Mechanical Design 2

Exam Information

Exam number
662

Items
40

Points
54

Prerequisites
Mechanical Design 1

Recommended course length
One semester

National Career Cluster
Architecture & Construction
Science, Technology, Engineering, & Mathematics
Manufacturing

Performance standards
Included (Optional)

Certificate available
Yes

Description

The Mechanical Design 2 industry certification exam assesses learners' ability to develop 3D models and 2D technical drawings for the mechanical and industrial engineering industry. This includes evaluating proficiency in using 3D modeling software to create models and produce drawings.
Please make sure students have access to CAD software while taking this certification.

Exam Blueprint

Standard	Percentage of exam
1. Mathematics, Measuring Conventions, and Scale	18%
2. 3D Modeling	22%
3. Line Types	13%
4. Sectional and Detail Views	15%
5. 3D Modeling Software	18%
6. Dimensioning and Tolerancing	15%

Standard 1

Origins of Law-Students will analyze the relationship between ethics and the law and explain the origin of today's law.

Objective 1 Perform basic arithmetic functions using fractions and decimals.

1. Add
2. Subtract
3. Multiply
4. Divide

Objective 2 Convert between fractions and decimals.

Objective 3 Convert between and within metric and imperial measurements.

Objective 4 Make and record basic measurements.

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

Standard 1 Performance Evaluation included below (Optional)

Standard 2

3D modeling with dimensional and geometric size constraints.

Objective 1 Demonstrate exactness and precision when producing drawing geometry.

1. Apply correct 3D geometric construction techniques.
2. Model elements accurately and to scale.
3. Create elements on the correct plane.

Objective 2 Be proficient in the use of terminology associated with 3D drafting and design.

1. Axis
2. Concentric
3. Dimensional constraint
4. Geometric constraint
5. Coordinate
6. Extrusion
7. Isometric view
8. Parallel
9. Perpendicular
10. Plane
11. Tangent
12. Vertical

Objective 3 Assign different materials to a part to determine physical properties such as:

1. Density
2. Volume
3. Surface area
    a. Net
    b. Gross
4. Center of Mass

Standard 2 Performance Evaluation included below (Optional)

Standard 3

Line Types

Objective 1 Understand and use the recommended thickness of lines.

1. Thick
    a. Visible edges and Outlines
2. Thin
    a. Hatching
    b. Leader Lines
    c. Center Lines
    d. Dimensions
    e. Projections

Objective 2 Know common line thicknesses:

1. Thick -0.7mm
2. Medium - 0.5mm
3. Thin - 0.35mm
4. Thinnest - 0.25mm

Objective 3 Understand and correctly use the following line types (the alphabet of lines).

1. Object lines
2. Hidden lines
3. Center lines
4. Dimension lines
5. Extension lines
6. Leader lines
7. Border lines
8. Phantom lines
9. Section lines
10. Cutting Plane lines
11. Construction

Standard 3 Performance Evaluation included below (Optional)

Standard 4

Sectional and Detail Views

Objective 1 Be familiar with and appropriately use the following section views.

1. Full
2. Half
3. Offset
4. Broken Out
5. Removed
6. Revolved

Objective 2 Cross Hatch lines are evenly spaced and drawn at a 45-degree angle unless a more appropriate angle is justified.

Objective 3 Cutting plane lines, section lines, and break lines are drawn according to the alphabet of lines.

Objective 4 Visible edges, hidden lines, and contours behind the cutting plane are correctly shown.

Objective 5 Be familiar with and appropriately use detail views.

Standard 4 Performance Evaluation included below (Optional)

Standard 5

Technical drawings using 3D modeling software.

Objective 1 Demonstrate how to save, open, rename, and move data files using common computer operations and operating system software.

Objective 2 Create technical drawings using 3D modeling software features.

1. Create a new drawing setup to support both English and metric drawing standards.
2. Create drawing setups for different sizes of drawing sheets.
3. The top, front, and side views are used unless otherwise required using orthographic projection.
4. All views are properly aligned and use third-angle projection.
5. Appropriate lines and surfaces are located on each view.

