Ingénierie Electronique pour le Traitement de l'Information

TD12

Corriger un « vrai » système

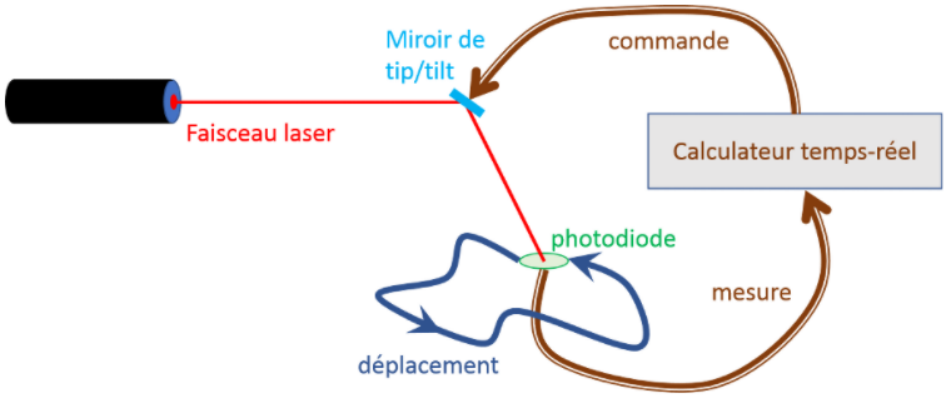
Julien VILLEMEJANE

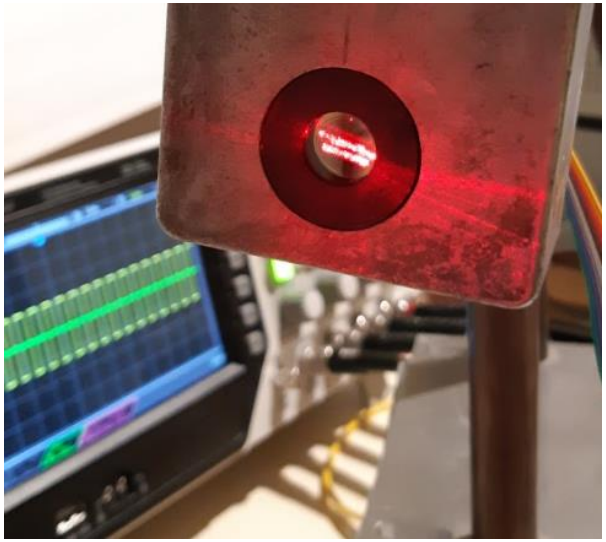
 Paris-Saclay

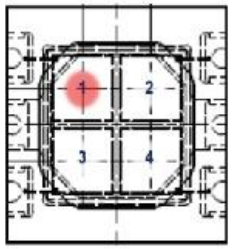
 Saint-Étienne

 Bordeaux

- **Asservissement de la position d'un faisceau LASER**

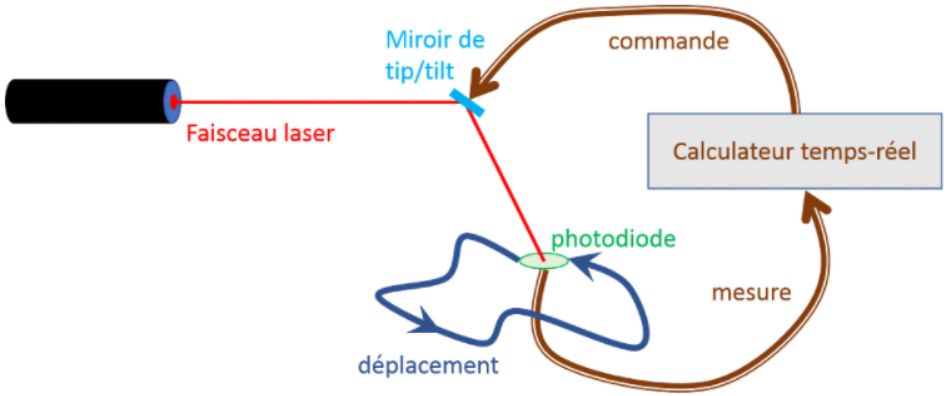


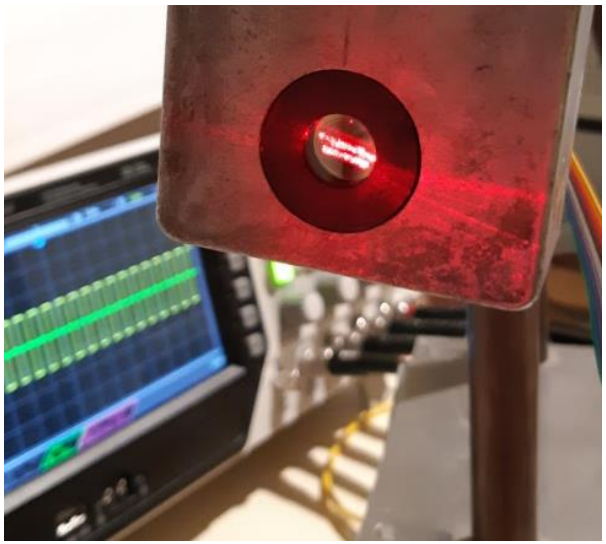


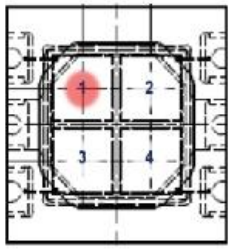


- **Asservissement de la position d'un faisceau LASER**

$$T(p) = \frac{G_0}{1 + \frac{2 \cdot m \cdot p}{w_c} + \frac{p^2}{w_c^2}}$$



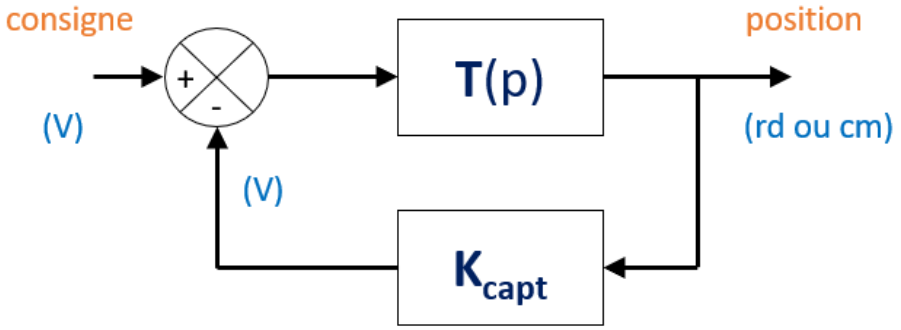


