EE412 CONTROL SYSTEMS

Final Examination

Name:....................................

ID No.: ....

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* Consider the feedback control system shown in Fig.1 to answer Q1,Q2, Q3 and Q4

Q1.The effect of increasing the gain k_3 on the step response is

(a) decrease the stability of the system
(b) increase the steady state error
(c) decrease the effect of the load disturbance
(d) b and c

Q2. The effect of increasing the gain k_4 on the step response is

(a) increase the stability of the system
(b) decrease the steady state error
(c) not affect the steady state error due to R(s) and disturbance
(d) a and c

Q3. The sensitivity of the closed loop transfer function $\frac{Y(s)}{R(s)}$ to k_2 is

(a) $\dfrac{-k_1k_2k_4s}{\tau s^2+(1+k_1k_2k_4)s+k_1k_2k_3}$

(b) $\dfrac{\tau s^2+s}{(\tau s^2+(1+k_1k_2k_4)s+k_1k_2k_3)^2}$

(c) $\dfrac{\tau s^2+s}{\tau s^2+(1+k_1k_2k_4)s+k_1k_2k_3}$

(d) $\dfrac{-\tau s^2}{\tau s^2+(1+k_1k_2k_4)s+k_1k_2k_3}$

Q4. The type of the system with respect to R(s) is

(a) Zero if $k_3=1$
(b) Zero if $k_3 \neq 1$
(c) One for any value of k_3
(d) One if $k_4=1$

reasons to design control systems are
) Automatic control (b) Remote control (c) Power amplification (d) all of the above

The actuating signal (u(t)) of a closed loop control system can be expressed as (f is some function)
(a) u(t)=f(r(t))
(b) u(t)=f(r(t),y(t))
(c) u(t)=f(y(t))
(d) c and b

Q7. Consider a transfer function G(s) with poles –1 and –2+j and zero 3 and G(2)=-0.1,
Then G(s) is

(a) $G(s) = \dfrac{5.1(s-3)}{(s+1)(s+2+j)(s+2-j)}$

(b) $G(s) = \dfrac{1.7(s-3)}{(s+1)(s+2-j)}$

(c) $G(s) = \dfrac{1.7(s-3)}{(s+1)(s+2+j)(s+2-j)}$

(d) $G(s) = \dfrac{51(s-3)}{(s+1)(s+2+j)(s+2-j)}$

Consider the block diagram shown in Fig.2, to answer Q8 and Q9.

Q8. The determinant of SFG corresponding to the block diagram shown in Fig2 is
(a) $\Delta = 1 + G_1G_2G_3 + G_1G_4 + G_1G_2G_6 + G_2G_3G_5 - G_4G_5$
(b) $\Delta = 1 + G_1G_2G_3 + G_1G_4 + G_1G_2G_6 - G_2G_3G_5 + G_4G_5$
(c) $\Delta = 1 + G_1G_2G_3 + G_1G_4 + G_1G_2G_6 + G_2G_3G_5 + G_4G_5$
(d) $\Delta = 1 + G_1G_2G_3 + G_1G_4 + G_1G_2G_6 - G_2G_3G_5 - G_4G_5$

Q9. The numerator of the transfer function $\dfrac{Y(s)}{R_2(s)}$ is

(a) $-G_2G_3G_5 + G_4G_5$
(b) $-G_2G_3G_5 - G_4G_5$
(c) $G_2G_3G_5 + G_4G_5$
(d) none of the above

Q10. If $\dfrac{Y(s)}{R(s)} = \dfrac{2+3s}{2+3s+s^2}$ and $R(s) = \dfrac{2}{s} + \dfrac{1}{s^2}$, then the steady state response is

(a) $(3+t)u(t)$ (b) $tu(t)$ (c) (2+t) u(t) (d) ∞

Q11. Consider a unity negative-feedback control system with $G(s) = \dfrac{25}{s^2+4s+25}$ and PI controller with transfer function $G_c(s) = k_p + \dfrac{k_i}{s}$, then the value of k_i so that the steady state error due to unit ramp input equal to 0.04 is

(a) 15 (b) 25 (c) 50 (d) none of the above

12. To obtain a zero steady state error for a step input, the system type should be at least

type

(a) one (b) zero (c) Two (d) Three

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Q13. A closed loop control system is described by the state equations

