Robotics [IIT-Jodhpur]
Practical 2 : Motion Analysis (Forward Dynamics) of 1-link robot

For the 1-link robot, shown in Fig. 1, equation of motion of which is given by

EoM: $I_{zz}\ddot{\theta} = \tau - mgl_c \cos\theta$ *or*

Forward Dynamics: $\ddot{\theta} = {I_{zz}}^{-1}(\tau - mgl_c \cos\theta)$

[**Inputs**: $\tau, \theta(t=0), \dot{\theta}\ (t=0)$][**Output**: $\theta(t), \dot{\theta}\ (t)$]

1. Perform the simulation (forward dynamics) of the 1-link robot free fall under gravity, i.e., $\tau = 0$, for the time period of T=3 sec and initial joint angle and joint velocity as $\theta(t=0) = 0\ rad, \dot{\theta}\ (t=0) = 0$ rad/s
2. Plot θ vs t, $\dot{\theta}$ vs t and $\ddot{\theta}$ vs t
3. Animate the system

Repeat the above steps for

a) $\theta(0) = \frac{\pi}{3}\ rad, \dot{\theta}\ (0) = 0$ rad/s
b) $\theta(0) = \frac{\pi}{3}\ rad, \dot{\theta}\ (0) = 0.1$ rad/s
c) *Input torque* τ = torque obtained using inverse dynamics in practical 1

Assume m = 1kg, l = 1m, l_c = 0.5m, $I_{zz} = \frac{1}{3}ml^2$ and g = 9.81 m/s^2.

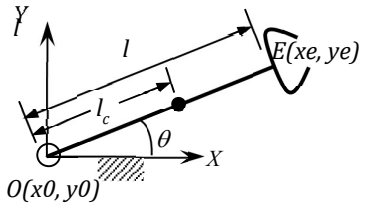

Figure 1: A 1-link robot

Hint:

- Represent it in terms of two first order differential equation using state space form, i.e., $y_1 = \theta$, $y_2 = \dot{\theta}$ and $\dot{y}_1 = \dot{\theta}$, $\dot{y}_2 = \ddot{\theta}$.
- Use Ordinary Differential Equation (ODE) solver "**ode45**"