STRANDS AND STANDARDS

ENGINEERING PRINCIPLES 2

Learning that works for Utah CTE®

Course 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.

Core Code	38.01.00.00.152
Concurrent Enrollment Core Code	38.01.00.13.152
Units of Credit	0.5
Intended Grade Level	10-12
Prerequisite	Engineering Principles 1
Skill Certification Test Number	602
Test Weight	0.5
License Area of Concentration	Secondary Education
Required Endorsement(s)	Technology & Engineering, or
	Engineering

STRAND 1

Students will follow safety practices.

Standard 1

Identify potential safety hazards and follow general laboratory safety practices.

- Assess workplace conditions regarding safety and health.
- Identify potential safety issues and align with relevant safety standards to ensure a safe workplace/jobsite.
- Locate and understand the use of shop safety equipment.
- Select appropriate personal protective equipment.

Standard 2

Use safe work practices.

- Use personal protective equipment according to manufacturer rules and regulations.
- Follow correct procedures when using any hand or power tools.
- Ref: https://schools.utah.gov/file/4de1dd59-0425-4f76-9e33-fdcf5de45dbf

Standard 3

Complete a basic safety test without errors (100%) before using any tools or shop equipment.

STRAND 2

Students will investigate career opportunities within the world of Engineering.

Standard 1

Identify occupations related to Engineering.

- Ref: https://schools.utah.gov/file/375c047f-5840-490f-b705-f307f1452ad1

Standard 2

Differentiate among various Engineering disciplines.

- Bioengineering
- Chemical Engineering
- Computer Engineering
- Electrical Engineering
- Civil & Environmental Engineering
- Mechanical Engineering
- Materials Science

Standard 3

Investigate different types of occupational training and educational opportunities.

STRAND 3

Students will understand and develop positive work ethics, communication skills, and leadership skills.

Standard 1

Demonstrate positive work ethics and leadership skills.

- Responsibility
- Reliability
- Dependability
- Effective Communication
- Delegation
- Cooperation
- Teamwork
- Integrity

Standard 2

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

Standard 3

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

Standard 4

Understand the importance of inter-disciplinary teams.

Standard 5

Take minutes of a team meeting.

Standard 6

Make accurately proportioned sketches using correct drawing conventions.

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

Standard 7

Create and utilize an engineering notebook per established conventions.

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

STRAND 4

Students will identify the qualities of successful engineering design, recognize its role in society, and develop projects using an engineering design process.

Standard 1

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

- Examine a design with respect to its quality and usability.
- Understand that these qualities are the result of choices made and constraints applied during the design process.

Standard 2

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

Standard 3

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

Standard 4

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

Standard 5

Identify and explain the elements of an engineering design process.

- Identify & define the design problem
- Brainstorm solutions
- Create models & build a prototype
- Test the prototype
- Redesign and optimize

Standard 6

Understand the concept of a problem statement and design requirements.

Standard 7

Create design specifications considering such factors as:

- Performance
- Time and financial constraints
- Ergonomics
- Safety
- The state-of-of the art

Standard 8

Translate design requirements into a design solution.

Standard 9

Use brainstorming methods to identify solutions to a design problem.

Standard 10
Recognize and demonstrate that there are many possible successful designs and that a design process does not always result in a single best design.

Standard 11
Explain the role of and be able to utilize mathematical and functional modeling in the creation and assessment of a design.

Standard 12
Perform a design-of-experiments.

Standard 13
Build and test designs against design specifications, evaluate the results of those tests, and present their analyses.

Standard 14
Demonstrate that design is an iterative process, subject to continuous evolutionary improvement.

STRAND 5
Students will understand ways in which Electrical Engineering can enhance health and well-being of individuals.

Standard 1
Identify several different careers that support the electrical or electronics industry.

- Control
- Electronics
- Microelectronics
- Signal Processing
- Power
- Telecommunications
- Instrumentation
- Mechatronics

Standard 2
Define and explain the following electronic terms and concepts:

- Electricity
- Electronics
- Conductor
- Insulator
- Semi-Conductor
- Series Circuit
- Parallel Circuit
- Voltage

- Resistance
- Current

Standard 3

Explore the fundamentals of atomic theory as it relates to electricity.

- The electron's role in electricity.
- The difference between an insulator and a conductor and be able to identify common examples of each.

Standard 4

Use idealized equations that are fundamental to Electrical Engineering.