$\dot{x} = \begin{bmatrix} 0 & -1 \\ 1 & -1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$, $y = \begin{bmatrix} 0 & 1 \end{bmatrix} x$, then the transfer function $T(s) = \dfrac{Y(s)}{U(s)}$ is:

(a) $\dfrac{2}{s^2 + 2s + 1}$ (b) $\dfrac{3}{s^2 + 3s + 1}$ (c) $\dfrac{1}{s^2 + s + 1}$ (d) none of the above

14. Consider a unity negative-feedback control system with an open loop transfer function $kG_c(s)G(s) = \dfrac{k(k_p + k_d s)}{s(s+2)}$, then system will have the fastest settling time if and only if

(a) $\sqrt{kk_p} = 1 + \dfrac{kk_d}{2}$ (b) $\sqrt{kk_p} = 1 + kk_d$ (c) $\sqrt{kk_p} = \dfrac{1}{3} + \dfrac{3kk_d}{2}$ (d) none of the above

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onsider a unity negative-feedback control system with an open loop transfer function $G(s) = \dfrac{s+k}{s^3 + (1+k)s^2 + (k-1)s + 1 - k}$ and root locus of this system is (as a function of the parameter k) is as shown in Fig.3 to answer Q15, Q16,Q17 and Q18.

5. It is desired that the absolute value of the steady state error for a unit step input be less than 10% of the magnitude of the unit step input, then the range of k required is

(a) 0.8<k<1.2 (b) 2.7<k<3.3 (c)3.6<k<4.4 (d) none of the above

.The open loop zeros of the root locus are

(a) 0 and –k (b) 0 and –1 (c) -k (d) none of the above

. The closed loop system is stable for

(a) k>0.618 (b)k>0 (c)k<0.618 (d) none of the above

. The open loop poles of the root locus are the roots of

(a) $s^2 + s$ (b) $s^3 + (1+k)s^2 + (k-1)s + 1 - k$ (c) 0 and –1 (d) $s^3 + s^2 + 1$

Consider a control system with transfer function $\dfrac{Y(s)}{R(s)} = \dfrac{s^2 - 1}{4s^2 + 1}$, the bounded input applied to this system that will excites an unbounded output is

a) r(t)=sin(2t) (b) r(t)=4sin(0.5t) (c)r(t)=6sin(0.25t) (d)r(t)=7sin(0.2t)

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Consider a negative feedback control system with $G(s) = \dfrac{4k}{s^2}$ and $H(s) = 1 + k_1 s$, then the value of k and k_1 such that $-1 \pm j\sqrt{3}$ are a closed loop poles are

) k=4, $k_1 = 0.5$ (b) $k = 2$, $k_1 = 0.5$ (c) k=1, $k_1 = 0.5$ (d) k=4, $k_1 = 0.125$

Q21. The unit step response of a system is measured as $y(t) = 1 + e^{-t} - 2e^{-2t}$, then the transfer function of the system is

(a) $\frac{3s+2}{s(s+1)(s+2)}$ (b) $\frac{3s+2}{(s+1)(s+2)}$ (c) $\frac{3s^2+6s+2}{(s+1)(s+2)}$ (d) none of the above

Q22. Aunity negative- feedback controller has the the plant $G(s) = \frac{k}{s(s+\sqrt{2k})}$, the range of k so that the settling time (2% criterion) is less than 2 seconds is

(a) k>32 (b) k>2 (c) k>8 (d) none of the above

23. In terms of k_1 and k_2 (assume of $k_1>0$ and $k_2>0$), the region of stability for the system shown in Fig.4 Is

(a) $0< k_2 < k_1$ (b) $0<2k_2 < k_1$ (c) $0< k_2 < 2k_1$ (d) none of the above

Consider the Bode-diagram of the transfer function G(s)H(s) shown shown in Fig.5, to answer Q24 and Q25

24. The poles of G(s)H(s) are the roots of

(a) s+0.2 (b) s(s+4) (c) $s(s+4)^2$ (d) s+4

25. The low frequency portion is

(a) $\frac{1}{s}$ (b) $\frac{0.8}{s}$ (c) $\frac{3.17}{s}$ (d) $\frac{12.62}{s}$

Consider the frequency response of the second order transfer function T(s) is as shown in Fig.6, to answer Q26, and Q27.

26. The damping ratio of the transfer function ξ is

(a) 0.29 (b) 0.2 (c) 0.1 (d) none of the above

7. The natural undamped frequency w_n is

(a) 0.88 (b) 0.83 (c) 0.81 (d) none of the above

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