Exam3

1. Consider a transfer matrix as follows:

$$\hat{G}(s) = \begin{bmatrix} \dfrac{4s-10}{2s+1} & \dfrac{3}{s+2} \\ \dfrac{1}{(2s+1)(s+2)} & \dfrac{1}{(s+2)^2} \end{bmatrix}$$

   a) Consider a noise signal $noise \sim 0.1 \cdot U(0,1)$ appears in all measurements. The desired steady-state of the step response is shown as follows:

$$\lim_{t\to\infty} \boldsymbol{y}(t) = \begin{bmatrix} -5 & 1 \\ 2 & 3 \end{bmatrix}$$

   Design both observer and controller according to separation principle. (20%)

2. Consider a transfer function as follows:

$$G(s) = \frac{s+4}{s^2+4s+3}$$

   a) Plot the step response of the system. (10%)
   b) Plot the impulse response of the system. (10%)
   c) Print the observability matrix and its rank. (10%)
   d) Consider a noise signal $noise \sim 0.05 \cdot U(0,1)$ appears in the measurement, where U is the uniform distribution. Plot the step response of the system with noise. (10%)
   e) Design a Kalman filter to estimate the system state. (20%)
   f) Follow the previous question, plot the step response of the estimated system state. (10%)
   g) Plot the Bode diagram of the system. (10%)