TEST 1. Rewrite

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Preliminary

The test consists of 10 questions with answers (**4 points max (because of rewrite)**

You have 1 attempt.

Any new attempt gives you 0,5-point penalty.

In the case of anonymous answer (like «Name – 1, HDU ID – 1 ……»)
ALL students will receive 0,5-point penalty for each case.

All questions are in this presentation.
Form with answers can be filled here:

https://forms.yandex.ru/u/67cdd11549af47060265fdde/

Question 1

Consider the differential equation of RL-circuit:

$$L\frac{di}{dt} = U - Ri$$

$$R = 0.5$$

$$L = 0.0006$$

Calculate the settling time within 5% tolerance for the step response of the voltage U

a) 0.0006 c

b) 0.0012 c

c) 0.0024 c

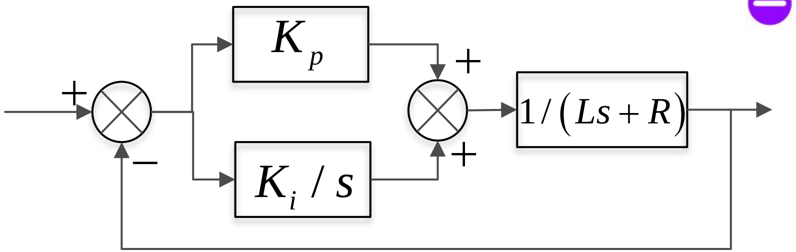
d) 0.0036 c

e) 0.0048 c

f) 0.006 c

Question 2

Consider the closed-loop system with the first order transfer function and proportional-integral controller.



Calculate symbolical equations for K_p and K_i that gives us the closed loop transfer function of the form: $W_{CL} = \dfrac{\omega_c}{s+\omega_c}$

a) $K_p = L\cdot\omega_c,\ K_i = R\cdot\omega_c$ b) $K_p = L\cdot\omega_c^2,\ K_i = R\cdot\omega_c^2$ c) $K_p = 1,\ K_i = \dfrac{L}{R}\cdot\omega_c$

d) $K_p = R\cdot\omega_c^2,\ K_i = L\cdot\omega_c^2$ e) $K_p = R\cdot\omega_c,\ K_i = L\cdot\omega_c$ f) $K_p = \dfrac{L}{R}\cdot\omega_c,\ K_i = 1$

Question 3

Consider the second order transfer function with the follows form:

$$W(s) = \frac{50000}{s^2 + 5s + 2500}$$

Determine *percent overshoot* of the output signal for unit step response.

a) $\approx 27.2\%$

b) $\approx 37.3\%$

c) $\approx 15.4\%$

d) $\approx 52.1\%$

e) $\approx 8.5\%$

f) 0

Question 4

Consider the second order transfer function with the follows form:

$$W(s) = \frac{242000}{s^2 + 66s + 12100}$$

Determine *damped natural frequency* of the output signal for unit step response.

a) $\approx 104.9\ rad/s$

b) $\approx 110\ rad/s$

c) $\approx 92\ rad/s$

d) $\approx 52.5\ rad/s$

e) $\approx 60.6\ rad/s$

f) $\approx 101.7\ rad/s$

Question 5

Consider the second order transfer function with the follows form:

$$W(s) = \frac{12500}{s^2 + 7.5s + 625}$$

Determine *peak time* of the output signal for unit step response.

a) $\approx 0.074\ s$

b) $\approx 0.246\ s$

c) $\approx 0.288\ s$

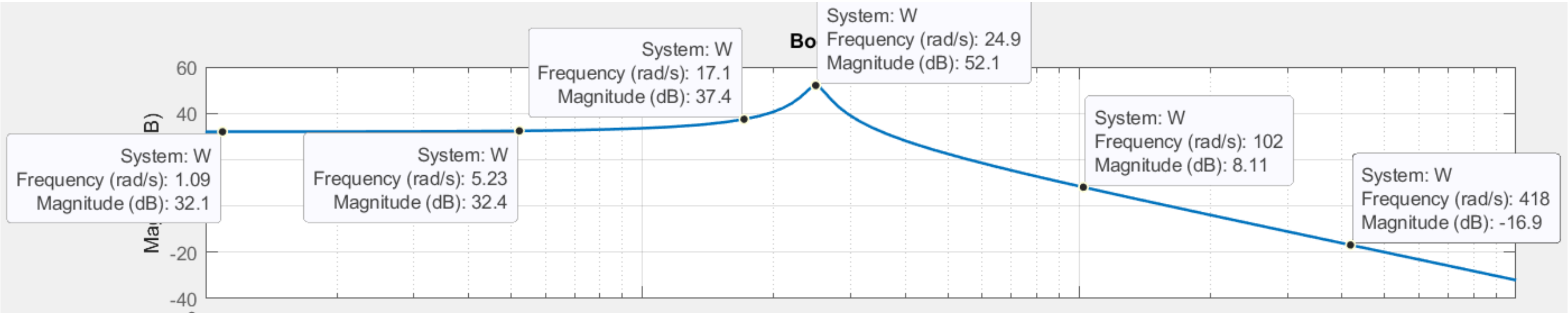
d) $\approx 0.123\ s$

e) $\approx 0.142\ s$

f) $\approx 0.061\ s$

Question 6

Consider the system with the follows bode plot. Find the static gain of the such system.



