Electronics AC/DC - AES

Level: 3
Career Cluster: Advanced Manufacturing
Program: Engineering
Pathway(s): Engineering Applications UAS, Aerospace Engineering Technician, Engineering

Course Catalog Description

Introduces AC/DC electronics through circuit analysis, measurement, safety, and hands-on lab work with an aerospace and avionics emphasis. Students build, test, and troubleshoot circuits while connecting core electronics concepts to aircraft, UAS, and aerospace system applications through engineering design and a final project.

Summary

This course provides students with a comprehensive study of AC/DC electronics through career exploration, laboratory safety, circuit analysis, hands-on construction, and engineering design with a clear aerospace and avionics emphasis. Students investigate aerospace engineering technician and aviation electronics career pathways, Colorado postsecondary opportunities, and industry expectations while developing professionalism, ethical awareness, and technical communication skills. Through classroom and lab experiences, students learn to measure electrical quantities, explain atomic theory and material behavior, analyze direct current and alternating current circuits, and examine the function of common electronic components, magnetism, electromagnetism, motors, and generators as they relate to aircraft, spacecraft, UAS, and support systems. Students also build and test circuits using breadboards and standard test equipment, collect and interpret technical data, troubleshoot circuit faults, and document their work using schematics, lab reports, and technical communication practices similar to those used in aerospace settings. By the end of the course, students apply electronics concepts and engineering reasoning to design, construct, test, revise, and present a functional project that demonstrates technical knowledge, problem-solving skill, and awareness of aerospace system applications.

Notes

This revised course is more clearly organized, more current, and more intentionally aligned to aerospace and avionics applications. The previous version emphasized broad electronics content, robotics, and printed circuit board fabrication in a draft format, while the new version restructures the content into clearly defined objectives and sequenced student learning outcomes focused on safety, measurement, DC and AC analysis, troubleshooting, technical communication, engineering design, leadership, and work-based learning. The updated course also strengthens career exploration and Colorado postsecondary connections, adds a stronger emphasis on professionalism and employability skills, and frames the final project around real-world aerospace, UAS, and engineering system applications. Overall, the revision provides a more career-connected and instructionally coherent framework for teaching electronics within the AES pathway.

Student Learning Outcomes

1. Career Exploration and Postsecondary Opportunities

Objective: *Students will analyze career pathways in aerospace engineering technician by exploring industry roles, workplace expectations, required education, certifications, professional organizations, and postsecondary opportunities available in Colorado in order to make informed academic and career decisions.*

1) Identify employment opportunities in various fields with a focus in the area of aerospace engineering technician
    a. Recognize the work typically performed, tools and technology used, and nature of work environments
    b. Identify potential certifications within the careers
    c. Find membership organizations associated with the careers
    d. Understand the necessary education associated within the careers
2) Define professionalism within the context of aerospace engineering technician
    a. Criticism and evaluation
    b. Presentation
    c. Assessment
3) Recognize laws, regulations, and ethics significant to the fields of aerospace engineering technician
4) Identify postsecondary opportunities offered in the state of Colorado
    a. Technical college, community college, 4-year institutions
    b. Certificates, associates, bachelor, and advanced degree opportunities

2. Safety Tools and Laboratory Practices

Objective: *Students will apply safe work habits, proper tool use, and lab procedures to prevent hazards while working with electrical, electronic, and introductory aerospace or avionics-related systems.*

5) Interpret classroom and lab safety rules related to electricity, tools, and electronic components.
6) Demonstrate appropriate use of personal protective equipment and safe workstation practices.
7) Use electrical tools and testing equipment according to standard operating procedures.
8) Recognize potential hazards such as shock, short circuits, heat, and improper grounding.
9) Explain basic first aid and emergency response procedures for electrical incidents.
10) Evaluate lab practices for safety, organization, and responsible tool handling.