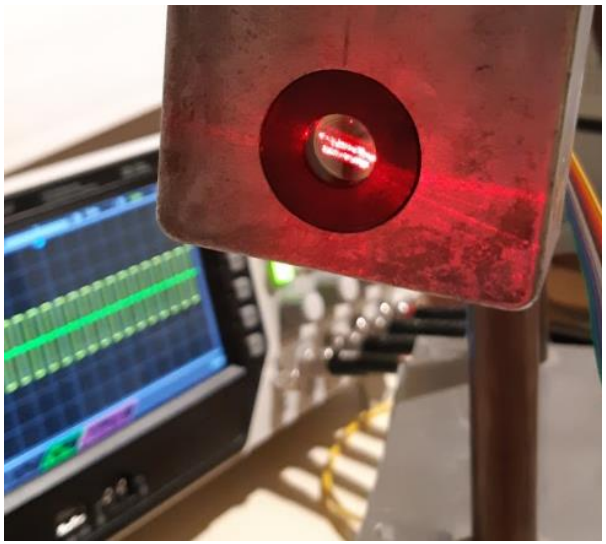


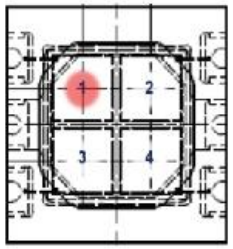
$$K_{capt} = 10$$

- **Asservissement de la position d'un faisceau LASER**

$$T(p) = \frac{G_0}{1 + \frac{2 \cdot m \cdot p}{w_c} + \frac{p^2}{w_c^2}}$$

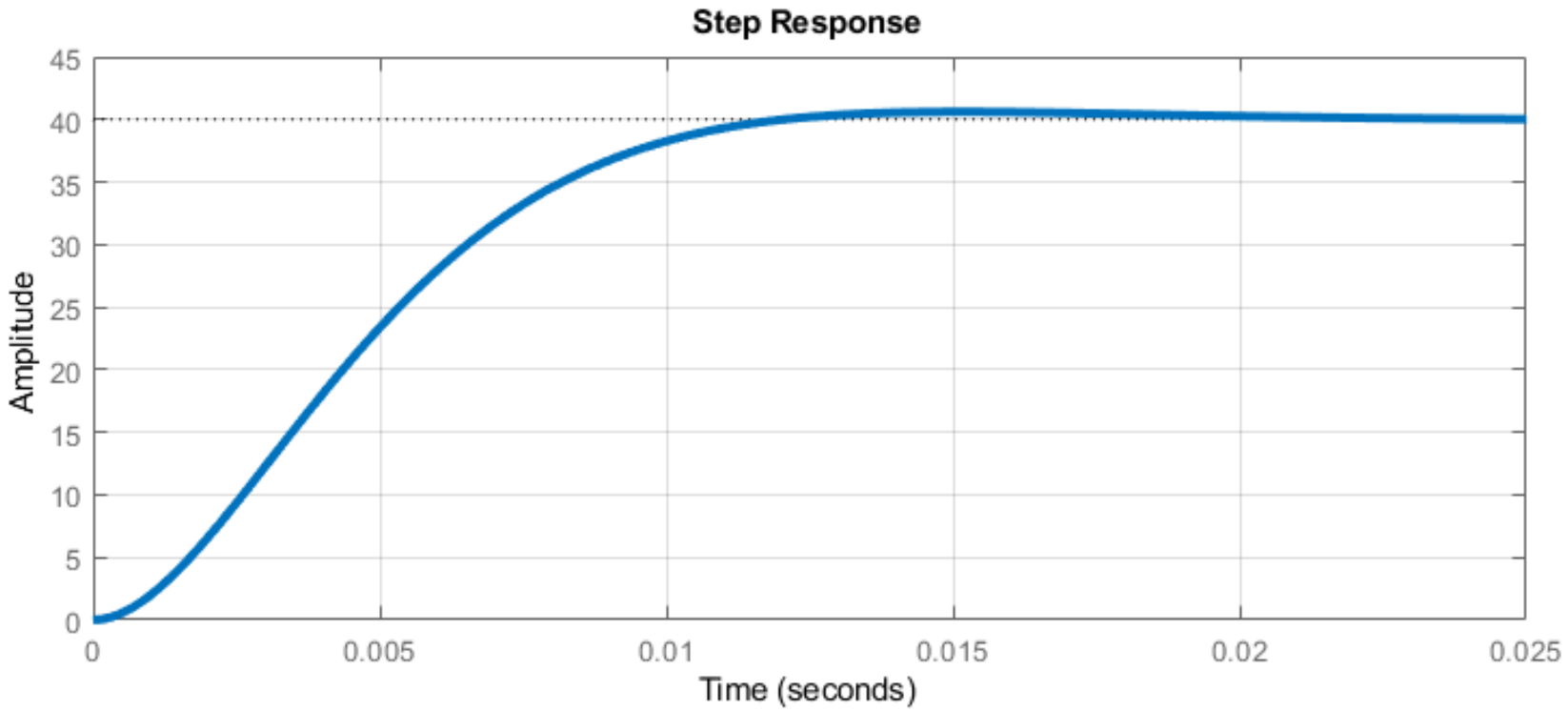






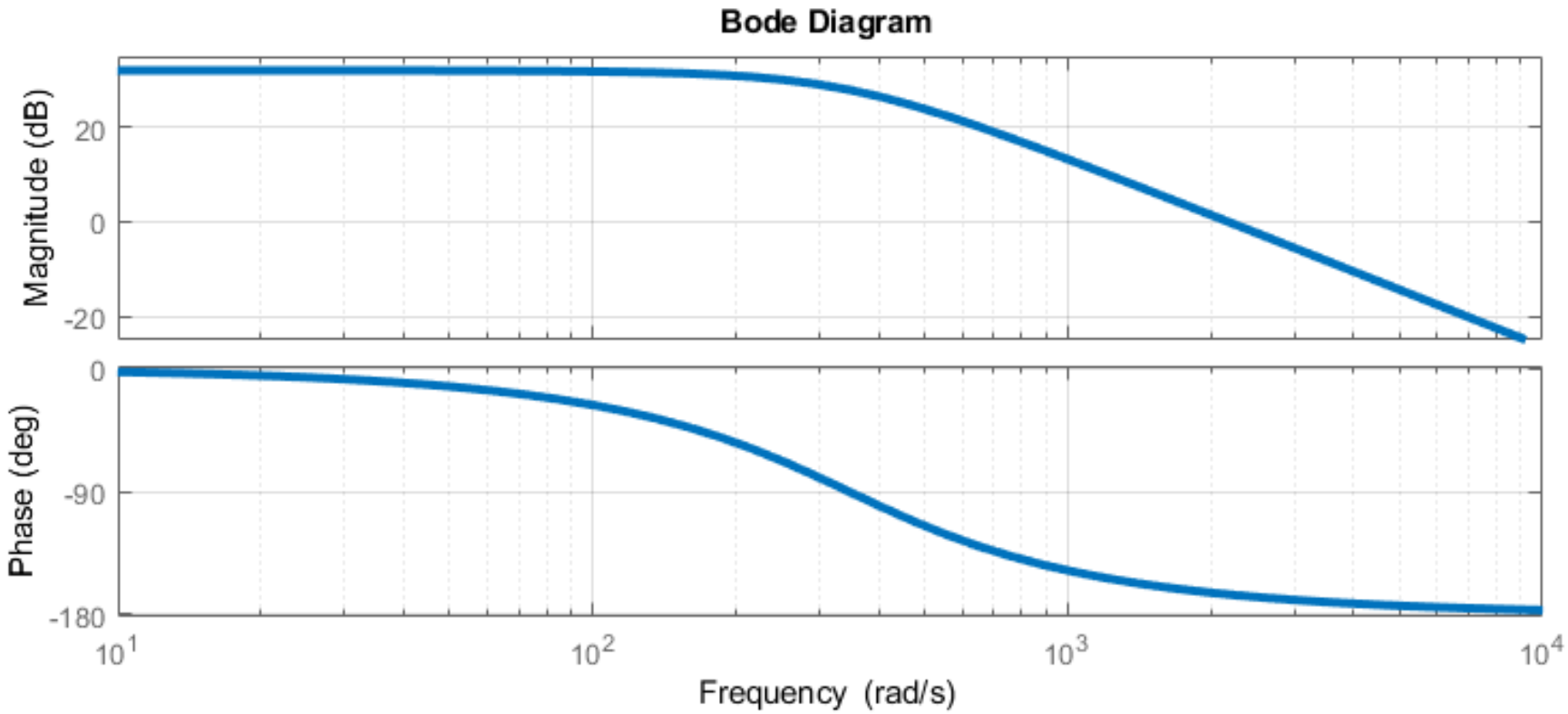
$$K_{capt} = 10$$

- **Exercice 1 / Réponse à un échelon**

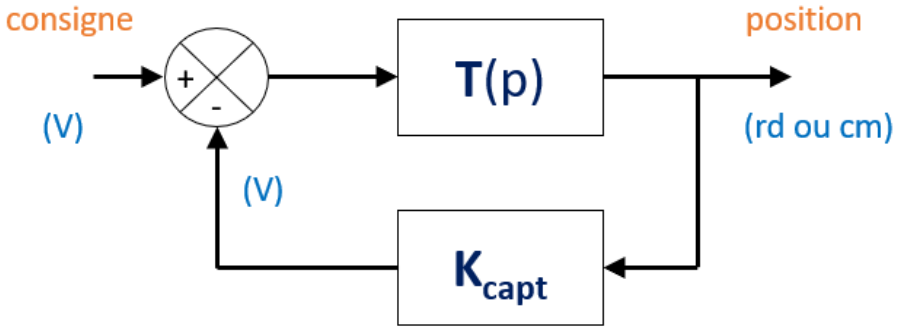


- **Exercice 1 / Diagramme de Bode**

G0 = 40
fc = 55 Hz
m = 0.8

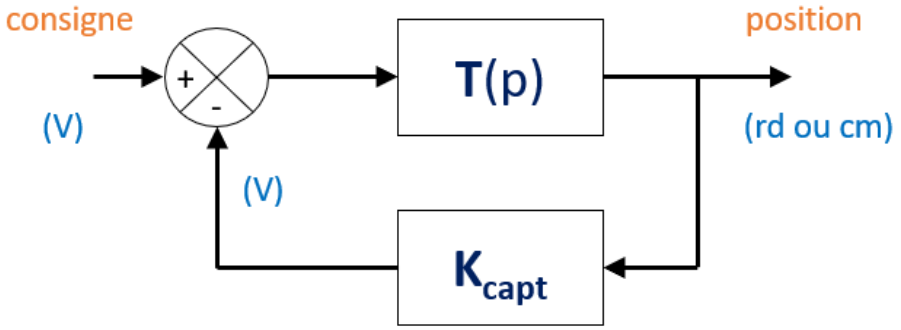


- **Exercice 2 / Système asservi**



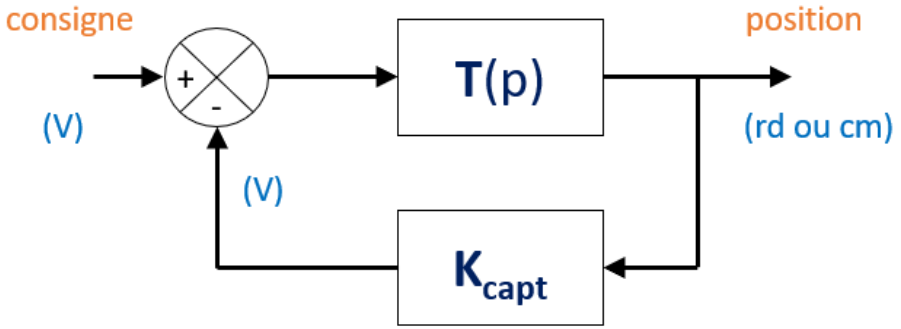
- **Exercice 2 / Système asservi**

$$T_{BF}(p) = \frac{T(p)}{1 + T(p) \cdot K_{capt}}$$



