*Note: 請將題號及答案標示清楚

1. (30%) Figure 1 shows a feedback control system with $G_p(s)=\frac{1}{ms+b}$, where m=5 and b=2.

(1) (10%) Determine the characteristic equation of this system and the controller gains of K_p, K_i, K_v such that the poles are located at $-0.5\pm j0.5,-10$.

(2) (10%) Determine the steady-state error with R=0 when the disturbance is

(a) a unit step, (b) ramp function $d(t)=3t$, (c) parabolic function $d(t)=t^2/2$.

(3) (10%) Neglect the real pole. Assume D=0 and $R(t)$ is a unit step. Sketch the step response of this system.

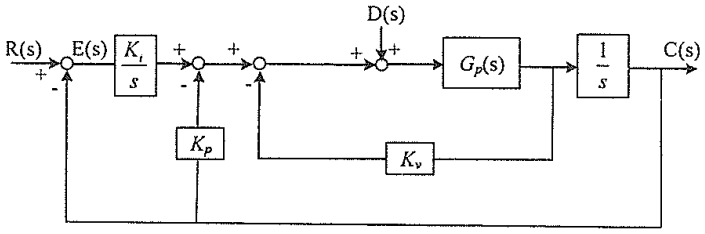

Figure 1

2. (20%) Consider the system in Figure 2.

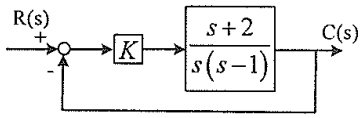

Figure 2

(1) (10%) Draw the root-locus as K varies from 0 to infinity. Find asymptote, the value of K where the root loci cross the imaginary axis, the values of K at the break-away point, break-in point, and the closed-loop poles for these K values.

(2) (10%) When the system is stable, find the range of K for the system is underdamped. If the design specification requires the damping ratio for the dominant closed-loop poles is equal to 0.707, determine the value of K and the closed-loop poles for this K value.

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3. (20%) Refer to Figure 3 with $G(s)=\frac{s+1}{s-9}$ and $C(s)=\frac{9}{s}$,

(1) (5%) Sketch the Bode plots of $L(s)=G(s)C(s)$.

(2) (5%) Sketch the Nyquist plot of $L(s)=G(s)C(s)$.

(3) (5%) Calculate the gain margin of the system.

(4) (5%) Calculate the phase margin of the system.

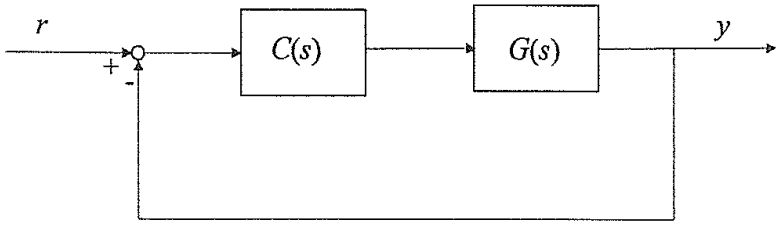

Figure 3

4. (30%) Consider Figure 3 with $G(s)=\frac{10(s+1)}{s(s-9)}$,

(1) (5%) Suppose $C(s)=K\in R$, sketch the root-loci of the closed-loop system as $K:0\to\infty$. Mark the important values of K on the plot.

(2) (5%) Find the range of K that can maintain system stability by the **Nyquist Criterion**.

(3) (5%) Find the frequency ω_1, where $|G(j\omega_1)|=1$.

(4) (5%) Design a first-order controller $C(s)$ to assign all closed-loop poles at $s=-2$.

(5) (10%) Design a controller $C(s)=\frac{k(s+z)}{s+p}$ such that the system has a phase margin of greater than 45° and a bandwidth of less than 20 rad/sec.

試題隨卷繳回