Assignment 3

1. For the coupled tank system considered in Assignment 2, the control objective is to maintain the water of tank 2 at desired level even in presence of some variation of its output flow rate. Suppose PI controllers with feedforward action and feedbacks from both the level sensors are to be used for this purpose. Using the system parameters (along with pump and sensors) given in Assignment 2, design the above controller using pole-placement technique to ensure the following in the regulation characteristics: (i) peak overshoot (P.O)$\leq 10\ \%$, (ii) settling time (2% tolerance band)$\leq 20\ s$, (iii) no steady-state error. Check the regulation performance of the designed controller through simulation of both linearized and nonlinear systems in presence of $\pm$ 10 % variation in the steady-state value of output flow rate of tank 2.

2. Given the cart-pendulum system in Assignment 2, design a first-order controller with feedbacks from θ and x to meet the following design specifications: (a) setting time $\leq 5\ s$, $|x| \leq 0.4\ m$, $|\theta| \leq 0.15$ rad, control voltage $|u| \leq 2.5\ V$ after 0.5 s with maximum initial peak of 20 V, $|GM| \geq 6$ dB, $|PM| \geq 40^0$ at the control input channel u. Assume the DC motor used to convert voltage u to force F is represented by a gain of 15. Use (dominant) pole-placement based method to design the controller and check if the performance of the above controller is met for both the linear and nonlinear systems.