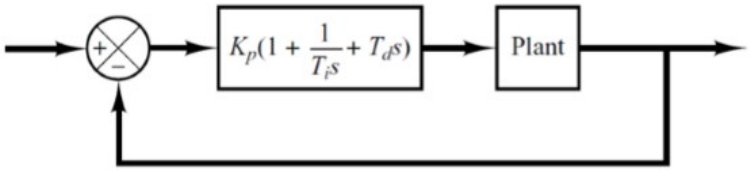
# Laboratory work No. 4: Tuning of PID controller

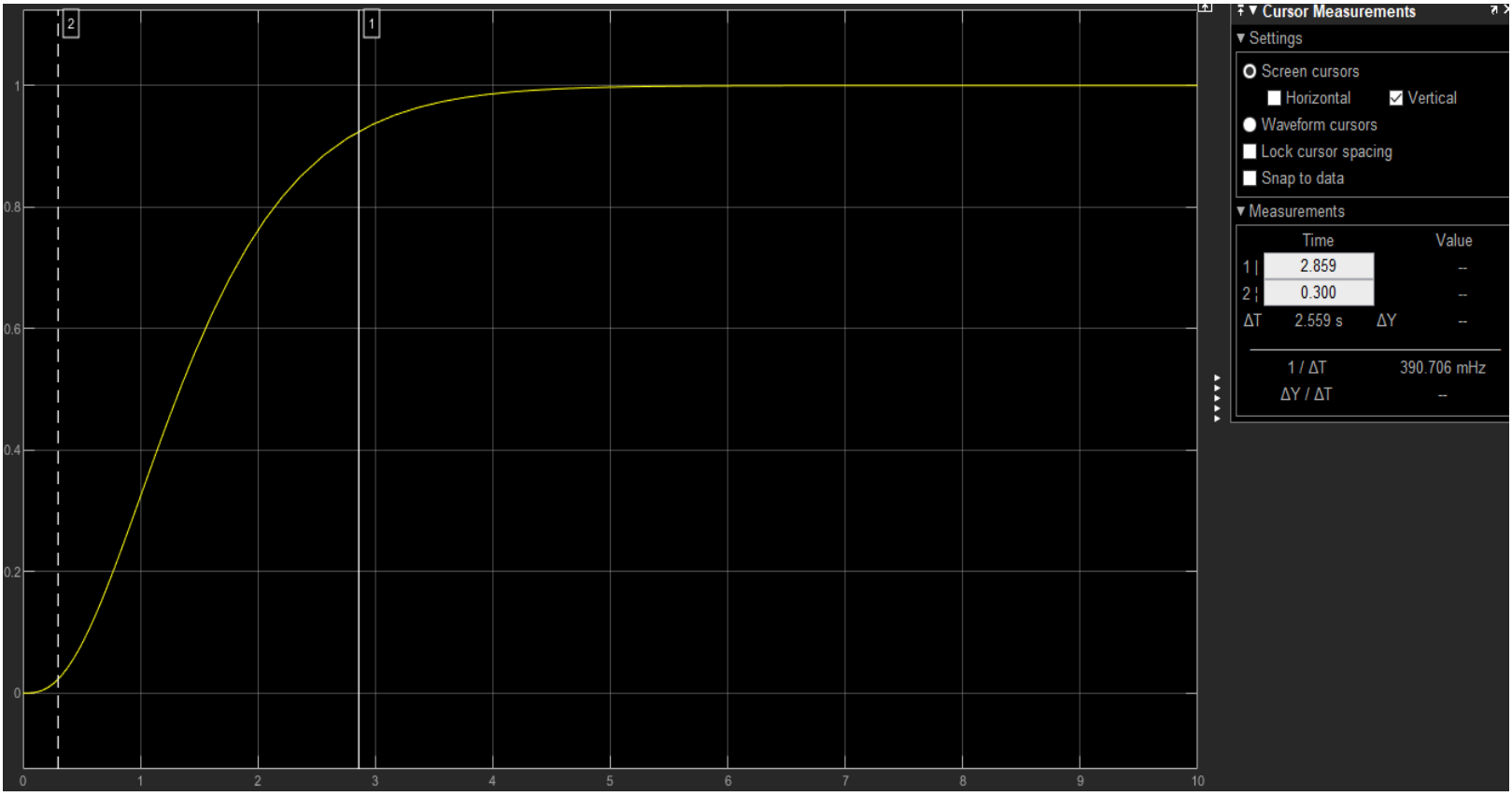
1. Calculate parameters for PID controller using open-loop method.




