Exam1

ⓘ This is a preview of the published version of the quiz

Started: Jan 19 at 10:08am

Quiz Instructions

Make sure that you have all 30 questions before starting

Open book (2 books): Weldon and Nagle or other choice as textbook

1 sheet front/back notes

You may use matlab or mathcad or both

Multiple-choice answers should be within 10% of correct value

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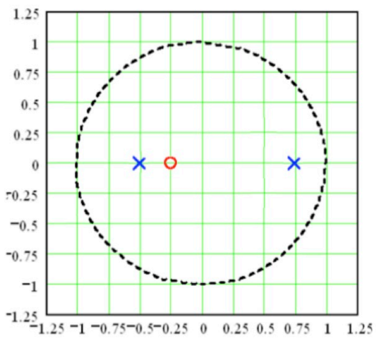
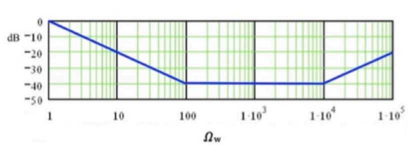
Question 1 — 5 pts



The causal LTI system with closed-loop pulse transfer function $G_{CL}(z)$ having the pole/zero plot to the right is $G_{CL}(z)$=

- ◯ $\frac{(z-1/4)}{(z+3/4)(z-1/2)}; |z| > 3/4$
- ◯ $\frac{(z+1/4)}{(z-3/4)(z-1/2)}; |z| > 1/4$
- ◯ $\frac{(z-3/4)(z-1/2)}{(z-1/4)}; |z| > 1/4$
- ◯ $\frac{(z+1/4)}{(z-3/4)(z+1/2)}; |z| > 3/4$

Question 2 — 5 pts



The PID compensator $D(w)=K_p+ K_i/w + K_d w$, above, has integrator coefficient K_i=

- ◯ none of the answers
- ◯ 0.1
- ◯ 10
- ◯ 1

Question 3 — 5 pts

The frequency of the pole of a digital lag controller (digital lag compensator) is higher than the frequency of the zero.

- ◯ True
- ◯ False

Question 4 — 5 pts

1. The w-transform of 1/(2z-3) in a 2 sample/s system is

- ◯ $\frac{4-w}{6w-8}$
- ◯ none of the answers
- ◯ $\frac{4-w}{5w-4}$
- ◯ $\frac{8-w}{6w-4}$

Question 5 — 5 pts

For a system with variable gain K>0, the closed-loop response $G_{CL}(z) = \frac{C(z)}{R(z)} = \frac{\frac{K}{z+3}}{1-\frac{2K}{z+3}}$ is stable for

- ◯ 2<K<4
- ◯ 0<K<1
- ◯ none of the answers
- ◯ 1<K<2

Question 6 — 5 pts

For a lag compensator with $D(w) = 5\frac{1+\frac{w}{9}}{1+\frac{w}{2}}$ in a system with sample period T_s=1/2 s, the corresponding discrete-time compensator is D(z) =

- ◯ $\frac{5}{9}\frac{(17z+1)}{(5z-3)}$
- ◯ $\frac{9}{5}\frac{(13z+5)}{(5z-3)}$
- ◯ $\frac{5}{9}\frac{(13z+5)}{(3z-1)}$
- ◯ non of the answers

Question 7 — 5 pts

The first row of the Routh table for $w^4 + 2w^3 + 3w^2 + 4w + 5$ is

- ◯ none of the answers
- ◯ 1 3 5
- ◯ 2 4 6
- ◯ 0 3 5
- ◯ 2 4 0

Question 8 — 5 pts

The convolution of the two sequences x[n] = {1,0,-1,0,0,0} and y[n] = {1,-1,1,0,0,0} is

- ◯ {1,-1,0,1,-1,0}
- ◯ non of the answers
- ◯ {1,0,0,1,-1,0}
- ◯ {1,0,1,0,-1,0}

Question 9 — 5 pts

The z-transform of $h[n]= (4)^{-n} u[n]$ is H(z) =

- ◯ none of the answers
- ◯ $\frac{z}{z-1/4}; |z| > 1/4$
- ◯ $\frac{1}{z+1/4}; |z| > 1/4$
- ◯ $\frac{z}{z-4}; |z| > 4$

Question 10 — 5 pts

In a phase-locked loop with a multiplier phase detector, decreasing the phase detector coefficient Kp from 16 volt/rad to 4 volt/rad will change the natural frequency ω_n by a multiplicative factor of

- none of the answers
- 1/2
- 1/8
- 1/4

Question 11 — 5 pts

In a state-variable control system, the controller K generates an estimate of the state variables.

- True
- False

Question 12 — 5 pts

In a in a 4 sample/s system with X(s)=1/s, the starred transform is $X^*(s)$ =

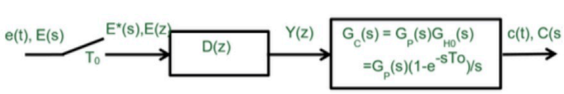
- $\frac{4}{e^{s/4}-1}$
- none of the answers
- $\frac{0.25}{e^{s/4}-1}$
- $\frac{e^{4s}}{e^{4s}-1}$

Question 13 — 5 pts

1. In a 4 sample/s system with $X^*(s) = 1/(4- e^{-s/2})$ the z-transform (ignoring ROC) is X(z) =

- $\frac{z}{4-z}$
- $\frac{4}{1-z}$
- none of the answers
- $\frac{1}{4-z^2}$

Question 14 — 5 pts

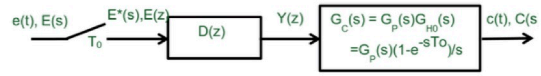


For the system above, $D(z) = 1\text{-}0.5z^{-1}$, $G_P(s)=3/(s+7)$, $G_{H0}(s)=(1+e^{-sT_0})/s$, $T_0=1/5$

In the open-loop system above, the open-loop pulse transfer function (excluding ROC) is G(z)=C(z)/E(z)=

- $0.23\frac{(z-0.25)}{z\,(z+0.25)}$
- $4.3\frac{(z-0.25)}{z\,(z-0.5)}$
- $0.32\frac{(z-0.5)}{z\,(z-0.25)}$
- none of the answers

Question 15 — 5 pts

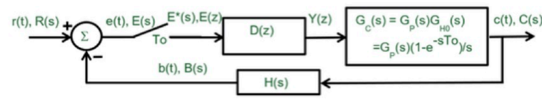


For the system above, $D(z) = 1\text{-}0.5z^{-1}$, $G_P(s)=3/(s+7)$, $G_{H0}(s)=(1+e^{-sT_0})/s$, $T_0=1/5$

In the open-loop system above, the starred transform of the output is C*(s)=

- $4.3\frac{(e^{s/5}-0.25)}{e^{s/5}\,(e^{s/5}-0.5)}E^*(s)$
- none of the answers
- $0.32\frac{(e^{s/5}-0.5)}{e^{s/5}\,(e^{s/5}-0.25)}E^*(s)$
- $0.23\frac{(e^{s/5}-0.25)}{e^{s/5}\,(e^{s/5}+0.25)}E^*(s)$

Question 16 — 5 pts

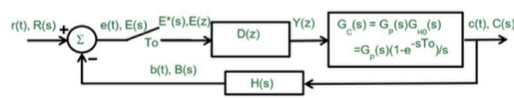


For the system above: $D(z) = 1\text{-}0.5z^{-1}$, $G_P(s)=3/(s+7)$, $G_{H0}(s)=(1+e^{-sT_0})/s$, $H(s)=1/2$, $T_0=1/5$

For the system above, the closed loop pulse transfer function is $G_{CL}(z)$= C(z)/R(z) =

- $0.22\frac{z+0.33}{z^2-0.22\,z-0.051}$
- $1.12\frac{z+0.5}{z^2-0.024\,z-0.032}$
- none of the answers
- $0.32\frac{z-0.5}{z^2-0.086\,z-0.081}$

Question 17 — 5 pts

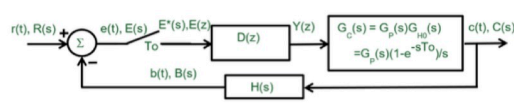


For the system above: $D(z) = 1\text{-}0.5z^{-1}$, $G_P(s)=3/(s+7)$, $G_{H0}(s)=(1+e^{-sT_0})/s$, $H(s)=1/2$, $T_0=1/5$

