



Engineering Principles II

EXAM INFORMATION

Items

31

Points

50

Prerequisites

ENGINEERING PRINCIPLES I

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 second 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	10%
3- Work Ethics, Communication & Leadership Skills	8%
4- Engineering Design	8%
5- Chemical Engineering	18%
6- Bioengineering	14%
7- Materials Science	17%
8- Mechanical Engineering	17%



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 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 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 5

STUDENTS WILL UNDERSTAND WAYS IN WHICH CHEMICAL ENGINEERING CAN ENHANCE THE LIVES OF INDIVIDUALS

- Objective 1 Identify several different careers that support the chemical industry.
1. Petroleum
 2. Pharmaceutical
 3. Plastics
 4. Biomaterials
 5. Food Production
 6. Mining & Minerals
 7. Environmental Engineering
- Objective 2 Understand the concepts of a process flow diagram.
1. Batch process
 2. Continuous process
- Objective 3 Understand the concepts of material balances and energy balances.
- Objective 4 Work in teams to design and build a project related to Chemical Engineering:
1. Photobioreactor to grow algae for biodiesel.
 1. Know the needs of algae in a bioreactor.
 2. Build and use a spectrophotometer to track the concentration of algae.
 3. Describe the transesterification reaction process of converting algae oil to biodiesel.
 4. Characterize the resulting product of the transesterification reaction.
- Objective 5 Write a reflection of the project.
1. What was the objective
 2. What worked
 3. What didn't work and why didn't it
 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 Chemical Engineering technology.



Standard 5 Performance Evaluation included below (Optional)

STANDARD 6

STUDENTS WILL UNDERSTAND WAYS IN WHICH BIOENGINEERING CAN ENHANCE LIVES OF INDIVIDUALS

Objective 1 Identify several different careers that support bioengineering or Biomanufacturing.

1. Bioinstrumentation
2. Biomechanics
3. Biomaterials
4. Clinical Engineering
5. Medical Imaging
6. Rehabilitation Engineering
7. Systems Physiology

Objective 2 Understand the role of specialists in solving bioengineering problems.

Objective 3 Work in teams to design and build a project related to Bioengineering.

1. Prosthetic arms for developing countries

Objective 4 Write a reflection of the project.

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

Objective 5 Give a brief presentation on an existing or an emerging Bioengineering technology.

Standard 6 Performance Evaluation included below (Optional)

STANDARD 7

STUDENTS WILL UNDERSTAND WAYS IN WHICH MATERIALS SCIENCE CAN ENHANCE HEALTH AND WELL-BEING OF INDIVIDUALS

Objective 1 Identify several different careers related to materials science.

1. Ceramics
2. Polymers
3. Metals
4. Semiconductors
5. Composites

Objective 2 Identify and explain the importance of material properties.

1. Materials have different properties based on their composition and chemical structure.
2. Specialized materials form the basis of many engineering designs.
3. Composite materials possess the material properties of their constituent materials.



- Objective 3** Use idealized equations that are fundamental to Statics.
1. Tension and compression stresses.
 2. Hooke's Law and how it applies to bending.
 3. A beam under a load perpendicular to the axis of the beam is under both tensile and compressive stress.
- Objective 4** Work in teams to design and build a project related to Materials Science.
1. Composite beam using supplied materials as agglomerates.
 1. Perform a design of experiments to determine optimal plaster to water mix ratio to give the desired properties of plaster.
- 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 Materials Science.

Standard 7 Performance Evaluation included below (Optional)

STANDARD 8

STUDENTS WILL UNDERSTAND WAYS IN WHICH MECHANICAL ENGINEERING CAN ENHANCE THE LIVES OF INDIVIDUALS

- Objective 1** Identify sub-disciplines of Mechanical Engineering and explain what each involves:
1. Robotics
 2. Aerospace Engineering
 3. Ergonomics and Safety
 4. Biomechanics
 5. Fluid Mechanics
 6. Micro and Nanoscale Engineering
- Objective 2** Use CAD to model a simple 3D object.
1. Trebuchet arm
- Objective 3** Understand the concept of design optimization: Balancing competing design requirements to create an optimal design.
1. Adjusting the release pin on a trebuchet to maximize its throwing distance.
 2. Using simulations to predict performance.
- Objective 4** Demonstrate design optimization by maximizing design performance while working within constraints.
1. Limiting the amount of material used
 2. Limiting the overall project cost



3. Limiting the types of materials that can be used
4. Limiting the dimensions of the design

Objective 5 Work in teams to design and build a project related to Mechanical Engineering.

1. Trebuchet

Objective 6 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 7 Give a brief presentation on an existing or an emerging Mechanical Engineering technology.

Standard 8 Performance Evaluation included below (Optional)



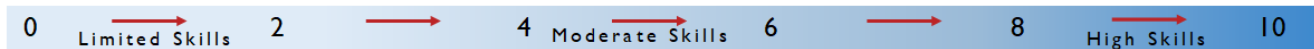
Engineering Principles II Performance Standards (Optional)

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 5 Chemical Engineering

Score:

- Understand ways in which Chemical Engineering can enhance the lives of individuals.

STANDARD 6 Bioengineering

Score:

- Understands ways in which Bioengineering can enhance the lives of individuals.

STANDARD 7 Materials Science

Score:

- Understands ways in which Materials Science can enhance the lives of individuals.

STANDARD 8 Mechanical Engineering

Score:

- Understands ways in which Mechanical Engineering can enhance the lives of individuals.

PERFORMANCE STANDARD AVERAGE SCORE: