

# CS498GC Mobile Robotics

## Extra Credit Quiz Questions

### Submission Guidelines

**Earn up to +7 Extra Credit Points**

+5 points per selected question  
+2 bonus for TA-proof questions

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## 1 Overview

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This document outlines the requirements and guidelines for submitting extra credit quiz questions for CS498GC Mobile Robotics. Students have the opportunity to contribute challenging, AI-resistant questions for Quiz 2 and Quiz 3, earning significant extra credit points.

### 1.1 Extra Credit Structure

Component	Points
Base Extra Credit (per selected question)	+5 points
TA-Proof Bonus (exceptionally challenging)	+2 points
Maximum Points per Question	+7 points

#### Important

Only the **TOP 10 SUBMISSIONS** based on quality criteria will receive extra credit. Focus on creating one exceptional question rather than multiple mediocre ones.

## 2 Submission Deadlines

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#### Deadline

##### Quiz 2 Questions

- Submission Deadline: **November 19, 2025 @ 11:59 PM**
- Quiz Date: November 21, 2025 (Online, 24-hour window)

#### Deadline

##### Quiz 3 Questions

- Submission Deadline: **December 6, 2025 @ 11:59 PM**
- Quiz Date: December 8, 2025 (Online, 24-hour window)

## 3 Submission Requirements

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### 3.1 Question Format

All submissions must be **MULTIMODAL**, incorporating both visual and textual elements:

#### 1. Visual Components (Required)

- Diagrams, graphs, or charts
- Mathematical equations as images
- System architectures or flowcharts
- Sensor data visualizations
- Robot trajectory plots

## 2. Text Components (Required)

- Clear problem statement
- Context and background information
- Multiple choice options (A, B, C, D, etc.)
- Instructions for solving

## 3. Answer Format (Required)

- Clearly specify: “Multiple Choice - Single Correct Answer” OR
- “Multiple Choice - Multiple Correct Answers”
- Include 4-6 answer options
- Provide detailed solution explanation

### 3.2 Quality Criteria

Questions will be evaluated based on four primary criteria:

Criterion	Description	Weight
Difficulty	Requires deep understanding of course concepts	30%
Semantic Complexity	Multi-step reasoning and concept integration	25%
Creativity	Novel problem formulation or unique perspective	20%
Documentation	Professional presentation and clarity	25%

## 4 AI-Resistance Requirements

### 4.1 What Makes a Question AI-Proof?

Your question must demonstrate resistance to current AI tools including:

- GPT-4 and GPT-4 Vision
- Claude Opus 4.1
- Google Gemini
- Other multimodal LLMs

### 4.2 Effective Strategies

#### ✓ Success Tip

##### Strong AI-Resistant Elements:

1. **Visual-Spatial Reasoning:** Interpreting complex robot trajectories or sensor coverage maps
2. **Multi-Step Integration:** Problems requiring kinematics → dynamics → control
3. **Numerical Verification:** Where intermediate calculations affect the final answer
4. **Domain-Specific Context:** Real-world scenarios requiring robotics expertise
5. **Time-Series Analysis:** Interpreting sensor data over time from graphs

### 4.3 Example Topics

- Extended Kalman Filter with visual state evolution
- Path planning with complex obstacle configurations
- Sensor fusion requiring graphical data interpretation
- Control system stability from Bode/Nyquist plots
- SLAM visualization and loop closure detection
- Kinematic chain analysis with visual representations
- Multi-robot coordination scenarios

## 5 Submission Format on Gradescope

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### 5.1 Required Files

Submit the following files to Gradescope under “Extra Credit Quiz Questions”:

1. **question.pdf** - Main question document
  - Question text with embedded images/diagrams
  - Multiple choice options clearly labeled
  - Any necessary formulas or equations
  - Space for student work (if applicable)
2. **solution.pdf** - Complete solution
  - Correct answer(s) clearly marked
  - Step-by-step solution process
  - Explanation of why incorrect options are wrong
  - Justification for AI-resistance
3. **metadata.txt** - Question information
  - Question type (Single/Multiple correct)
  - Topic area (e.g., EKF, Path Planning)
  - Difficulty rating (1-10 scale)
  - AI-resistance explanation (200 words)

### 5.2 File Naming Convention

Use the following naming format:

[YourNetID]\_[Quiz2/Quiz3]\_[Topic]\_[question/solution/metadata].[pdf/txt]

Example: ksingh42\_Quiz2\_EKF\_question.pdf

## 6 Evaluation Process

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### 6.1 Selection Criteria

Questions will be evaluated in three stages:

#### 1. Initial Screening

- Format compliance check
- Multimodal requirement verification
- Basic quality assessment

#### 2. AI Testing

- Test with multiple AI models
- Verify resistance claims
- Check for solution uniqueness

#### 3. Final Selection

- Rank by quality criteria
- Select top 10 submissions
- Award extra credit points

### 6.2 TA-Proof Bonus

For the additional +2 points, questions must be:

- Challenging for graduate-level understanding
- Require extensive domain knowledge
- Have non-obvious solution paths
- Demonstrate exceptional creativity

## 7 Tips for Success

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### ✔ Success Tip

#### DO:

- Test your question with AI tools before submission
- Include realistic robotics scenarios
- Use high-quality, clear diagrams
- Provide unambiguous problem statements
- Consider edge cases in your solution
- Reference course material appropriately

**⚠ Important****DON'T:**

- Submit text-only questions
- Use easily searchable facts
- Create ambiguous questions
- Copy from existing resources
- Submit questions with errors
- Ignore formatting requirements

## 8 Example Question Structure

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### 8.1 Sample Format

**Question:** Consider the mobile robot trajectory shown in Figure 1, where the robot uses an Extended Kalman Filter for localization...

[Complex diagram showing robot path, sensor readings, and uncertainty ellipses]

Given the following sensor measurements at time  $t = 5s$ :

- IMU:  $\omega_z = 0.5$  rad/s
- GPS:  $(x, y) = (10.2, 5.8)$  m
- Wheel encoders:  $v_L = 1.2$  m/s,  $v_R = 1.4$  m/s

What is the estimated position uncertainty after the measurement update?

**Options:**

- A.  $\sigma_x = 0.3m, \sigma_y = 0.5m$
- B.  $\sigma_x = 0.5m, \sigma_y = 0.3m$
- C.  $\sigma_x = 0.8m, \sigma_y = 0.6m$
- D.  $\sigma_x = 0.2m, \sigma_y = 0.2m$

## 9 Support and Resources

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### 9.1 Getting Help

- **Campuswire:** Post with tag `#extra-credit-questions`
- **Office Hours:** Get feedback on question ideas
- **Email:** [ksingh42@illinois.edu](mailto:ksingh42@illinois.edu) for submission confirmation

## 9.2 Additional Resources

- Course website: <https://kulbir-singh-ahluwalia.com/cs498gc/fa25/>
- Gradescope Course ID: 1102297
- Entry Code: KDP5G8

## 10 Special Note: Quiz 1 Calculator Policy

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For students affected by the Quiz 1 calculator policy:

We acknowledge that the “no digital devices” policy during Quiz 1 was not explicitly clear about scientific calculators. This extra credit opportunity is especially encouraged for students who were affected by this ambiguity.

**Future Quiz Policy Clarification:**

- ✓ Basic scientific calculators ARE allowed
- ✗ Prohibited: smartphones, tablets, smartwatches, laptops, smart glasses, internet-connected devices

**Good luck with your submissions!**

*Let's create challenging, meaningful assessments together.*