For the system above, the dc gain is

- 0.19
- 1.12
- 0.27
- none of the answers

Question 18 — 5 pts

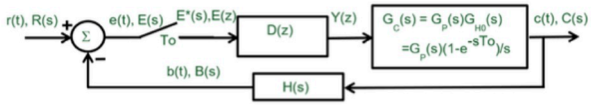


For the system above: $D(z) = 1\text{-}0.5z^{-1}$, $G_P(s)=3/(s+7)$, $G_{H0}(s)=(1+e^{-sT_0})/s$, $H(s)=1/2$, $T_0=1/5$

For the system above, the poles of the closed-loop pulse transfer function $G_{CL}(z)$ are at

- 0.33 and -0.24
- 0.42 and 0.51
- none of the answers
- 0.18 and 0.73

Question 19 — 5 pts

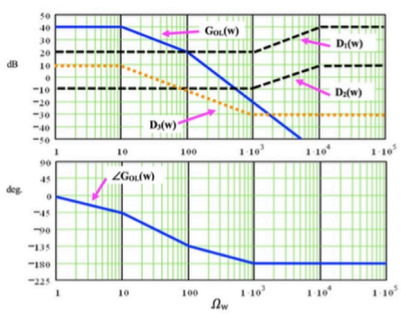


For the system above: $D(z) = 1-0.5z^{-1}$, $G_P(s)=3/(s+7)$, $G_{H0}(s)=(1+e^{-sT_0})/s$, $H(s)=1/2$, $T_0=1/5$

For the system above, the open loop pulse transfer function is $G_{OL}(z)$ =

- $0.33\frac{(1-e^{-7T_0})(z-1/3)}{z(1-e^{-7T_0})}$
- none of the answers
- $0.21\frac{(z-0.5)(1-e^{-7T_0})}{z(z-e^{-7T_0})}$
- $1.76\frac{(z-1/7)(1-e^{-3T_0})}{z(z-e^{-3T_0})}$

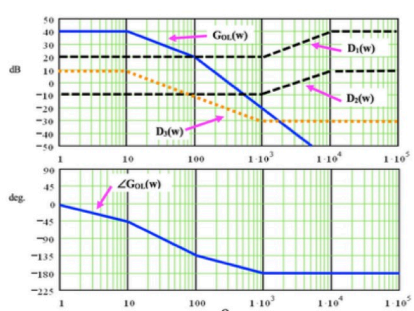
Question 20 — 5 pts



For the w-transforms shown above, where the w-transform open-loop gain $G_{OL}(w)$ is shown above, $G_{OL}(w)$ =

- $\frac{10^5}{(w+10)(w+100)}$
- $\frac{100}{(w+10)(w+100)}$
- none of the answers
- $\frac{1}{(w+10)(w+1000)}$

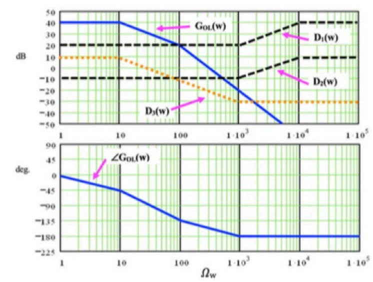
Question 21 — 5 pts



For the w-transforms shown above, the Bode plot phase of the three compensators D(w) are not shown (you may assume the phases are the correct Bode plot phases for lag, lag-lead, PID, or lag compensators). The lag-lead controller (assuming correct phase) is

- $D_3(w)$
- none of the answers
- $D_1(w)$
- $D_2(w)$

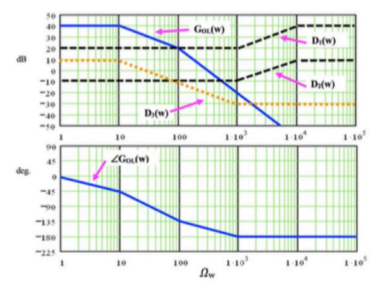
Question 22 — 5 pts



For the w-transforms shown above, the Bode plots phase of the three compensators D(w) are not shown (you may assume the phases are the correct Bode plot phases for lag, lag-lead, PID, or lag compensators). For the w-transform open-loop gain $G_{OL}(w)$ shown above, the compensator in series with $G_{OL}(w)$ that results in 45 degree phase margin is

