve engineering/technological problems in the STEM workplace.

- 4.1 Identify, define, and research a technological problem.
- 4.2 Utilize planning, time management, and leadership skills to organize an engineering project.
- 4.3 Research, select, and safely apply engineering concepts, machines, and tools for completion of the project.
- 4.4 Develop alternative solutions to a technological problem.
- 4.5 Select an appropriate solution that optimizes the outcome based on the specifications, constraints, and resources of the project.
- 4.6 Develop a 3D model of the solution using modeling software and/or physical materials.
- 4.7 Develop a working prototype of the solution
- 4.8 Test the prototype using engineering tools, concepts, and methods.
- 4.9 Analyze the results of the testing and modify the solution as needed.

Course Standard 5

STEM-EA-5

Employ planning and time management skills and tools to enhance results and complete work tasks.

- 5.1 Develop goals and objectives to complete a technological problem.
- 5.2 Prioritize tasks to be completed during a STEM project.
- 5.3 Develop project timelines using time management knowledge and skills.
- 5.4 Use project-management skills to improve workflow of a STEM project.

Course Standard 6

STEM-EA-6

Apply oral, written, and visual communication skills to obtain, interpret, and present information to and from intended audiences.

- 6.1 Apply the ability to read, interpret, and analyze STEM materials discerning the information and concepts.
- 6.2 Use appropriate listening skills to obtain and interpret messages or information provided to clarify issues, ideas, plans, projects, or processes.
- 6.3 Demonstrate understanding by responding to and/or restating information that will clarify STEM techniques to be used and/or information to be applied to projects, plans, or processes.
- 6.4 Use effective oral, written, and visual methods to communicate concepts of STEM to an audience.
- 6.5 Utilize an engineering design notebook and/or portfolios to collect, organize, and document the design process.

Course Standard 7

STEM-EA-7

Develop and apply detailed plans to solutions for design problems using mathematical and scientific concepts.

- 7.1 Analysis of design problems will be conducted and include flow charts, timelines, milestones, models, and other information to complete solutions.
- 7.2 Prove optimal solutions through the application of mathematical models and calculations necessary to complete predictive analysis.
- 7.3 Modify design plans and schedules that are informed directly by data collected and analyzed using graphical and algebraic solutions.
- 7.4 Critique the effectiveness and accuracy of design plans for each possible solution.
- 7.5 Implement failure analysis techniques to a design solution to enhance future solutions for a design problem.
- 7.6 Evaluate design solutions using the standards required to maintain a system in a condition of static equilibrium with respect to gravitational forces and normal operating conditions.
- 7.7 Devise technical solutions that demonstrate an understanding of the relationships between work, power, and energy within a system.
- 7.8 Develop design alternatives by incorporating the principles of energy transformations.
- 7.9 Optimize design solutions by evaluating and selecting appropriate mechanical devices and electrical components.

Course Standard 8

STEM-EA-8

Develop appropriate models.

- 8.1 Understand the concept of model as it relates to engineering design.
- 8.2 Understand the concept of scale as it relates to models.
- 8.3 Prepare mock-up and scale models.
- 8.4 Create 3D models using appropriate software and technologies.

Course Standard 9

STEM-EA-9

Design and construct a testable prototype.

- 9.1 Understand the concept of prototype as it relates to engineering design.
- 9.2 Select and apply appropriate materials, tools, and processes for prototype development.
- 9.3 Consider end user experience and interface in prototype development.
- 9.4 Test prototype for performance, usability, and durability.
- 9.5 Assess and evaluate prototype testing data to recommend design improvements, optimization, or re-design of prototype.

Course Standard 10

STEM-EA-10

Understand engineering impacts of social, economic, design and environmental issues.

- 10.1 Apply knowledge of external issues such as time constraints, budget, supply chain and available technology that strain the engineering design process to optimize a solution to a STEM problem.
- 10.2 Analyze and connect the impacts of events in the global marketplace to understand the importance of national standards, supply chains, and timelines.
- 10.3 Analyze the sustainability and life cycle of an engineered product and their applications on a worldwide scale.
- 10.4 Connect cultural diversity to possible impacts on creating solutions to engineering design problems.

Course Standard 11

STEM-EA-11

Explain the impact of business and marketing on engineering design.

- 11.1 Gather and synthesize information using social media and the internet.
- 11.2 Research the global nature of engineering design in multinational corporations.
- 11.3 Demonstrate an understanding of the design timeline, time to market, and the impact of a rapidly changing consumer market.
- 11.4 Generate and analyze market research in terms of consumer requirements, competitive landscape, and market opportunity.
- 11.5 Develop iterative accounting analysis for engineering designs such as cost analysis, return on investment, Bill of Materials, and labor and production costs using appropriate spreadsheet software.
- 11.6 Apply supply and demand economics to determine market pricing.
- 11.7 Create and present marketing plans to peers, decision makers, and potential investors.

Course Standard 12

STEM-EA-12

Explore 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).

- 12.1 Explain the goals, mission and objectives of Career Technical Student Organizations (CTSOs).
- 12.2 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.
- 12.3 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.
- 12.4 Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development.
- 12.5 Demonstrate teamwork, leadership, interpersonal relations, and project management.
- 12.6 Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned.
- 12.7 Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.
- 12.8 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.
- 12.9 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).
- 12.10 Understand and demonstrate proper work ethics when working with plans, processes, and projects as assigned.