



# Engineering Principles I

## EXAM INFORMATION

**Items**

36

**Points**

50

**Prerequisites**

NONE

**Grade Level**

10-12

**Course Length**

ONE SEMESTER

**Career Cluster**

ARCHITECTURE AND CONSTRUCTION

MANUFACTURING

SCIENCE, TECHNOLOGY, ENGINEERING  
AND MATHEMATICS**Performance Standards**

INCLUDED

**Certificate Available**

YES

## DESCRIPTION

The first in a sequence of “hands on” courses that tie observations and concepts common to a variety of different engineering disciplines in order to develop a better understanding of basic math and science principles used in engineering. By utilizing problem-solving skills in a laboratory environment, students will develop skills and attitudes that impact and expand occupational opportunities. This is a foundation course in the Engineering pathway.

## EXAM BLUEPRINT

STANDARD	PERCENTAGE OF EXAM
1- Safety Practices	8%
2- Career Opportunities	13%
3- Work Ethics, Communication & Leadership Skills	13%
4- Engineering Design	30%
5- Civil Engineering	13%
6- Computer Engineering	13%
7- Electrical Engineering	10%



## STANDARD 1

### STUDENTS WILL FOLLOW SAFETY PRACTICES

- Objective 1 Identify potential safety hazards and follow general laboratory safety practices
1. Assess workplace conditions with regard to safety and health.
  2. Identify potential safety issues and align with relevant safety standards to ensure a safe workplace/jobsite.
  3. Locate and understand the use of shop safety equipment.
  4. Select appropriate personal protective equipment.
- Objective 2 Use safe work practices.
1. Use personal protective equipment according to manufacturer rules and regulations.
  2. Follow correct procedures when using any hand or power tools.
- Objective 3 Complete a basic safety test without errors (100%) before using any tools or shop equipment.

Standard 1 Performance Evaluation included below (Optional)

## STANDARD 2

### STUDENTS WILL INVESTIGATE CAREER OPPORTUNITIES WITHIN THE WORLD OF ENGINEERING

- Objective 1 Identify occupations related to Engineering.
- Objective 2 Differentiate among various Engineering disciplines.
1. Bioengineering
  2. Chemical Engineering
  3. Civil and Environmental Engineering
  4. Computer Engineering
  5. Electrical Engineering
  6. Mechanical Engineering
  7. Materials Science
- Objective 3 Investigate different types of occupational training and educational opportunities.

Standard 2 Performance Evaluation included below (Optional)

## STANDARD 3

### STUDENTS WILL UNDERSTAND AND DEVELOP POSITIVE WORK ETHICS, COMMUNICATION SKILLS, AND LEADERSHIP SKILLS

- Objective 1 Demonstrate positive work ethics and leadership skills.
1. Responsibility
  2. Reliability
  3. Dependability



4. Effective Communication
5. Delegation
6. Cooperation
7. Teamwork
8. Integrity

Objective 2 Employ the Technology Student Association (TSA) student organization's program as an integral element of the curriculum.

Objective 3 Participate in problem-solving, both individually and as part of a team.

Objective 4 Understand the importance of inter-disciplinary teams.

Objective 5 Take minutes of a team meeting.

Objective 6 Make accurately proportioned sketches using correct drawing conventions.

1. Notes are neat and legible.
2. Objects should be drawn to correct proportions.
3. Dimensions are used appropriately.
4. Views can be isometric, orthogonal, sections, or assemblies.

Objective 7 Create and utilize an engineering notebook per established conventions.

1. Sequential and chronological
2. Accurate and complete reflection of the progress being recorded
3. Sketches or pictures are included where appropriate
4. No loose entries or pages
5. Each page is dated and witnessed
6. Unused spaces are identified and lined out
7. Errors are not erased or obliterated
8. Test data and calculations are included

Standard 3 Performance Evaluation included below (Optional)

## STANDARD 4

STUDENTS WILL IDENTIFY THE QUALITIES OF SUCCESSFUL ENGINEERING DESIGN, RECOGNIZE ITS ROLE IN SOCIETY, AND DEVELOP PROJECTS USING AN ENGINEERING DESIGN PROCESS

Objective 1 Identify the qualities of good design and their relationship to the design's user.

