Electromechanical Control Systems - AES

Level: 4
Career Cluster: Advanced Manufacturing
Program: Engineering
Pathway(s): Aerospace Engineering Technician

Course Catalog Description

Students learn to analyze, operate, and troubleshoot electromechanical systems used in aerospace manufacturing, aviation, and space technology settings. The course emphasizes safety, technical drawings, measurement tools, diagnostics, avionics-related controls, and career exploration in aerospace engineering and technician pathways.

Summary

Prepares students to analyze, operate, and troubleshoot the electrical, mechanical, hydraulic, pneumatic, and automated systems used in aerospace manufacturing, aircraft support systems, avionics-adjacent environments, and space-related technology settings. Through hands-on and technical learning experiences, students apply industry-standard safety practices, interpret schematics and technical drawings, and use measurement and calibration tools to evaluate system performance in high-reliability applications. Students develop knowledge of electrical fundamentals, digital electronics, programmable logic controllers, motor control, mechanical drives, and fluid power systems as they examine how individual components function within integrated electromechanical systems used in aerospace production and maintenance contexts. The course also emphasizes troubleshooting, diagnostics, technical documentation, and communication so students can explain procedures, justify decisions, and present technical solutions effectively. In addition, students explore aerospace engineering technician and related aviation, avionics, manufacturing, and space-industry career pathways, workplace expectations, ethical responsibilities, and postsecondary opportunities in Colorado.

Notes

The updated course reflects a transition from a traditional, component-focused controls course to a more comprehensive, systems-integrated and industry-aligned program. The original course primarily emphasized foundational topics such as basic circuits, motor control, hydraulics, and mechanical drives with a focus on individual system components and operation. In contrast, the revised course organizes these concepts into a structured framework that emphasizes integrated electromechanical systems, diagnostics, data analysis, and troubleshooting across electrical, mechanical, hydraulic, and automated control domains. Additionally, the updated version incorporates programmable logic controllers (PLCs), digital electronics, technical documentation, and system design, while embedding career exploration, leadership, work-based learning, and a formal final assessment project. These updates strengthen alignment with current CTE expectations by emphasizing real-world application, system integration, technical communication, and career readiness in aerospace and advanced manufacturing contexts.

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 and Industrial Laboratory Practices

Objective: *Students will apply aerospace and industry-standard safety practices in order to minimize risk while working with electrical, mechanical, hydraulic, pneumatic, and automated systems.*

5) Interpret safety rules and regulations related to electromechanical work environments
6) Demonstrate proper use of personal protective equipment, tools, and equipment
7) Identify hazards related to electricity, moving machinery, heat, hydraulics, and stored energy
8) Apply safe operating procedures when inspecting, wiring, assembling, and troubleshooting systems
9) Evaluate a work area for compliance with safety standards and safe practices
10) Document safety observations and corrective actions using appropriate technical language

3. Electrical Fundamentals and Circuit Analysis

Objective: *Students will analyze electrical concepts and circuit behavior in order to explain and solve electromechanical control problems in aerospace and advanced manufacturing systems.*

11) Define voltage, current, resistance, power, and related electrical units
12) Explain the relationship among voltage, current, and resistance using Ohm's Law
13) Apply Ohm's Law and power formulas to solve electrical circuit problems
14) Differentiate AC and DC electricity and explain their industrial uses

15) Analyze series, parallel, and combination circuits using calculations and measurements
16) Interpret electron flow, electromagnetic induction, and related electrical principles in control systems
17) Evaluate circuit performance using test equipment and observed results

4. Schematics, Wiring, and Technical Drawings

Objective: *Students will interpret schematics, one-line diagrams, wiring prints, and aerospace technical drawings in order to communicate and apply control system information accurately.*

18) Identify symbols, lines, abbreviations, and details used in electrical and mechanical drawings
19) Interpret one-line diagrams, wiring diagrams, and elementary control prints
20) Analyze process instrument diagrams to identify field devices and system relationships
21) Construct simple wiring diagrams or annotated drawings for electromechanical systems
22) Apply schematic information to support installation, testing, and troubleshooting
23) Evaluate the clarity and accuracy of technical drawings and documentation

5. Instrumentation, Measurement, and Calibration

Objective: *Students will use measurement and calibration tools to verify system performance and ensure proper operation of electromechanical equipment in aerospace and high-reliability technical environments.*

