Assignment – 2
Team: 7
Name: Neeraj Krishna N, Ashwin R Nair, Kiran M V
Roll no: 112101033, 122101004, 122101019

1 Problem 1

The MATLAB code for problem has been attached.

2 Problem 2

2.1 Choose motors and battery and system mass such that you can achieve the above task in hardware

- From the simulation, we got angular velocity,

$$\omega_{max} = 2\,rad/s$$

  Maximum forward acceleration,

$$a_{max} = 0.25\,m/s^2$$

- Given radius, $R = 0.025$ m

- Desired velocity

$$v = R \times \omega_{max} = 0.025 \times 2 = 0.05\,m/s$$

- Motor rpm

$$\text{rpm} = \frac{v \times 60}{2\pi R}$$

$$\text{rpm} = \frac{0.05 \times 60}{2\pi \times 0.025} \approx 19.1\,\text{rpm}$$

- So, the motor should have a speed of around 20 rpm

- To calculate the torque, mass is required. Let's take a reference mass m of 2 kg, lightweight two-wheeled robot.

- For two-wheeled robot, each wheel needs to generate torque to provide the required force. The force needed per wheel is

$$F = \frac{m \times a_{max}}{2} = \frac{2 \times 0.25}{2} = 0.25\,N$$

- So torque to provide the required force

$$T = F \times R = 0.25 \times 0.025 = 0.00625Nm = 6.25mNm = 0.0637kg.cm$$

- Using the angular velocity and torque, we can calculate power

$$P = T \times \omega = 0.00625 \times 2 \approx 0.0125W$$

- The following motor was chosen - N20 3V 50RPM Micro Metal Gear Motor With Encoder. Specifications of the motor are

  - Rated voltage - 3V
  - Rated speed - 40 rpm
  - Rated torque - 0.2 kg-cm
  - Rated current - 30 mA
  - Weight: 11 g

- Operating voltage of motor is 3V and rated current is 30mA. For 2 motors, current supplied should be 60mA. Assuming a one hour operating duration, the battery should have a minimum of 60mAh capacity.

- The chosen battery is 3.7V 130mAH Li-Po Rechargeable Battery. Its specifications are

  - Voltage - 3.7 V
  - Capacity - 130 mAh
  - Weight - 2.8 g

- If we consider it as self balancing robot, we need to consider the weight of

  - Accelerometer - 5 g
  - Microcontroller - 20 g
  - Chassis - 100 g
  - Wheels - 2 $\times$ 25 g = 50 g

- So total mass $\approx$ 250 - 300 g