Assignment 5

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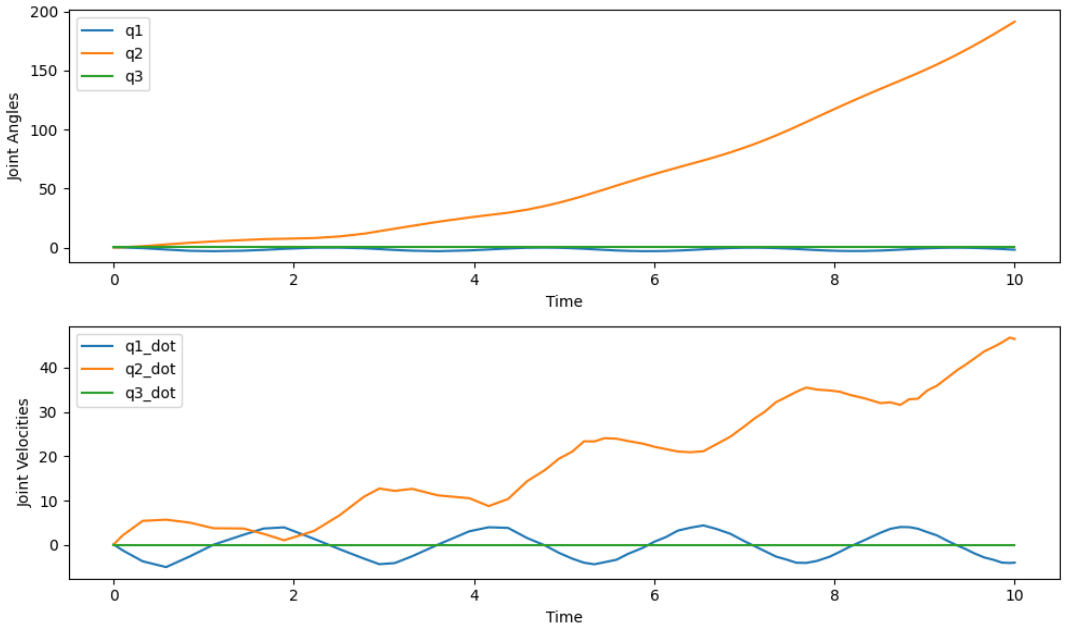
Q.1 , Q.2 and Q.5 have been answered previously in the Assignent- 3/4.

Q6.a To account for the dynamics of a 3-DOF bot, i have taken the example of a SCARA bot.
I have included Lagrangian dynamics of the bot by considering the Mass Inertia Matrix, Coriolis/Centrifugal Matrix. And taking the initial values as-

```
initial_conditions = np.array([0.1, 0.1, 0.1, 0.1, 0.1, 0])# [q1, q2, q3, q1_dot, q2_dot, q3_dot]
time_span = (0, 10)  # Time range for simulation
```