Objective 3 Add correct annotation to drawings.

1. Add general notes to a drawing following proper conventions including size and placement.
2. Complete/create a proper title block and border with all required information.
3. Using the 3D modeling software verify that all text is correctly sized and meet all conventions as
4. specified in the current ANSI/ASME standards. Use the correct text height.
5. Use Gothic letters and numerals.
6. Understand the placement and use of general notes.

7. Prepare and/or understand title blocks.

Objective 4 Plot to scale and use correct plot specifications.

1. Plot drawings with correct line widths.
2. Sheet sizes are correct, and scales are applied properly.
3. Students identify and demonstrate the ability to print/plot to standard sheet sizes as specified by their instructor.

Standard 5 Performance Evaluation included below (Optional)

Standard 6

Dimensioning and Tolerancing

Objective 1 Describe/create/apply nominal dimensions, tolerancing, limit dimensions, and allowances of two or more mating parts.

Objective 2 Identify and properly size:

1. Clearance fit.
2. Interference fit.
3. Transition fit.

Objective 3 Describe and use the basic hole and the basic shaft dimensions.

Objective 4 Dimension two or more mating parts using: limit dimension, unilateral tolerances, and bilateral tolerances.

Objective 5 Identify and specify the classes of fits as required on drawings.

Standard 6 Performance Evaluation included below (Optional)

Technology & Engineering Workplace Skills

- Exceed the established school attendance policy to establish a consistent record of punctuality and dependability.
- Appropriately use (or not use) personal electronic devices.
- Maintain a high standard of industrial hygiene by:
    - adopting strong habits of professional dress and personal hygiene,
    - wearing the appropriate personal protective equipment, adopting the habit to “clean as you go”, and
    - guarding against foreign object debris (FOD) from contaminating the workspace or product.
- Contribute to a culture of safety by:
    - understanding and complying with established safety procedures,
    - watching for and speaking out when potential hazards and concerns are observed, and
    - actively participating in improving safety conditions.
- Follow established practices and procedures with exactness.
- Work productively as a member of a team with an awareness of and respect for global diversity and cultural differences.

• Exhibit initiative and leadership while maintaining a flexible and adaptable attitude.
• Communicate clearly & effectively with others.
• Proficiently use software found in the professional environment, such as MS PowerPoint, MS Excel, and MS Word.
• Correctly apply mathematics in areas such as:
    • addition, subtraction, multiplication, division,
    • fraction to decimal as well as decimal to fraction conversions, and
    • using decimal places.
• Understand mathematical concepts such as:
    • ratios and proportions,
    • rounding and tolerance ranges,
    • engineering notation, and
    • metric equivalents.
• Demonstrate an ability to think critically and creatively to solve problems and develop improvements to products and processes.
• Read and understand technical documents, such as work orders, specifications, and standard operating procedures.
• Complete assigned tasks in a timely manner and with a high degree of workmanship.

Mechanical Design 2

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.

Student's Name: _____

Class: _____

Performance standards rating scale

0	Limited skills	2	→	4	Moderate skills	6	→	8	High skills	10

Standard 1 – Mathematics, Measuring Conventions, and Scale **Score:**

- Student can use scales, micrometers, and calipers (dial and digital) to take accurate measurements.

Standard 2 – 3D Modeling **Score:**

- Student can create and evaluate an accurate, basic 3D model using 3D design software.

Standard 3 – Line Types **Score:**

- Student can apply correct line types and thicknesses to a drawing.

Standard 4 – Sectional and Detail Views **Score:**

- Student can create an accurate sectional view and a detail view of a part.

Standard 5 – 3D Modeling Software **Score:**

- Student can create accurate technical drawings using 3D modeling software.

Standard 6 – Dimensioning and Tolerancing **Score:**

- Students can properly dimension a drawing with tolerances.

Performance standard average score:

Evaluator Name: _____

Evaluator Title: _____

Evaluator Signature: _____

Date: _____