24) Identify common instruments used to measure electrical and electromechanical variables
25) Demonstrate correct use of multimeters and related testing devices
26) Measure voltage, current, resistance, continuity, and selected system values
27) Explain the purpose of calibration in industrial maintenance and control work
28) Analyze measurement data to determine system condition and performance
29) Evaluate whether instrument readings indicate normal operation or malfunction

6. Digital Electronics and Logic Control

Objective: *Students will analyze digital control concepts in order to construct and explain the logic used in electromechanical and aerospace control systems.*

30) Identify common digital components such as logic gates, flip-flops, and counters
31) Interpret truth tables and logic relationships in control applications
32) Construct basic logic circuits from given logic statements or schematics
33) Analyze how digital logic supports automated control functions
34) Document the function of logic components using appropriate technical language
35) Evaluate the effectiveness of a logic design in achieving the required control outcome

7. Programmable Logic Controllers and Automated Controls

Objective: *Students will apply programmable control concepts to develop and analyze automated electromechanical systems used in aerospace, manufacturing, and mission-critical environments.*

36) Identify the basic components of a PLC including CPU, power supply, input modules, and output modules

37) Explain the role of sensors, processors, and outputs in automated control
38) Set up a basic communication loop between a PLC and its interface
39) Program a simple control task using a computing device or PLC platform
40) Analyze how programmed logic affects system behavior and process control
41) Evaluate the performance of an automated control system based on accuracy and task completion

8. AC and DC Motors, Motor Control, and Protection

Objective: *Students will analyze motor systems in order to select, wire, and explain appropriate motor applications in electromechanical systems, including aerospace actuation and support equipment.*

42) Identify AC and DC motor types, components, and operating characteristics
43) Explain how torque, slip, speed, and frequency influence motor performance
44) Compare the design and application of shunt, series, compound, and induction motors
45) Select a motor based on voltage, speed, enclosure, and application requirements
46) Apply approved procedures to wire or connect motors in common industrial applications
47) Evaluate motor protection requirements and over-current considerations using technical references

9. Mechanical Drive Systems and Power Transmission

Objective: *Students will analyze mechanical drive systems in order to compare, maintain, and apply power transmission methods used in industrial and aerospace electromechanical systems.*

48) Define gear drives and belt drives and describe their major components
49) Explain pitch, pitch diameter, and pitch length in drive systems
50) Compare gear and belt drive systems in terms of function, maintenance, and application
51) Disassemble and reassemble drive system components using safe procedures
52) Analyze how drive selection affects system performance and downtime
53) Evaluate a drive system for efficiency, wear, and suitability for a given application

10. Hydraulic Systems, Pumps, and Fluid Power

Objective: *Students will apply fluid power concepts to analyze hydraulic and pump systems used in electromechanical applications, including aerospace actuation and support systems.*

54) Identify major hydraulic and pneumatic components such as cylinders, valves, regulators, pumps, and motors
55) Explain how fluid energy is transferred within a mechatronic or electromechanical system
56) Measure physical properties of hydraulic and pneumatic components
57) Interpret work orders and system descriptions to explain component operation
58) Analyze the flow of fluid power within a hydraulic subsystem
59) Evaluate system performance using technical descriptions, observations, and measured evidence

11. Integrated Electromechanical System Design

Objective: *Students will synthesize electrical, mechanical, hydraulic, and control components in order to design and explain integrated electromechanical systems for aerospace and advanced technology applications.*

60) Combine electrical, mechanical, hydraulic, and control elements into a functioning system concept
61) Design a system that includes inputs, processing, and outputs to complete a defined task
62) Analyze subsystem interactions within an electromechanical system
63) Construct or simulate a basic integrated control system
64) Refine system design based on testing, feedback, and observed performance
65) Evaluate system effectiveness in meeting stated criteria and constraints

12. Troubleshooting, Diagnostics, and Maintenance Procedures

Objective: *Students will diagnose faults in electromechanical systems and recommend corrective actions using structured troubleshooting procedures applicable to aerospace and other high-reliability systems.*

66) Identify mechanical, electrical, hydraulic, and control-related faults in electromechanical systems
67) Apply a structured troubleshooting process using prints, schematics, and observed symptoms
68) Use testing equipment and diagnostic procedures to isolate system malfunctions
69) Analyze system data and component behavior to determine probable root causes
70) Recommend corrective actions based on evidence from diagnostics and system documentation
71) Evaluate whether repairs or changes restored proper system function

13. Technical Documentation, Communication, and Final Application

Objective: *Students will document, present, and defend technical solutions in order to communicate electromechanical system design, maintenance, and troubleshooting clearly.*