- $D_3(w)$
- none of the answers
- $D_1(w)$
- $D_2(w)$

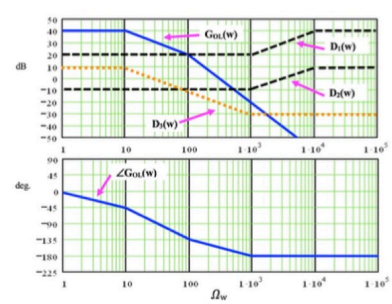
Question 23 — 5 pts



For the w-transforms shown above, the Bode plots phase of the three compensators D(w) are not shown (you may assume the phases are the correct Bode plot phases for lag, lag-lead, PID, or lag compensators). The phase of compensator $D_3(w)$ at frequency $\Omega_w = 10^3$ is

- none of the answers
- -90 degrees
- 135 degrees
- -45 degrees

Question 24 — 5 pts

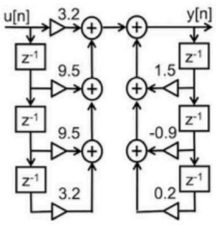


For the w-transforms shown above, the Bode plots phase of the three compensators D(w) are not shown (you may assume the phases are the correct Bode plot phases for lag, lag-lead, PID, or lag compensators). Compensator $D_1(w)$ =

- none of the answers
- $100\frac{(w+10^2)}{(w+10^3)}$
- $\frac{(w+10^3)}{(w+10^4)}$
- $100\frac{(w+10^3)}{(w+10^4)}$

Question 25

5 pts

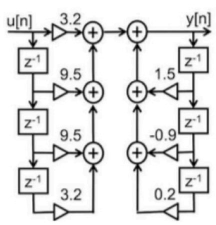


For the digital system above with sample period To=0.001 s, controllable form state-variable matrix A=

- $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0.2 & -0.9 & 1.5 \end{bmatrix}$
- $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -0.2 & 0.9 & -1.5 \end{bmatrix}$
- none of the answers
- $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0.2 & -0.9 & 1.5 \end{bmatrix}$

Question 26

5 pts

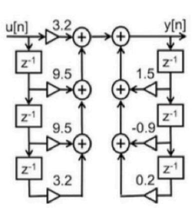


For the digital system above with sample period To=0.001 s, controllable form state-variable matrix B=

- $\begin{bmatrix} -0.2 \\ 0.9 \\ -1.5 \end{bmatrix}$
- none of the answers
- $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$
- $\begin{bmatrix} 0 \\ 0 \\ 0.2 \end{bmatrix}$

Question 27

5 pts

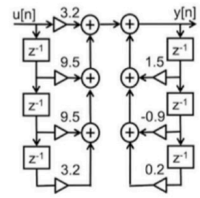


For the digital system above with sample period To=0.001 s, the controllability matrix is

- $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1.5 \\ 1 & 1.5 & 1.35 \end{bmatrix}$
- none of the answers
- $\begin{bmatrix} 1 & 1 & 0 \\ 1 & -1.5 & 1 \\ 0.2 & -0.9 & 1.35 \end{bmatrix}$
- $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -0.2 & 0.9 & -1.5 \end{bmatrix}$

Question 28

5 pts

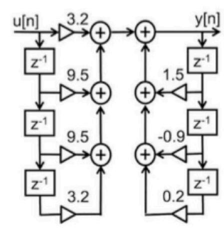


For the digital system above with sample period To=0.001 s, the observability matrix is

- $\begin{bmatrix} 1.2 & 6.3 & 12.1 \\ 4.5 & 4.5 & -24.2 \\ -3.3 & 3.9 & -11.0 \end{bmatrix}$
- $\begin{bmatrix} 0 & 3.2 & 9.5 \\ 9.5 & 3.2 & 0 \\ -0.2 & 0.9 & -1.5 \end{bmatrix}$
- none of the answers
- $\begin{bmatrix} 3.2 & 9.5 & 9.5 \\ 9.5 & 9.5 & 3.2 \\ -0.2 & 0.9 & -1.5 \end{bmatrix}$

Question 29

5 pts

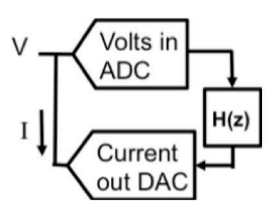


For the digital system above with sample period To=0.001 s, the system is controllable.

- True
- False

Question 30

5 pts



If H(z)= 1 - z^{-1} and T_0=10^{-3} s for the system above, and for the direction of DAC current as shown, the input capacitance in seen at the point V is

- none of the answers
- 0.01 F
- 0.1 F
- 0.001 F