PID control of a plant

Transfer function of the plant:

$$G_o(s)=\frac{1}{0,125\,s^3+0,75\,s^2+1,5\,s+1}$$



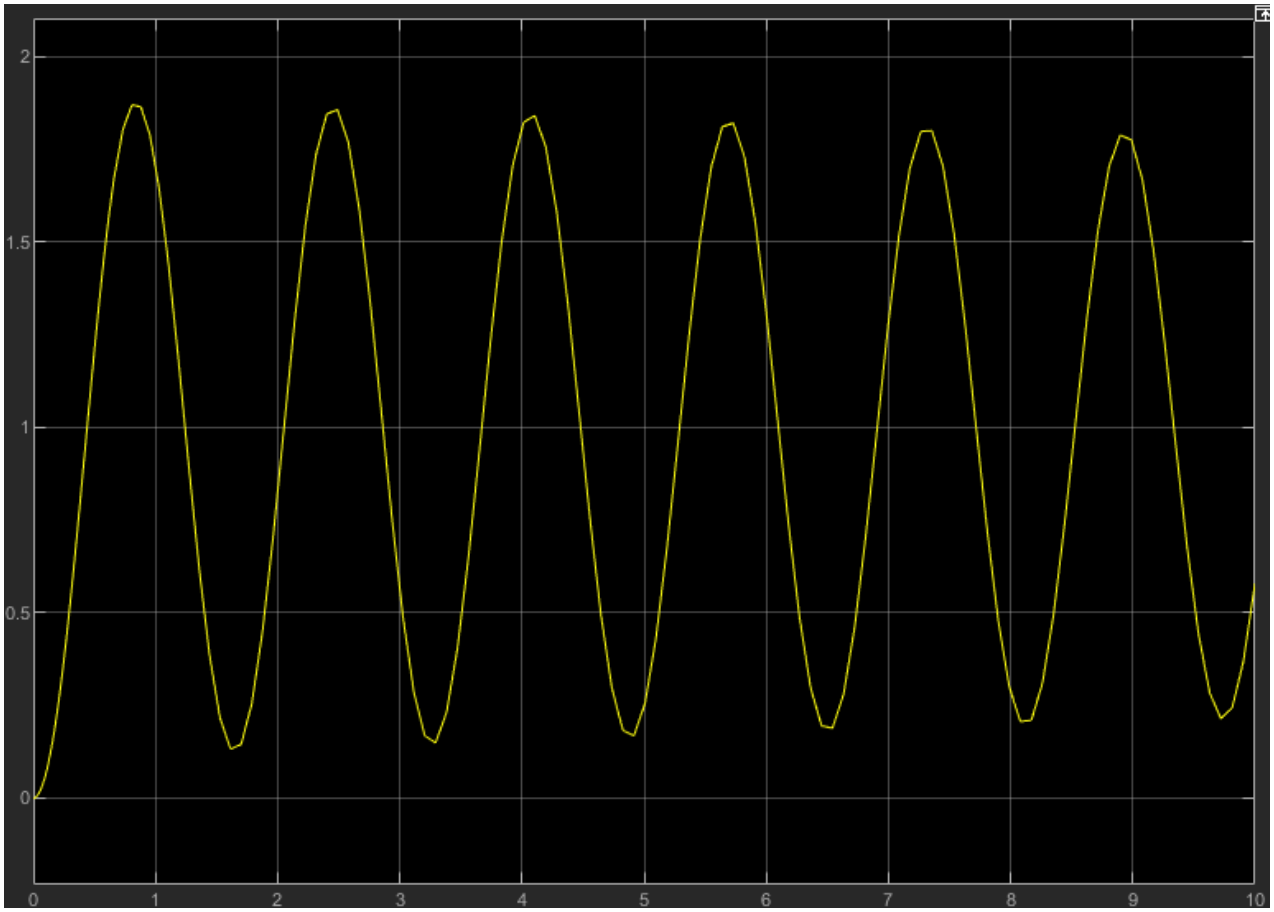
L = 0.300 T = 2.860 – 0.3 = 2.560

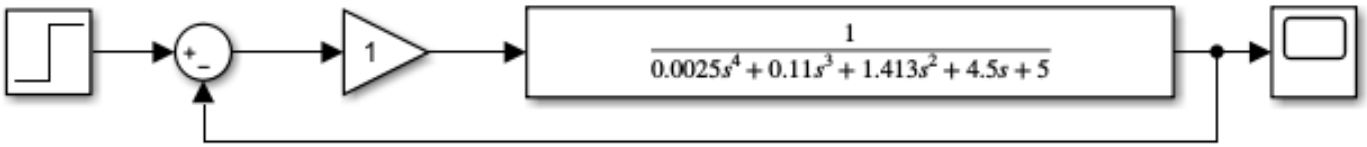
| Type of Controller | $K_p$ | $T_i$ | $T_d$ |
|---|---|---|---|
| PID | $1.2\frac{T}{L}$ | $2L$ | $0.5L$ |

