

**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

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
Reading Body Language and mixed Messages	Constructive Criticism in Writing	One-on-One Conversations	Writing a Cover Letter

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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
Behaving Appropriately	Gaining and Showing Respect	Objectionable Behaviors	Keeping Information Confidential	Dealing with Difficult Coworkers

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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-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 21st 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.