

## Colorado CTE Course – Scope and Sequence

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| Course Name                                                                                                                                                                                                                                                                                                                        | Electronics- Analog/Robotics                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                           | Course Details                                                                                                                                                                                                                                                                                                                | Credit= 0.5<br><br>Prerequisite: Robotics and Automated Systems<br><br>CTE Credential: CTE Manufacturing; CTE STEM                                                                                                                                                                                                                                                            |                  |
|                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                           | Course = 0.50 Carnegie Unit Credit                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                               |                  |
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| Course Description                                                                                                                                                                                                                                                                                                                 | An in-depth study of series-parallel circuits, inductive and capacitive reactance, rectification, amplification, voltage regulation, semi-conductors, and robotics will be conducted. Electronic theory is reinforced through breadboarding circuits in the lab. Students will program robots to perform a specific task. |                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                               |                  |
| Note:                                                                                                                                                                                                                                                                                                                              | This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.                                                                                                           |                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                               |                  |
| SCED Identification #                                                                                                                                                                                                                                                                                                              | 17111                                                                                                                                                                                                                                                                                                                     | Schedule calculation based on 60 calendar days of a 90-day semester. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.                          |                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                               |                  |
| All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at <a href="https://www.cde.state.co.us/standardsandinstruction/essentialskills">https://www.cde.state.co.us/standardsandinstruction/essentialskills</a> |                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                               |                  |
| Instructional Unit Topic                                                                                                                                                                                                                                                                                                           | Suggested Length of Instruction                                                                                                                                                                                                                                                                                           | CTE or Academic Standard Alignment                                                                                                                                                                                                        | Competency / Performance Indicator                                                                                                                                                                                                                                                                                            | Outcome / Measurement                                                                                                                                                                                                                                                                                                                                                         | CTSO Integration |
| Safety                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                           | Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the manufacturing sector workplace environment. | The student practices safe and proper work habits. The student is expected to:<br><br>(A) master relevant safety tests;<br><br>(B) comply with safety guidelines as described in various manuals, instructions, and regulations;<br><br>(C) identify governmental and organizational regulations for health and safety in the | Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. |                  |

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|                           |  |                                                                                                                                                                   | <p>workplace related to electronics;</p> <p>(D) identify and classify hazardous materials and wastes according to Occupational Safety and Health Administration (OSHA) regulations;</p> <p>(E) dispose of hazardous materials and wastes appropriately;</p> <p>(F) perform maintenance on selected tools, equipment, and machines;</p> <p>(G) handle and store tools and materials correctly; and</p> <p>(H) describe the results of improper maintenance of material, tools, and equipment.</p> | <p>Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment.</p>                                  |  |
| <b>Career Development</b> |  | <p>Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.</p> | <p>The student demonstrates the skills necessary for success in a technical career. The student is expected to:</p> <p>(A) distinguish the differences between an engineering technician, engineering technologist, and engineer;</p>                                                                                                                                                                                                                                                            | <p>In teams, develop a persuasive paper or presentation arguing for the importance of electrical and/or computer engineers' contributions to society. Select several such contributions as justification, and provide compelling evidence for how</p> |  |

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|  |  | <p>Identify career paths available in manufacturing and electronics.</p> | <p>(B) identify employment and career opportunities;</p> <p>(C) identify industry certifications;</p> <p>(D) discuss ethical issues related to engineering and technology and incorporate proper ethics in submitted projects;</p> <p>(E) identify and demonstrate respect for diversity in the workplace;</p> <p>(F) identify and demonstrate appropriate actions and identify consequences relating to discrimination, harassment, and inequality;</p> <p>(G) explore electronics engineering careers and preparation programs;</p> <p>(H) explore career preparation learning experiences, including job shadowing, mentoring, and apprenticeship training</p> | <p>electrical/computer engineers' designs are used in everyday applications. Incorporate a variety of sources to gather data, including print and electronic; cite each source, and briefly describe why the particular source is reliable.</p> <p>Research the postsecondary institutions in Colorado that offer electrical engineering or electrical and/or computer engineering technology. Individually or in teams, develop and publish information that identifies admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare students for success after high school in electrical or computer engineering fields. Cite each source adhering to standard citation conventions used in engineering disciplines.</p> <p>Investigate local employment opportunities requiring skills in robotics. Identify preferred requirements and certifications. Analyze the student ICAP for gaps in developing preferred</p> |  |
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|                                     |  |                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | experience or requirements and identify ways to fulfill these requirements. |  |
| <b>Circuits, Sources, and Loads</b> |  | Understand and apply electrical scientific concepts to electronic operations and component functions. | <p>Student understands and apply electrical concepts. Student is expected to:</p> <ul style="list-style-type: none"> <li>(A) define charge, current, voltage</li> <li>(B) understand concepts related to sources and Loads: power, resistors, sources</li> <li>(C) understand how scientific laws and principles are used in DC circuit analysis: Kirchhoff's laws, series and parallel resistors, voltage divider, current divider, Thevenin's theorem, analysis strategies;</li> <li>(D) understand Energy and power sources: batteries, efficiency, maximum power transfer; and</li> <li>(E) apply AC concepts: DC and AC, sinusoidal functions, AC voltage and current, RMS</li> </ul> |                                                                             |  |
| <b>Power Supplies</b>               |  | Understand how power supplies are used in analog electronic components and systems.                   | Apply understanding of power supplies and diodes to analog electronic components and systems. Student is expected to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                             |  |