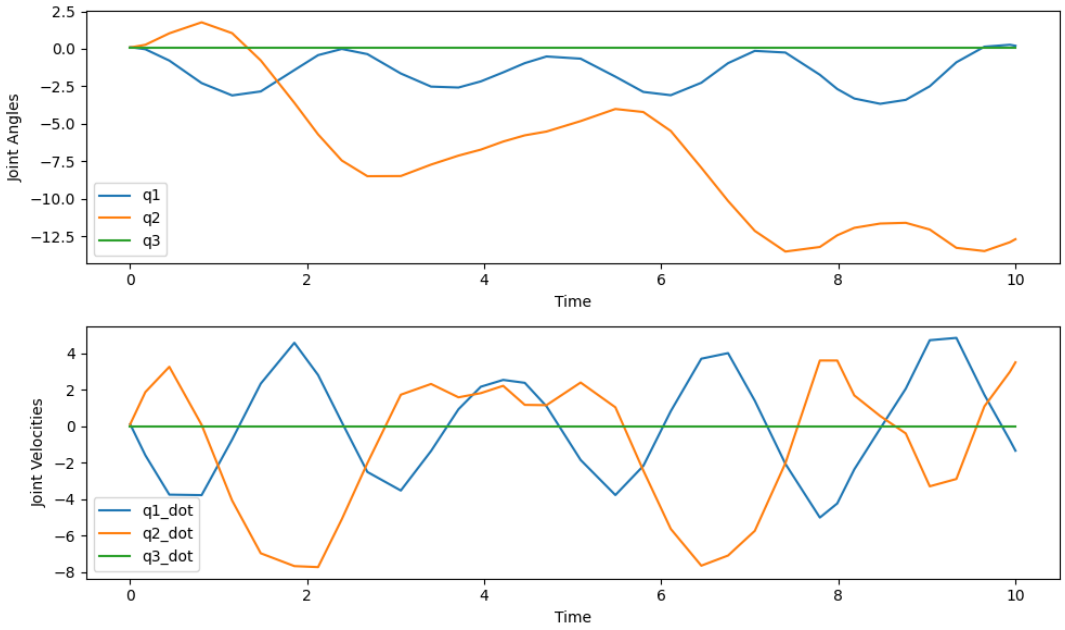
We can also change the value of Initial torque applied , which when put a large value, we get continuously accelerating joint acceleration values in the graph.

For $\tau = [3.5, 3.5]$
`tau_values=np.array([3.5, 3.5])  # [tau1, tau2]`
We get the following joint trajectory-



For $\tau = [0.1, 0.1]$ -
`tau_values=np.array([0.1, 0.1])  # [tau1, tau2]`

We get the following joint trajectory-



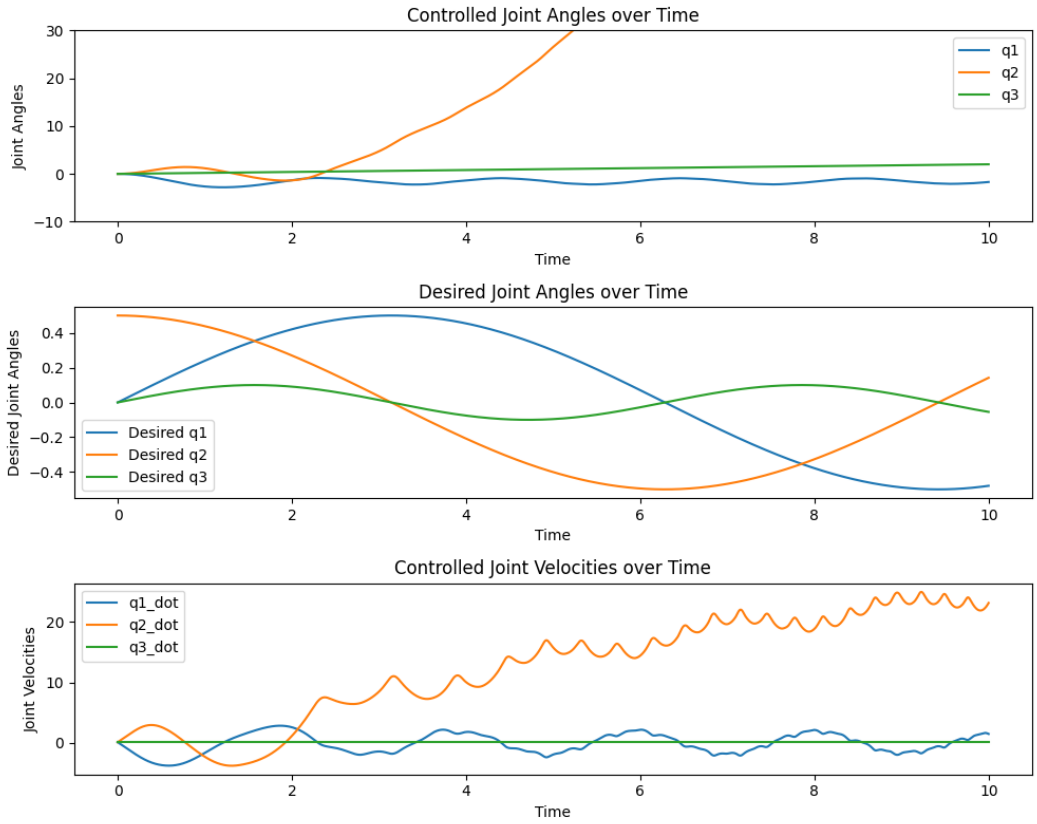
We can see at high values of Torque the velocity keeps increasing and it accelerates continuously.

