

**COOL NAME PENDING**

# **FTC CAD 16-Week Mentor Teaching Script**

Elite Competition Engineering Development Manual (Expanded Edition)

# Week 1: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

Evaluate subsystem based on repeatability, mechanical simplicity, serviceability, ease of manufacturing, and strategic advantage. Conduct structured critique session. Students must defend design choices logically rather than emotionally. Require at least one iteration improvement before week completion.

## ***Mentor Coaching Standards***

- Do not correct instantly — ask probing engineering questions.
- Reject vague explanations like 'it looked right'.
- Force data-backed decisions.
- Encourage iteration over aesthetic perfection.
- Model professional engineering communication standards.

## **Week 2: Advanced FTC CAD Engineering Development**

### ***Strategic Objective***

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

### ***Technical Theory Session (Whiteboard Intensive)***

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

### ***Live CAD Demonstration***

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### ***Hands-On Lab Implementation***

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

Evaluate subsystem based on repeatability, mechanical simplicity, serviceability, ease of manufacturing, and strategic advantage. Conduct structured critique session. Students must defend design choices logically rather than emotionally. Require at least one iteration improvement before week completion.

## ***Mentor Coaching Standards***

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## **Week 3: Advanced FTC CAD Engineering Development**

### ***Strategic Objective***

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

### ***Technical Theory Session (Whiteboard Intensive)***

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

### ***Live CAD Demonstration***

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

### ***Hands-On Lab Implementation***

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

Evaluate subsystem based on repeatability, mechanical simplicity, serviceability, ease of manufacturing, and strategic advantage. Conduct structured critique session. Students must defend design choices logically rather than emotionally. Require at least one iteration improvement before week completion.

## ***Mentor Coaching Standards***

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## **Week 4: Advanced FTC CAD Engineering Development**

### ***Strategic Objective***

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

### ***Technical Theory Session (Whiteboard Intensive)***

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

### ***Live CAD Demonstration***

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

### ***Hands-On Lab Implementation***

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

Evaluate subsystem based on repeatability, mechanical simplicity, serviceability, ease of manufacturing, and strategic advantage. Conduct structured critique session. Students must defend design choices logically rather than emotionally. Require at least one iteration improvement before week completion.

## ***Mentor Coaching Standards***

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# Week 5: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

Evaluate subsystem based on repeatability, mechanical simplicity, serviceability, ease of manufacturing, and strategic advantage. Conduct structured critique session. Students must defend design choices logically rather than emotionally. Require at least one iteration improvement before week completion.

## ***Mentor Coaching Standards***

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## **Week 6: Advanced FTC CAD Engineering Development**

### ***Strategic Objective***

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

### ***Technical Theory Session (Whiteboard Intensive)***

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

### ***Live CAD Demonstration***

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

### ***Hands-On Lab Implementation***

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
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## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

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## ***Mentor Coaching Standards***

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# Week 7: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
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- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

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## ***Mentor Coaching Standards***

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## **Week 8: Advanced FTC CAD Engineering Development**

### ***Strategic Objective***

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

### ***Technical Theory Session (Whiteboard Intensive)***

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

### ***Live CAD Demonstration***

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### ***Hands-On Lab Implementation***

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# Week 9: Advanced FTC CAD Engineering Development

## *Strategic Objective*

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## *Technical Theory Session (Whiteboard Intensive)*

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## *Hands-On Lab Implementation*

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# Week 10: Advanced FTC CAD Engineering Development

## *Strategic Objective*

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## *Technical Theory Session (Whiteboard Intensive)*

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# Week 11: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

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## ***Mentor Coaching Standards***

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# Week 12: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

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## ***Mentor Coaching Standards***

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# Week 13: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

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## ***Performance Metrics & Review Structure***

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## ***Mentor Coaching Standards***

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# Week 14: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

Evaluate subsystem based on repeatability, mechanical simplicity, serviceability, ease of manufacturing, and strategic advantage. Conduct structured critique session. Students must defend design choices logically rather than emotionally. Require at least one iteration improvement before week completion.

## ***Mentor Coaching Standards***

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# Week 15: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

## ***Performance Metrics & Review Structure***

Evaluate subsystem based on repeatability, mechanical simplicity, serviceability, ease of manufacturing, and strategic advantage. Conduct structured critique session. Students must defend design choices logically rather than emotionally. Require at least one iteration improvement before week completion.

## ***Mentor Coaching Standards***

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# Week 16: Advanced FTC CAD Engineering Development

## *Strategic Objective*

This week focuses on building competition-grade mechanical design thinking. Students must connect CAD modeling decisions directly to match performance, cycle time, durability, manufacturability, and judging impact. The mentor must continuously push students to justify every dimension, tolerance, and structural choice using engineering reasoning.

## *Technical Theory Session (Whiteboard Intensive)*

Begin with a 30–45 minute structured lecture. Explain load paths, torque transfer, center of gravity shifts, stress concentration points, and subsystem interaction. Use real FTC failure examples. Calculate expected loads using simplified formulas. Discuss trade-offs between weight reduction and structural rigidity.

## *Live CAD Demonstration*

Model a subsystem live while narrating engineering logic. Demonstrate proper sketch constraint discipline, parametric dimension planning, reference geometry usage, mate connectors, and interference detection. Highlight common mistakes such as floating sketches, unanchored mates, and over-constrained assemblies.

## *Hands-On Lab Implementation*

- Students independently model subsystem aligned to weekly theme.
- Mandatory interference check before mentor review.
- Run simulated motion analysis if applicable.
- Perform structural simplification review (remove unnecessary material).
- Prepare short 3-minute engineering explanation of design logic.

## ***Engineering Depth Focus***

Mentors must introduce tolerance stacking concepts and real-world fabrication limitations. Students must understand that CAD perfection does not equal real-world precision. Discuss bearing alignment sensitivity, shaft deflection under torque, screw shear strength, and the importance of dual support for rotating elements. Require naming discipline inside feature tree and structured assembly hierarchy.

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