72) Document procedures, findings, and corrective actions using technical language
73) Create diagrams, notes, or reports that explain system operation and maintenance tasks
74) Present system designs, diagnostics, or maintenance decisions to peers or instructors
75) Defend control, calibration, or component-selection decisions using evidence
76) Evaluate the clarity, completeness, and professionalism of technical documentation
77) Reflect on system performance, problem-solving decisions, and technical growth

14. Leadership

Objective: *Students will demonstrate leadership skills in order to contribute effectively to team success, workplace readiness, and professional growth in aerospace and electromechanical environments.*

78) Demonstrate leadership skills such as initiative, responsibility, dependability, and ethical decision-making in classroom and technical settings

79) Collaborate effectively with peers to plan, complete, and evaluate aerospace and electromechanical projects
80) Apply communication, conflict resolution, and problem-solving strategies in team-based technical tasks
81) Evaluate personal leadership strengths and areas for growth through reflection and feedback

15. Work-Based Learning

Objective: *Students will engage in work-based learning experiences in order to connect classroom knowledge and technical skills to real-world aerospace, manufacturing, and engineering applications.*

82) Identify the purpose and value of work-based learning experiences such as industry visits, job shadows, internships, and guest speakers
83) Apply technical knowledge and employability skills during authentic workplace experiences
84) Demonstrate appropriate workplace behaviors including punctuality, communication, teamwork, and professionalism
85) Reflect on work-based learning experiences to evaluate career interests, skill development, and future goals

16. Final Assessment Project

Objective: *Students will complete a final assessment project in order to demonstrate mastery of electromechanical concepts, technical skills, and professional communication developed throughout the course.*

86) Plan and develop a project that integrates course concepts related to electromechanical systems, safety, troubleshooting, and technical design
87) Apply research, design, technical documentation, and problem-solving skills to complete the project
88) Present the final project using clear technical communication, supporting evidence, and appropriate visual or written documentation
89) Evaluate the final project based on technical accuracy, completion of requirements, professionalism, and reflection on learning

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: Electromechanical Control Systems
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 who listen actively and respectfully.	Students work productively in teams during aerospace manufacturing, maintenance, and control system tasks, communicate roles and safety procedures, and listen to peers and instructors when troubleshooting, calibrating, and verifying electromechanical systems.
Standard 1: Oral Expression and Listening	Prepared Graduate 2 – Oral Presentations	Deliver effective oral presentations for varied audiences and varied purposes.	Students verbally explain aerospace control system operation, PLC logic, troubleshooting results, maintenance procedures, and safety considerations

			using industry-appropriate technical language.
Standard 2: Reading for All Purposes	Prepared Graduate 4 – Informational Texts	Read a wide range of informational texts to build knowledge.	Students read and interpret technical manuals, wiring diagrams, PLC documentation, schematics, aerospace maintenance references, safety standards, and informational texts related to motors, hydraulics, and control equipment.
Standard 2: Reading for All Purposes	Prepared Graduate 5 – Language in Context	Understand how language functions in different contexts.	Students use precise electromechanical, aerospace, and technical terminology, interpret symbolic and procedural language, and adjust communication for instructional, safety, troubleshooting, maintenance, or reporting contexts.
Standard 3: Writing and Composition	Prepared Graduate 6 – Craft arguments	Craft arguments using techniques specific to the genre.	Students justify control strategies, calibration choices, and troubleshooting decisions, and defend maintenance procedures using specifications, diagnostics, safety criteria, aerospace documentation practices, and industry standards.
Standard 3: Writing and Composition	Prepared Graduate 7 – Informational Writing	Craft informational/explanatory	Students produce technical explanations of

		texts using techniques specific to the genre.	control system behavior, written reports documenting maintenance procedures and outcomes, and explanatory summaries of PLC programming, system diagnostics, and aerospace electromechanical applications.
Standard 3: Writing and Composition	Prepared Graduate 9 – Writing Process	Demonstrate mastery of their own writing process.	Students draft, revise, and finalize professional technical documentation, maintain safety and maintenance records, and produce clear, coherent, and accurate written work aligned to aerospace and industry expectations.
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 electromechanical systems, aerospace components, and industry standards, analyze technical information to diagnose system issues, and use information ethically to support safe and effective maintenance practices.

