

**Architecture and Construction Career Cluster**  
**Electrical Motor Control**  
**Course Number: 46.43000**

**Course Description:**

This course provides instruction in the fundamentals of electric motors and wiring as it relates to the manufacturing environment. Topics include motor theory and magnetism, various control devices, identification of symbols and schematic diagrams and proper wiring. Students will review and learn to properly apply standards from the National Electrical Code and National Electrical Manufacturers Association. *Prerequisites for the course include Industrial Maintenance and Fluid Power and Piping Systems.*

**Course Standard 1**

**AC-EMC-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

## Georgia Department of Education

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

## Georgia Department of Education

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

### AC-EMC-2

#### **Demonstrate appropriate safety procedures in an Industrial Environment.**

- 2.1 Wear approved PPE (shoes, eye wear, gloves, hard hats, etc.).
- 2.2 Understand the importance of lockout/tag-out procedures to control various energy types (i.e. electrical, thermal (steam), hydraulic, pneumatic, or gravitational). Practice correct lockout/tag-out procedures using a padlock and tag as described under OSHA's 29 CFR 1910.147 standard, the Control of Hazardous Energy (Lockout/Tag-out).
- 2.3 Discuss the Material Safety Data Sheets (MSDS) Right-to-Know Law.
- 2.4 Identify types of fires, types of fire extinguishers, and types of protective clothing.
- 2.5 Identify the appropriate action for reporting fires and appropriate firefighting procedures.
- 2.6 Demonstrate Use of Lab Emergency Power Disconnect ("Kill Switch").
- 2.7 Demonstrate an understanding of safety precautions and procedures.
- 2.8 Demonstrate the safe use of test equipment.
- 2.9 Understand safety rules to follow when working with mechanical and electrical systems.
- 2.10 Identify and discuss the potential safety hazards and precautions of working with mechanical and electrical systems.

## Course Standard 3

### AC-EMC-3

#### **Demonstrate an understanding of motor theory and operating principles.**

- 3.1 Describe the laws of magnetism and their application to AC and DC motors.
- 3.2 Compare the operating principles of AC motors with those of DC motors.
- 3.3 Compare the characteristics of AC motors with those of DC motors.
- 3.4 Define terms associated with electric motors.
- 3.5 Identify the component parts of an electric motor.
- 3.6 Name different types of AC and DC motors.
- 3.7 Determine voltage, amperage, speed, horsepower, NEMA class, and environmental requirements of electric motors using data from the motor name plate.

## Course Standard 4

### AC-EMC-4

#### **Demonstrate an understanding of the differences between AC and DC of motor controls.**

- 4.1 Describe the operating characteristics of the three classes of DC motors.
- 4.2 State the function of starter devices in DC motors.
- 4.3 Name the types of manual DC motor starters.
- 4.4 Identify the components used in DC motor control.
- 4.5 Name the types of automatic DC motor starters.
- 4.6 Describe the methods of controlling the speed of DC motors.
- 4.7 Describe the operating characteristics of the three classes of AC motors.
- 4.8 State the purpose of controllers in AC motor circuits.
- 4.9 Name the types of AC motor controllers.
- 4.10 Identify the components used in AC motor controls.
- 4.11 Describe the methods used to provide circuit protection in AC motor control applications.

## Course Standard 5

### AC-EMC-5

#### Demonstrate an understanding of the purpose of control devices.

- 5.1 Identify and describe various devices used for sensing temperature, pressure, level, motion, and position.
- 5.2 Identify and describe the devices used in switching circuits.
- 5.3 Identify and describe the devices used for motor overload protection.
- 5.4 Identify and describe the devices used for ground fault and short circuit protection.
- 5.5 Identify and describe various other devices used in motor control circuits.

## Course Standard 6

### AC-EMC-6

#### Read and interpret symbols and schematic diagrams.

- 6.1 Identify and draw the various symbols for components and conditional state of devices used in motor control circuits.
- 6.2 Describe a typical motor control schematic diagram.
- 6.3 Draw a schematic diagram of a motor control circuit.
- 6.4 Interpret schematic diagrams of various motor control circuits.

## Course Standard 7

### AC-EMC-7

#### Demonstrate an understanding of magnetic starters and braking.

- 7.1 Wire control transformers for the various 24V, 120V, and 230V secondary control voltages used in the industry.
- 7.2 Wire an across-the-line motor starter using a start-stop switch.
- 7.3 Wire a forward/reverse motor starter using a stop/forward/reverse switch.
- 7.4 Wire a magnetic starter for a motor control using a run/jog/stop switch without a control relay.
- 7.5 Wire a magnetic starter for a motor control using a control relay and a run/jog/stop switch.
- 7.6 Identify and describe the different dynamic, plugging, electronic, electric, and manual types of motor braking devices used in the industry.
- 7.7 Install a braking system on a motor.

## Course Standard 8

### AC-EMC-8

#### Apply concepts of the NEMA (National Electrical Manufacturers Association) and NFPA (National Fire Protection Agency) Standards.

- 8.1 Identify and explain the purpose of NEMA standards for electric motors.
- 8.2 Interpret NEMA design codes to operating characteristics of electric motors.
- 8.3 Differentiate between types of electric motor enclosures as outlined in NEMA standards.
- 8.4 Interpret NFPA (National Fire Protection Agency) 70E standards.

## Course Standard 9

### AC-EMC-9

#### Apply concepts from article 430 of the NEC (National Electrical Code).

- 9.1 Calculate the size for branch circuit conductors covered by NEC selection 430-22.
- 9.2 Calculate the size for feeder circuit protection covered by NEC section 430-22.
- 9.3 Calculate the size for ground fault/short circuit protection (fuses and circuit breakers) using locked motor current, Table 430-152, and Article 430-52 of the NEC.

## Georgia Department of Education

- 9.4 Calculate the size of overload protection according to sections 430-74 and 430-34 of the NEC.
- 9.5 Size equipment grounds according to Table 250-95 of the NEC.
- 9.6 Size and locate the motor disconnects according to NEC Part H, Article 430.
- 9.7 Size controllers according the NEMA standards.
- 9.8 Calculate the size of control conductors according to Article 430-72 of the NEC.
- 9.9 Size raceways for motor circuits using Chapter 9: Table 3A, 3B, 3C, 4, and 5 of the NEC.

### Course Standard 10

#### AC-EMC-10

##### **Demonstrate knowledge of preventative maintenance and troubleshooting.**

- 10.1 Perform a visual inspection using procedures described in the manufacturer's service manual.
- 10.2 Lubricate a motor according to procedures described in the manufacturer's service manual.
- 10.3 Clean a motor according to procedures outlined in the manufacturer's service manual.
- 10.4 Discuss techniques for troubleshooting electric motors.

### Course Standard 11

#### AC-EMC-11

##### **Examine how related student organizations are integral parts of career and technology education courses through leadership development, school and community service projects, and competitive events.**

- 11.1 Explain the purpose, mission, objectives, motto, colors, official dress and other distinguishing characteristics of SkillsUSA.
- 11.2 Explain how participation in SkillsUSA can promote lifelong responsibility for community service, professional growth and development.
- 11.3 Explore the impact and opportunities SkillsUSA can develop to bring business and industry together with education in a positive working relationship through innovative leadership and career development programs.
- 11.4 Explore the local, state, and national opportunities available to students through participation in SkillsUSA including but not limited to conferences, competitions, community service, philanthropy, and other SkillsUSA activities.