- Ohm's law to calculate current, voltage or resistance in simple circuits.
- Kirkhoff's voltage law and understand how it applies to simple circuits.
- Kirckhoff's current law and understand how it applies to simple circuits.
- Watt's law to calculate current, voltage or power.

Standard 5

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

Standard 6

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

- LED Light Display

Standard 7

Write a reflection of the project.

- What was the objective?
- What worked?
- What didn't work and why didn't it work?
- How did the design compare with the best and worst performers?
- What you would do differently?
- Was the objective accomplished?

Standard 8

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

STRAND 6

Students will understand ways in which Chemical Engineering can enhance the lives of individuals.

Standard 1

Identify several different careers that support the chemical industry.

- Petroleum
- Pharmaceutical
- Plastics

- Biomaterials
- Food Production
- Mining & Minerals
- Environmental Engineering

Standard 2

Understand the concepts of a process flow diagram.

- Batch process
- Continuous process

Standard 3

Understand the concepts of material balances and energy balances.

Standard 4

Work in teams to design and build a project related to Chemical Engineering.

- Photobioreactor to grow algae for biodiesel.
  - Know the needs of algae in a bioreactor.
  - Build and use a spectrophotometer to track the concentration of algae.
  - Describe the transesterification reaction process of converting algae oil to biodiesel.
  - Characterize the resulting product of the transesterification reaction.

Standard 5

Write a reflection of the project.

- What was the objective?
- What worked?
- What didn't work and why didn't it work?
- How did the design compare with the best and worst performers?
- What you would do differently?
- Was the objective accomplished?

Standard 6

Give a brief presentation on an existing or an emerging Chemical Engineering technology.

STRAND 7

Students will understand ways in which Materials Science can enhance health and well-being of individuals.

Standard 1

Identify several different careers related to materials science.

- Ceramics
- Polymers
- Metals
- Semiconductors

- Composites

Standard 2

Identify and explain the importance of material properties.

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

Standard 3

Use idealized equations that are fundamental to Statics.

- Tension and compression stresses.
- Hooke's Law and how it applies to bending.
- A beam under a load perpendicular to the axis of the beam is under both tensile and compressive stress.

Standard 4

Work in teams to design and build a project related to Materials Science.

- Composite beam using supplied materials as agglomerates.
    - Perform a design of experiments to determine optimal plaster to water mix ratio to give the desired properties of plaster.

Standard 5

Write a reflection of the project.

- What was the objective?
- What worked?
- What didn't work and why didn't it work?
- How did the design compare with the best and worst performers?
- What you would do differently?
- Was the objective accomplished?

Standard 6

Give a brief presentation on an existing or an emerging Materials Science.

STRAND 8

Students will understand ways in which Mechanical Engineering can enhance the lives of individuals.

Standard 1

Identify sub-disciplines of Mechanical Engineering and explain what each involves:

- Robotics
- Biomechanics
- Aerospace Engineering
- Ergonomics and Safety

- Fluid Mechanics
- Micro and nanoscale engineering

Standard 2

Use CAD to model a simple 3D object.

- Trebuchet arm

Standard 3

Understand the concept of design optimization; balancing competing design requirements to create an optimal design.

- Adjusting the release pin on a trebuchet to maximize its throwing distance.
- Using simulations to predict performance.

Standard 4

Demonstrate design optimization by maximizing design performance while working within constraints.

- Limiting the amount of material used.
- Limiting the overall project cost.
- Limiting the types of materials that can be used.
- Limiting the dimensions of the design.

Standard 5

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

- Trebuchet

Standard 6

Write a reflection of the project.

- What was the objective?
- What worked?
- What didn't work and why didn't it work?
- How did the design compare with the best and worst performers?
- What you would do differently?
- Was the objective accomplished?

Standard 7

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

Skill Certificate Test Points by Strand

Test Name	Test #	Number of Test Points by Strand								Total Points	Total Questions
		1	2	3	4	5	6	7	8		
Engineering Principles 2	602	4	5	4	4	6	9	8	8	48	32

Performance Skills

1. Create and utilize an engineering notebook per established conventions. https://schools.utah.gov/file/71cd951d-a99b-45ac-a426-6c824700fdfe
2. Demonstrate practice of the *Technology & Engineering Professional Workplace Skills*. https://schools.utah.gov/file/fd0c16aa-8bee-4d07-85b5-88e0c913790e
3. Participate in a significant activity that provides each student with an opportunity to render service to others, employ leadership skills, or demonstrate skills they have learned through this course, preferably through participation in a Career & Technical Student Organization (CTSO) such as the Technology Student Association (TSA).