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|                                       |  |                                                                                        | <p>(A) explain Diode characteristics, construction and operation;</p> <p>(B) identify diode order models;</p> <p>(C) understand half wave rectifiers and how to calculate peak output voltage;</p> <p>(D) explain how capacitors function;</p> <p>(E) understand voltage ripple;</p> <p>(F) understand concepts related to full wave rectifiers: voltage ripple, transformers</p> <p>(G) identify Voltage regulators doublers, and inductors;</p> <p>(H) understand how DC-DC converters function and identify transistors as switches, RL circuits, and switched regulators.</p> |  |  |
| <b>Machines and Power Electronics</b> |  | Understand and apply knowledge of DC motors to analog electronics and simple machines. | <p>Understand how DC motors function in analog electronic applications. Student is expected to :</p> <p>(A) Apply concepts of the work done by simple machines: force on a conductor, motor and</p>                                                                                                                                                                                                                                                                                                                                                                               |  |  |

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|                          |  |                                                                | <p>generator action, commutation, DC motors;</p> <p>(B) apply Faraday's law, to DC generators, and AC motors;</p> <p>(C) understand how DC machines operate;</p> <p>(D) define terminology related to DC machines: equivalent circuit model, torque/current and voltage/speed relationships, performance parameters, efficiency;</p> <p>(E) define terminology related to AC machines: rotating magnetic fields, synchronous machines, inductor motors, comparison of electric machines;</p> <p>(F) understand concepts related to Power electronics: speed control of DC motors, pulse width modulation, H bridges, and H-bridge drive of DC motors.</p> |  |  |
| <b>Linear Amplifiers</b> |  | Understand the concept of amplification in analog electronics. | Amplifier concepts: input resistance and output resistance, gain, offset,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |

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|                                         |  | Explain the operation of circuits using transistors in switching mode to achieve a variable DC output.                      | maximum output voltage and current, differential amplifiers<br>Op-amps: concept, equivalent circuit model, inverting, non-inverting and summing amplifiers, power op-amps<br>Transistors: principles of BJTs and MOSFETs, simple models, linear amplifier configurations<br>Frequency dependent gain: frequency response, RC transfer function, cross-over frequency, low pass and high pass filters |  |  |
| <b>RLC Circuits</b>                     |  | Explain the transient behavior of RLC circuits.                                                                             | Superposition<br>Norton's Theorem<br>Mesh analysis<br>Nodal analysis<br>Time domain response: RC, RL and RLC networks, transient response, steady state DC response, step response, periodic response                                                                                                                                                                                                |  |  |
| <b>Steady State Sinusoidal Analysis</b> |  | Use piecewise linear models to predict the steady state behavior of simple diode and transistor circuits, AC and DC motors. | Complex signals and impedance: complex exponentials, complex arithmetic in Cartesian and polar form, complex impedance<br>Phasors<br>Filters: RC filters, buffered and unbuffered bandpass filters, RL filters, active filters<br>Resonant Circuits: series and parallel resonant                                                                                                                    |  |  |

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|  |  |  | circuits, resonant frequency,<br>bandwidth, quality factor |  |  |
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## Academic Standards Alignment

Colorado CTE courses are required to integrate academic and essential skills into course content. The following academic standards have been identified as aligned to this course and should be integrated throughout instruction.

[CO CTE Academic Standards Resources](#) (Rubrics, integration strategies, etc) [CDE Colorado Academic Standards Online](#) (Online standards lookup tool)

### Reading, Writing, & Communicating

#### Standard 1: Oral Expression and Listening

- **Prepared Graduate 1:** Collaborate effectively as group members or leaders who listen actively and respectfully; pose thoughtful questions, acknowledge the ideas of others; and contribute ideas to further the group's attainment of an objective.
- **Prepared Graduate 2:** Deliver effective oral presentations for varied audiences and varied purposes.

#### Standard 2: Reading for All Purposes .

- **Prepared Graduate 4:** Read a wide range of informational texts to build knowledge and to better understand the human experience.
- **Prepared Graduate 5:** Understand how language functions in different contexts, command a variety of word-learning strategies to assist comprehension, and make effective choices for meaning or style when writing and speaking.

#### Standard 3: Writing and Composition

- **Prepared Graduate 8:** Craft narratives using techniques specific to the genre.
- **Prepared Graduate 9:** Demonstrate mastery of their own writing process with clear, coherent, and error-free polished products.

#### Standard 4: Research Inquiry and Design

- **Prepared Graduate 10:** Gather information from a variety of sources; analyze and evaluate its quality and relevance; and use it ethically to answer complex questions.

*Note: Mathematics and Science standards will be added in the future. Visit the [Colorado Academic Standards](#) page for the most current version.*