

**Science, Technology, Engineering, Mathematics Career Cluster
Foundation of Electronics
Course Number 21.45200**

Course Description:

This foundational course is designed for students who are interested in careers related to the design, production, analysis, repair, and operation of devices that use electronics. Students will study and apply using project based learning activities the fundamentals of electricity and electronic systems including the theory and operation of how the basic components function, how a variety circuits are connected, and how to design these circuits. The pre-requisite for this course is advisor approval.

Course Standard 1

STEM-FE-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
Matching Verbal and Nonverbal communication		Small Group Communication	Things to Include in a Résumé

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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
Maintaining Honesty	Demonstrating Responsibility	Establishing Credibility	Avoiding Gossip	Dealing with a Difficult Boss

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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. Additional Georgia Standards of Excellence ELA/Literacy standards for Speaking and Listening are listed in the foundational course standards below.

Course Standard 2

STEM-FE-2

Develop an understanding of engineering and electronics and describe the principal fields of engineering and electronic specializations (ex. aeronautical, automotive, chemical, civil, industrial, and mechanical, computer software, electrical, and biomedical) and identify associated career tracks.

- 2.1 Explain a contemporary definition of engineering and electronics.
- 2.2 Identify education requirements for engineering and electronics occupations and locations where programs of study are available.
- 2.3 Match engineering and electronics job titles with qualifications and responsibilities.
- 2.4 Participate in activities related to career interests.
- 2.5 Explain how each engineering and electronic discipline will relate to a green environment and sustainability.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

ELACC9-10SL1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

ELACC9-10SL2: Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

ELACC9-10SL4: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

Course Standard 3

STEM-FE-3

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

- 3.1 Implement workplace and product safety standards such as OSHA, EPA, ISO, GMP, and UL. (STEM-ST3).
- 3.2 Accurately interpret safety signs, symbols, and labels (Hazardous Communications).
- 3.3 Demonstrate and incorporate safe laboratory procedures in lab, shop, and field environments.
- 3.4 Explain how the incorporation or lack of safety practices impact the economy and costs of safety in business and industry.
- 3.5 Identify, select, and use appropriate Personal Protective Equipment (PPE), follow work area organization procedures and follow Standard Operating Procedures (SOP) when performing work.

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ELACC9-10SL4: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

SCSh2: Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate technique in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

Course Standard 4

STEM-FE-4

Identify criteria of usage, care, and maintenance for tools and machines.

- 4.1 Identify, select and use appropriate tools and machines for specific tasks.
- 4.2 Demonstrate safe use of tools and machines.
- 4.3 Use precision tools and instruments to measure and convert units.
- 4.4 Utilize appropriate computer hardware and software to compose, analyze and synthesize data to document the design process.
- 4.5 Apply proper maintenance techniques for tools, machines, and hardware.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

ELACC9-10SL5: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

SCSh5: Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

- c. Recognize the relationship between accuracy and precision.
- d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.

SCSh4: Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

- c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh2: Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate technique in all laboratory situations.

Course Standard 5

STEM-FE-5

Introduce the history and development of electron theory.

- 5.1 Discuss the history of electron theory.
- 5.2 Identify the atom: protons, neutrons, and electrons.
- 5.3 Identify material conductivity/insulators.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

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ELACC9-10SL4: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

SPS1: Students will investigate our current understanding of the atom.

- a. Examine the structure of the atom in terms of: proton, electron, and neutron locations.

SCSh7: Students will analyze how scientific knowledge is developed. Students will recognize that:

- b. Universal principles are discovered through observation and experimental verification.
- c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

- d. Hypotheses often cause scientists to develop new experiments that produce additional data.
- e. Testing, revising, and occasionally rejecting new and old theories never ends.

Course Standard 6

STEM-FE-6

Identify electronic theories applicable to electronic processes.

- 6.1 Define Ohm's law and formula component parts.
- 6.2 Define Kirchoff's law and component parts.
- 6.3 Define Watt's law and component parts.
- 6.4 Design and analyze a simple circuit to determine the values of the various electronic component parts.
- 6.5 Demonstrate the use of metric prefixes and value conversions.

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SP5: Students will evaluate relationships between electrical and magnetic forces.

- b. Determine the relationship among potential difference, current, and resistance in a direct current circuit.
- c. Determine equivalent resistances in series and parallel circuits.

Course Standard 7

STEM-FE-7

Introduce electronic components that comprise an electronic system.

- 7.1 Identify Resistor Color Code and component polarity.
- 7.2 Identify and describe various resistors, capacitors, transistors, coils, semiconductors, etc.
- 7.3 Discuss circuit design and construction.
- 7.4 Develop and evaluate a prototype device.

