Addis Ababa Institute of Technology
Department of Electrical and Computer Engineering

ECEG-5223: Introduction to Robotics

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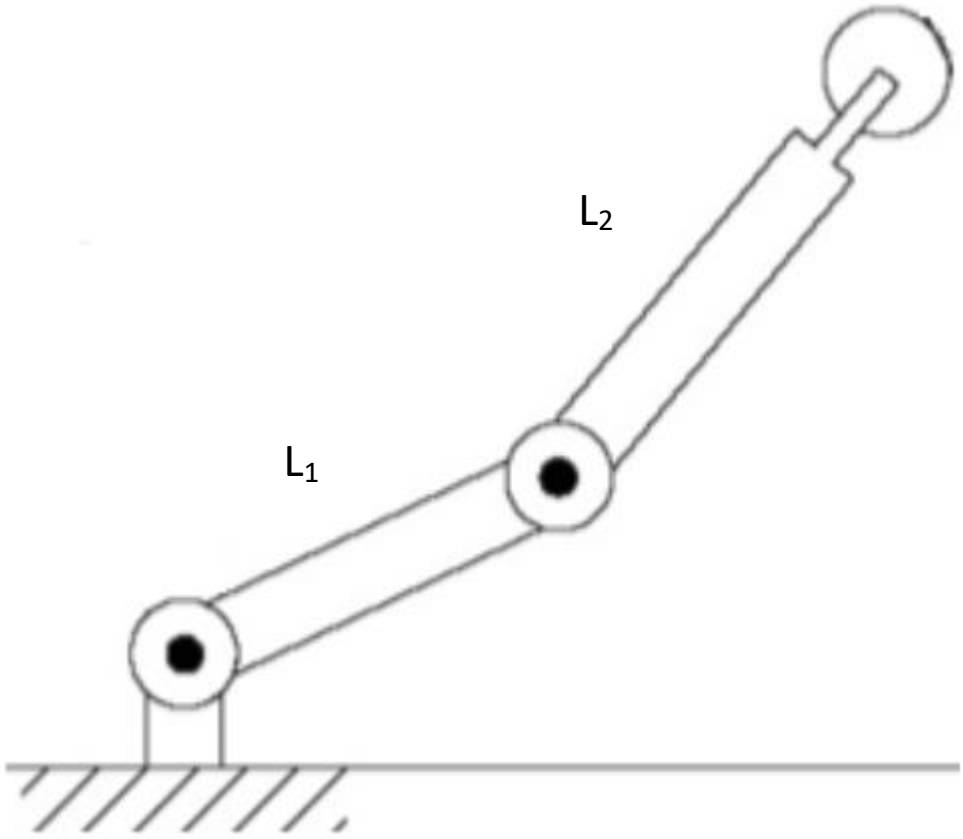
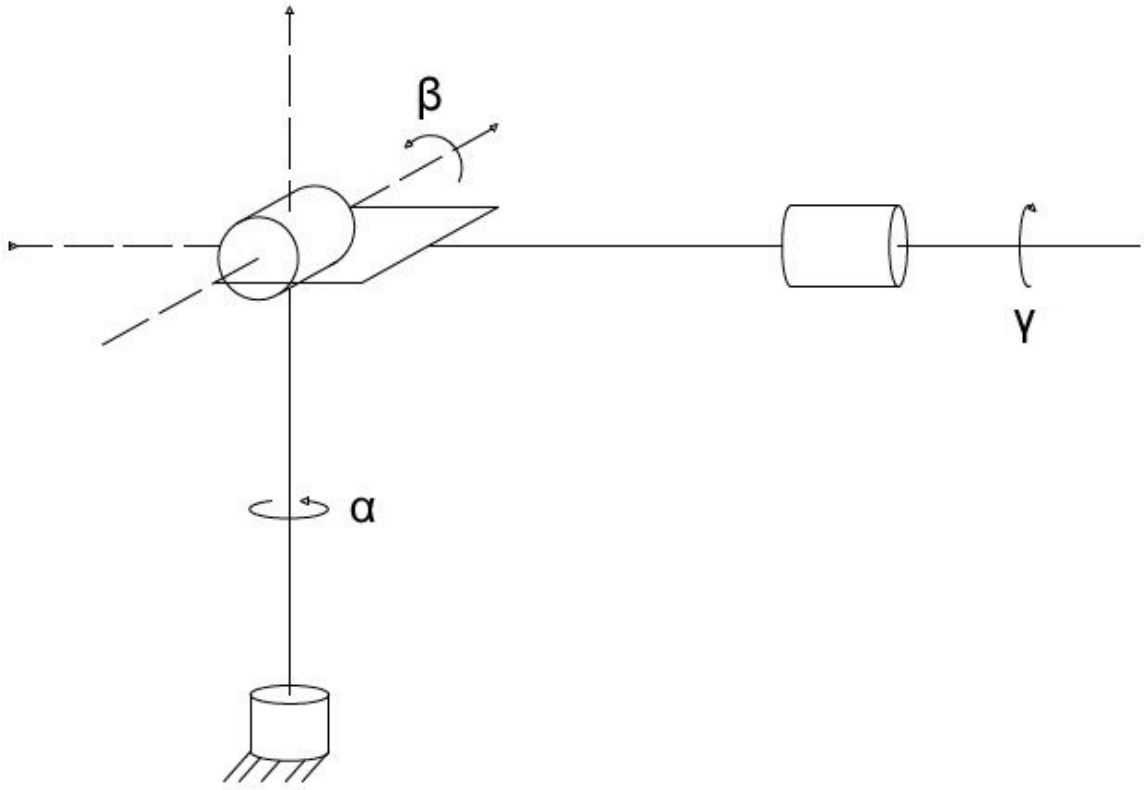
PRACTICE EXERCISE 1

1. Following DH-Rules, Define all axes for the planar elbow manipulator illustrated below.
   i. How many joints and links does it have? Label all of them starting with index 0.
   ii. How many frames of reference do you need?
   iii. Draw all frames and indicate the DH parameters for all frames. (a, d, α, θ)
   iv. Compute all transformation matrices between each consecutive frames.
   v. Compute the complete transformation matrix between the base frame and the tool frame. *[Redo this using trigonometry and not with DH Transformation. Compare the result]*



2. The Spherical Wrist manipulator can be represented as a combination of three revolute joints without any offset.
   i. What is the complete, derived transformation matrix for the spherical wrist?
   ii. What are the frames?
   iii. What are the DH parameters?
   iv. What are the individual transformation matrices?
   v. What's the final transformation matrix?
   [What is the final transformation matrix for this wrist, without using the Method?]



3. What is the complete, derived transformation matrix for a 3-link cylindrical robot illustrated below?
   i. What are the frames?
   ii. What are the DH parameters?
   iii. What are the individual transformation matrices?
   iv. What's the final transformation matrix?

   Suppose L0=50cm, L1=30cm, L2=40cm and L3=30cm;
   i. Compute the final transformation matrix.
   ii. With Initial Configuration (L2 and L3 are aligned 180^0 , L0 perpendicular to L1), what will be the coordinate of the end effector P with respect to the base frame (x_0,y_0,z_0) ?
   iii. If L1 is rotated by 300 and L3 is rotated by 600, what will be the new coordinate of P with respect to the base frame (x_0,y_0,z_0)?