Mechanical Design 3

Exam Information

Exam number
663

Items
34

Points
45

Prerequisites
Mechanical Design 1
Mechanical Design 2

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 3 industry certification exam assesses the development of technical knowledge and skills to create working drawings and prototypes for the mechanical and industrial engineering industries. This includes evaluation of proficiency in the use of 3D modeling software, 3D prototyping, and understanding threads and fasteners, welding symbols, and assemblies.

Exam Blueprint

Standard	Percentage of exam
1. Portfolio and Resume	4%
2. Fasteners	27%
3. Welding Symbols	13%
4. 3D Printing	16%
5. Flat Pattern Development	7%
6. Assembly and Working Drawings	33%

Standard 1

Portfolio and Resume

Objective 1 A student's notebook/portfolio records:

1. the chronological account of all projects
2. research and citations
3. notes
4. sketches
5. test procedures and resulting data.

Objective 2 Resume and Cover Letter

Standard 1 Performance Evaluation included below (Optional)

Standard 2

Fasteners

Objective 1 Define thread terminology.

1. Major Diameter
2. Minor Diameter
3. Pitch Diameter
4. Root
5. Flank Angle
6. Pitch
7. Angle
8. Crest
9. Flank

Objective 2 Identify the following thread types.

1. Unified
2. Acme
3. Pipe
4. Square

Objective 3 Know the common uses of the thread types in Objective 2.

Objective 4 Calculate thread pitch.

1. TP = L/n
    a. TP = Thread Pitch
    b. L = Length of thread
    c. n = Number of threads

Objective 5 Understand thread callout notes.

Objective 6 Draw screw threads using these three methods:

1. Detailed
2. Schematic
3. Simplified

Objective 7 Compare common head types:

1. Round
2. Oval
3. Pan
4. Countersink
5. Hex

Objective 8 Compare common drive types:

1. Slotted
2. Philips
3. Square
4. Hexagonal

Objective 9 Understand the hardness grading system:

1. Metric
    a. Class 8.8
    b. Class 10.9
    c. Class 12.9
2. SAE
    a. Grade 2
    b. Grade 5
    c. Grade 8

Standard 2 Performance Evaluation included below (Optional)

Standard 3

Welding Symbols

Objective 1 Understand, identify and specify welds on drawings.

1. Type
2. Size and length
3. Finish & contour
4. Field welds
5. Basic welding processes

Standard 3 Performance Evaluation included below (Optional)

Standard 4

3D Printing

Objective 1 Successfully prepare a 3D printing strategy using slicing software.

1. File Types
    a. STL vs OBJ
    b. G-Code
2. Layer Height
3. Infill
4. Base Supports
    a. Raft
    b. Brim
    c. Skirt
5. Overhang Supports
    a. Breakaway
    b. Dissolvable

Objective 2 Identify each of the 3D printing materials and technologies.

1. FDM Fused Deposition Modeling (Filament)
2. SLA Stereolithography (Resin)

Objective 3 Understand commonly used 3D printing materials and their appropriate applications.

1. PLA
2. PETG
3. ABS
    a. Filament
    b. Resin
4. TPU

Objective 4 Identify the specific parts of a 3D printer.

1. Feeder
2. Extruder Assembly
3. Bed
    a. Heated
    b. Glass
    c. Flexible
4. X,Y, & Z Axes
5. Print Envelope
6. Spool/Reservoir
7. Control Board
8. Power Supply
9. Guide Tube

Standard 4 Performance Evaluation included below (Optional)

Standard 5

Students will be able to demonstrate the ability to create a flat pattern development.

Objective 1 Understand and calculate bend allowance.

Standard 5 Performance Evaluation included below (Optional)

Standard 6

Students will create assembly and working drawings.

Objective 1 Develop a set of working drawings of six or more parts of industry assembled parts.

1. Draw all necessary views of each part.
2. Draw only one part per sheet.
3. Dimension parts as per current ASME/ANSI standards.
4. Apply appropriate tolerances.
5. Apply necessary notes, material specifications, symbols, and other data.
6. Complete a parts list of the parts, which include, parts number, manufacturer's name, manufacturer's stock number, material specs, quantity of each part, and notes for assembly.
7. Complete an assembly drawing showing the relationship of the parts to each other.
8. Analyze center of mass, surface area, and volume of an assembly.
9. Include title block and border on each production drawing sheet.

Standard 6 Performance Evaluation included below (Optional)

Mechanical Design 3

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 – Portfolio and Resume **Score:**

- Create and maintain a digital Portfolio of work (hard copy can be used if necessary).
- Create a digital Resume and Cover Letter with professional formatting (hard copy can be used if necessary).

Standard 2 – Fasteners **Score:**

- Student can correctly place and label fasteners in their mechanical models and drawings.

Standard 3 – Welding Symbols **Score:**

- Student can correctly place a weld symbol on a mechanical drawing.

Standard 4 – 3D Printing **Score:**

- A student will model, slice, and successfully print an object/prototype of their own design.

Standard 5 – Flat Pattern Development **Score:**

- Create a flat pattern development of a simple part to be made from sheet metal.

Standard 6 – Assembly and Working Drawings **Score:**

- A student can create parts and assembly drawings. They can analyze the center of mass, surface area, and volume.

Performance standard average score:

Evaluator Name: _____

Evaluator Title: _____

Evaluator Signature: _____

Date: _____