

ME 639: INTRODUCTION TO ROBOTICS
MID SEM EXAMINATION
DHVANI SHAH | 19110046
30/09/2021 - 01/10/2021

1. Code

2.

- a. The grips used for pill picking should not apply a lot of pressure, because the pills can be soft/fragile and need to be handled with the least impact. Soft grippers are the best choice in this application as they don't exert impact/pressure while picking the pills, ensuring that pills don't crush/reshape. These grippers can grab the pills by pinching, resembling the human method. Also, such grippers come in various materials which are health-friendly and won't contaminate the medicines(since such grippers are also used in the food industry). [Source1](#) [Source2](#)
- b. Ideas to be explored:
 - i. Flexible Mechanisms: Flexible mechanisms in robotics might mean the mechanisms which allow the motion of robots without any constraints in angles and orientations. That is, the robot can bend and move in various directions. These tools are made with components that can bend and are also known as compliant mechanisms.
 - ii. Soft Robotic Grippers: These grippers are made from intrinsically soft materials like silicon and rubber. They are flexible, softer and useful for handling delicate objects without damaging them. The gripper works through pressure variation throughout the gripper body. The advantage is that the gripper won't buckle given the even distribution of pressure throughout. [Source1](#)
 - iii. Universal Grippers: These grippers are versatile. They are designed so that they can pick up all kinds of objects. The design is analogous to a balloon filled with granular substance attached to a vacuum. The balloon can take shape of any substance it comes in contact with and therefore, easily lift it up. [Source1](#) [Source2](#)
 - iv. Paper Grippers: This is a type of soft gripper, derived from origami grippers. The advantages of paper grippers are low cost, easy fabrication, lightweight and variable stiffness. [Source1](#)
 - v. Origami Robots: Origami Robots or Oribots are folding robots. Combining origami folding with smart material actuators gives many soft body properties, decouples design from fabrication complexity and has the potential to yield compliance. [Source1](#)

According to me, the best option is using gripper with flexible mechanisms. These are cheap, precise, portable and predictable and if a suitable gripper is available in the market at a competitive price, we should go with it. [Video1](#). Paper grippers are also a good option in case flexible mechanisms gripper isn't

available. The only disadvantage here is that paper might become moist and require regular replacement due to external effects. [Video2](#)

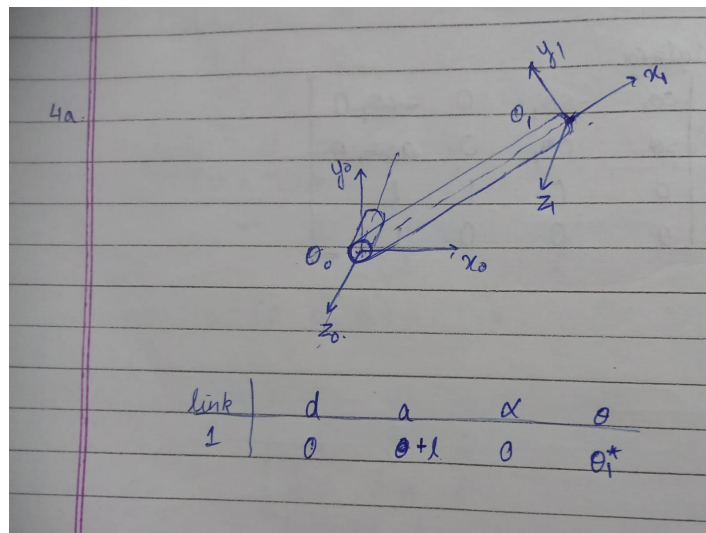
3.

a. Hip-knee length = 40 cm

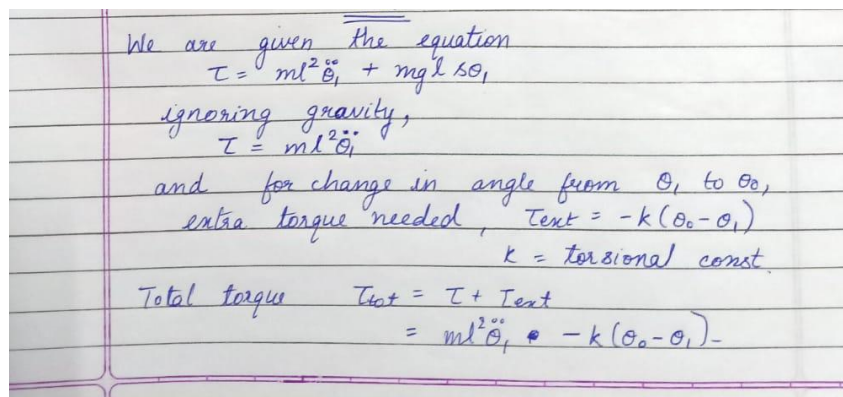
Knee-ankle length = 44 cm (measured own)

- i. Gait trajectory: The gait cycle is the interval between a foot leaving the ground and the same foot contacting the ground again. The trajectory of the heel or toe during this gait cycle is known as gait trajectory.
- ii. Step height: The maximum clearance between the ground and the foot when one step is taken.
- iii. Step length: Length covered by a single step. When one foot leaves the ground and steps forward, the distance between the two toes/heels is the step length.

4.



a.



b.

Level 0:

5. No - According to the rules, the choice of z_i is arbitrary (Textbook page 68, line 1). However, it is a general practice to fix it in line with the axis of actuation of joints.
6. No

7. Yes
8. Yes - only if the series of rotations is with respect to the current coordinate frame. If the rotations are about a fixed coordinate frame, then the rotation matrices need to be multiplied in reverse order to the order of rotations performed.
9. Yes