

STRANDS AND STANDARDS

CAD MECHANICAL DESIGN 1



Course Description

The first in a sequence of courses that prepares individuals to develop technical knowledge and skills required to plan and prepare scale pictorial interpretations and technical documentation of engineering and design concepts. This includes instruction in the use of 2D Computer-Aided Design (CAD) software, sketching, drawing layout, geometric construction, orthographic projection, and dimensioning.

Core Code	38.01.00.00.051
Concurrent Enrollment Core Code	38.01.00.13.051
Units of Credit	0.5
Intended Grade Level	10-12
Prerequisite	None
Skill Certification Test Number	661
Test Weight	0.5
License Type	Secondary Education 6-12
Required Endorsement(s)	Technology & Engineering, or T&E Drafting (CAD)

STRAND 1

Students will investigate career opportunities in engineering & engineering technology.

Standard 1

Identify occupations related to engineering and engineering technology.

Standard 2

Differentiate among different engineering & engineering technology disciplines.

Standard 3

Investigate different forms of occupational training and educational opportunities for careers in engineering and engineering technology.

STRAND 2

Students will understand the elements of an organized approach to solving an engineering design problem.

Standard 1

Form a basic design process that can be used to solve an engineering problem.

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

Standard 2

In order to better comprehend the engineering design process, students should learn that:

- Design problems are seldom presented in a clearly defined form.
- The design needs to be continually checked and critiqued, and the ideas of the design must be refined and improved.
- Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.
- Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
- The process of engineering design takes in to account a number of factors including safety, reliability, cost, quality control, the environment, manufacturability, maintenance and repair, and human factors.

STRAND 3

Students will document the design process and communicate the results of that process using appropriate techniques.

Standard 1

Make accurately proportioned sketches using correct drawing conventions.

- Understand and use accepted dimensioning practices for sketches.
- Create freehand sketches using paper, pencil, and an eraser which is neat, clear, and smudge-free.
- Views can be isometric, orthogonal, sections, or assemblies.
- Understand and demonstrate the use of the alphabet of lines.
- Use letters and numerals that conform to a Gothic style.
- Notes are neat and legible.

Standard 2

Create and utilize an engineering notebook per established conventions.

- Entries are 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, lined out, and initialed.
- Errors are not erased or obliterated.
- Test data and calculations are included.

STRAND 4

Students will understand and apply mathematics, measuring conventions, and scale.

Standard 1

Perform basic arithmetic functions using fractions and decimals.

- Add
- Subtract
- Multiply
- Divide

Standard 2

Accurately and efficiently convert between fractions and decimals.

- Decimal/fraction equivalent chart

Standard 3

Convert between metric and imperial measurements.

Standard 4

Demonstrate an ability to make and record basic measurements.

- Use scales, micrometers, and calipers (dial and digital) to take measurements.
- Understand and demonstrate the conversion of actual lengths to common technical drawing scales.
- Accurately scale drawings using CAD techniques when drawing and plotting.
- Record measurements using Cartesian and polar coordinates, as well as absolute and relative distances.

STRAND 5

Students will be able to develop orthographic views of a part with the correct dimensions and geometry.

Standard 1

Demonstrate exactness and precision when producing drawing geometry.

- Apply correct 2D geometric construction techniques.
- Drawing elements are accurate and drawn to scale.
- Draw on the correct plane.
- The top, front, and side views are used unless otherwise required using orthographic projection.
- All views are properly aligned and use third-angle projection.
- Appropriate lines and surfaces are located on each view.

Standard 2

Be proficient in the use of terminology associated with drafting and design.

- Axis
- Concentric
- Diameter
- Coordinate
- Fillet
- Horizontal
- Orthographic view
- Parallel
- Perpendicular
- Plane
- Radius
- Round
- Sketch
- Tangent
- Third angle projection
- Vertical

STRAND 6

Students will be able to understand and demonstrate the use of correct line types.

Standard 1

Understand and use the recommended thickness of lines.

Standard 2

Understand and correctly employ conventionally used line types.

- Object lines
- Hidden lines

- Center lines
- Dimension lines
- Extension lines
- Leader lines
- Border lines
- Phantom lines
- Section lines
- Cutting Plane lines
- Construction lines

STRAND 7

Students will know and follow ANSI Y14.5 dimensioning standards and apply the appropriate dimensions to drawings.

Standard 1

Understand and choose the best location for dimensions.

- Locate dimensions on the profile view and between views.
- Apply appropriate spacing between the object and the first dimension.
- Apply uniform spacing between dimension lines.
- Use correct dimension line terminators such as arrowheads ticks, and dots.

Standard 2

Understand and appropriately use baseline and chain dimensioning.

Standard 3

Demonstrate an ability to fully dimension a part.

Standard 4

Demonstrate the correct use of leaders and notes.

- Understand and correctly form callouts for thru holes, countersinks, counterbores, and spotfaces.
- Demonstrate correct dimensioning for fillets, and rounds.
- Understand and correctly form callouts for threaded holes.
- Use appropriate angles for leaders.

STRAND 8

Students will be able to understand and use 2D computer software to create technical drawings.

Standard 1

Know how to save, open, rename, and move data files using common computer operating system software.

Standard 2

Originate technical drawings using 2D CAD software features.

- Create a new drawing setup to support both English and metric drawing standards.
- Create drawing setups for different sizes of drawing sheets.
- Use and control accuracy enhancement tools.
- Using snap, grid and positioning methods.
- Analyze drawings using the software features.
- X,Y coordinates, area, distance, perimeter, etc.

Standard 3

Prepare and understand proper title blocks.

Standard 4

Add correct annotation to drawings.

- Use the correct text height.
- Use Gothic letters and numerals.
- Understand the placement and use of general notes.

Standard 5

Revise existing technical drawings using the software features.

Standard 6

Reproduce originals using different methods.

Standard 7

Plot to scale and use correct plot specs.

- Plot drawings with correct line widths.

Skill Certificate Test Points by Strand

Example table below. Refer to instructions for specifics.

Test Name	Test #	Number of Test Points by Strand								Total Points	Total Questions
		1	2	3	4	5	6	7	8		
CAD Mechanical Design 1	661	1	5	4	17	18	13	14	13	85	58

Performance Skills

1. Create and maintain a portfolio of exemplary work.
2. Demonstrate practice of the *Technology & Engineering Professional Workplace Skills*.
<https://schools.utah.gov/cte/engineering/resources>
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).