- **Exercice 2 / Système asservi**

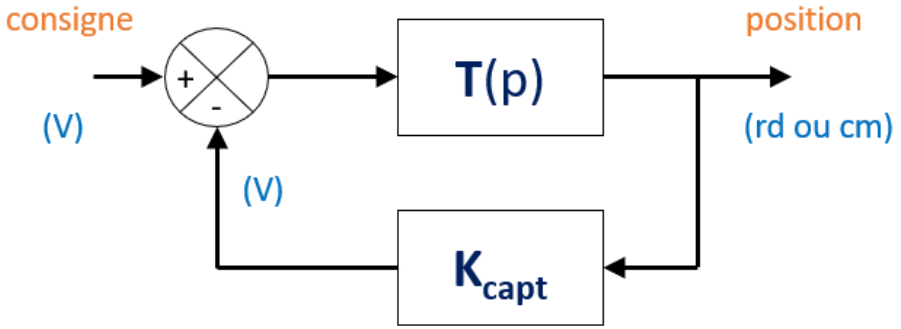
$$T_{BF}(p) = \frac{T(p)}{1 + T(p) \cdot K_{capt}}$$



$$T_{BF}(p) = \frac{G_0}{1 + G_0 \cdot K_{capt}} \cdot \frac{1}{1 + \frac{2 \cdot m \cdot p}{\omega_c \cdot (1 + G_0 \cdot K_{capt}} + \frac{p^2}{\omega_c^2 \cdot (1 + G_0 \cdot K_{capt}}}$$

- **Exercice 2 / Système asservi**

$$T_{BF}(p) = \frac{T(p)}{1 + T(p) \cdot K_{capt}}$$

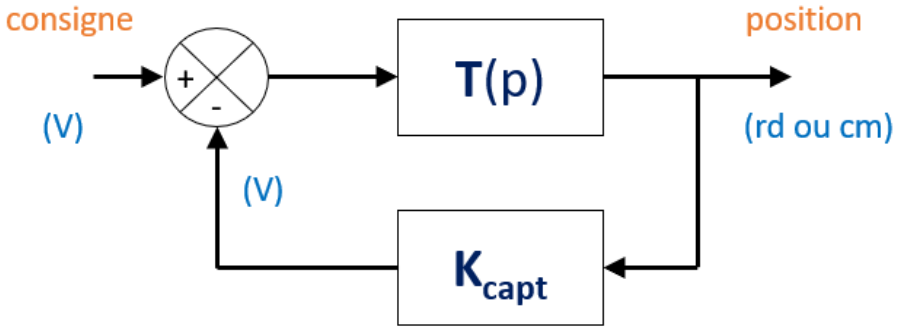


$$T_{BF}(p) = \frac{G_0}{1 + G_0 \cdot K_{capt}} \cdot \frac{1}{1 + \frac{2 \cdot m \cdot p}{\omega_c \cdot (1 + G_0 \cdot K_{capt}} + \frac{p^2}{\omega_c^2 \cdot (1 + G_0 \cdot K_{capt}}}$$

