G11 :

* EL HASSOUNI AYMAN

* LAQRAA NADA

COLLE

Correction proposée par : LAQRAA NADA

Concours national commun 2020

Epreuve : GE

Partie D : Asservissement du panneau photovoltaïque

D-1. Etude de la boucle de régulation de courant

Q29.

$$\frac{I(P)}{V(P)} = FTBF$$

$$\frac{I(P)}{V(P)} = \frac{\frac{G}{\cancel{P}} \times \frac{a\cancel{P}}{(1+TP)}}{1 + \frac{G.a.\cancel{P}.B_1}{\cancel{P}(1+TP)}}$$

$$= \frac{\frac{a.G}{1+TP}}{1 + \frac{G.a.B_1}{1+TP}}$$

$$= \frac{aG}{1 + TP + G.a.B_1}$$

$$= \frac{aG}{1 + G.a.B_1 + TP}$$

d'où :

$$\frac{I(P)}{V(P)} = \frac{\frac{a.G}{1+G.a.B_1}}{1 + \frac{T}{1+G.a.B_1}P}$$

$$\boxed{\frac{I(P)}{V(P)} = \frac{K}{1+T_m P}}$$

avec :

$$\boxed{K = \frac{a.G}{1+G.a.B_1} = 0{,}44}$$

$$\boxed{T_m = \frac{T}{1+G.a.B_1} = 0{,}22}$$

Q30.

$$I_{max} = \lim_{P \to 0} P\,I(P)$$

$$= \lim_{P \to 0} \cancel{P} \frac{K}{1+T_m P} \times \frac{15}{\cancel{P}}$$

$$\boxed{I_{max} = 15 \times K = 6\ A}$$

D-2. Etude de la boucle de vitesse

Q31.

$$\frac{\Omega(P)}{V_1(P)} = \frac{G_2 \times \frac{b}{P} \times \frac{K}{1+T_m P}}{1 + G_2.B_2.\frac{b}{P}.\frac{K}{1+T_m P}}$$

$$= \frac{G_2.b.K}{T_m P^2 + P + G_2.B_2.b.K}$$

$$= \frac{\frac{\cancel{G_2.b.K}}{\cancel{G_2.B_2.b.K}}}{1 + \frac{1}{G_2.B_2.b.K}P + \frac{T_m}{G_2.B_2.b.K}P^2}$$

$$= \frac{\frac{1}{B_2}}{1 + \frac{1}{G_2.B_2.b.K}P + \frac{T_m}{G_2.B_2.b.K}P^2}$$

On a :

- $$\frac{1}{\omega_n^2} = \frac{T_m}{G_2.B_2.b.K}$$

$$\omega_n = \sqrt{\frac{G_2.B_2.b.K}{T_m}}$$

- $$\frac{2z}{\omega_n} = \frac{1}{G_2.B_2.b.K}$$

$$z = \frac{1}{2} \times \frac{1}{G_2.B_2.b.K} \times \sqrt{\frac{G_2.B_2.b.K}{T_m}}$$

d'où $z = \frac{1}{2}\sqrt{\frac{1}{G_2 B_2 b.K}}$

$$\boxed{F(P) = \frac{A}{1 + \frac{2z}{\omega_n}P + \frac{1}{\omega_n^2}P^2}}$$

Q32.

$$z = \frac{1}{2}\sqrt{\frac{1}{G_2 B_2 b.K}}$$

$$4 = \frac{1}{G_2.B_2.b.K}$$

$$G_2 = \frac{1}{4.B_2.b.K.T_m}$$

$$\boxed{G_2 = 1{,}25}$$

Q33.

