GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

COURSE: Engineering Concepts (ET-EC)

UNIT: 4. Engineering, Mathematics, and Analysis

# INTRODUCTION

**Annotation:**

This unit stresses the importance of mathematical models. Most mechanical engineering design problems can be described by mathematics. Mathematics illustrates the relationships of variables in physics principles. Mathematics provides data for decision making. Students will learn to use the basic solution sheet. This will enable the generation of graphs for visual interpretation of scientific principles important to a particular engineering problem. This unit will also express the importance of SI and English standard units and variables.

**Grade(s):**

| | |
|---|---|
| | 9th |
| X | 10th |
| X | 11th |
| X | 12th |

**Time:**

15 hours

**Author:**

Charles J. Kachmar

**Students with Disabilities:**

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

# FOCUS STANDARDS

**GPS Focus Standards:** Please list the standard and elements covered.

- ENGR-EC-3 – Students will solve problems using basic engineering tools and resources.
- ENGR-STEM-3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
- ENGR-STEM-4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.
- ENGR-STEM-5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.
- ENGR-STEM-6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.
- CTAE-FS-1 – Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.
- CTAE-FS-2 – Academic Foundations: Learners achieve state academic standards at or above grade level.
- CTAE-FS-5 – Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

**GPS Academic Standards:**

**National / Local Standards / Industry / ISTE:**

# UNDERSTANDINGS & GOALS

**Enduring Understandings:**
Students will learn about the integration of mathematics with the engineering design process.

**Essential Questions:**

- How is Excel used to demonstrate the engineering solution?
- How are graphs interpreted and what are their significance in variable relationships?
- How are mathematical models used to generate data for engineering problem solving?
- What are basic, supplement, and derived units?

**Knowledge from this Unit:** Factual information.

**Skills from this Unit:** Performance.

# ASSESSMENT(S)

**Assessment Method Type:** Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

_____ Pre-test
X Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
__ Unit test
_____ Group project
X Individual project
_____ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
__ Self-check during writing/planning process
__ Journal reflections on concepts, personal experiences and impact on one's life
__ Reflect on evaluations of work from teachers, business partners, and competition judges
__ Academic prompts
__ Practice quizzes/tests
X Subjective assessment/Informal observations
__ Essay tests
__ Observe students working with partners
__ Observe students role playing
_____ Peer-assessment
__ Peer editing & commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
_____ Dialogue and Discussion
__ Student/teacher conferences
__ Partner and small group discussions

_____ __ Whole group discussions
__ Interaction with/feedback from community members/speakers and business partners
_____ Constructed Responses
__ Chart good reading/writing/listening/speaking habits
__ Application of skills to real-life situations/scenarios
_____ Post-test

### Assessment(s) Title:

Mathematical Problems (1-5)

### Assessment(s) Description/Directions:

The problems can be found in the Engineering Solutions PowerPoint. See below for more detailed directions.

### Attachments for Assessment(s): Please list.

- Engineering Solutions PowerPoint
- Engineering Solution Layout (Excel)
- Problem 1
- Problem 2
- Problem 3
- Problem 4a
- Problem 4b

## LEARNING EXPERIENCES

**Instructional planning: Include lessons, activities and other learning experiences in this section with a brief description of the activities to ensure student acquisition of the knowledge and skills addressed in the standards. Complete the sequence of instruction for each lesson/task in the unit.**

### Sequence of Instruction

**1. Identify the Standards. Standards should be posted in the classroom for each lesson.**

- ENGR-EC-3 – Students will solve problems using basic engineering tools and resources.
- ENGR-STEM-3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

- ENGR-STEM-4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.
- ENGR-STEM-5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.
- ENGR-STEM-6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.
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- CTAE-FS-2 – Academic Foundations: Learners achieve state academic standards at or above grade level.
- CTAE-FS-5 – Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

**2. Review Essential Questions.**

- How is Excel used to demonstrate the engineering solution?
- How are graphs interpreted and what are their significance in variable relationships?
- How are mathematical models used to generate data for engineering problem solving?
- What are basic, supplement, and derived units?

**3. Identify and review the unit vocabulary.**

**4. Use the PowerPoint Engineering Solutions to introduce and discuss concepts with the class.**

**5. Have students open the Excel spreadsheet titled Engineering Solution Layout on their individual computers. This spreadsheet provides the format in which students should answer the mathematical problems. Review all the sections of the format. An explanation of each area is documented in red.**

**6. Provide students with simple applications, such as creating hypothetical math models for the following equations: F=ma, W=d*m, etc. Provide students with simple problems that require these equations so students will be comfortable using them.**

**7. Review units, basic, supplemental, and derived. Explain SI and English unit systems.**

**8. Review four basic conversions students should commit to memory for mass, temperature, distance, and volume.**

**9. Assessment Activity**

- Assign problem 1 in the PowerPoint as a quiz grade or class assignment. Ask students to write their solutions to the problem in the Engineering Solution Layout template and print for a grade.
- Assign problem 2 in the PowerPoint as a quiz grade or class assignment. Again, ask students to write their solutions to the problem in the Engineering Solution Layout template and print for a grade.
- Assign problem 3 in the PowerPoint as a quiz grade or class assignment. Students should submit their solutions in the proper format for a grade.
- Assign problem 4a to submit as a quiz grade or class assignment. Assign problem 4b to submit as a quiz grade or class assignment.
- Students perform problem 5 as a quiz grade or class assignment. No answer sheet is provided for this problem. The problem is a good culminating activity that reviews all aspects of this unit.
- Note: Grading is based on correctness of answers as well as the layout, set up, illustration, data generation, and graphic analysis. The solutions are provided for teachers in the Excel files titled Problem 1, Problem 2, Problem 3, Problem 4a, and Problem 4b.

**Attachments for Learning Experiences:** Please list.

**Notes & Reflections:** May include notes to the teacher, pre-requisite knowledge & skills, suggestions, etc.

## CULMINATING PERFORMANCE TASK (Optional)

**Culminating Unit Performance Task Title:**

**Culminating Unit Performance Task Description/Directions/Differentiated**

**Attachments for Culminating Performance Task**

# UNIT RESOURCES

**Web Resources:**

**Attachment(s):** Supplemental files not listed in assessment, learning experiences, and performance task.

**Materials & Equipment:**

**What 21st Century Technology was used in this unit:**

| | | | | | |
|---|---|---|---|---|---|
| X | Slide Show Software | | Graphing Software | | Audio File(s) |
| | Interactive Whiteboard | | Calculator | | Graphic Organizer |
| | Student Response System | | Desktop Publishing | | Image File(s) |
| | Web Design Software | | Blog | | Video |
| | Animation Software | | Wiki | | Electronic Game or Puzzle Maker |
| | Email | | Website | | |