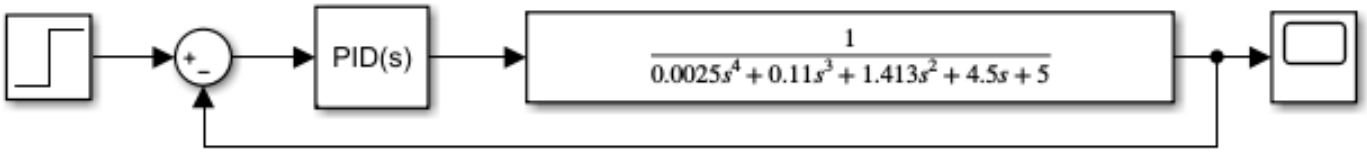
$P=K_p;\ \ I=K_p/T_i;\ \ D=K_p*T_d.$

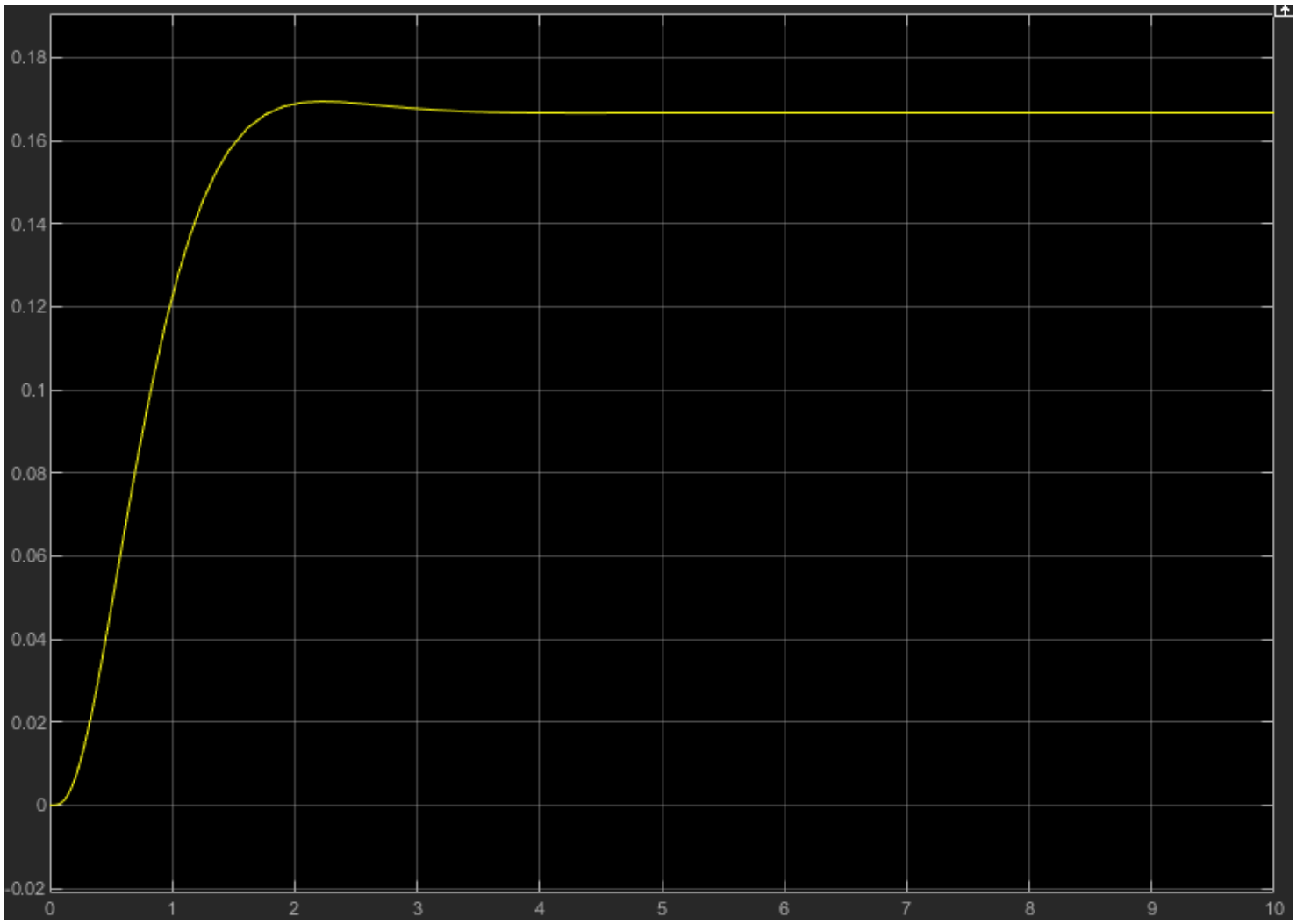
| Type of Controller | $K_p$ | $T_i$ | $T_d$ |
|---|---|---|---|
| PID | 10.24 | 0.6 | 0.15 |

