1. (30 %)The closed-loop transfer function of the system is

$$\frac{Y(s)}{U(s)} = \frac{6(s+3)}{(s+8)(s^2+4s+8)}$$

   a. Find the impulse response of this system. (10 points)
   b. Realize the system to be

$$\dot{x}(t) = Ax(t) + Bu(t)$$
$$y(t) = Cx(t)$$ (10 points)

   c. Derive the transfer function from (b) (10 points)

2. (10%) The system can be described as $y(t) = \int_{-\infty}^{\infty} g(t,\tau)u(\tau)d\tau$ and the $g(t,\tau)$ is the impulse response function of the system. Please explain the meaning of $g(t,\tau)$. (10 points)

3. (30%) The system is described as;

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 2 & 1 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$
$$y(t) = \begin{bmatrix} 0 & 1 & 2 \end{bmatrix} x(t)$$

   a. Please check the system controllability and observability without using the controllability and observability matrix. (10 points)
   b. Find the impulse response of the system (10 points)
   c. Utilize the state feedback $u(t) = \begin{bmatrix} k_1 & k_2 & k_3 \end{bmatrix} x(t)$ to relocate the system eigenvalues $\lambda = -1,-1,-1$. (10 points)

(背面仍有題目,請繼續作答)

4. (15%) The dynamic equation is following

$$\dot{x}(t) = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 1 \end{bmatrix} x(t)$$

a. Check its controllability! (5 points)

b. Can you find a u(t), such that the state $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$ can be steered to state $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$? If you can , find the $u(t)$; If you can not, explain the reasons. (10 points)

5. (15 %)Three different systems can be described as (a) s (b) $\frac{1}{s}$ (c) e^{-s}, respectively.
If the input signal is $\cos t$, please find and plot the output signals of above systems, respectively.