

Course

- MEC-E5001
- Course materials
- Your points
- Lab Queue

This course has already ended.

« 4.1 Materials  
MEC-E5001 / 4. Control / 4.2 Lecture Quiz 4

# Lecture Quiz 4

Points 0 / 350 My submissions 0 / 2

The deadline for the assignment has passed

Why does closed-loop control reduces control error?

Question 1 29 points

The open-loop transfer function equals to  $C(s)$

- $U(s) - E(s) = C(s)Y(s)$
- $y(t) * u(t) = 0$
- $\frac{Y(s)}{U(s)} = C(s)P(s)$

Question 2 29 points

The closed-loop transfer function equals to

- $\frac{Y(s)}{U(s)} = \frac{C(s)P(s)}{C(s)P(s)}$
- $\frac{Y(s)}{U(s)} = \frac{C(s)P(s)}{1+C(s)P(s)}$
- $\frac{Y(s)}{U(s)} = \frac{C(s)P(s)}{1-C(s)P(s)}$

Question 3 29 points

If the controller  $C$  is a large number, the relative error becomes...

- ...extra large
- ...large
- ...small

Question 4 29 points

On the other hand, if the controller  $C$  is a small number, the tracking error becomes...

- ...very small
- ...large
- ...small

Design a proportional speed controller for a wheel with inertia  $J$ . For a unit step in speed command, 63 % of the command value needs to be achieved in 1 second. Derive the proportional gain  $K$  (=controller). The plant (=process) equals to:

$T = J\dot{\omega}$

The system looks like in Figure 1 above.

Question 5 29 points

What the system is in Laplace domain as transfer function (open loop control)? (Calculate the transfer function from torque to angular speed.)

- $\frac{\omega(s)}{T(s)} = Js$
- $\frac{\omega(s)}{T(s)} = \frac{1}{Js^2}$
- $\frac{\omega(s)}{T(s)} = \frac{1}{Js}$

Question 6 29 points

The closed loop system equals to

- $\frac{y(s)}{u(s)} = \frac{K/J}{s+K/J}$
- $\frac{y(s)}{u(s)} = \frac{K}{K/J}$
- $\frac{y(s)}{u(s)} = \frac{1}{s+KJ}$

Question 7 29 points

The rise time of the system is...

- 1 second
- 0.1 second
- 10 seconds

Question 8 29 points

What is the proportional gain  $K$  of the system? It is based on the time constant.

- $K = 1$
- $K = J$
- $K = Js$

If you would code a PID controller, then what do you need to define and how? Please answer in the tasks below.

Question 9 29 points

The code for digital PID controller needs to have the following information

- Corresponding P, I, and D gains, sample time, and signal values for one time step
- Corresponding P, I, and D gains, sample time, and signal values for two successive time steps
- Corresponding P, I, and D gains, sample time, and signal values for three successive time steps

Question 10 29 points

The derivative term can be expressed as...

Notation:  
 $K_d$ : derivative gain  
 $\Delta t$ : sample time  
 $u(t)$ : signal to be derived at time instant t

- $K_d(u(t) - u(t - \Delta t)) * \Delta t$
- $K_d u(t)$
- $K_d \frac{u(t) - u(t - \Delta t)}{\Delta t}$

Question 11 30 points

The integral term can be expressed...

Notation:  
 $K_I$ : integral gain  
 $\Delta t$ : sample time  
 $u(t)$ : signal to be integrated at time instant t

Assume previous integral value is added later on the integral term you select

- $K_I \frac{u(t) + u(t - \Delta t)}{2} \Delta t$
- $K_I(u(t) - u(t - \Delta t))$
- $K_I u(t)$

Question 12 30 points

The proportional term can be expressed

Notation:  
 $K_p$ : proportional gain  
 $\Delta t$ : sample time  
 $u(t)$ : signal at time instant t

- $K_p K_I K_d u(t)$
- $K_p u(t)$
- $K_I u(t)$

Submit

Question 5 29 / 29

What the system is in Laplace domain as transfer function (open loop control)? (Calculate the transfer function from torque to angular speed.)

- $\frac{\omega(s)}{T(s)} = Js$
- $\frac{\omega(s)}{T(s)} = \frac{1}{Js^2}$
- $\frac{\omega(s)}{T(s)} = \frac{1}{Js}$

Question 6 29 / 29

The closed loop system equals to

- $\frac{y(s)}{u(s)} = \frac{K/J}{s+K/J}$
- $\frac{y(s)}{u(s)} = \frac{K}{K/J}$
- $\frac{y(s)}{u(s)} = \frac{1}{s+KJ}$

Question 7 29 / 29

The rise time of the system is...

- 1 second
- 0.1 second
- 10 seconds

Question 8 29 / 29

What is the proportional gain  $K$  of the system? It is based on the time constant.

- $K = 1$
- $K = J$
- $K = Js$

If you would code a PID controller, then what do you need to define and how? Please answer in the tasks below.

Question 9 29 / 29

The code for digital PID controller needs to have the following information

- Corresponding P, I, and D gains, sample time, and signal values for one time step
- Corresponding P, I, and D gains, sample time, and signal values for two successive time steps
- Corresponding P, I, and D gains, sample time, and signal values for three successive time steps

Question 10 29 / 29

The derivative term can be expressed as...

Notation:  
 $K_d$ : derivative gain  
 $\Delta t$ : sample time  
 $u(t)$ : signal to be derived at time instant t

- $K_d(u(t) - u(t - \Delta t)) * \Delta t$
- $K_d u(t)$
- $K_d \frac{u(t) - u(t - \Delta t)}{\Delta t}$

Question 11 30 / 30

The integral term can be expressed...