P = 10.24 I = 17.06 D = 1.536


2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
9
10


1
$\frac{1}{0.0025s^4 + 0.11s^3 + 1.413s^2 + 4.5s + 5}$

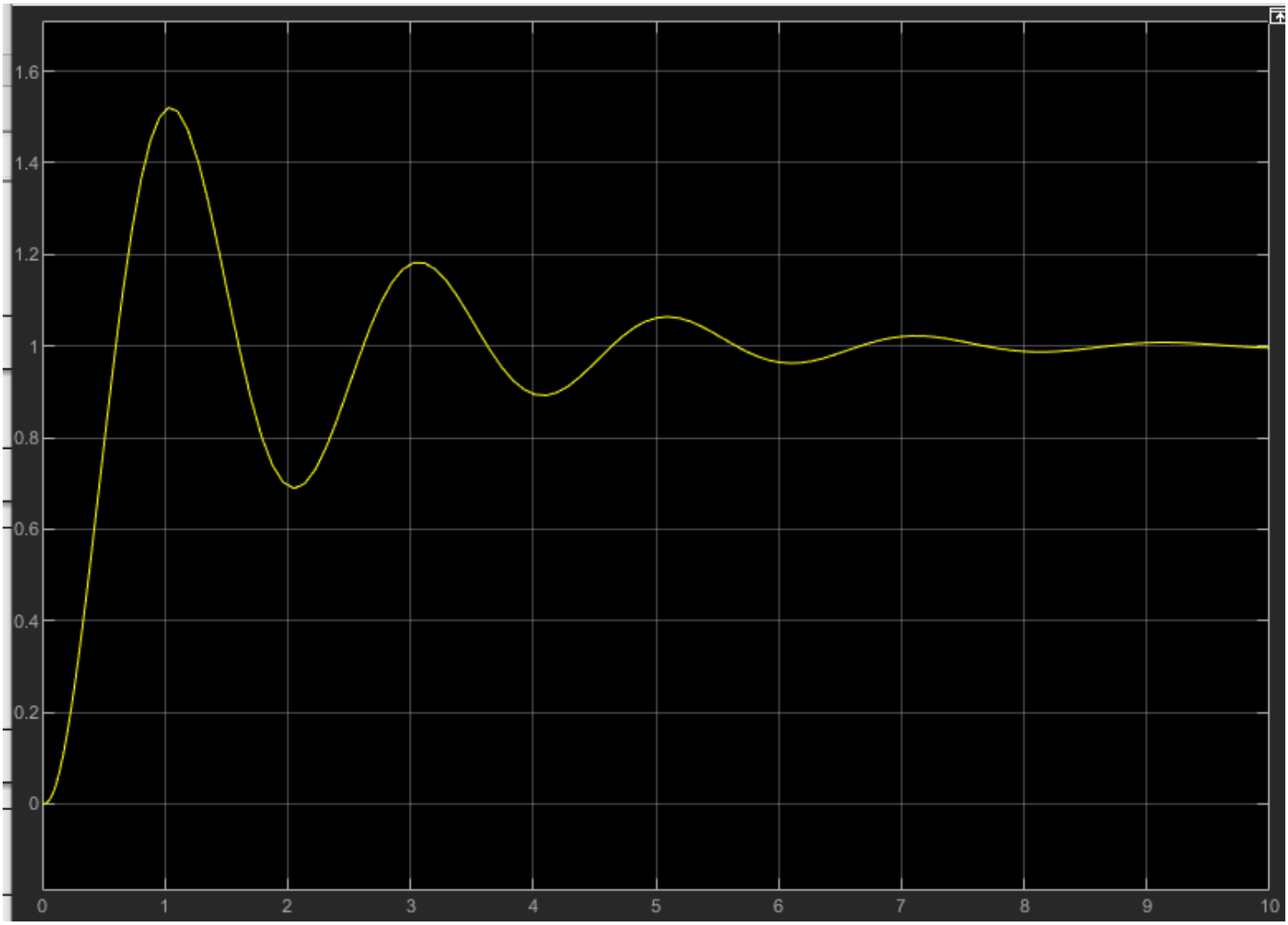

PID(s)
$\frac{1}{0.0025s^4 + 0.11s^3 + 1.413s^2 + 4.5s + 5}$



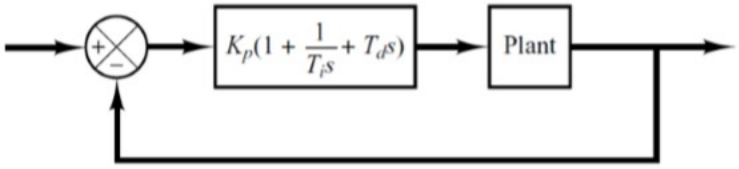

L = 0.178 T = 1.782 – 0.178 = 1.604