Objective 2 Examine a design with respect to its quality and usability.

Objective 3 Understand that these qualities are the result of choices made and constraints applied during the design process.

Objective 4 Recognize and identify the role of engineering and engineered products in society.

Objective 5 Identify the requirements for and role of intellectual property in design.

Objective 6 Recall education requirements for professional success as a designer/engineer.

Objective 7 Identify and explain the elements of an engineering design process.

1. Identify & define the design problem
2. Brainstorm solutions
3. Create models & build a prototype
4. Test the prototype



- 5. Redesign and optimize
- Objective 8 Understand the concept of a problem statement and design requirements.
- Objective 9 Create design specifications considering such factors as:
  - 1. Performance
  - 2. Time and financial constraints
  - 3. Ergonomics
  - 4. Safety
  - 5. The state-of-of the art
- Objective 10 Translate design requirements into a design solution.
- Objective 11 Use brainstorming methods to identify solutions to a design problem.
- Objective 12 Recognize and demonstrate that there are many possible successful designs and that a design process does not always result in a single best design.
- Objective 13 Explain the role of and be able to utilize mathematical and functional modeling in the creation and assessment of a design.
- Objective 14 Perform a design-of-experiments.
- Objective 15 Build and test designs against design specifications, evaluate the results of those tests, and present their analyses.
- Objective 16 Demonstrate that design is an iterative process, subject to continuous evolutionary improvement.

Standard 4 Performance Evaluation included below (Optional)

## STANDARD 5

STUDENTS WILL UNDERSTAND WAYS IN WHICH CIVIL ENGINEERING CAN ENHANCE HEALTH AND WELL-BEING OF INDIVIDUALS

- Objective 1 Identify several different careers that support large scale civil or environmental projects.
  - 1. Transportation Engineering
  - 2. Structural Engineering
  - 3. Construction Engineering
  - 4. Environmental Engineering
  - 5. Geotechnical Engineering
  - 6. Water Resources Engineering
- Objective 2 Use idealized equations that are fundamental to Civil Engineering.
  - 1. Hydrostatic pressure from density and height.
  - 2. Flow velocity in an ideal (frictionless) system using Bernoulli's equation.
  - 3. Internal forces in a simple truss structure.
- Objective 3 Describe how real-world factors change performance from the ideal to:
  - 1. Water tower height affects pressure driving force.
  - 2. Pressure driving force affects flow rate from a pipe.
  - 3. Fittings, bends, pipe length, and pipe diameter affect flow rate in a pipe.



- Objective 4 Work in teams to design and build a project related to Civil Engineering.
1. Water distribution network
  2. Tower building
- Objective 5 Write a reflection of the project.
1. What was the objective
  2. What worked
  3. What didn't work and why it didn't
  4. How did the design compare with the best and worst performers
  5. What you would do differently
  6. Was the objective accomplished
- Objective 6 Give a brief presentation on an existing or an emerging Civil Engineering technology.

Standard 5 Performance Evaluation included below (Optional)

## STANDARD 6

STUDENTS WILL UNDERSTAND WAYS IN WHICH COMPUTER ENGINEERING CAN ENHANCE HEALTH AND WELL-BEING OF INDIVIDUALS

- Objective 1 Identify several different careers that support the computer industry.
1. Computer hardware design
  2. Network design
  3. Network management
  4. Programming
  5. Systems support
- Objective 2 Identify the main internal and external components of a computer.
1. Memory
  2. Processor
  3. Video and Sound
  4. Input peripherals
  5. Output peripherals
- Objective 3 Explain the basic components of a computer's programming design.
1. Purpose of software
  2. Difference between software and data
  3. Purpose of computer programming languages
- Objective 4 Understand various elements of coding structure.
1. Explain the difference between a variable's name and its value.
  2. Predict the results of code snippets which use.
    1. Variables
    2. Operators
    3. Branching structures
    4. Looping structures
    5. Function calls
- Objective 5 Work in teams to design and build a project related to Computer Engineering.