G_{0BF}	m_{BF}	w_{CBF}
0.0998	0.04	1100 Hz

- **Exercice 2 / Système asservi**

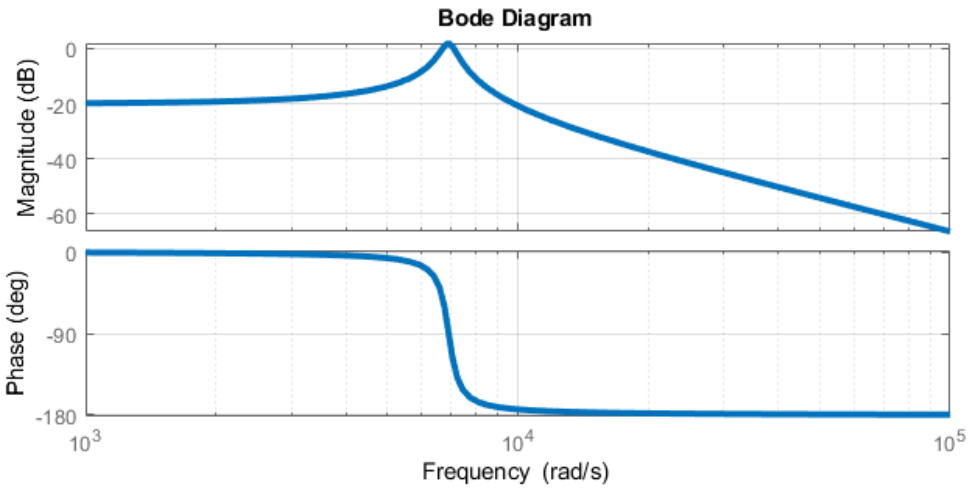
$$T_{BF}(p) = \frac{T(p)}{1 + T(p) \cdot K_{capt}}$$



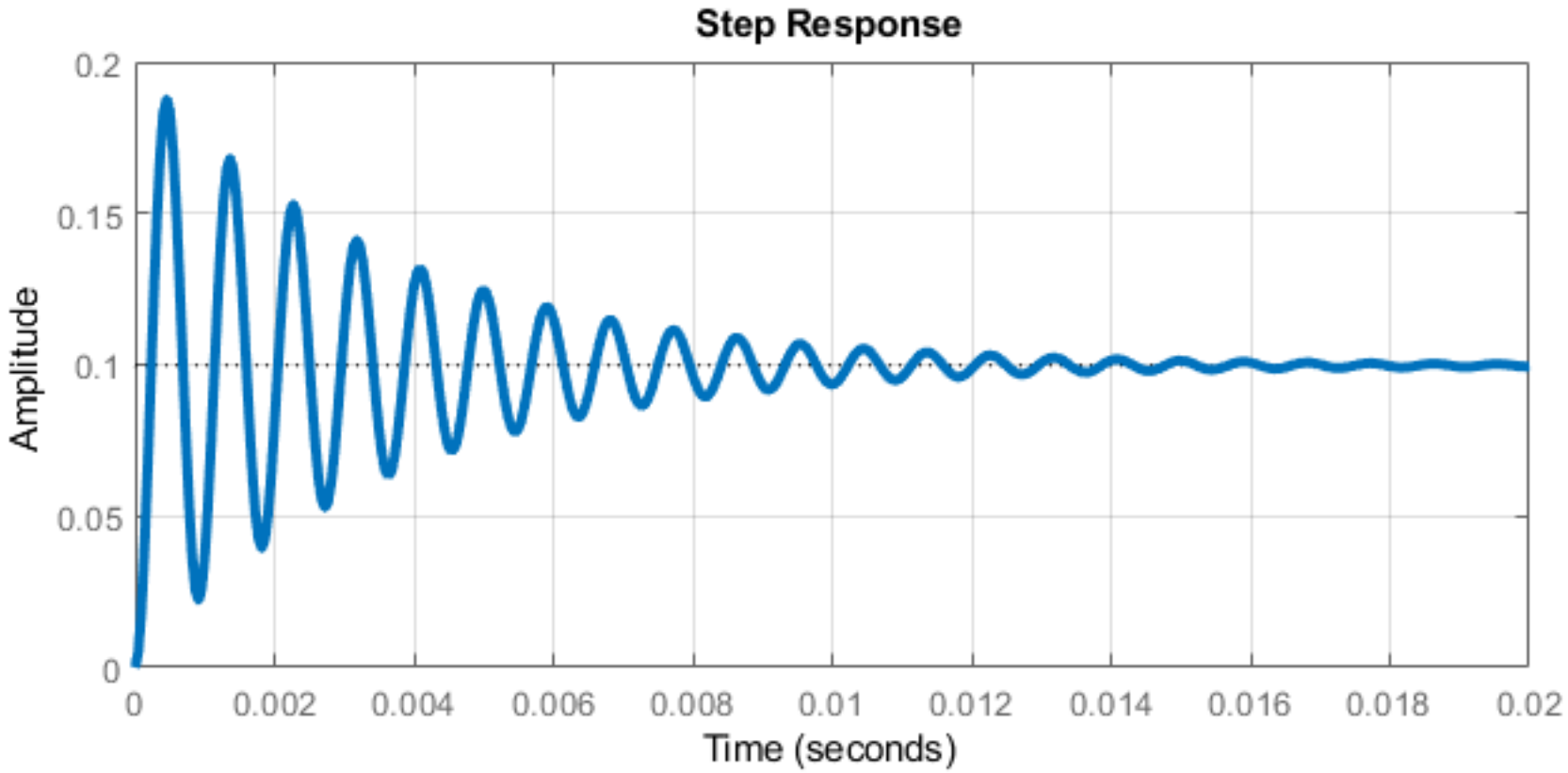
$$G_{0BF} = \frac{G_0}{1 + G_0 \cdot K_{capt}} = 0.0998$$

