

**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

The following standard is included in all CTAE courses adopted for the Career Cluster/Pathways. Teachers should incorporate the elements of this standard into lesson plans during the course. The topics listed for each element of the standard may be addressed in differentiated instruction matching the content of each course. These elements may also be addressed with specific lessons from a variety of resources. This content is not to be treated as a unit or separate body of knowledge but rather integrated into class activities as applications of the concept.

Standard: 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.

Person-to-Person Etiquette	Telephone and Email Etiquette	Cell Phone and Internet Etiquette	Communicating At Work	Listening
Interacting with Your Boss	Telephone Conversations	Using Blogs	Improving Communication Skills	Reasons, Benefits, and Barriers
Interacting with Subordinates	Barriers to Phone conversations	Using Social Media	Effective Oral Communication	Listening Strategies
Interacting with Co-workers	Making and Returning Calls		Effective Written Communication	Ways We Filter What We Hear
Interacting with Suppliers	Making Cold Calls		Effective Nonverbal Skills	Developing a Listening Attitude
	Handling Conference Calls		Effective Word Use	Show You Are Listening
	Handling Unsolicited Calls		Giving and Receiving Feedback	Asking Questions
				Obtaining Feedback
				Getting Others to Listen

Nonverbal Communication	Written Communication	Speaking	Applications and Effective Résumés
Communicating Nonverbally	Writing Documents	Using Language Carefully	Completing a Job Application

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Reading Body Language and mixed Messages	Constructive Criticism in Writing	One-on-One Conversations	Writing a Cover Letter
Matching Verbal and Nonverbal communication		Small Group Communication	Things to Include in a Résumé
Improving Nonverbal Indicators		Large Group Communication	Selling Yourself in a Résumé
Nonverbal Feedback		Making Speeches	Terms to Use in a Résumé
Showing Confidence Nonverbally		Involving the Audience	Describing Your Job Strengths
Showing Assertiveness		Answering Questions	Organizing Your Résumé
		Visual and Media Aids	Writing an Electronic Résumé
		Errors in Presentation	Dressing Up Your Résumé

1.2 Demonstrate creativity by asking challenging questions and applying innovative procedures and methods.

Teamwork and Problem Solving	Meeting Etiquette
Thinking Creatively	Preparation and Participation in Meetings
Taking Risks	Conducting Two-Person or Large Group Meetings
Building Team Communication	Inviting and Introducing Speakers
	Facilitating Discussions and Closing
	Preparing Visual Aids
	Virtual Meetings

1.3 Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations.

Problem Solving	Customer Service	The Application Process	Interviewing Skills	Finding the Right Job
Transferable Job Skills	Gaining Trust and Interacting with Customers	Providing Information, Accuracy and Double Checking	Preparing for an Interview	Locating Jobs and Networking
Becoming a Problem Solver	Learning and Giving Customers What They Want	Online Application Process	Questions to Ask in an Interview	Job Shopping Online
Identifying a Problem	Keeping Customers Coming Back	Following Up After Submitting an Application	Things to Include in a Career Portfolio	Job Search Websites
Becoming a Critical Thinker	Seeing the Customer's Point	Effective Résumés:	Traits Employers are Seeking	Participation in Job Fairs
Managing	Selling Yourself and the Company	Matching Your Talents to a Job	Considerations Before Taking a Job	Searching the Classified Ads
	Handling Customer Complaints	When a Résumé Should be Used		Using Employment Agencies
	Strategies for Customer Service			Landing an Internship
				Staying Motivated to Search

1.4 Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity.

Workplace Ethics	Personal Characteristics	Employer Expectations	Business Etiquette	Communicating at Work
Demonstrating Good Work Ethic	Demonstrating a Good Attitude	Behaviors Employers Expect	Language and Behavior	Handling Anger

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Behaving Appropriately	Gaining and Showing Respect	Objectionable Behaviors	Keeping Information Confidential	Dealing with Difficult Coworkers
Maintaining Honesty	Demonstrating Responsibility	Establishing Credibility	Avoiding Gossip	Dealing with a Difficult Boss
Playing Fair	Showing Dependability	Demonstrating Your Skills	Appropriate Work Email	Dealing with Difficult Customers
Using Ethical Language	Being Courteous	Building Work Relationships	Cell Phone Etiquette	Dealing with Conflict
Showing Responsibility	Gaining Coworkers' Trust		Appropriate Work Texting	
Reducing Harassment	Persevering		Understanding Copyright	
Respecting Diversity	Handling Criticism		Social Networking	
Making Truthfulness a Habit	Showing Professionalism			
Leaving a Job Ethically				

1.5 Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply team work skills.

Expected Work Traits	Teamwork	Time Management
Demonstrating Responsibility	Teamwork Skills	Managing Time
Dealing with Information Overload	Reasons Companies Use Teams	Putting First Things First
Transferable Job Skills	Decisions Teams Make	Juggling Many Priorities
Managing Change	Team Responsibilities	Overcoming Procrastination
Adopting a New Technology	Problems That Affect Teams	Organizing Workspace and Tasks
	Expressing Yourself on a Team	Staying Organized
	Giving and Receiving Constructive Criticism	Finding More Time
		Managing Projects
		Prioritizing Personal and Work Life

1.6 Present a professional image through appearance, behavior and language.

On-the-Job Etiquette	Person-to-Person Etiquette	Communication Etiquette	Presenting Yourself
Using Professional Manners	Meeting Business Acquaintances	Creating a Good Impression	Looking Professional
Introducing People	Meeting People for the First Time	Keeping Phone Calls Professional	Dressing for Success
Appropriate Dress	Showing Politeness	Proper Use of Work Email	Showing a Professional Attitude
Business Meal Functions		Proper Use of Cell Phone	Using Good Posture
Behavior at Work Parties		Proper Use in Texting	Presenting Yourself to Associates
Behavior at Conventions			Accepting Criticism
International Etiquette			Demonstrating Leadership
Cross-Cultural Etiquette			
Working in a Cubicle			

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

L9-10RST 1-10 and L9-10WHST 1-10:

Georgia Standards of Excellence ELA/Literacy standards have been written specifically for technical subjects and have been adopted as part of the official standards for all CTAE courses.

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 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), 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.

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- 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.