- 1. Pinball game
  - 2. Rehabilitation therapy game
- Objective 6 Write a reflection of the project.
- 1. What was the objective
  - 2. What worked
  - 3. What didn't work and why
  - 4. How did the design compare with the best and worst performers
  - 5. What would you do differently
  - 6. Was the objective accomplished
- Objective 7 Work in teams to design and build a project related to Computer Engineering.
- Objective 8 Identify and explain three types of businesses.

Standard 6 Performance Evaluation included below (Optional)

## STANDARD 7

STUDENTS WILL UNDERSTAND WAYS IN WHICH ELECTRICAL ENGINEERING CAN ENHANCE HEALTH AND WELL-BEING OF INDIVIDUALS

- Objective 1 Identify several different careers that support the electrical or electronics industry.
- 1. Power
  - 2. Control
  - 3. Electronics
  - 4. Microelectronics
  - 5. Signal Processing
  - 6. Telecommunications
  - 7. Instrumentation
  - 8. Mechatronics
- Objective 2 Define and explain the following electronic terms and concepts.
- 1. Electricity
  - 2. Electronics
  - 3. Conductor
  - 4. Insulator
  - 5. Semi-conductor
  - 6. Series circuit
  - 7. Parallel circuit
  - 8. Voltage
  - 9. Resistance
  - 10. Current
- Objective 3 Explore the fundamentals of atomic theory as it relates to electricity.
- 1. The electron's role in electricity.
  - 2. The difference between an insulator and a conductor and be able to identify common examples of each.
- Objective 4 Use idealized equations that are fundamental to Electrical Engineering.
- 1. Ohm's law to calculate current, voltage or resistance in simple circuits.



2. Kirkhoff's voltage law and understand how it applies to simple circuits.
3. Kirkhoff's current law and understand how it applies to simple circuits.
4. Watt's law to calculate current, voltage or power

**Objective 5** Assemble an electronic circuit and understand the use of schematics, function of basic electronic components, and electronic measurement.

**Objective 6** Work in teams to design and build a project related to Electrical Engineering.

1. LED Light Display

**Objective 7** Write a reflection of the project.

1. What was the objective
2. What worked
3. What didn't work and why it didn't
4. How did the design compare with the best and worst performers
5. What would you do differently
6. Was the objective accomplished

**Objective 8** Give a brief presentation on an existing or an emerging Electrical Engineering technology.



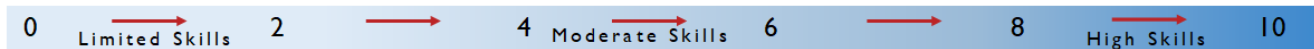
## Engineering Principles I Performance Standards (Optional)

Performance assessments may be completed and evaluated at any time during the course. The following performance skills are to be used in connection with the associated standards and exam. To pass the performance standard the student must attain a performance standard average of **8 or higher** on the rating scale. Students may be encouraged to repeat the objectives until they average **8 or higher**.

Students Name \_\_\_\_\_

Class \_\_\_\_\_

### PERFORMANCE RATING SCALE



#### STANDARD 1 Safety Practices

Score:

- Follow safety practices

#### STANDARD 2 Career Opportunities

Score:

- Investigate career opportunities within the world of Engineering

#### STANDARD 3 Work Ethics, Communication & Leadership Skills

Score:

- Understand and develop positive work ethics, communication skills, and leadership skills.

#### STANDARD 4 Engineering Design

Score:

- Identify the qualities of successful engineering design, recognizes its role in society, and develops projects using an engineering design process.

#### STANDARD 5 Civil Engineering

Score:

- Understand ways in which Civil Engineering can enhance health and wellbeing of individuals.

#### STANDARD 6 Computer Engineering

Score:

- Understand ways in which Computer Engineering can enhance health and wellbeing of individuals.

### PERFORMANCE STANDARD AVERAGE SCORE: