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## Introduction to Robotics Systems Assignment 2

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**Course Code: EE428**

**Course Title: Introduction to Robotics Systems**

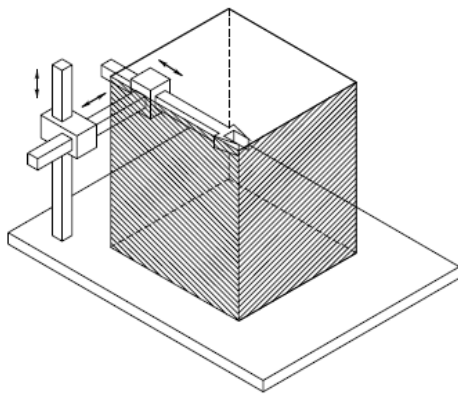
**Assignment 2**

**Due Date: September 9<sup>th</sup>, 2024**

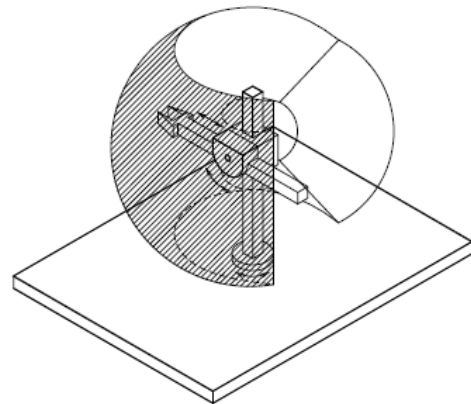
**Assignment purpose:**

1. Be able to Identify the methodologies of solving engineering problems, collecting data and interpreting this data.
2. Understand the workspace based on the robot specifications.
3. Identify the principles of operation and the performance specifications of electrical and electromechanical engineering systems.
4. Analyze, design and implement various methods of control techniques using analogue and digital control systems.
5. Formulate the problem through realizing the requirements and identifying the constraints.

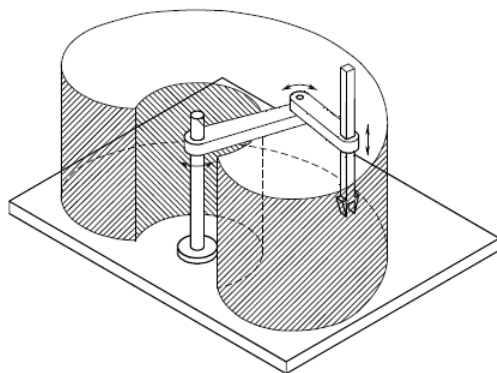
**Q1.** Identify the type of manipulator used along with its joints' connection type.



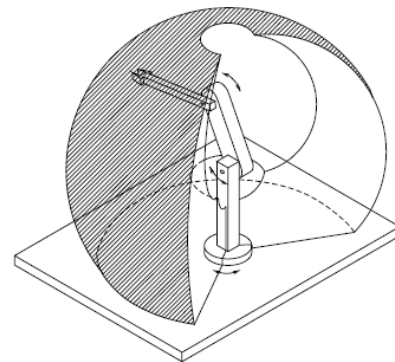
(a)



(b)

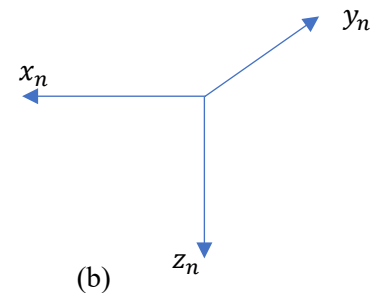
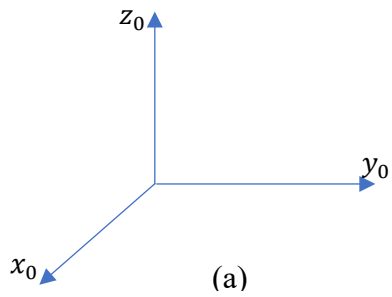


(c)



(d)

**Q2.** Use the least number of steps to find the change in co-ordinates from (a) to (b) and show the total rotation matrix



**Q3.** Find the rotation matrix corresponding to the set of Euler angles  $ZXZ$ . Then substitute  $\vartheta = 0$

**Q4.** Use an AI platform to compare and verify your answers.

# Assignment 2 Reformatted Using TILT Template

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## Course Information

Course Code: EE428

Course Title: Introduction to Robotics Systems

## Assignment Details

Assignment Name: Assignment 2

Due Date: September 9th, 2024

## Purpose

The purpose of this assignment is to help you:

- Identify methodologies for solving engineering problems by collecting and interpreting data.
- Understand the workspace based on the robot specifications.
- Identify the principles of operation and the performance specifications of electrical and electromechanical engineering systems.
- Analyze, design, and implement various methods of control techniques using analogue and digital control systems.
- Formulate problems by realizing the requirements and identifying the constraints.

