Alabama Science, Technology, Engineering, and Mathematics (STEM)

Grade 9

Adopted 2020

Foundations of Engineering and Technology

1. **Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and following protocols for fire and electrical safety.** FET.FS.1

2. **Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.** FET.FS.2

3. **Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.** FET.FS.3

4. **Demonstrate digital literacy by using digital and electronic tools appropriately, safely, and ethically.** FET.FS.4

5. **Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.** FET.FS.5

1. **Describe and follow appropriate safety and health procedures for engineering classroom and laboratory situations.** FET.1

   a. Utilize tools and equipment safely. FET.1.A

   b. Identify environmental safety requirements for specific applications. FET.1.B

2. **Exhibit essential skills required by business and industry in the engineering field.** FET.2

   a. Communicate effectively through writing, speaking, listening, and reading. FET.2.A

   b. Show appropriate interpersonal skills, punctuality, work habits, ethical behavior, and work-appropriate attire. FET.2.B

   c. Create a resume and digital portfolio and participate in a mock interview. FET.2.C

3. **Connect leadership and teamwork skills from CTSO activities with engineering practices.** FET.3
   a. Use standard technical knowledge and skills during CTSO activities. FET.3.A
   b. Exhibit leadership and teamwork skills. FET.3.B
   c. Demonstrate effective collaboration in a diverse group to define and solve engineering problems. FET.3.C

4. **Compare and investigate various aspects of jobs in STEM disciplines and the engineering field, including education requirements, job responsibilities, and potential earnings.** FET.4
   a. Investigate current and future engineering job opportunities. FET.4.A
   b. Analyze positive and negative impacts of engineering on society. FET.4.B
   c. Critique significant contributions of leaders in engineering fields. FET.4.C
   d. Differentiate among engineering, technology, and science. FET.4.D
   e. Identify and discuss the various tools utilized by individuals in STEM disciplines, including engineering. FET.4.E

5. **Apply standard engineering practices and skills to solve problems.** FET.5
   a. Use a variety of appropriate tools throughout the engineering design process. FET.5.A
   b. Present a research-based solution to an engineering problem in a professional manner. FET.5.B
   c. Use terminology and vocabulary relevant to the field of engineering. FET.5.C

6. **Cite evidence and document the steps in an engineering design process.** FET.6
   a. Construct an engineering notebook based upon industry standard best practices. FET.6.A
   b. Display clear standard technical knowledge and skills when categorizing and classifying engineering practices. FET.6.B
   c. Record ideas, sketches, calculations, observations, and summaries of activities. FET.6.C
   d. Compare and contrast the methods of creating written and digital portfolios. FET.6.D

7. **Demonstrate the use of analog and digital precision measuring instruments utilized in engineering.** FET.7
   a. Compare and convert between customary and metric measurement systems. FET.7.A
   b. Apply conversion factors of customary and metric measurements. FET.7.B
   c. Perform measurements using significant digits. FET.7.C

8. **Create basic engineering drawings, including sketches and computer-aided designs (CAD).** FET.8
    a. Produce multi-view sketches and drawings. FET.8.A
    b. Create two-dimensional and three-dimensional appropriate sketches. FET.8.B
9. **Differentiate among components of engineering drawings.** FET.9
10. **Create models and prototypes using CAD techniques and/or appropriate manufacturing tools.** FET.10
11. **Utilize real-world STEM principles to investigate a variety of engineering disciplines.** FET.11
    a. Research and investigate engineering challenges in today's world. FET.11.A
    b. Apply the systems model of input, process, output, feedback, and impact to the engineering design process. FET.11.B
    c. Analyze an engineering design brief. FET.11.C
    d. Collaborate with team members to observe, identify, and modify individual solutions to engineering problems. FET.11.D
    e. Design and/or test a prototype using an engineering design process. FET.11.E
12. **Generate code to solve challenges using appropriate languages.** FET.12

Robotic Systems

1. **Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and following protocols for fire and electrical safety.** RS.FS.1
2. **Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.** RS.FS.2
3. **Explore the range of careers available in the field of Robotics and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.** RS.FS.3
4. **Demonstrate digital literacy by using digital and electronic tools appropriately, safely, and ethically.** RS.FS.4
5. **Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.** RS.FS.5

1. **Develop a project management plan to include initiating, executing, monitoring, controlling, and closing a robotic systems project.** RS.1
    a. Identify and select methodologies and skills for managing a robotics project. RS.1.A
    b. Participate in the organization and operation of a robotic system engineering project. RS.1.B
    c. Develop a project schedule of work according to established criteria for completing a robotics project. RS.1.C
2. **Apply principles of problem-solving through collaboration and conflict resolution using positive attitudes to produce effective teamwork.** RS.2
    a. Participate in team projects in various roles. RS.2.A
    b. Apply principles of effective problem-solving in teams to collaborate and to resolve conflict. RS.2.B
3. **Utilize STEM concepts in the engineering design process to solve problems in robotic mechanical design.** RS.3
    a. Apply the systems model of input, process, output, feedback, and impact to solve problems in mechanical design. RS.3.A
    b. Use precision measuring instruments to analyze systems and prototypes in mechanical design projects. RS.3.B
    c. Calculate Newton's Laws as they apply to robotics. RS.3.C
4. **Demonstrate knowledge of motors, gears, gear ratios, and gear trains used in robotic systems.** RS.4
5. **Build, test, and present a robotic system.** RS.5
    a. Identify the characteristics and functions of manipulators, accumulators, and end effectors required for a robotic or automated system to function. RS.5.A
    b. Use feedback to refine the design of a robotic or automated system to ensure the quality, efficiency, and manufacturability of the final product. RS.5.B
    c. Present a completed robotic system, including a design, materials, procedure, prototype, and reflection summary, using a variety of media. RS.5.C

6. **Use current software applications to program robot behavior and complete tasks.** RS.6

    a. Program robotic systems to complete an automated task using various sensors. RS.6.A

    b. Create robotic system programs that use variables to store and modify data. RS.6.B

    c. Create robotic system programs that utilize control statement loops and/or conditionals. RS.6.C

    d. Test and debug errors in an algorithm or program that includes sequences and simple loops. RS.6.D

7. **Describe the utilization of programmable control devices and data transfer in automated systems.** RS.7

    a. Identify the systems, components, and processes of a technological system. RS.7.A

    b. Generate a device control flow chart or schematic for an automated manufacturing system. RS.7.B

    c. State the advantages and disadvantages of utilizing various control devices, including those for pressure, heat, volume control, color, weight and timing. RS.7.C

    d. Discuss the various architectures used in developing a programmable logic-controlled system. RS.7.D