Assignment 1

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Question 1.

Consider the pendulum state-space model with external torque and friction as discussed in class. Design a torque controller to do the following.

- Stabilize the pendulum at $\theta = \frac{\pi}{1.5}$ while starting at $\theta(0) = \frac{\pi}{2}, \dot{\theta}(0) = 0$.
- Behave as a frictionless pendulum, i.e., demonstrate sustained oscillation around the downward equilibrium point. Does the amplitude of oscillation sensitive to initial condition? Test with $\theta(0) = \frac{\pi}{4}$ and $\theta(0) = \frac{\pi}{3}$ and report the observation.

In both cases, provide the expression of the controller with choice of controller gains (k_p, k_d or k_i) along with brief explanation and the plots of $\theta(t)$-vs-t and $\dot{\theta}(t)$-vs-t. (You can use Simulink or Matlab/Python/C++ script with appropriate ODE-solver depending on your preference.The SImulink file for pendulum control is shared in the classroom.)

You have to submit the above details in a single PDF file along with an animation video of both the cases merged. **Create one single zip file comprising the pdf and the video file to upload in the classroom.**