## Skills

This assignment is designed to help you practice the following skills essential for your success in this course and in the field of robotics engineering:

- Understanding: Basic disciplinary knowledge and methods/tools related to robotics and control systems.
- Applying: Basic disciplinary knowledge/tools to problem-solving, particularly in robotics and control techniques.
- Analyzing: Breakdown of robotic systems to understand their functionality and control mechanisms.

- Synthesizing: Integrating different control methods and robotic principles to create effective solutions.
- Evaluating: Judging and selecting the best approaches for robotic control and operation.
- Creating: Developing new interpretations or solutions based on your understanding of robotics systems.

### Knowledge

This assignment will also help you to become familiar with the following important content knowledge in this discipline:

- Robotic manipulator types and joint connections.
- Transformation matrices and their application in robotics.
- Euler angles and their use in defining rotational movements in robotics.
- Utilization of AI platforms for verification and comparison in robotics tasks.

### Tasks

You are required to complete the following tasks:

1. Identify the type of manipulator used along with its joints' connection type.
  - Provide a detailed description of the manipulator and its joint connections.
2. Use the least number of steps to find the change in coordinates from (a) to (b) and show the total rotation matrix.
  - Clearly outline the steps taken to find the change in coordinates. Include the rotation matrix as part of your solution.
3. Find the rotation matrix corresponding to the set of Euler angles ZXZ. Then substitute  $\theta=0$ .
  - Derive the rotation matrix and show the steps involved. Include the substitution of the angle.
4. Use an AI platform to compare and verify your answers.
  - Document the process of using the AI platform and include the verification of your solutions.

### Criteria for Success

- The correct identification and explanation of manipulator types and joint connections.
- Accuracy in the calculation of coordinate changes and rotation matrices.

- Clear and logical derivation of the rotation matrix for the given Euler angles.
- Proper usage and documentation of AI platforms for verification purposes.
- Additional Information: Consider providing examples or checklists to ensure students understand what excellent work looks like.

**Based on the TILT template, here are some suggestions to improve the areas that might be currently lacking or could be further developed in your Assignment 2:**

### **1. Purpose:**

- **Current Content:** The purpose of the assignment is generally well-defined, focusing on problem-solving, understanding robot specifications, and analyzing control techniques.
- **Improvement Suggestion:** To enhance clarity, you might consider explicitly connecting the purpose of the assignment to real-world applications or future professional scenarios. For example, you could add statements like, "This assignment will prepare you for challenges you may face in designing control systems for industrial robots," or "Understanding these concepts is crucial for roles in automation and robotics engineering."

### **2. Skills:**

- **Current Content:** The skills section is well-drafted, mentioning key cognitive tasks like understanding, applying, analyzing, synthesizing, evaluating, and creating.
- **Improvement Suggestion:** You could expand on how these skills translate into practical capabilities. For instance, you might specify, "Analyzing robotic systems will enable you to troubleshoot and optimize real-world robotic operations," or "Creating solutions will be essential when you design new robotic control systems."

### **3. Knowledge:**

- **Current Content:** The knowledge section outlines the key content areas, such as robotic manipulator types and Euler angles.
- **Improvement Suggestion:** You could make this section more robust by detailing how this knowledge is foundational for the course and future courses or careers. For example, "Understanding transformation matrices is vital for developing algorithms in robotic motion planning," or "Knowledge of Euler angles is essential for any role involving robotic kinematics and dynamics."

#### ### **4. Tasks:**

- **Current Content:** The tasks are clearly stated, focusing on practical problems related to manipulators, rotation matrices, and AI verification.

- **Improvement Suggestion:** Consider adding more detailed instructions or breaking down complex tasks into sub-tasks to guide students through the process. For example, you could include a step-by-step guide for deriving the rotation matrix or suggest tools/software for using the AI platform. Additionally, clarifying expectations for each task, such as the depth of analysis or the format for presenting answers, could further enhance understanding.

#### ### **5. Criteria for Success:**

- **Current Content:** The criteria for success are mentioned but could benefit from additional detail.

- **Improvement Suggestion:** Provide specific examples or rubrics that outline what constitutes excellent, good, or adequate work. You might also consider including a checklist that students can use to self-assess their work before submission. For instance, "An excellent response will not only correctly identify the manipulator type but also provide a thorough explanation of why this type is suitable for certain applications."

