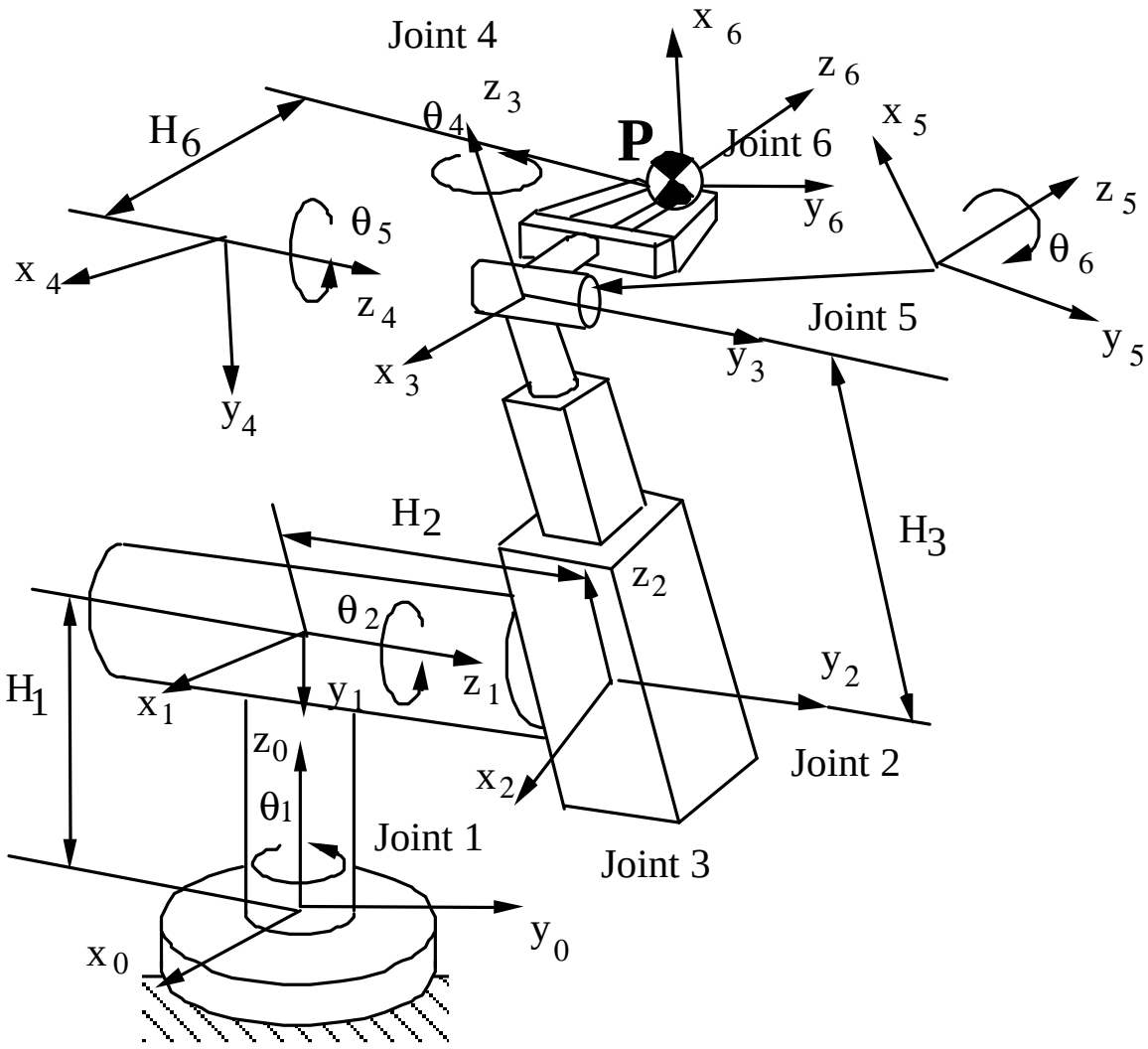
Problem 1



The manipulator shown above is a six-DOF manipulator with five revolute joints and one prismatic joint. The link lengths are H1=H2=H6=1m. The Denavit-Hartenberg coordinate axes are given and assume the manipulator position is given by:

$\theta_1 = 10^0$, $\theta_2 = 20^0$, $d_3 = 1$ m, $\theta_4 = 0$, $\theta_5 = 0$, $\theta_6 = 0$

1) Write out the Denavit-Hartenberg parameters for each link and compute numerically each DH matrix as well as the global homogeneous 4x4 transformation matrix (from Frame 0 to Frame 6) for the given configuration.

2) Find the angular velocity ${}^0w_6$ and the linear velocity ${}^0V_P$ of point **P** if the joints have the following velocities:

$\dot{\theta}_1 = 0.1$ rad / sec

$\dot{\theta}_2 = 0.2$ rad / sec

$\dot{d}_3 = 0.1$ m / sec

$\dot{\theta}_4 = \dot{\theta}_5 = \dot{\theta}_6 = 0.0$

3) Model this robot manipulator with Working Model 3D.
Use the given configuration in 1) as a starting configuration (t=0) and apply the joint velocities given in 2) to the manipulator for a simulation time of 1 second.

Using Working Model-3D graphics, print out some graphical results showing:

- The model in the starting configuration and its bodies / connections list
- The plotted curves of velocities (${}^0w_6$, ${}^0V_P$) versus time
- The final configuration of the manipulator and the trajectory of P from t=0 to t=1 (in the 0 frame)

The number (and the organization) of pictures you will choose to include in the homework is left to your discretion, but try to be concise and precise.