3. Electrical Quantities and Measurement

Objective: *Students will develop an understanding of fundamental electrical quantities and measure them accurately using standard test equipment in electronics and introductory avionics contexts.*

11) Define voltage, current, resistance, and power using appropriate units and symbols.
12) Distinguish between current measurement, voltage measurement, and resistance measurement.
13) Demonstrate proper use of a multimeter to collect electrical measurements.

14) Measure voltage, current, and resistance in simple circuits and introductory aerospace electronics scenarios.
15) Describe the function and application of oscilloscopes in analyzing electronic and avionics-related signals.
16) Record measurements using correct notation, units, and technical vocabulary.

4. Atomic Theory Conductors and Circuit Fundamentals

Objective: *Students will explain how atomic structure and material properties influence electrical behavior in circuits and electronic systems.*

17) Describe atomic structure and the relationship between electrons, conductivity, and insulation.
18) Differentiate conductors, insulators, and semiconductors based on material properties.
19) Explain how electric charge and electron movement create current flow.
20) Classify common materials used in electronic systems based on their electrical properties.
21) Analyze how material selection impacts circuit performance and safety.

5. Direct Current DC Circuit Analysis

Objective: *Students will analyze direct current circuits by applying laws, formulas, and schematic conventions to predict and verify circuit behavior in electronics and aerospace-related systems.*

22) Define direct current and identify common DC power sources and applications.
23) Interpret electronic schematics and symbols for switches, sources, resistors, fuses, meters, and ground.
24) Determine resistor values using color codes.
25) Apply Ohm's Law to calculate voltage, current, and resistance.
26) Apply the Power Law to calculate electrical power in DC circuits.
27) Differentiate series, parallel, and combination circuits.
28) Calculate current, voltage drops, resistance, and power in DC circuit configurations.
29) Analyze how circuit changes affect overall circuit performance, including in introductory avionics-style applications.
30) Verify calculations through circuit construction and measurement.

6. Circuit Construction Breadboarding and Prototyping

Objective: *Students will construct and test functional circuit prototypes using breadboards, components, and engineering design practices.*

31) Identify the purpose and layout of a breadboard.
32) Assemble simple series, parallel, and combination circuits on a breadboard.
33) Select appropriate components based on circuit requirements.
34) Demonstrate proper wiring techniques for prototype circuits.
35) Test breadboarded circuits for continuity and expected operation.
36) Modify circuit designs based on observed results and test data.
37) Evaluate prototype quality for organization, functionality, and safety.

7. Electronic Components and Devices

Objective: *Students will examine the function of common electronic components and predict how they influence circuit performance.*

38) Identify the characteristics and purposes of resistors, potentiometers, capacitors, switches, and protective devices.
39) Explain how component values affect current, voltage, and circuit behavior.
40) Compare fixed and variable components in practical applications.
41) Select components for specific functions in a circuit design.
42) Analyze how component failure or incorrect selection affects system operation.
43) Construct simple circuits using a variety of passive components.

8. Magnetism Electromagnetism Motors and Generators

Objective: *Students will explain magnetic principles and analyze how electromagnetic systems are used to produce motion and electrical energy.*

44) Describe the relationship between electricity and magnetism.
45) Explain electromagnetic induction and its role in electrical systems.
46) Identify the operating principles of motors and generators.
47) Compare electrical energy conversion in motors and generators.
48) Analyze how magnetic fields support device operation in engineering systems.
49) Demonstrate understanding of electromagnetism through circuit activities or lab investigations.

9. Alternating Current AC Fundamentals

Objective: *Students will interpret the characteristics of alternating current and analyze how AC differs from DC in electronic, aerospace, and engineering systems.*

50) Define alternating current and describe common AC applications.
51) Compare AC and DC in terms of direction of flow, sources, and uses.
52) Identify waveform characteristics including amplitude, frequency, and period.
53) Interpret graphical representations of AC waveforms.
54) Measure selected AC circuit values using proper test equipment.
55) Explain why AC power is widely used in electrical systems, support equipment, and aerospace-related technologies.