#### ### **6. Examples and Checklists:**

- **Current Content:** There are no examples or checklists provided.

- **Improvement Suggestion:** Consider creating examples of high-quality work for each task or a checklist that students can use to ensure they have met all the requirements. For example, you could show a model solution for a similar problem or provide a checklist that includes items like "Have I clearly explained each step in deriving the rotation matrix?" or "Have I correctly applied the AI platform to verify my results?"

#### ### **7. Reflection:**

- **Current Content:** No reflection component is currently included.

- **Improvement Suggestion:** Add a short reflection section where students can reflect on what they learned from the assignment, what challenges they faced, and how they overcame

them. This can help reinforce learning and provide valuable feedback for future assignments.

By addressing these areas, you can further align your assignment with the TILT framework, enhancing transparency and clarity, which can lead to improved student engagement and learning outcomes.



Assignment Name: Assignment 2

Due date(s): September 9th, 2024

Purpose: This assignment will help you:

1. Identify the methodologies of solving engineering problems, collecting data and interpreting this data.
2. Understand the workspace based on the robot specifications.
3. Identify the principles of operation and the performance specifications of electrical and electromechanical engineering systems.
4. Analyze, design and implement various methods of control techniques using analogue and digital control systems.
5. Formulate the problem through realizing the requirements and identifying the constraints.

Skills: The purpose of this assignment is to help you practice the following skills that are essential to your success in this course:

- Identifying manipulator types and joint connection types
- Calculating coordinate changes and rotation matrices
- Understanding and applying Euler angles
- Verifying solutions using AI platforms

Knowledge: This assignment will also help you to become familiar with the following important content knowledge in this discipline:

- Types of robotic manipulators
- Coordinate transformations
- Rotation matrices
- Euler angles

Tasks: Q1. Identify the type of manipulator used along with its joints' connection type for the four diagrams provided (a, b, c, d).

Q2. Use the least number of steps to find the change in co-ordinates from (a) to (b) and show the total rotation matrix.

Q3. Find the rotation matrix corresponding to the set of Euler angles ZXZ. Then substitute  $\theta = 0$ .

Q4. Use an AI platform to compare and verify your answers.

Criteria for Success: [This section is left blank as it was not included in the original assignment]

Certainly. Based on the TILT template, here are some suggestions for improving the areas that are currently lacking in your assignment draft:

1. Skills: While you've implicitly covered some skills, you could make them more explicit. Consider adding: • Analyzing robotic systems • Applying mathematical concepts to robotics • Critical thinking and problem-solving in robotics contexts • Using technology (AI platforms) for solution verification
2. Knowledge: You could expand this section to include more specific content areas, such as: • Robotic workspace analysis • Coordinate systems in robotics • Principles of robotic manipulator design • Applications of rotation matrices in robotics
3. Criteria for Success: This section is entirely missing from your current draft. Consider adding: • Clear expectations for each question (e.g., level of detail required, format of answers) • Rubric or scoring guide for each question • Examples of what constitutes a good answer • Any specific requirements for showing work or explaining reasoning
4. Connection to broader goals: The TILT template suggests connecting the assignment to broader learning outcomes. You could add: • How this assignment relates to the overall course objectives • Relevance of these skills and knowledge to future coursework or career in robotics/engineering
5. Guidelines or recommended sequence: Consider adding: • Suggested order for tackling the questions • Estimated time to spend on each question • Any resources students should consult before beginning
6. Common mistakes to avoid: Adding a brief section on common pitfalls could be helpful, such as: • Misidentifying manipulator types • Errors in matrix multiplication • Misinterpreting Euler angle conventions
7. Reflection component: The TILT template emphasizes the importance of student reflection. Consider adding a task like: • Briefly explain how each question relates to the course learning objectives • Discuss any challenges faced and strategies used to overcome them

By addressing these areas, you'll create a more comprehensive and transparent assignment that aligns closely with the TILT template's goals of enhancing student understanding and learning outcomes.

# Comparison of Assignments Based on TILT Template

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## 1. Purpose

### ChatGPT\_Assignment (Pros):

Clearly outlines the purpose, connecting it to specific learning objectives.

Specifies the broader applicability of the skills learned (e.g., designing control systems, understanding specifications).

### Claude\_Assignment (Cons):

The purpose is outlined but lacks explicit connections to real-world applications or future professional scenarios.

More generic in terms of linking the purpose to broader learning outcomes.