Free Resource Links

1. Career Exploration and Postsecondary Opportunities

- O NET Online (careers electromechanical technician automation manufacturing pathways)
  https://www.onetonline.org/
- My Next Move (career exploration engineering technology industrial systems)
  https://www.mynextmove.org/
- CareerOneStop (training certifications advanced manufacturing careers)
  https://www.careeronestop.org/
- CCCS Career Advising (Colorado postsecondary engineering pathways planning)
  https://cccs.edu/career-advising/

2. Safety and Industrial Laboratory Practices

- OSHA (electrical safety industrial systems standards hazards prevention)
  https://www.osha.gov/
- CDC NIOSH (engineering workplace safety hazard control practices)
  https://www.cdc.gov/niosh/
- Tool Box Talks (industrial lab safety procedures training)
  https://www.toolbox-talks.com/
- NFPA Electrical Safety (electrical hazard safety codes standards)
  https://www.nfpa.org/

3. Electrical Fundamentals and Circuit Analysis

- Khan Academy Electrical Engineering (voltage current resistance ohms law basics)
  https://www.khanacademy.org/science/electrical-engineering
- All About Circuits (electrical circuits analysis fundamentals dc ac systems)
  https://www.allaboutcircuits.com/
- Electronics Tutorials (circuit analysis series parallel calculations)
  https://www.electronics-tutorials.ws/
- CircuitLab (circuit simulation analysis practice tools)
  https://www.circuitlab.com/

4. Schematics, Wiring, and Technical Drawings

- Blueprint Reading Guide (engineering drawings symbols schematics basics)
  https://www.engineersupply.com/
- All About Circuits Schematics (electrical schematics diagrams interpretation)
  https://www.allaboutcircuits.com/
- Electronics Tutorials Symbols (circuit symbols diagrams wiring interpretation)
  https://www.electronics-tutorials.ws/
- Lucidchart (schematics diagrams technical drawing tools)
  https://www.lucidchart.com/

5. Instrumentation, Measurement, and Calibration

- Fluke Learn (measurement tools calibration electrical testing fundamentals) https://www.fluke.com/en-us/learn
- Tektronix Education (oscilloscope measurement signals instrumentation analysis) https://www.tek.com/en/education
- Keysight Learn (electronic testing measurement systems calibration) https://www.keysight.com/us/en/learn.html
- NI LabVIEW (data acquisition measurement instrumentation systems) https://www.ni.com/en-us/shop/labview.html

6. Digital Electronics and Logic Control

- All About Circuits Digital (logic gates digital electronics design basics) https://www.allaboutcircuits.com/
- Khan Academy Logic (digital logic gates circuits truth tables basics) https://www.khanacademy.org/computing
- Electronics Tutorials Logic (digital circuits flip flops counters concepts) https://www.electronics-tutorials.ws/
- Logic.ly Simulator (logic circuit simulation digital design practice) https://logic.ly/

7. Programmable Logic Controllers and Automated Controls

- PLC Academy (plc basics programming automation control systems) https://www.plcacademy.com/
- Siemens Automation (plc systems industrial automation control platforms) https://www.siemens.com/
- Allen Bradley Rockwell Automation (plc programming industrial control systems) https://www.rockwellautomation.com/
- RealPars PLC Training (plc programming control systems tutorials) https://www.realpars.com/

8. AC and DC Motors, Motor Control, and Protection

- Learn Engineering Motors (ac dc motor operation control explanation animation) https://www.youtube.com/@LearnEngineering
- All About Circuits Motors (motor control ac dc electrical machines) https://www.allaboutcircuits.com/
- Electrical4U Motors (ac dc motors operation characteristics applications) https://www.electrical4u.com/
- NEMA Motors Standards (motor standards specifications electrical systems) https://www.nema.org/

9. Mechanical Drive Systems and Power Transmission

- Engineering Toolbox Mechanical (gear drives belt systems power transmission) https://www.engineeringtoolbox.com/
- MIT OpenCourseWare Mechanics (mechanical systems motion transmission analysis) https://ocw.mit.edu/

- Learn Engineering Gears (gear systems mechanical motion explanation) https://www.youtube.com/@LearnEngineering
- Design World Drives (drive systems components industrial applications) https://www.designworldonline.com/

10. Hydraulic Systems, Pumps, and Fluid Power

- Festo Learning (pneumatics hydraulics industrial automation systems) https://www.festo.com/
- Hydraulic Supermarket (hydraulic systems components fluid power basics) https://www.hydraulicsupermarket.com/
- Engineering Toolbox Fluids (fluid power hydraulics engineering principles) https://www.engineeringtoolbox.com/
- Parker Hannifin (hydraulics pneumatics motion control systems) https://www.parker.com/