$$f_{cBF} = f_c \cdot \sqrt{1 + G_0 \cdot K_{capt}} = 1100\,\text{Hz}$$

$$m_{BF} = \frac{m}{\sqrt{1 + G_0 \cdot K_{capt}}} = 0.04$$



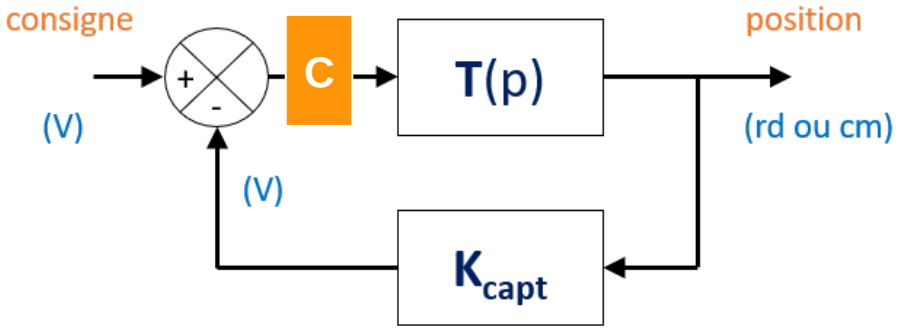
- **Exercice 2 / Système asservi**



- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

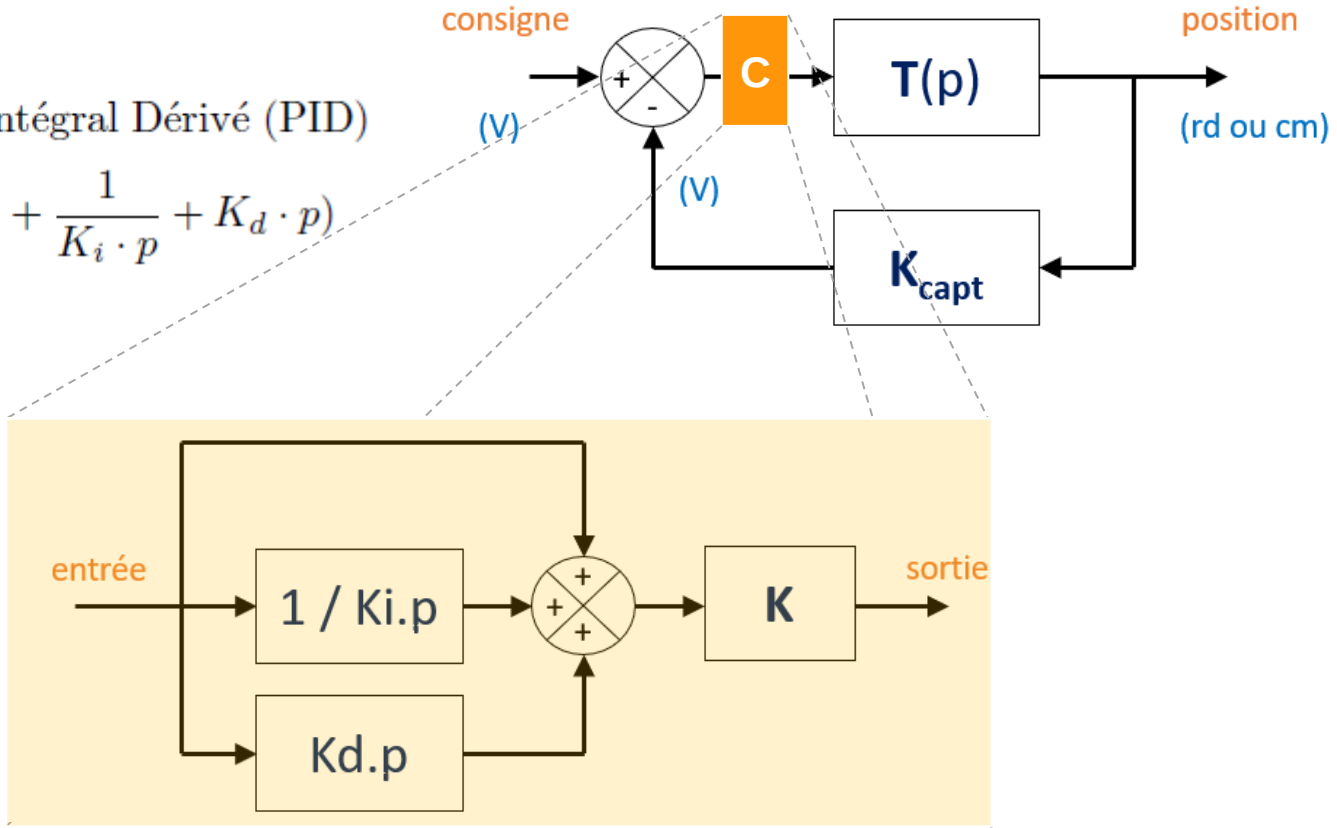
$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$



- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

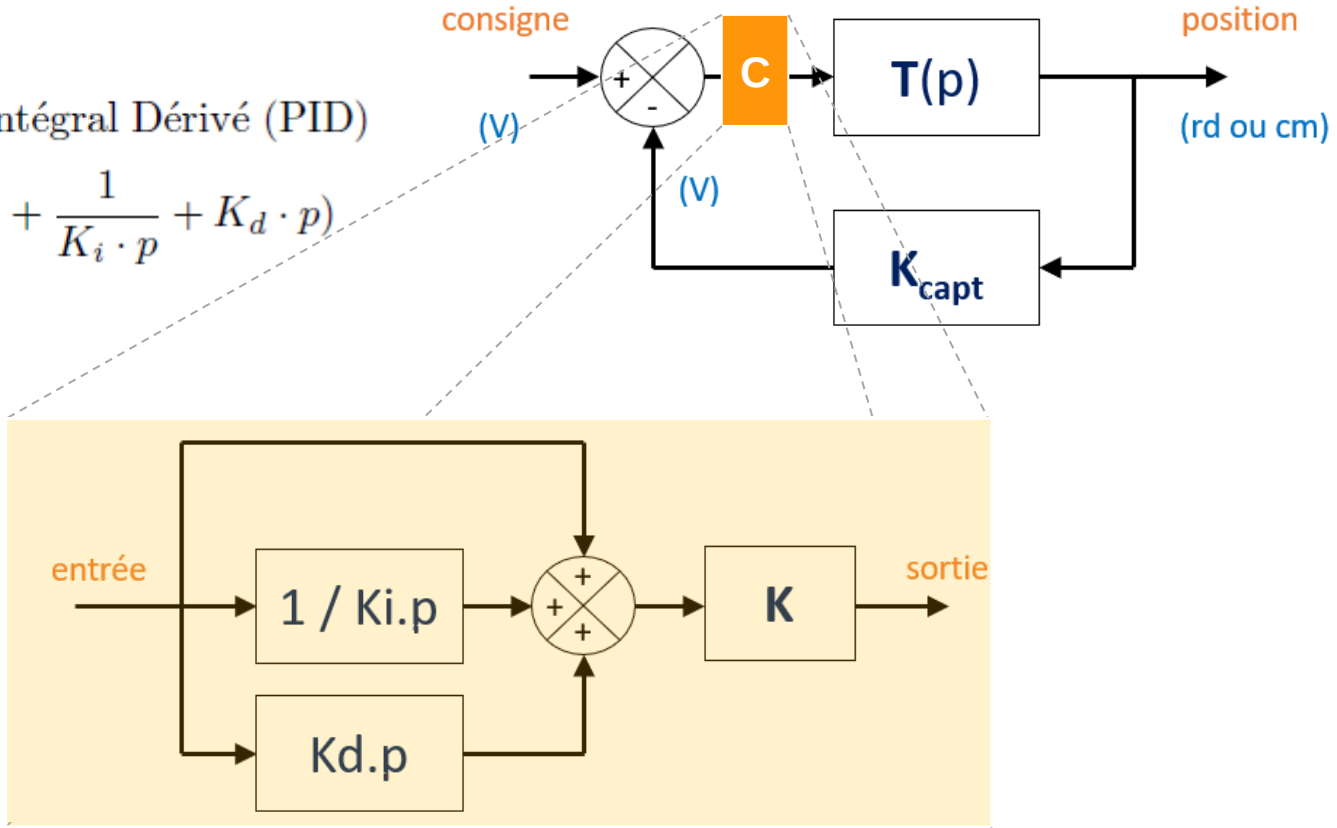
$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$



- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

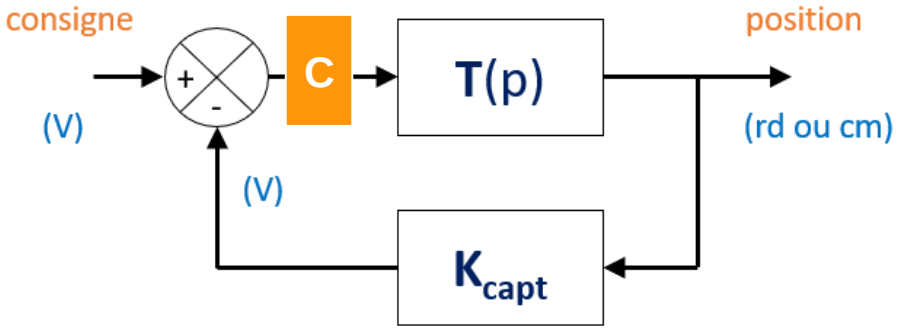
$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$



- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

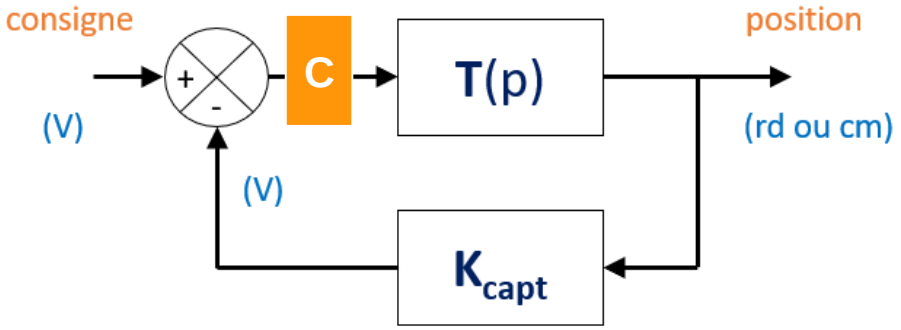
$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$



- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$

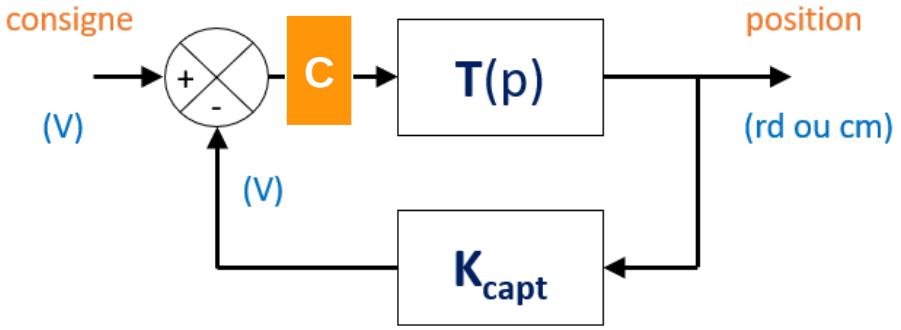


$$T_{BF}(p) = \frac{K \cdot T(p)}{1 + K \cdot T(p) \cdot K_{capt}}$$

- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$



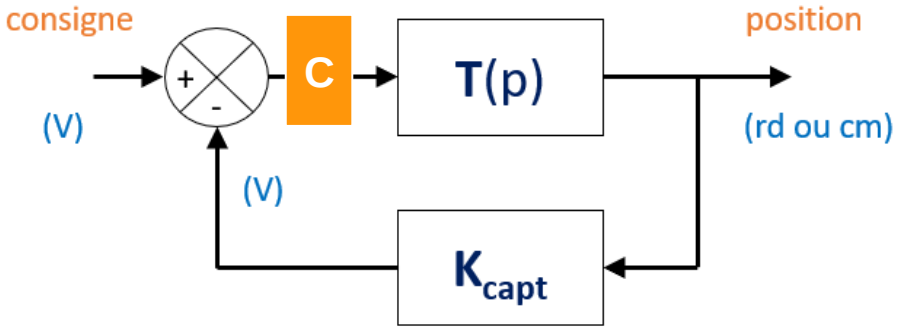
$$T_{BF}(p) = \frac{K \cdot T(p)}{1 + K \cdot T(p) \cdot K_{capt}}$$

$$T_{BF}(p) = \frac{K \cdot G_0}{1 + K \cdot G_0 \cdot K_{capt}} \cdot \frac{1}{1 + \frac{2 \cdot m \cdot p}{\omega_c \cdot (1 + G_0 \cdot K \cdot K_{capt})} + \frac{p^2}{\omega_c^2 \cdot (1 + G_0 \cdot K \cdot K_{capt})}}$$

- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$



$$T_{BF}(p) = \frac{K \cdot T(p)}{1 + K \cdot T(p) \cdot K_{capt}}$$

$$G_{0BF} = \frac{K \cdot G_0}{1 + K \cdot G_0 \cdot K_{capt}}$$

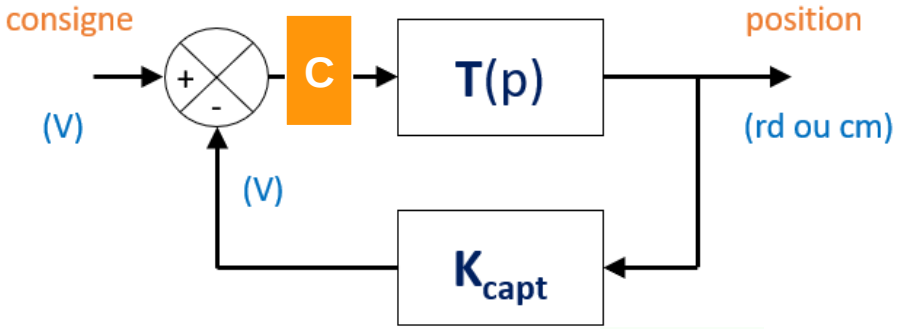
$$f_{cBF} = f_c \cdot \sqrt{1 + G_0 \cdot K \cdot K_{capt}}$$

$$m_{BF} = \frac{m}{\sqrt{1 + G_0 \cdot K \cdot K_{capt}}}$$

- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot \left(1 + \frac{1}{K_i \cdot p} + K_d \cdot p\right)$$