a) ≈ 42

b) ≈ 40

c) ≈ 403

d) ≈ 74

e) ≈ 2.5

f) ≈ 0.14

Question 7

Consider the DC motor described by the follows equations:

$$\begin{cases} 0.001 \cdot \dfrac{di_a}{dt} = U - 0.3 \cdot i_a - 0.1 \cdot \omega \\ 0.01 \cdot \dfrac{d\omega}{dt} = 0.1 \cdot i_a - T_L \end{cases}$$

Calculate poles of the transfer function from the voltage to speed.

a) $s_{12} \approx -0.15 \pm 0.99i$

b) $s_1 \approx -999, s_2 \approx -1$

c) $s_1 \approx -296.6, s_2 \approx -3.4$

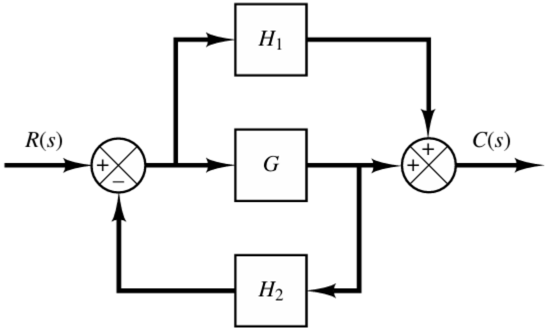
d) $s_1 \approx -0.26, s_2 \approx -0.03$

e) $s_{12} \approx -150 \pm 278i$

f) $s_1 \approx -300, s_2 \approx -0.03$

Question 8

Consider the follows block diagram:



Simplify this to 1 transfer function from R(s) to C(s).

a) $W(s)=\dfrac{G+H_1}{1-GH_2}$

b) $W(s)=\dfrac{G+H_1}{1+GH_2}$

c) $W(s)=\dfrac{G+H_2}{1+GH_1}$

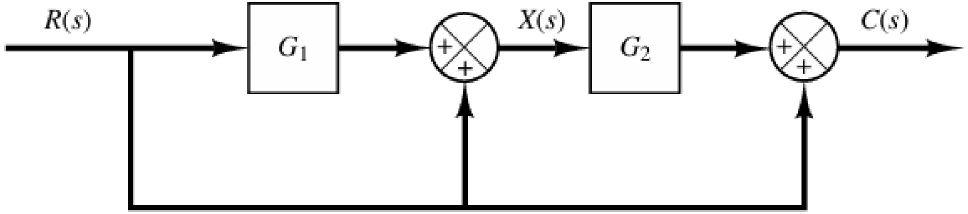
d) $W(s)=\dfrac{G-H_2}{1+GH_1}$

e) $W(s)=\dfrac{G-H_1}{1+GH_2}$

f) $W(s)=\dfrac{G+H_1}{1+H_1H_2}$

Question 9

Consider the follows block diagram:



Simplify this to 1 transfer function from R(s) to C(s).

a) $W(s) = G_1G_2 + G_2 + 1$

b) $W(s) = G_1G_2 + G_1 + 1$

c) $W(s) = \frac{G_1G_2}{G_2 + 1}$

d) $W(s) = G_1G_2 - G_2 - 1$

e) $W(s) = \frac{G_1 + G_2}{G_1}$

f) $W(s) = \frac{G_1G_2}{G_1 + 1}$

Question 10

Consider the dynamic system that is described by the follows differential equation: $6\ddot{y} + 9\dot{y} + 36y = u$

Also, that can be described in state space form with some coefficients a_{21}, a_{22}, b_{21}:

$$\dot{x}_1 = x_2$$
$$\dot{x}_2 = a_{21}x_1 + a_{22}x_2 + b_{21}u$$
$$y = x_1$$

Find the value of the coefficient a_{22}

a) $a_{22} = 4$

b) $a_{22} = -6$

c) $a_{22} = 1.5$

d) $a_{22} = -4$

e) $a_{22} = 6$

f) $a_{22} = -1.5$

THANK YOU
FOR YOUR TIME!

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