Note:
• During the attendance check a sticker containing a unique code will be put on this exam.
• This code contains a unique number that associates this exam with your registration number.
• This number is printed both next to the code and to the signature field in the attendance check list.

CAD/TD for Aerospace Engineers

Exam: CADTD / LRG Master - Aptitude Assessment                  Date: Thursday 22nd August, 2024
Examiner: Prof. Dr.-Ing. Fernaß Daoud                           Time: 13:30 – 15:00

Working instructions

• This exam consists of 12 pages with a total of 3 problems.
  Please make sure now that you received a complete copy of the exam.

• The total amount of achievable credits in this exam is 60 credits.

• Detaching pages from the exam is prohibited.

• Allowed resources:
  – one non-programmable pocket calculator
  – one analog dictionary English ↔ native language

• Answers are only accepted if the solution approach is documented. Give a reason for each answer unless explicitly stated otherwise in the respective subproblem.

• Do not write with red or green colors nor use pencils.

• Physically turn off all electronic devices, put them into your bag and close the bag.

Left room from _________ to _________ / Early submission at _________
Problem 1  Technical Drawing (24 credits)

1.1 Which kind of view is shown in the following drawing?

- Partial view
- Section view
- Isometric view
- Dimetric view

1.2 Which projection method is indicated by the following symbol?

- Projection method 2
- Projection method 1
- Arrow method
- Projection method 3

1.3 Which projection method has to be used for partial views?

- Projection method 2
- Projection method 3
- Depends on the projection method used for the remainder of the drawing.
- Projection method 1
1.4 Which projection method has been used in the following technical drawing?

- Projection method 2
- Projection method 1
- Arrow method
- Projection method 3

1.5 What does the following view represent?

- A sphere
- An external thread
- An internal thread
- A hole

1.6 What does the following symbol in technical drawings mean?

- Identical surface properties of the outer contour of a part.
- The surface must be machined.
- For the surface removing material by machining is permitted.
- For the surface removing material by machining is not permitted.
1.7 Which information can you derive from the following surfaces specification?

- The surface must be produced with cutting with a maximum average roughness value of $R_z \leq 16 \mu m$
- The surface must be produced without cutting with a maximum averaged roughness depth of $R_z \leq 16 \mu m$
- The surface must be produced with cutting with a maximum averaged roughness depth of $R_z \leq 16 \mu m$

1.8 Which of the test body is used for the hardness specification measurement of Vickers?

- Three-sided pyramid
- Cone
- Sphere
- Four-sided pyramid

1.9 What does the following symbol in technical drawings mean?

- Burring up to 0.3 mm allowed, burr direction vertical.
- Burring up to 0.3 mm allowed.
- Burring up to 0.3 mm allowed, burr direction horizontal.
- Without burring, removal up to 0.3 mm allowed

1.10 Which form tolerance is specified by the following symbol in technical drawings?

- Roundness tolerance
- Profile form tolerance
- Coaxiality tolerance
- Cylinder form tolerance
1.11 Which form tolerance is specified by the following symbol in technical drawings?

- Straightness tolerance
- Levelness tolerance
- Parallelism tolerance
- Runout tolerance

1.12 Determine the correct value of the dimension tolerance of the following dimension:

\[ 40^{+0.1}_{-0.05} \]

- 100 \( \mu m \)
- 15 \( \mu m \)
- 150 \( \mu m \)
- 50 \( \mu m \)

1.13 Assign the correct fit type for the following fit pair \( \varnothing 25 \text{ H7/C7} \).

- Interference Fit
- Transition Fit
- Clearance Fit
- Not Valid

1.14 Assign the correct fit type for the following fit pair \( \varnothing 25 \text{ H7/s7} \).

- Clearance Fit
- Transition Fit
- Interference Fit
- Not Valid

1.15 What does the following symbol denote in technical drawings?

- A fillet seam with a seam length of 4 mm
- An I-seam with a seam length of 4 mm
- A continuous fillet seam with a seam thickness of 4 mm
- A continuous I-seam with a seam thickness of 4 mm

A fillet seam with a seam length of 4 mm
Problem 2  CAD (16 credits)

2.1 What does the abbreviation CAD mean?

☐ Computer Added Design  ☒ Computer Aided Design
☐ Computer Aided Drawing  ☐ Computer Added Dynamics

2.2 What does the abbreviation CAM mean?

☐ Computer Added Management  ✔ Computer Aided Manufacturing
☐ Computer Added Manufacturing  ☐ Computer Aided Management

2.3 Which modeling technique has the highest information content of the model?

☐ Edge model  ☐ Volume model
☐ Surface model  ☐ Wireframe model

2.4 Which modeling techniques requires the least memory?

☐ Surface model  ☐ Point model
☐ Volume model  ✔ Wireframe model

2.5 What is the major benefit of neutral data formats?

☐ Data exchange among different CAD programs  ☐ More precise
☐ Containing many additional information  ☐ Less metadata as native formats

2.6 Curvature continuity of two curves at a common endpoint requires that ...

☐ the second derivatives of the curves are equal at this point.
☐ the third derivatives of the curves are equal at this point.
✔ the first and the second derivatives of the curves are equal at this point.
☐ the first derivatives of the curves are equal at this point.

2.7 Which of the following statements about splines is incorrect?

☐ NURBS is a mathematical model using basis splines.
☐ The term "B-spline" is short for basis spline.
☐ A NURBS curve is defined by its order, a set of weighted control points, and a knot vector.
✔ A basis spline is defined by its order, a set of weighted control points, and a knot vector.
2.8 Which of the following operation isn’t a boolean operation?

- Subtract
- Add
- Extrusion
- Intersection

2.9 Given are the following functions of two curves:

\[ y_1(x) = 3 (x^2 - 1)^2 : x \in [-\infty, 1] \tag{2.1} \]
\[ y_2(x) = 2 (x^2 - 1)^2 : x \in [1, +\infty] \tag{2.2} \]

Check the continuities of the curves at \( x = 1 \) and decide which of the following statements is correct at \( x = 1 \).

- Positional, tangential and curvature continuity are fulfilled at \( x = 1 \).
- Positional, tangential and curvature continuity aren’t fulfilled at \( x = 1 \).
- Positional continuity is fulfilled at \( x = 1 \). Tangential and curvature continuity aren’t fulfilled at \( x = 1 \).
- Positional and tangential continuity are fulfilled at \( x = 1 \). Curvature continuity is not fulfilled at \( x = 1 \).

\[
\begin{align*}
y_1(x) &= 3 (x - 1)^2 ; y_1(1) = 0 \\
y_2(x) &= 2 (x - 1)^2 ; y_2(1) = 0 \\
y_1'(x) &= 6 (x - 1) ; y_1'(1) = 0 \\
y_2'(x) &= 4 (x - 1) ; y_2'(1) = 0 \\
y_1''(x) &= 6 ; y_1''(1) = 6 \\
y_2''(x) &= 4 ; y_2''(1) = 4
\end{align*}
\]
Problem 3  Design Theory (20 credits)

3.1 Fail Safe Design is an example of ...

- Basic safety
- Illustrative safety
- Direct Safety
- Indirect Safety

3.2 Which milling process is shown in the following picture?

- Face-circumference milling
- Circumference-face milling
- Circumference milling
- Face milling

3.3 Which machining process is shown in the following picture?

- Round turning
- Circumference turning
- Face turning
- Form turning

3.4 The Bottom-Up design approach is considered beneficial, if ...

- a low number of variants with low degree of commonality is considered.
- a large number of variants with high degree of commonality is considered.
- the form/functionality is driven by the “outer shape”.
- the detail design of the individual components is still unclear.

3.5 The Integral design approach ...

- reduces the weight efficiency of the component.
- devides large components in smaller single parts.
- reduces the number of single parts of a component.
increases the design space.

3.6 Which of the following basic guidelines for machining is correct?
- Planes or turning surfaces should not be parallel or vertical to the clamping surface.
- Provide blind holes if possible.
- Specify tolerances of holes only as deep as necessary
- Re-clamping of the workpiece doesn't increase the machine costs.

3.7 Which of the following statements about casting is correct?
- During machining the casted component tends to warp or crack due to changes in internal stress conditions.
- A homogenous temperature distribution during the casting process leads to less shrinkage and contraction.
- Different cooling speeds in the component avoids the formation of cavities.
- A Decrease in density caused by cooling results in a reduction of the volume.

3.8 Which of the following design rule for casting is correct?
- Large wall thickness changes aren’t restricted for casted components.
- Choose the position of the separation planes in a way to avoid casting offsets in joints.
- Avoid ribs in casted parts.
- The use of so called “sand corners” improves the casting result.

3.9 Which of the following design rule for welding is correct?
- Avoid tensile stress in thickness direction.
- Avoid flattening and overhangs.
- Avoid concave fillet welds.
- Multiple seams and seam crossing increases the strength of the weld seam.

3.10 Which of the following design rule for soldering is correct?
- Use as less area as possible for the solder connection.
- Avoid pressure.
- Avoid shear stresses.
- Avoid tensile and bending stresses.

3.11 Which of the following assembly design guideline is correct?
- A differential design leads to shorter assembly time.
- Don’t combine assembly operations.
- Combine components by integral and composite construction.
- Multiple simultaneous fitting operations improve the assembly sequence.
# Recommended edge dimensions “a” in mm

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 2,5</td>
<td>For burred edges or transition</td>
</tr>
<tr>
<td>+ 1</td>
<td></td>
</tr>
<tr>
<td>+ 0,5</td>
<td></td>
</tr>
<tr>
<td>+ 0,3</td>
<td></td>
</tr>
<tr>
<td>+ 0,1</td>
<td></td>
</tr>
<tr>
<td>+ 0,05</td>
<td></td>
</tr>
<tr>
<td>+ 0,02</td>
<td></td>
</tr>
<tr>
<td>− 0,02</td>
<td></td>
</tr>
<tr>
<td>− 0,05</td>
<td></td>
</tr>
<tr>
<td>− 0,1</td>
<td>For burr-free edges or removal</td>
</tr>
<tr>
<td>− 0,3</td>
<td></td>
</tr>
<tr>
<td>− 0,5</td>
<td></td>
</tr>
<tr>
<td>− 1</td>
<td></td>
</tr>
<tr>
<td>− 2,5</td>
<td></td>
</tr>
</tbody>
</table>

1) Other dimensions as required
Additional space for solutions–clearly mark the (sub)problem your answers are related to and strike out invalid solutions.