$K = 10$

$$G_{0BF} = \frac{K \cdot G_0}{1 + K \cdot G_0 \cdot K_{capt}} = 0.1$$

$$f_{cBF} = f_c \cdot \sqrt{1 + G_0 \cdot K \cdot K_{capt}} = 3.48\,\text{kHz}$$

$$m_{BF} = \frac{m}{\sqrt{1 + G_0 \cdot K \cdot K_{capt}}} = 0.0126$$

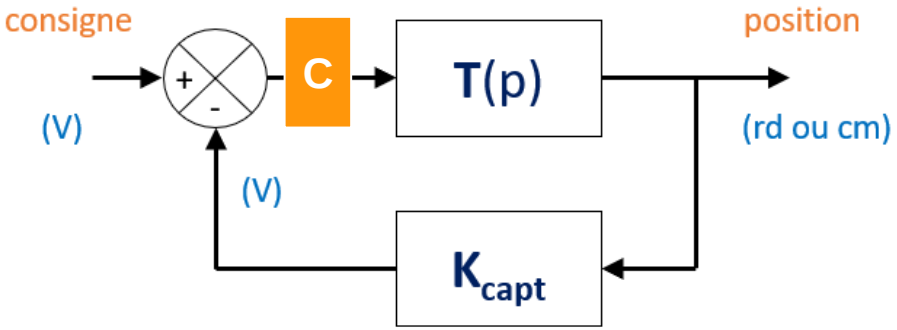
$K = 0.1$

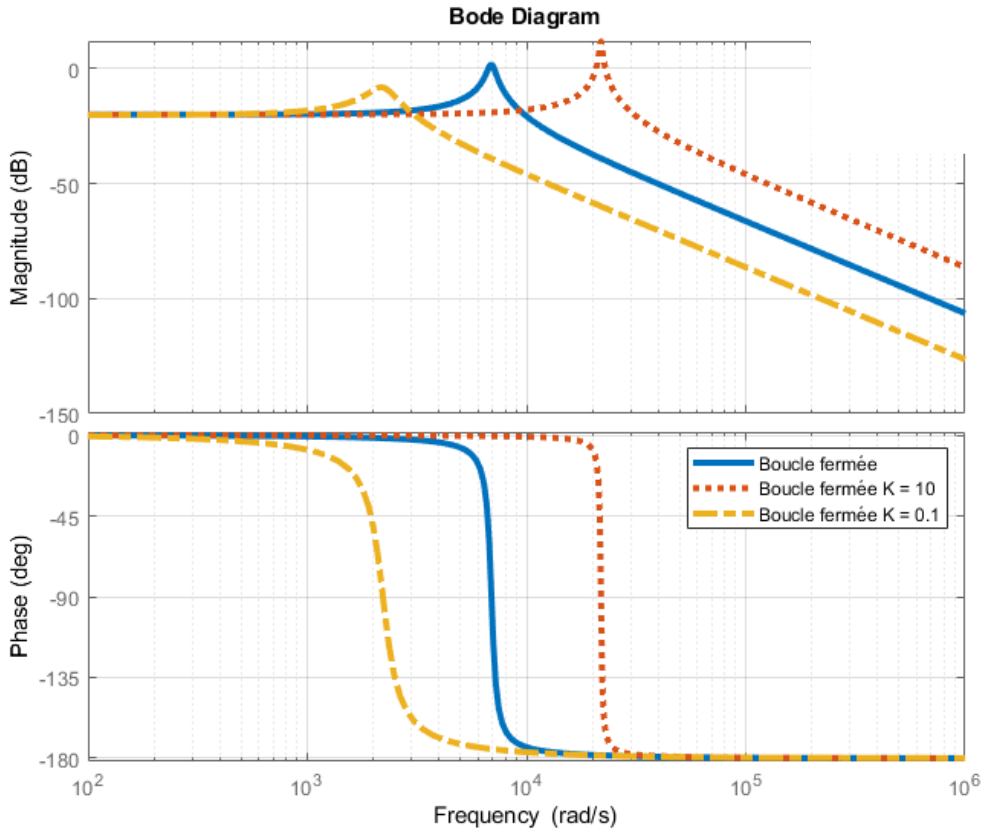
$$G_{0BF} = \frac{K \cdot G_0}{1 + K \cdot G_0 \cdot K_{capt}} = 0.0976$$

$$f_{cBF} = f_c \cdot \sqrt{1 + G_0 \cdot K \cdot K_{capt}} = 352\,\text{kHz}$$

$$m_{BF} = \frac{m}{\sqrt{1 + G_0 \cdot K \cdot K_{capt}}} = 0.125$$

- **Exercice 3 / Système corrigé**





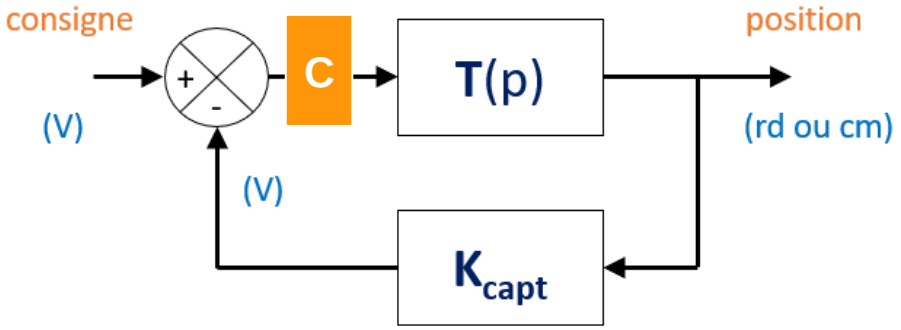
Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot \left(1 + \frac{1}{K_i \cdot p} + K_d \cdot p\right)$$

- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

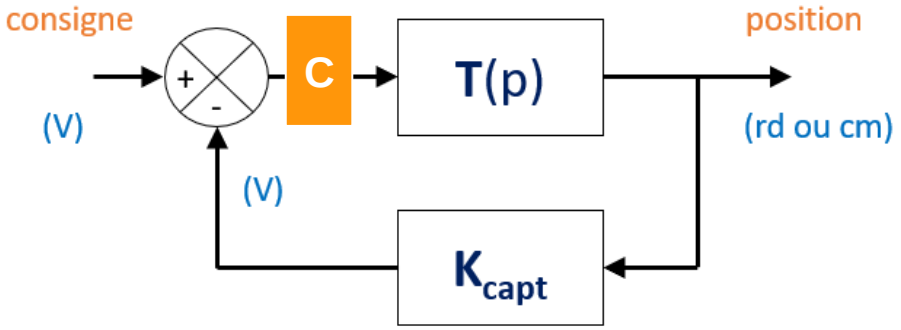
$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$



- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$

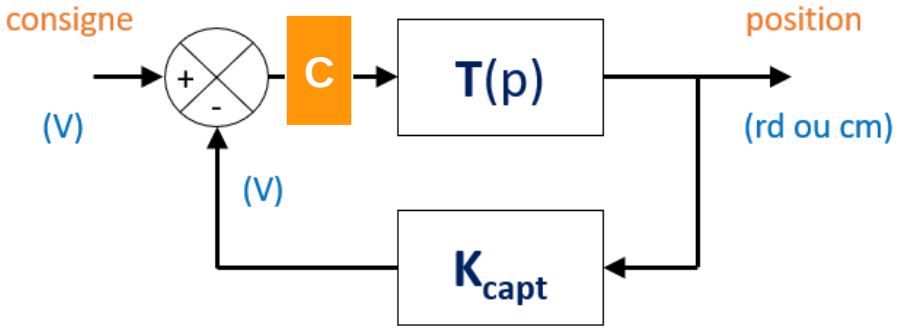


$$T_{BF}(p) = \frac{C(p) \cdot T(p)}{1 + K_{capt} \cdot C(p) \cdot T(p)}$$

- **Exercice 3 / Système corrigé**

Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$

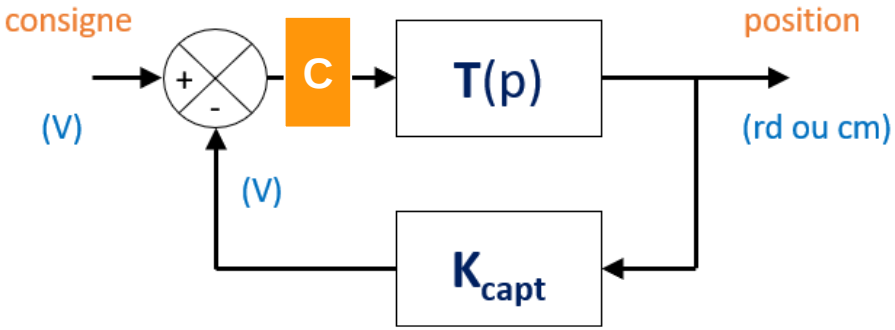


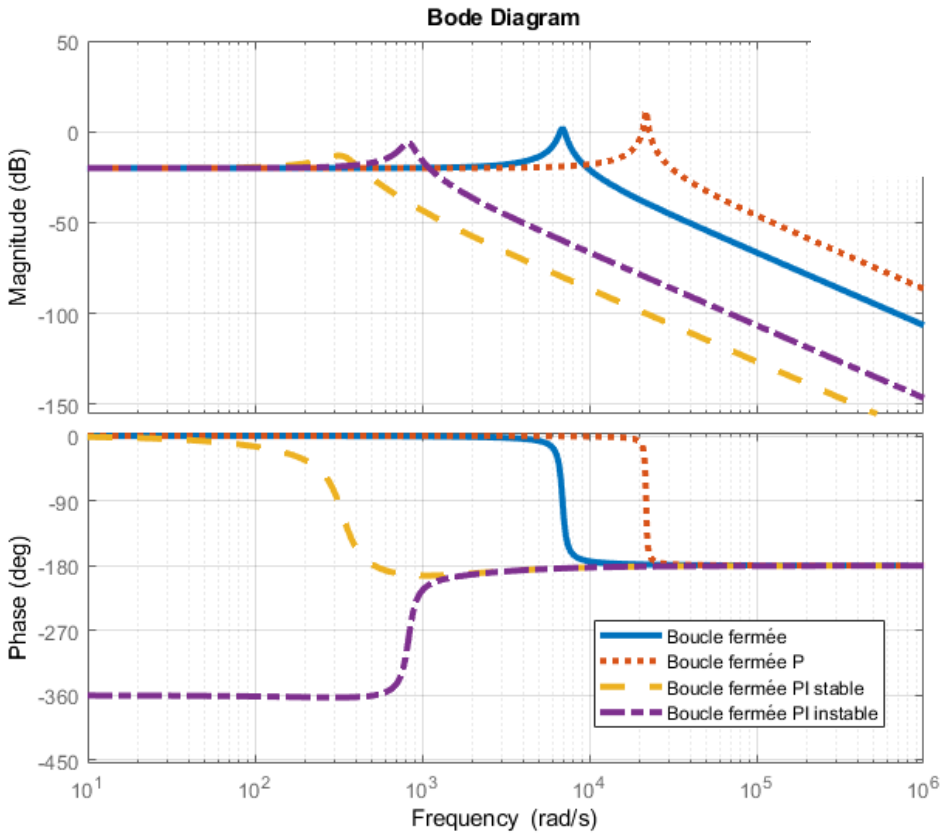
$$T_{BF}(p) = \frac{C(p) \cdot T(p)}{1 + K_{capt} \cdot C(p) \cdot T(p)}$$

$$M = K_{capt} \cdot K \cdot G_0$$

$$T_{BF}(p) = \frac{K \cdot G_0}{1 + M} \cdot \frac{1 + \tau_i \cdot p}{1 + \frac{p}{1+M} \cdot (\frac{2 \cdot m}{\omega_c} + \tau_i \cdot M) + \frac{p^2}{\omega_c^2 \cdot (1+M)}}$$

- **Exercice 3 / Système corrigé**

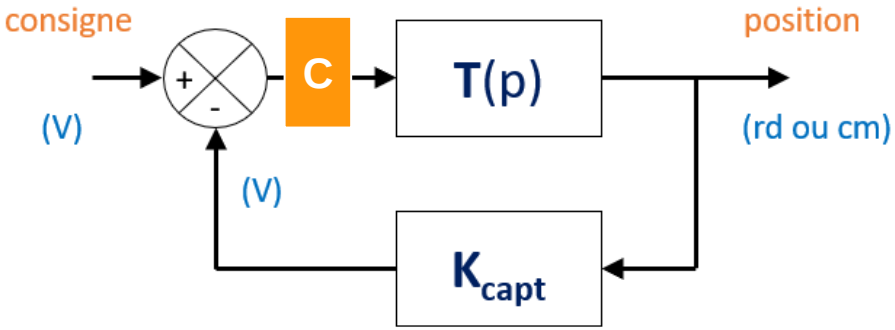


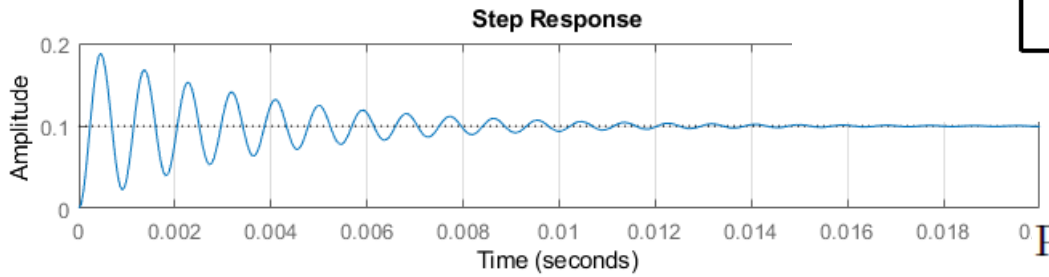


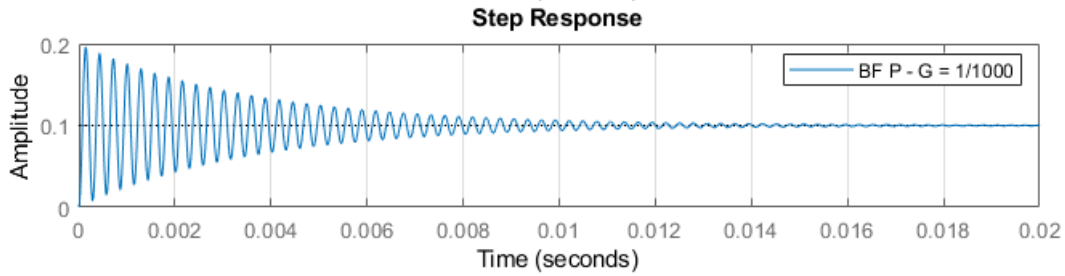
Proportionnel Intégral Dérivé (PID)

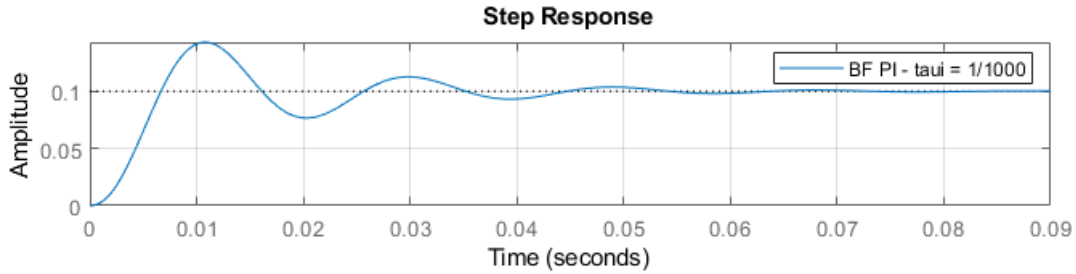
$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$

- **Exercice 3 / Système corrigé**









Proportionnel Intégral Dérivé (PID)

$$C(p) = K \cdot (1 + \frac{1}{K_i \cdot p} + K_d \cdot p)$$