總分100分，共6大題。

1. In the Figure shown below with \( G = K/(s(s + 1)) \):

\[
\begin{array}{c}
R \\
\downarrow \\
\rightarrow \quad G_2 \quad \rightarrow \quad G \\
\downarrow \\
\rightarrow \\
\end{array}
\]

(1) With \( G_c = 1 \) find \( K \) for a damping ratio 0.707 and the steady-state error for the unit ramp input.

(2) Sketch the root loci for \( G_c = (10s+1)/(40s+1) \).

2. In the Figure shown below with \( G_c = K, \ G = 1/(s+2)(s+10) \):

\[
\begin{array}{c}
R \\
\downarrow \\
\rightarrow \quad G_c \quad \rightarrow \quad G \\
\downarrow \\
\rightarrow \\
\end{array}
\]

Calculate the unit step responses and the steady-state error values for \( K=7 \) and \( K=20 \).

3. For the unity feedback system, where \( G(s) = \frac{K(s+6)}{(s^2+10s+20)(s+1)} \), \( K > 0 \)

\[
K(s+6) \quad K \rightarrow \\
\frac{1}{(s^2+10s+20)(s+1)} \quad K \rightarrow \\
\]

Design \( K \) and \( \alpha \) so that the dominant complex poles of the closed-loop function have a damping ratio of 0.45 and an undamped natural frequency of \( \frac{9}{8} \) rad/s.

\[
\begin{array}{c}
R(s) \\
\downarrow \\
\rightarrow \quad G(s) \quad \rightarrow \quad C(s) \\
\end{array}
\]
4. Given the unity feedback system with 

\[ G(s) = \frac{K(s + 2)}{s^2 + 1(s + 4)(s - 1)} \]

Find the range of \( K \) for which there will be only two closed-loop, right-half-plane poles, and the range of \( K \) for which there will be only three closed-loop, right-half-plane poles. Also, find the range of \( K \) for stability.

5. A feedback control system's block diagram is shown below. Determine the gain \( K \) for a stable feedback system given \( K > 0 \). (15%)

6. The controllers' block diagram indicated below represents the system control. It consists of a proportional controller with reset action, a velocity feedback, and a feedforward path.

(a) Determine the controller gain \( K_a \), such that the overshoot in the velocity feedback is minimized. (50%)

(b) Determine the input command \( u(t) \) for the system to follow a sinusoidally varying input \( x(t) \). (50%)