## 2. Skills

### ChatGPT\_Assignment (Pros):

Skills are comprehensively listed, using Bloom's Taxonomy to categorize them.

Clearly connects skills to practical tasks in robotics engineering, making them relevant to real-world applications.

### Claude\_Assignment (Cons):

Skills are mentioned but not as explicitly categorized or connected to real-world tasks.

Lacks detail in explaining how these skills will benefit students beyond the assignment.

## 3. Knowledge

### ChatGPT\_Assignment (Pros):

Lists key content knowledge in detail, making it clear what students will learn.

Connects the knowledge to future courses and career paths, enhancing relevance.

### Claude\_Assignment (Cons):

Lists knowledge areas but lacks the depth of connection to broader learning contexts.

Could benefit from additional details on why this knowledge is important.

## 4. Tasks

### **ChatGPT\_Assignment (Pros):**

Tasks are clearly defined with detailed instructions, making it easier for students to understand what is expected.

Provides guidance on how to approach each task, potentially improving student performance.

### **Claude\_Assignment (Cons):**

Tasks are listed but lack the level of detail found in the ChatGPT assignment.

Could be improved by breaking down complex tasks into simpler steps or providing more guidance.

## 5. Criteria for Success

### **ChatGPT\_Assignment (Pros):**

Includes criteria for success, helping students understand how their work will be evaluated.

Suggests the inclusion of examples or rubrics, which could further clarify expectations.

### **Claude\_Assignment (Cons):**

The section is entirely missing, leaving students without clear guidance on what constitutes successful work.

This omission could lead to confusion or inconsistent grading.

## 6. Examples and Checklists

### **ChatGPT\_Assignment (Pros):**

Suggests adding examples and checklists, which could help students self-assess their work and understand expectations better.

### **Claude\_Assignment (Cons):**

Does not include examples or checklists, which could make it harder for students to gauge the quality of their work.

## 7. Reflection

### ChatGPT\_Assignment (Pros):

Suggests the addition of a reflection component, encouraging students to think about their learning process and challenges.

This could enhance metacognitive skills and provide valuable feedback for future assignments.

### Claude\_Assignment (Cons):

No reflection component is included, missing an opportunity for students to deepen their understanding of the material.

### Conclusion:

ChatGPT\_Assignment:

Pros: More comprehensive, with clear connections to real-world applications, detailed task instructions, and suggestions for enhancing student understanding through examples, checklists, and reflections.

Cons: Could still be improved by adding real examples and checklists, which were only suggested but not included.

Claude\_Assignment:

Pros: Contains the essential elements of an assignment but is more basic and less detailed.

Cons: Lacks depth in several key areas, such as criteria for success, detailed task instructions, and real-world connections, which could limit student understanding and performance.

### Claude Comparison:

Certainly. I'll compare the two assignments, highlighting the pros and cons of each version.

ChatGPT Assignment:

Pros:

1. More comprehensive and detailed overall.
2. Includes a well-structured "Skills" section that aligns with Bloom's Taxonomy.

3. Provides more context in the "Knowledge" section.
4. Offers more detailed instructions in the "Tasks" section.
5. Includes a "Criteria for Success" section, which is missing in the other version.
6. Provides suggestions for improvement, including examples and checklists.

Cons:

1. May be slightly overwhelming due to its length and detail.
2. The additional context might make it harder for students to quickly identify the core requirements.

Claude Assignment:

Pros:

1. More concise and straightforward.
2. Easy to quickly grasp the main requirements of the assignment.
3. Clearly separates the original assignment from the suggestions for improvement.

Cons:

1. Lacks detail in some sections, particularly "Skills" and "Knowledge".
2. Missing a "Criteria for Success" section in the original format.
3. Tasks are less detailed, which might lead to confusion for some students.
4. Doesn't provide as much context for the assignment's relevance to the broader course goals.

Comparison:

1. Structure: Both follow the TILT template, but the ChatGPT version is more comprehensive.
2. Detail: The ChatGPT version provides more detail and context throughout, which can be beneficial for student understanding but might also be more time-consuming to read.
3. Clarity: The Claude version is more concise, which makes it easier to quickly grasp the main points, but it might lack necessary details for some students.

4. Improvement suggestions: Both provide valuable suggestions for improvement, but the ChatGPT version integrates these suggestions into the assignment structure, while the Claude version keeps them separate.

In conclusion, the ChatGPT version aligns more closely with the TILT template's goals of enhancing transparency and student understanding. However, the Claude version's conciseness might be preferred by some students or instructors. An ideal approach might be to combine the detailed structure of the ChatGPT version with some of the concise elements of the Claude version.