10. Reactive Components and AC Circuit Behavior

Objective: *Students will analyze the behavior of capacitive and inductive elements in alternating current circuits and interpret their effects on circuit operation.*

56) Describe the behavior of capacitors and inductors in AC circuits.
57) Explain capacitive reactance and inductive reactance.
58) Compare resistance and impedance in circuit analysis.
59) Analyze how frequency affects component behavior in AC circuits.
60) Interpret the role of phase relationships in AC circuit performance.
61) Evaluate AC circuit behavior using observations, data, and calculations.

11. Test Equipment Data Collection and Technical Analysis

Objective: *Students will use electronic test equipment to collect, interpret, and communicate circuit data accurately.*

62) Operate multimeters and oscilloscopes safely and effectively.
63) Measure circuit performance using appropriate tools and procedures.
64) Collect and organize test data in tables, charts, or lab notes.
65) Interpret measured data to determine whether a circuit is functioning properly.
66) Compare expected and actual results from a circuit investigation, including introductory aerospace electronics investigations.
67) Communicate findings using appropriate technical language and evidence.

12. Troubleshooting and Problem Solving in Electronic Systems

Objective: *Students will diagnose faults in electrical and electronic circuits by using systematic troubleshooting strategies and engineering reasoning relevant to classroom circuits and introductory aerospace system applications.*

68) Identify common circuit problems such as open circuits, shorts, poor connections, and incorrect component placement.
69) Use a step-by-step troubleshooting process to isolate faults.
70) Analyze measurement data to determine possible root causes.
71) Test circuit sections to verify operation and locate errors.
72) Recommend corrective actions based on evidence from observations and measurements.
73) Evaluate whether repairs or modifications resolved the original problem.

13. Circuit Design Documentation and Technical Communication

Objective: *Students will document circuit designs, procedures, and results in order to communicate technical information clearly and professionally using conventions relevant to engineering and aerospace documentation.*

74) Interpret and draw basic electronic schematics using standard symbols.
75) Label circuit diagrams accurately and clearly.
76) Document procedures, measurements, and observations in engineering notebooks or lab reports.
77) Summarize circuit function and testing results in written form.
78) Present technical information using appropriate vocabulary, visuals, and evidence.
79) Evaluate technical documentation for clarity, completeness, and accuracy.

14. Engineering Design Application and Final Project

Objective: *Students will apply AC/DC electronics concepts to design, construct, test, and present a functional engineering project connected to an aerospace, avionics, UAS, or related system application.*

80) Define a project goal or engineering problem related to electronics and aerospace system applications.

81) Design a circuit solution that meets stated criteria and constraints.
82) Construct a functional prototype using appropriate components and tools.
83) Test the project for performance, reliability, and safety.
84) Revise the design based on troubleshooting and data analysis.
85) Present the final design, process, and results to an audience.
86) Reflect on technical growth, problem solving, and engineering decision making in relation to aerospace and avionics career pathways.

15. Leadership

Objective: *Students will develop leadership skills by demonstrating responsibility, collaboration, initiative, ethical decision making, and effective communication in classroom, lab, and career-connected settings.*

87) Demonstrate leadership behaviors such as responsibility, initiative, accountability, and dependability in classroom and lab activities.
88) Collaborate with peers to plan, organize, and complete team-based technical tasks and projects.
89) Practice effective communication, active listening, and constructive feedback in group and professional settings.
90) Apply ethical decision making and professionalism when solving problems and representing the program.
91) Reflect on personal leadership strengths and identify areas for growth in academic and career contexts.

