EE 561: Digital Control Systems

Spring 2017

Quiz # 2

Time: 30 min

Name: _____

Roll #: _____

Question # 1 **(10 marks)**

Consider the following block diagram of a regulated plant

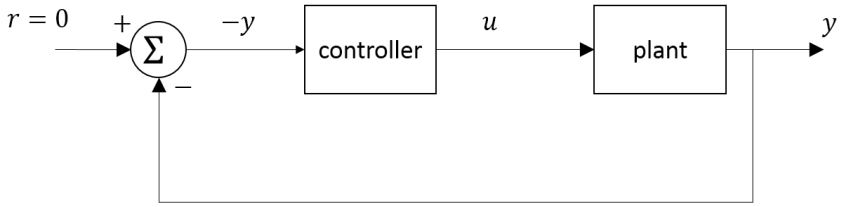

Figure 1: .

The plant dynamics are described in state space form as

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 20 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Suppose that the compensator is designed as an observer-controller pair with $\tilde{x} = A\tilde{x} + Bu + L(y - C\tilde{x})$ and $u = -K\tilde{x}$, where $\tilde{x}$ is the estimated state. In order to meet the design requirements, the gains are selected such that

$$K = \begin{bmatrix} 30 \\ 5 \end{bmatrix} \quad \text{and} \quad L = \begin{bmatrix} 10 \\ 80 \end{bmatrix}$$

Obtain the transfer function $\dfrac{U(s)}{-Y(s)}$ of the observer-based controller.