11. Integrated Electromechanical System Design

- MIT OpenCourseWare Systems (systems engineering integration design concepts) https://ocw.mit.edu/
- Teach Engineering Systems (engineering design integration systems projects) https://www.teachengineering.org/
- Autodesk Design Academy (engineering design cad integrated systems) https://academy.autodesk.com/
- FIRST Robotics Design (system integration robotics engineering design) https://www.firstinspires.org/

12. Troubleshooting, Diagnostics, and Maintenance Procedures

- iFixit (troubleshooting diagnostics repair methodology systems) https://www.ifixit.com/
- Fluke Troubleshooting (electrical troubleshooting measurement diagnostics tools) https://www.fluke.com/en-us/learn
- All About Circuits Troubleshooting (circuit diagnostics fault analysis systems) https://www.allaboutcircuits.com/
- Engineering Toolbox Troubleshooting (engineering problem solving systems analysis) https://www.engineeringtoolbox.com/

13. Technical Documentation, Communication, and Final Application

- Purdue OWL Technical Writing (technical communication engineering documentation) https://owl.purdue.edu/
- Lucidchart (documentation diagrams schematics technical communication tools) https://www.lucidchart.com/
- IEEE Resources (engineering documentation standards technical writing) https://www.ieee.org/
- Instructables Projects (engineering design documentation project examples) https://www.instructables.com/

14. Leadership

- Overcoming Obstacles (leadership communication decision-making goal setting life skills)
  https://www.overcomingobstacles.org/
- Career Preparation Toolkit (leadership teamwork professionalism career readiness)
  https://teaching.uoregon.edu/career-preparation-toolkit
- Stanford Online Free Content (leadership communication teamwork professional development)
  https://online.stanford.edu/free-content

15. Work-Based Learning

- CCCS Work-Based Learning (apprenticeships earn-and-learn workforce development Colorado)
  https://cccs.edu/academic-student-affairs/workforce-development/work-based-learning/
- CareerOneStop GetMyFuture (work experience job search career planning youth resources)
  https://www.careeronestop.org/GetMyFuture/default.aspx
- Apprenticeships.org (apprenticeships internships job shadowing work-based learning pathways)
  https://apprenticeships.org/

16. Final Assessment Project

- OTCC Technical Communication Resources (lab reports technical writing documentation project communication)
  https://otcc.mines.edu/otcc-resources/
- Northeastern Capstone Sample Documents (proposal report presentation engineering project examples)
  https://ece.northeastern.edu/fac-ece/dimarzio/capstone/samples/index.html
- MIT Communication Lab Technical Presentation (technical presentation slides audience message structure)
  https://mitcommlab.mit.edu/meche/commkit/technical-presentation/

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 system that uses inputs, outputs, circuits, sensors, motors, controls, feedback, or programmable components.
- Create a program or control sequence that allows the system to operate as intended.
- Construct and test the system using approved materials, tools, electronics, and safety procedures.
- Troubleshoot mechanical, electrical, sensor, programming, or feedback-loop issues to improve system performance.
- Maintain an inventor's log documenting design decisions, testing, revisions, and final system operation.
- Demonstrate the completed system and explain how the design meets the problem criteria during judge evaluation.

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
- VEX Robotics STEM Labs – Mechanisms, sensors, and programming https://education.vex.com/

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, adhesives, measuring devices, and safety procedures during construction.
- Apply engineering, electronics, mechanical systems, 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 task completion.
- 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

Robotics

Objective: *Students will design, build, test, operate, document, and explain a robot that completes the annual TSA Robotics challenge within competition requirements.*

- Analyze the annual TSA Robotics challenge and identify required tasks, constraints, safety considerations, and scoring criteria.
- Design and construct a robot that integrates mechanical, electrical, control, and structural systems.
- Program or configure the robot to complete required challenge tasks.
- Test robot performance before competition and make adjustments to improve reliability, control, and task completion.
- Operate the robot during the timed challenge while following TSA event procedures.
- Document the robot's design, construction, testing, revisions, and team problem-solving process.
- Participate in a team interview explaining robot systems, design decisions, programming or control strategies, and performance results.

Resources

- Technology Student Association – Robotics competition guidelines
  https://tsaweb.org/competitions-programs/tsa/themes-problems
- VEX Robotics STEM Labs
  https://education.vex.com/
- Arduino Education – Robotics and electronics resources
  https://www.arduino.cc/education
- FIRST Robotics Resource Library
  https://www.firstinspires.org/resource-library