16. Work-Based Learning

Objective: *Students will connect classroom learning to real-world applications through career awareness, workplace experiences, industry engagement, and reflection on employability skills relevant to electronics and engineering careers.*

92) Identify the purpose and value of work-based learning experiences such as job shadows, internships, industry tours, mentorships, and guest speakers.
93) Demonstrate workplace readiness skills including punctuality, communication, teamwork, adaptability, and professional conduct.
94) Connect course concepts and technical skills to career tasks performed in electronics, engineering, and aerospace-related workplaces.
95) Engage with industry professionals to gather information about career pathways, expectations, and workplace trends.
96) Reflect on work-based learning experiences to evaluate personal interests, skill development, and next steps for career planning.

17. Career and Technical Student Organizations

Objective: *Using the CTSO Resource Document, chapter activities will provide some of the best opportunities CTSO members will have to learn by doing. A successful program of work creates a positive learning atmosphere in the classroom. CTSO members learn how to accept responsibility, work as a team, manage a budget, and handle success and failure. Per the CTE Admin Handbook, CTSOs are embedded into curriculum.*

Professional Development

Prepare each member for entry into the workforce and provide a foundation for success in a career. Becoming a professional does not stop with acquiring a skill, but involves an increased awareness of the meaning of good citizenship and the importance of labor and management in the world of work.

Community Service

Promote and improve goodwill and understanding among all segments of the community through services donated by CTSO chapters, and to instill in its members a lifetime commitment to community service.

Business and Industry Connections

Increase awareness of quality job practices and attitudes, and increase the opportunities for employer engagement and eventual employment.

Financial Leadership

Plan and participate in activities to allow all members to carry out the chapter's projects. Educate members on their own personal finance for current and future success.

Public Relations

Make the general public aware of the good work that students in career and technical education are doing to better themselves and their community, state, nation, and world.

Social Activities

To increase cooperation in the school and community through activities that allow CTSO members to get to know each other in something other than a business or classroom setting.

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)

Note: Mathematics and Science standards will be added in the future. Visit the Colorado Academic Standards page for the most current version.

Reading, Writing and Communicating Crosswalk

Course: Electronics AC/DC
Colorado Academic Standards – Reading, Writing, and Communicating

Standard	Prepared Graduate Competency	Description	Course Evidence / Alignment
Standard 1: Oral Expression and Listening	Prepared Graduate 1 – Collaboration	Collaborate effectively as group members or leaders.	Students work in lab teams to build, test, and troubleshoot circuits; communicate findings and procedures with peers; and practice shared responsibility and respectful collaboration in electronics.
Standard 1: Oral Expression and Listening	Prepared Graduate 2 – Oral Presentations	Deliver effective oral presentations for varied audiences and purposes.	Students explain circuit behavior and lab results, describe troubleshooting steps and safety considerations, and communicate technical information clearly for electronics and introductory avionics-related applications.
Standard 2: Reading for All Purposes	Prepared Graduate 4 – Informational Texts	Read a wide range of informational texts.	Students read and interpret circuit

			diagrams and schematics, datasheets, manuals, safety documentation, and technical explanations of DC/AC.
Standard 2: Reading for All Purposes	Prepared Graduate 5 – Language in Context	Understand how language functions in different contexts.	Students use discipline-specific electrical terminology and interpret symbolic and technical language used in electronics documentation.
Standard 3: Writing and Composition	Prepared Graduate 7 – Informational Writing	Craft informational/explanatory texts using techniques specific to the genre.	Students produce lab reports, written explanations of circuit function, and documentation of measurements, procedures, and outcomes.
Standard 3: Writing and Composition	Prepared Graduate 9 – Writing Process	Demonstrate mastery of their own writing process.	The course requires drafting, revising, and finalizing lab documentation and producing clear, accurate, technically correct written work.
Standard 4: Research Inquiry and Design	Prepared Graduate 10 – Research and Ethics	Gather information from a variety of sources; analyze and evaluate its quality and relevance.	Students research electrical components, circuit behavior, and aerospace-related applications, analyze measurement data, and use information ethically to support conclusions.