| Type of Controller | $K_p$ | $T_i$ | $T_d$ |
|---|---|---|---|
| PID | 10.8135 | 0.356 | 0.089 |

P = 10.8135 I = 30.375 D = 0.9624015


1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8
9
10

2. Calculate parameters for PID controller using closed-loop method.



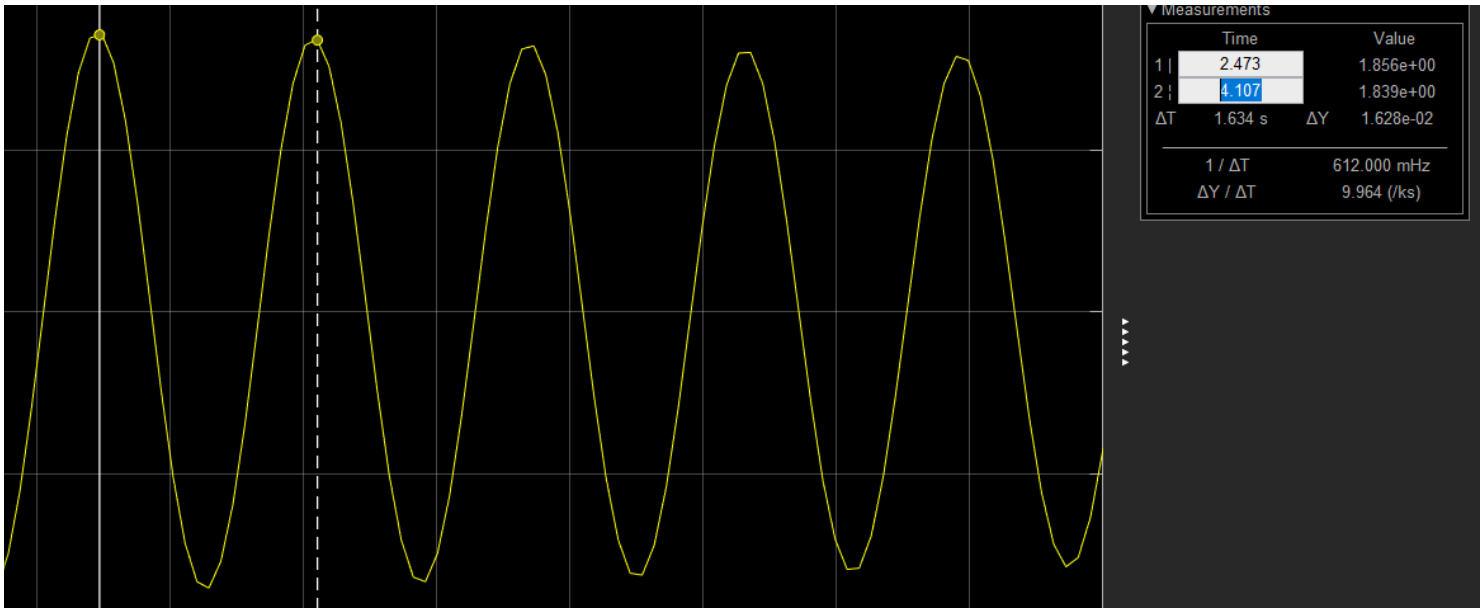

PID control of a plant

Transfer function of the plant:

$$G_o(s)=\frac{1}{0,0025\,s^4+0,11\,s^3+1,413\,s^2+4,5\,s+5}.$$

| Type of Controller | $K_p$ | $T_i$ | $T_d$ |
|---|---|---|---|
| PID | $0.6K_{cr}$ | $0.5P_{cr}$ | $0.125P_{cr}$ |

$$P=K_p;\quad I=K_p/T_i;\quad D=K_p*T_d.$$

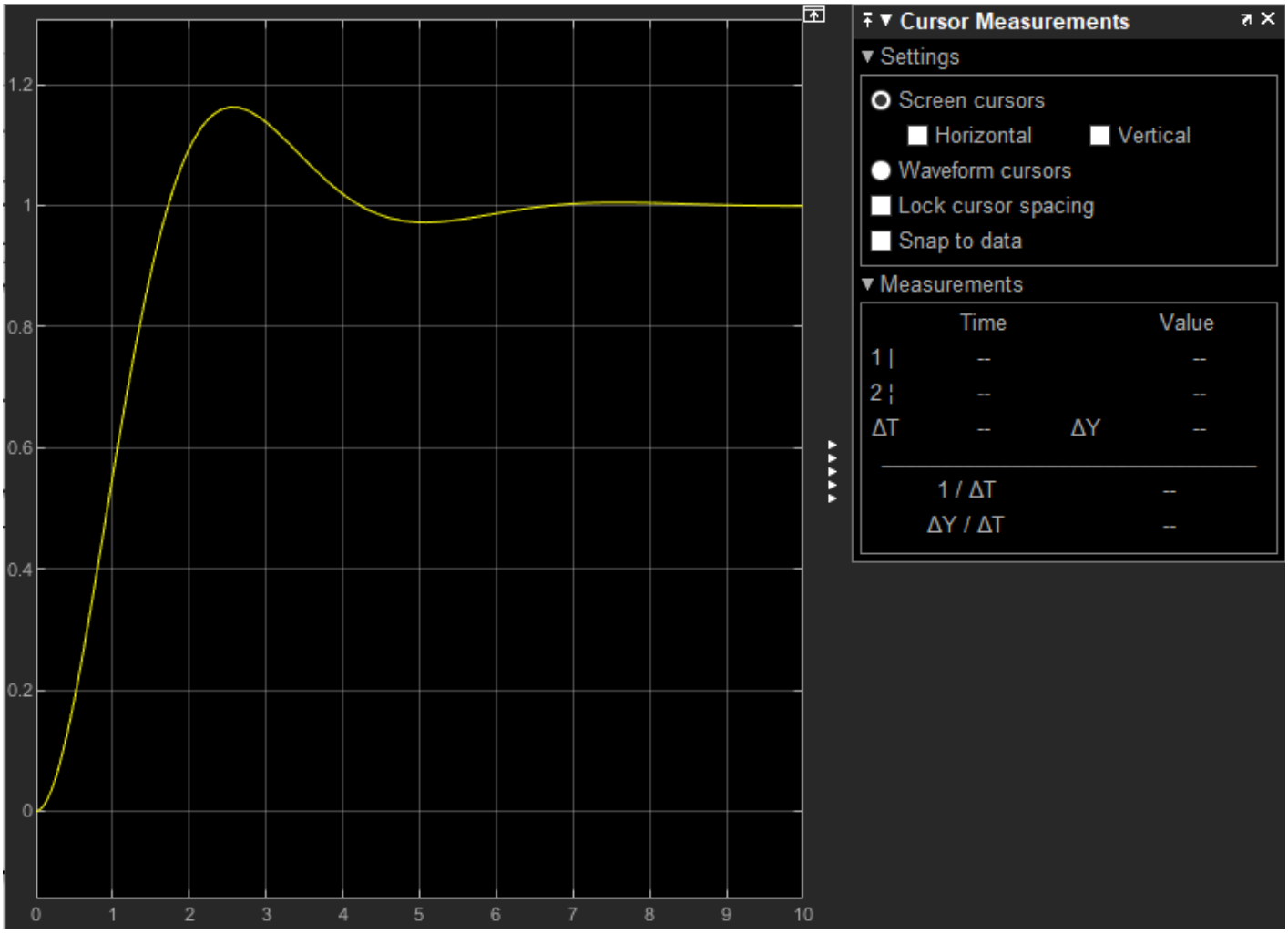


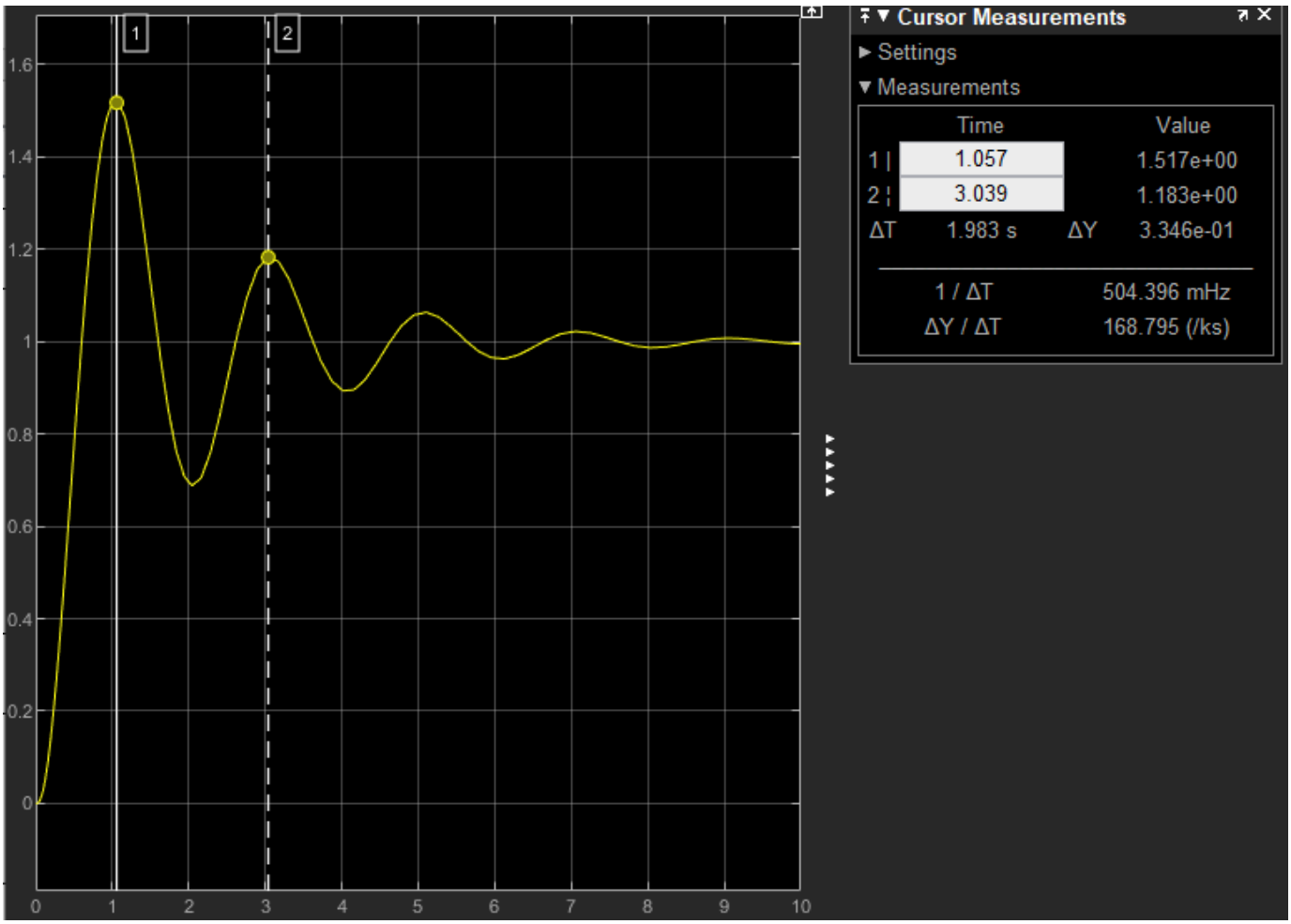

$P_{CR} = 4.107 - 2.473 = \underline{1.634}$

$K_{CR} = \underline{1.871}$

| Type of Controller | $K_p$ | $T_i$ | $T_d$ |
|---|---|---|---|
| PID | 1.1226 | 0.817 | 0.20425 |