Q.6b Code is attached.

PID control with low controller gains:-

Kp = 10
Ki = 5
Kd = 0.1

Graph attached shows desired trajectory and actual trajectory of the joints vs time.

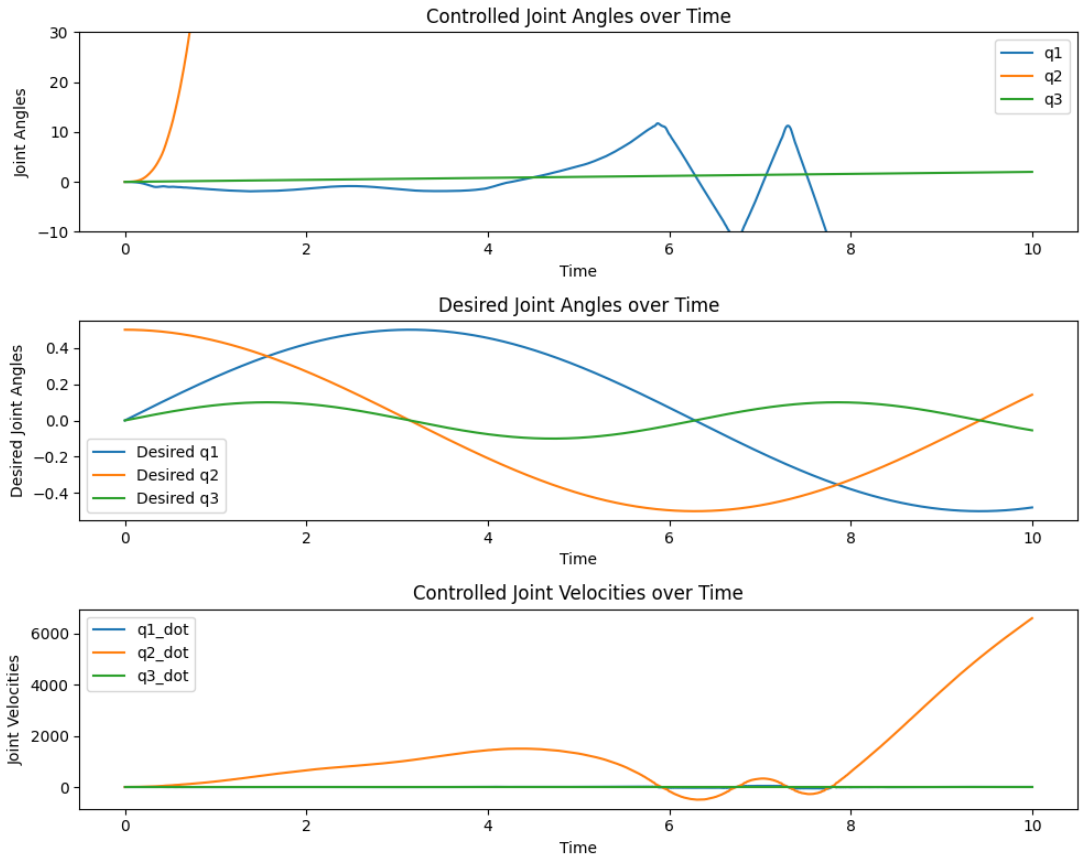


PID control with high gain:-

Kp =100

Ki =50

Kd =1


Controlled Joint Angles over Time
Joint Angles
Time
q1
q2
q3
Desired Joint Angles over Time
Desired Joint Angles
Time
Desired q1
Desired q2
Desired q3
Controlled Joint Velocities over Time
Joint Velocities
Time
q1_dot
q2_dot
q3_dot