Free Resource Links

1. Career Exploration and Postsecondary Opportunities

- FAA Aviation and Space Education (aerospace careers aviation pathways student exploration)
  https://www.faa.gov/education
- Colorado CTE Aerospace Engineering Technician (Colorado pathway scope and sequence aerospace engineering technician)
  https://cteincolorado.org/hs-scope-sequence/aerospace-engineering-technician/
- CareerOneStop (career planning certifications technical training)
  https://www.careeronestop.org/
- CCCS Career Advising (Colorado pathways education planning)
  https://cccs.edu/career-advising/

2. Safety Tools and Laboratory Practices

- OSHA (workplace safety standards electrical)
  https://www.osha.gov/
- CDC NIOSH (safety hazard prevention workplace)
  https://www.cdc.gov/niosh/
- Electronics Club Safety (electronics lab safety basic practices)
  https://electronicsclub.info/
- Tool Box Talks (shop safety training procedures)
  https://www.toolbox-talks.com/

3. Electrical Quantities and Measurement

- Khan Academy Electrical Engineering (voltage current resistance basics)
  https://www.khanacademy.org/science/electrical-engineering
- SparkFun Learn (measurement circuits electronics fundamentals)
  https://learn.sparkfun.com/
- Electronics Tutorials (measurement voltage current resistance)
  https://www.electronics-tutorials.ws/
- All About Circuits (electrical measurements theory applications)
  https://www.allaboutcircuits.com/

4. Atomic Theory Conductors and Circuit Fundamentals

- CK 12 Physics (atomic structure conductivity basics)
  https://www.ck12.org/physics/
- HyperPhysics Electricity (atomic theory electricity fundamentals)
  http://hyperphysics.phy-astr.gsu.edu/
- Physics Classroom Electricity (conductors insulators circuits basics)
  https://www.physicsclassroom.com/
- BBC Bitesize Electricity (atomic model electrical behavior)
  https://www.bbc.co.uk/bitesize

5. Direct Current DC Circuit Analysis

- All About Circuits DC (dc circuits ohms law analysis) https://www.allaboutcircuits.com/
- Electronics Tutorials DC (dc circuits fundamentals examples) https://www.electronics-tutorials.ws/dccircuits/
- Khan Academy Circuits (dc analysis ohms law practice) https://www.khanacademy.org/science/electrical-engineering
- Circuit Lab (circuit simulation analysis practice) https://www.circuitlab.com/

6. Circuit Construction Breadboarding and Prototyping

- SparkFun Breadboard Guide (breadboard prototyping wiring) https://learn.sparkfun.com/tutorials/how-to-use-a-breadboard
- Adafruit Learn (electronics prototyping projects circuits) https://learn.adafruit.com/
- Digi Key Electronics Tutorials (breadboarding prototyping circuits) https://www.digikey.com/en/resources
- Tinkercad Circuits (virtual circuit building simulation) https://www.tinkercad.com/circuits

7. Electronic Components and Devices

- Electronics Tutorials Components (resistors capacitors basics) https://www.electronics-tutorials.ws/
- All About Circuits Components (electronic components applications) https://www.allaboutcircuits.com/
- SparkFun Components Guide (components electronics basics usage) https://learn.sparkfun.com/
- Digi Key Component Library (component identification datasheets) https://www.digikey.com/

8. Magnetism Electromagnetism Motors and Generators

- Khan Academy Magnetism (magnetism electromagnetism basics) https://www.khanacademy.org/science/physics/magnetic-forces-and-magnetic-fields
- HyperPhysics Magnetism (electromagnetic principles explanations) http://hyperphysics.phy-astr.gsu.edu/
- Learn Engineering YouTube (motors generators explanation animation) https://www.youtube.com/@LearnEngineering
- National Geographic Electricity (magnetism real world applications) https://www.nationalgeographic.org/

9. Alternating Current AC Fundamentals

- Electronics Tutorials AC (ac circuits waveform basics) https://www.electronics-tutorials.ws/accircuits/
- Khan Academy AC Circuits (alternating current concepts) https://www.khanacademy.org/science/electrical-engineering