P = 1.1226 I = 1.3740514076 D = 0.23



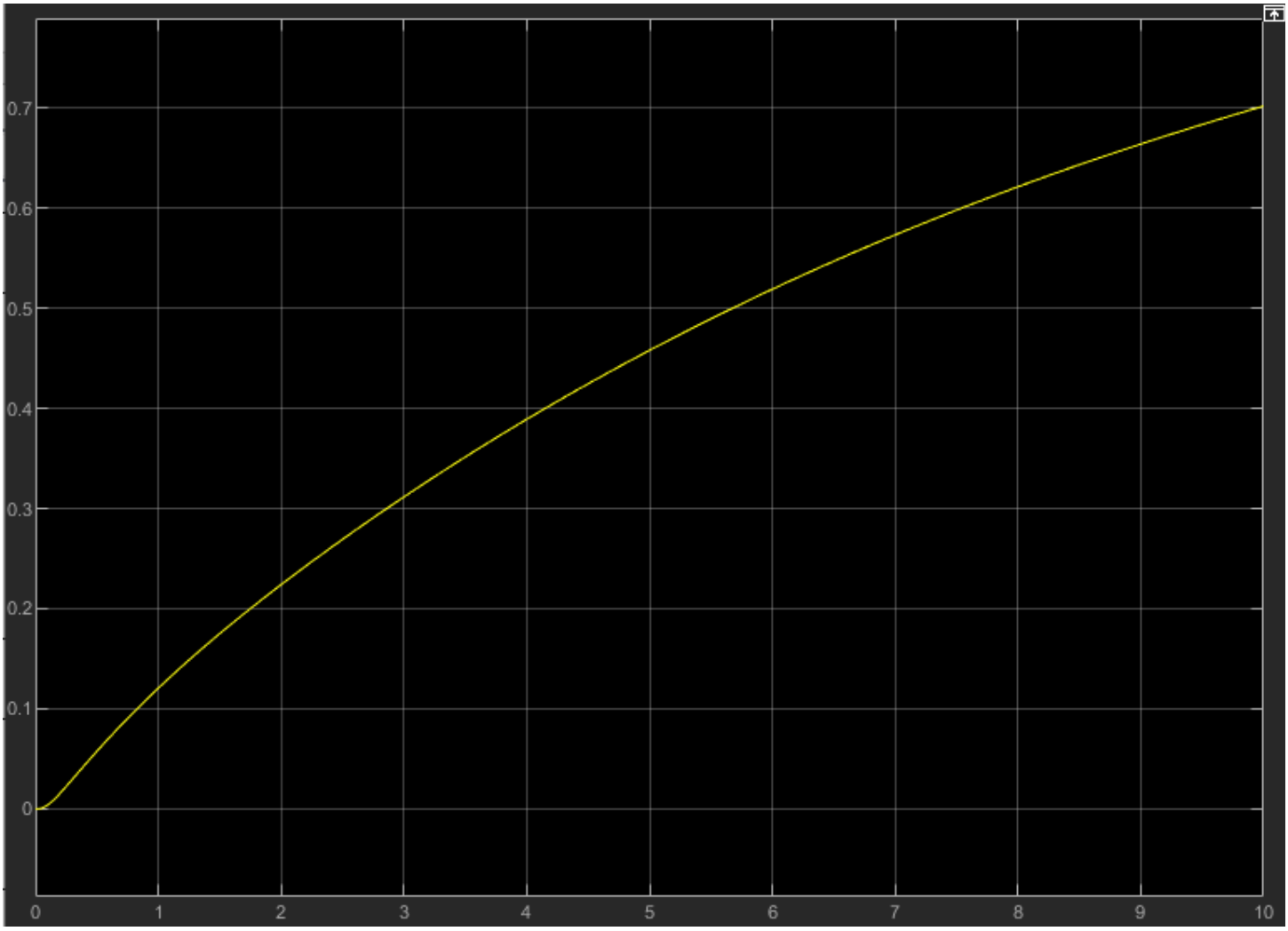



$P_{CR} = 3.039 – 1.057 = 1.982$

$K_{CR} = 1$

| Type of Controller | $K_p$ | $T_i$ | $T_d$ |
|---|---|---|---|
| PID | 0.6 | 0.991 | 0.24775 |

P = 0.6 I = 0.6055 D = 0.14865


0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
7
8
9
10