**Control Systems Engineering Internship**

**Assignments: Week 3 and 4**

Greetings Learners,

We hope you are enjoying the journey of this internship course curated in the domain of Control Systems.

The following tasks are defined to test the learner’s understanding and comfort in the modelling and setup of Transfer Functions and System Tuning of standard Closed Loop and Drone Control Models.

Please make sure to tackle these tasks without an active reference of the content. **A video discussing the results and the steps to solve the tasks would be uploaded on the Sunday of Week 4.**

**Task 1:**

The transfer function of a second order system has been defined as follows:

1. Use the transfer function to obtain the peak time, rise time, settling time and steady state error on applying a unit step input. (This design would be an Open Loop System)

Introduce a PID Controller to the present design and create a standard closed loop system.

1. Keeping KI and KD gains zero, tune the value of KP gain to achieve a rise time that is less than 10% of the value observed in the open loop system response.
2. Maintaining the KP gain value, introduce a KD gain value such that the percentage overshoot is less than 10%.
3. Introduce a KI gain value in the controller. Is there any change in the values of Percentage overshoot, steady-state error and rise time?
4. Tune the KP, KI and KD values to satisfy the targets mentioned in (b) and (c).

**Task 2:**

The two physical equations governing the motor actuation have been given below.

The aim is to obtain a transfer function with **Voltage V(s)** to be the input and **Angular Velocity W(s)** to be the output.

1. Once the transfer function has been created, apply the same in the drone control model and obtain an output.
2. What is the difference between the now obtained transfer function and the one taken in the lecture?
3. Substitute the constant values of Moment Arm Length and Drone Inertia in their respective gain blocks.
4. Tune the PID Controller to get a stable response, keeping the input same. (**Note:** The gain blocks can take up any real number value from -inf to +inf)

**Parameters:**

1. KE = 0.375 V/rad/sec
2. J = 0.206 kg.m^2
3. R = 0.0057 ohms
4. KT = 0.1637 N.m/A
5. b = 3.38x10^-3 N.m/rad/sec
6. L = 0.0031 Henry
7. Drone Inertia = 60
8. Moment Arm Length =0.4 m