- All About Circuits AC (ac fundamentals waveforms frequency) https://www.allaboutcircuits.com/
- Electrical4U AC (ac theory frequency concepts) https://www.electrical4u.com/

10. Reactive Components and AC Circuit Behavior

- Electronics Tutorials Reactance (capacitive inductive reactance) https://www.electronics-tutorials.ws/accircuits/reactance.html
- All About Circuits AC Analysis (impedance phase relationships) https://www.allaboutcircuits.com/
- Khan Academy Waves and Circuits (frequency and phase concepts) https://www.khanacademy.org/science/electrical-engineering
- Electrical4U Reactance (inductors capacitors ac behavior) https://www.electrical4u.com/

11. Test Equipment Data Collection and Technical Analysis

- NASA NESC Academy Avionics (avionics systems test measurement reliability training) https://nescacademy.nasa.gov/catalogs/avionics1
- Tektronix Education (oscilloscope measurement analysis) https://www.tek.com/en/education
- Keysight Resources (test equipment data analysis tools) https://www.keysight.com/us/en/learn.html
- NI LabVIEW Resources (data acquisition analysis systems) https://www.ni.com/en-us/shop/labview.html

12. Troubleshooting and Problem Solving in Electronic Systems

- iFixit (diagnostics troubleshooting methodology) https://www.ifixit.com/
- Electronics Tutorials Troubleshooting (circuit fault finding basics) https://www.electronics-tutorials.ws/
- Fluke Troubleshooting Guide (electrical system diagnostics) https://www.fluke.com/en-us/learn
- All About Circuits Troubleshooting (circuit diagnostics analysis) https://www.allaboutcircuits.com/

13. Circuit Design Documentation and Technical Communication

- Purdue OWL Technical Writing (technical communication documentation) https://owl.purdue.edu/
- Lucidchart (diagram schematics documentation tools) https://www.lucidchart.com/
- Autodesk Design Academy (technical drawing cad documentation) https://academy.autodesk.com/
- IEEE Resources (technical documentation standards engineering) https://www.ieee.org/

14. Engineering Design Application and Final Project

- NASA Learning Resources (aerospace design challenges STEM projects engineering applications)
  https://www.nasa.gov/learning-resources/
- Colorado Space Institute at ACC (Colorado aerospace workforce space education student pathways)
  https://www.arapahoe.edu/workforce-community-programs/colorado-space-institute
- MIT OpenCourseWare Projects (engineering design applications)
  https://ocw.mit.edu/
- NASA Design Challenge (engineering problem solving projects)
  https://www.nasa.gov/stem

15. Leadership

- Student Leadership Competencies - University of Washington (leadership competencies community engagement student leadership development)
  https://cele.uw.edu/site/assets/files/1211/guide_to_building_student_leadership_competencies_for_community_based_engagement.pdf
- A Guide for Effective Teamwork - University of Nebraska (teamwork collaboration group projects communication skills)
  https://teaching.unl.edu/resources/strategies-techniques/teamwork/
- Leadership Lesson Plans - Ohio State University (active listening collaboration meetings group dynamics leadership lessons)
  https://involvedliving.osu.edu/leadership-lesson-plans
- Engineering Leadership Development - Penn State (engineering leadership teamwork innovation technical work environments)
  https://www.sedi.psu.edu/eld/index.aspx

16. Work-Based Learning

- Work-Based Learning Toolkit - Chicago Public Schools (career day guest speakers site visits job shadowing internships)
  https://www.cps.edu/academics/work-based-learning/toolkit/
- Job Shadowing - Chicago Public Schools (job shadow preparation reflection workplace behavior career planning)
  https://www.cps.edu/academics/work-based-learning/toolkit/job-shadowing/
- Work-Based Learning Resources - Northern Illinois University (K-12 work-based learning guidance career technical education resources)
  https://www.niu.edu/career-technical-education/resources/wbl-resources.shtml
- Career Center Work-Based Learning Experiences - James Madison University (internships reflection mentorship feedback career readiness)
  https://www.jmu.edu/career/work-based-learning/index.shtml