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ELACC9-10SL2: Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

ELACC9-10SL4: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

SPS10: Students will investigate the properties of electricity and magnetism.

- b. Explain the flow of electrons in terms of:
 - alternating and direct current.
 - the relationship among voltage, resistance and current.
 - simple series and parallel circuits.

Course Standard 8

STEM-FE-8

Introduce the techniques and processes in electronics systems.

- 8.1 Explain and demonstrate basic soldering techniques.
- 8.2 Explain procedures for connecting circuit components.
- 8.3 Conduct laboratory experiments utilizing appropriate soldering techniques.
- 8.4 Evaluate prototype produced.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

ELACC9-10SL1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

ELACC9-10SL2: Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

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Course Standard 9

STEM-FE-9

Understand the various measuring apparatuses appropriate to electronics systems.

- 9.1 Identify and demonstrate proper use of a multi-meter.
- 9.2 Identify and demonstrate proper use of an oscilloscope.
- 9.3 Discuss virtual computer simulation testing and how it is used in electronics.
- 9.4 Construct a continuity prototype device.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

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Course Standard 10

STEM-FE-10

Use appropriate technology to collect, record, manipulate, analyze, and report data.

- 10.1 Demonstrate the ability to recognize cause and effect when faced with projects or issues.
- 10.2 Recognize measurable attributes in units, objects, systems, and processes in assigned activities.
- 10.3 Organize data and the consequences of the problems or issues, and research the material placing it in manageable formats.
- 10.4 Attempt to predict the outcomes based on data collected in a project or experiment.
- 10.5 Defend one's position based on quality collection of facts and data supporting plans, processes, and/or projects.
- 10.6 Draw a conclusion when confronted with data or observations that focus on the observed plans, processes, or projects at hand.
- 10.7 Analyze change as a result of data differences and changing environmental values.

- 10.8 Use qualitative and quantitative skills to conduct a simple scientific inquiry and economic analysis; use the data to draw a conclusion based on the analysis.
- 10.9 Recognize the value of the reiterative process to improve data and to improve the design process.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

ELACC9-10SL1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

ELACC9-10SL2: Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

ELACC9-10SL3: Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.

ELACC9-10SL4: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

MCC9-12.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

SCSh3: Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.
- d. Graphically compare and analyze data points and/or summary statistics.
- e. Develop reasonable conclusions based on data collected.
- f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

Course Standard 11

STEM-FE-11

Design a solution to an engineering and electronics problem applying math and science principles.

- 11.1 Apply science and mathematics concepts and principles to resolve plans, projects, processes, issues, or problems through methods of inquiry.
- 11.2 Use the protocols in science and mathematics to integrate solutions related to technical, electronic, or engineering activities using the content and concepts related to the situation or problems.
- 11.3 Explain the role of modeling and/or simulation in electricity and electronics.
- 11.4 Communicate and collaborate with others on inquiry or resolution of issues/problems in the global community.
- 11.5 Defend one's solution based on quality collection of facts and data supporting plans, processes, and/or projects and communicate the solution both orally and written.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

ELACC9-10SL1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

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logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

SCSh6: Students will communicate scientific investigations and information clearly.

- c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
- d. Participate in group discussions of scientific investigation and current scientific issues.

SCSh8: Students will understand important features of the process of scientific inquiry.

Students will apply the following to inquiry learning practices:

- a. Scientific investigators control the conditions of their experiments in order to produce valuable data.
- b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations' hypotheses, observations, data analyses, and interpretations.
- c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

Course Standard 12

STEM-FE-12

Construct an electronic device as a culminating experience.

- 12.1 Construct Series, Parallel and Series/Parallel circuits.
- 12.2 Simulate test circuits utilizing electronic software.
- 12.3 Design, construct, and test an electronic device from component parts.

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence

SPS10: Students will investigate the properties of electricity and magnetism.

- b. Explain the flow of electrons in terms of: simple series and parallel circuits.

Course Standard 13

STEM-FE-13

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.

- 13.1 Explain the goals, mission and objectives of CTSO's.
- 13.2 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.
- 13.3 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.
- 13.4 Explain how participation in career and technology education student organizations can

- promote lifelong responsibility for community service and professional development.
- 13.5 Demonstrate teamwork, leadership, interpersonal relations, and project management.
 - 13.6 Through teamwork, apply the skills and abilities in requirements analysis and configuration control while working with plans, processes, and projects as assigned.
 - 13.7 Through teamwork, use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.
 - 13.8 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.
 - 13.9 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).
 - 13.10 Understand and demonstrate proper work ethics when working with plans, processes, and projects as assigned.

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ELACC9-10SL4: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.