Notes: 1. You are allowed three 8 ½ x 11 sheets of notes and Z-transform tables.
2. Show work for partial credit.
3. Exam is closed-book and closed-notes.
4. The duration of the exam is two hours.

1. (20 pts)

![Block Diagram](image1)

Figure 1.

Let \( G(z) = K \frac{z}{(z-1)(z-0.6065)} \)

(a) Find the value of \( K \) for the steady-state error to unit ramp input to be \( \leq 0.25 \).

(b) Find the value of \( K \) for stability. Also find the frequency of oscillation.

2. (5 pts)

![Block Diagram](image2)

Figure 2

Assume \( x(t) = s(t) \). Find \( c(0), c(0.5), c(0.25), c(T) \) and \( c(2T) \).

3. (10 pts)

![Block Diagram](image3)

Draw the magnitude spectrum of \( e(t), e^*(t) \) and \( u(t) \).

(a) \( m(kT) = 2e(kT) - e(k-1T) - m(k-1T) \)

(b) \( D(z) = \frac{M(z)}{E(z)} \).
Find \( \frac{C(z)}{R(z)} \) using signal flow graph:

\[
\begin{align*}
G_c(s) &= \frac{16(s+2)}{(s+4)} \\
G_p(s) &= \frac{1}{s(s+2)}
\end{align*}
\]

(a) Find \( K_v \), \( s \) and \( \omega_n \) of the continuous system shown in Fig. 5(a).

(b) It is required to discretize the system i.e. convert the continuous data control system shown in Figure 5(a) into a digital control system shown in Figure 5(b).

For the system shown in Figure 5(b), determine an adequate sampling period \( T \).

(i) Convert \( G_c(s) \) to \( D(z) \) using the matched \( Z \)-transform.

(ii) For the \( D(z) \) obtained in part (ii), obtain the difference equation.