Technology Student Association – National Competitive Events

Technology Problem Solving

Objective: *Students will work as a team to solve an on-site TSA technology challenge by designing, constructing, testing, and evaluating a solution using limited materials, tools, and time.*

- Analyze an on-site TSA problem and identify the required task, constraints, materials, and scoring criteria.
- Collaborate with a partner to plan and construct a working solution within the competition time limit.
- Use approved materials, tools, and measuring devices safely and effectively during the build process.
- Apply engineering and technology concepts to improve the performance of the solution.
- Test the solution using the required objective measure, such as strength, distance, time, accuracy, or completion of a task.
- Revise the solution based on observed performance and available time.
- Evaluate the final product using TSA criteria for problem solving, construction quality, teamwork, and measurable performance.

Resources

- Technology Student Association – Technology Problem Solving competition guidelines https://tsaweb.org/competitions-programs/tsa/themes-problems
- TeachEngineering – Hands-on engineering design challenges https://www.teachengineering.org/
- Science Buddies – Engineering Design Process https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps
- OSHA – Young Worker Safety and Health https://www.osha.gov/young-workers

Technology Student Association – National Competitive Events

Senior Solar Sprint

Objective: *Students will design, construct, test, document, and race a solar-powered model vehicle that meets TSA Senior Solar Sprint competition requirements.*

- Research solar vehicle design, electrical power, energy transfer, motors, materials, and TSA Senior Solar Sprint requirements.
- Design a solar-powered model car that meets required dimensional, material, and construction specifications.
- Construct a model vehicle that demonstrates creativity, originality, quality construction, and engineering design.
- Create a display and decorated shoebox that professionally communicate the vehicle's design concept.
- Test and refine the vehicle to improve alignment, reliability, energy efficiency, and race performance.
- Participate in inspection, interview, time trials, and final race procedures according to TSA competition rules.
- Evaluate the final vehicle using TSA criteria for model design, creativity, construction quality, display, interview, and race performance.

Resources

- Technology Student Association – Senior Solar Sprint competition guidelines https://tsaweb.org/competitions-programs/tsa/themes-problems
- National Renewable Energy Laboratory – Solar energy basics https://www.nrel.gov/research/re-solar.html
- U.S. Department of Energy – Solar Energy Technologies Office https://www.energy.gov/eere/solar/solar-energy-technologies-office
- Autodesk Fusion – CAD/CAM tools for vehicle design and prototyping https://www.autodesk.com/products/fusion-360/education

Technology Student Association – National Competitive Events

System Control Technology

Objective: *Students will design, construct, program, troubleshoot, document, and demonstrate a working control-system solution that responds to a TSA-provided problem.*

- Interpret the TSA-provided control-system problem and identify the required functions, constraints, and performance goals.
- Design a working system that uses inputs, outputs, controls, sensors, motors, circuits, or programmable components.
- Construct and test the system using approved materials, tools, electronics, and safety procedures.
- Troubleshoot electrical, mechanical, sensor, programming, or reliability issues to improve system performance.
- Maintain an inventor's log documenting design decisions, testing, revisions, and final system operation.
- Demonstrate the completed system for judges and explain how the design meets the problem criteria.
- Evaluate the system using TSA criteria for functionality, design quality, problem interpretation, documentation, and communication.

Resources

- Technology Student Association – System Control Technology competition guidelines https://tsaweb.org/competitions-programs/tsa/themes-problems
- Arduino Education – Electronics and control systems https://www.arduino.cc/education
- Tinkercad Circuits – Circuit simulation and prototyping https://www.tinkercad.com/circuits
- PhET Interactive Simulations – Circuit Construction Kit https://phet.colorado.edu/