• On calcul ω_n pour $z = 1$

$\Rightarrow \omega_n = 2,5$ rad/s

$D(P) = 0$

$$1 + \frac{2z}{\omega_n} P + \frac{1}{\omega_n^2} P^2 = 0$$

$\Delta = 0$

$$P_1 = P_2 = \frac{-b}{2a} = \frac{-2z}{2\omega_n} \times \omega_n^2$$

$$P_{12} = -z\omega_n$$

$$P_{12} = -2,5$$

• nouvelle forme de la fonction de transfert $\frac{\Omega(P)}{V_1(P)}$

$$\frac{\Omega(P)}{V_1(P)} = \frac{\frac{1}{B_2}}{1 + \frac{2z}{\omega_n} P + \frac{1}{\omega_n^2} P^2}$$

$$\frac{\Omega(P)}{V_1(P)} = \frac{\frac{1}{B^2}}{(1 + 0,4P)^2}$$

$$\boxed{\frac{\Omega(P)}{V_1(P)} = \frac{10}{(1 + 0,4P)^2}}$$

D-3. Etude de la boucle de position

Q34.

$$FTBO(P) = \frac{K' . N . B_3}{P(1 + T'P)^2}$$

Q35.

• Traçons diagramme de Bode :

$$FTBO(j\omega) = \frac{K' . N . B_3}{j\omega(1 + T' j\omega)^2}$$

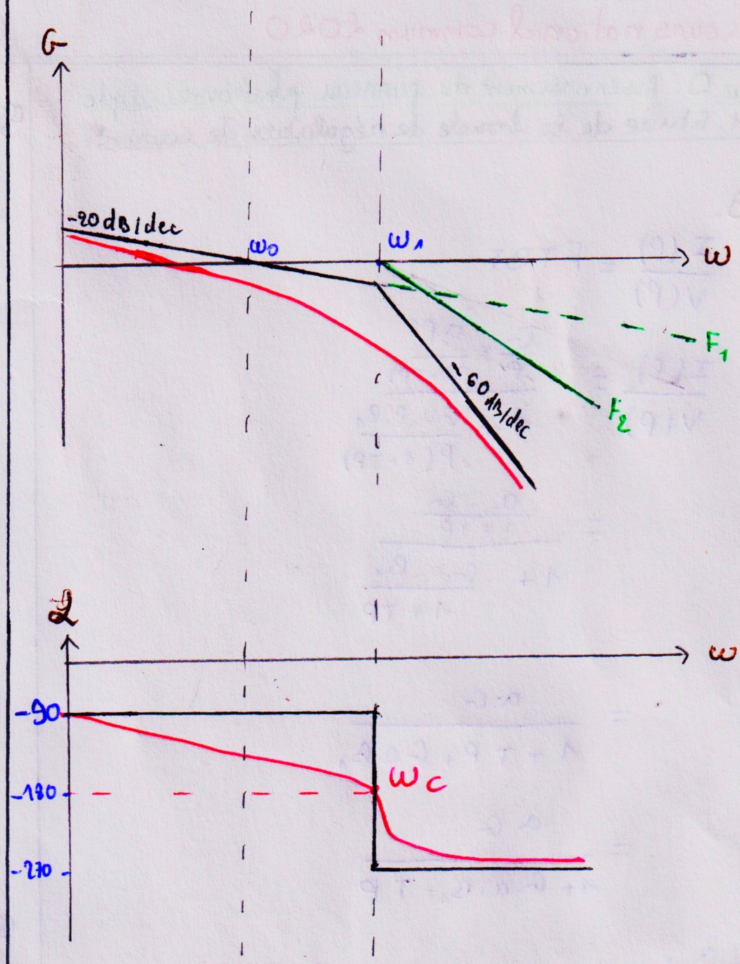
$$= \frac{1}{j\frac{\omega}{K'NB_3}\left(1 + j\frac{\omega}{1/T'}\right)^2}$$

$$\boxed{FTBO(j\omega) = \underbrace{\frac{1}{j\frac{\omega}{\omega_0}}}_{F_1} \times \underbrace{\frac{1}{\left(1 + j\frac{\omega}{\omega_1}\right)^2}}_{F_2}}$$

avec :

$$\boxed{\omega_0 = K'NB_3 = 1,25 \text{ rad/s}}$$

$$\boxed{\omega_1 = \frac{1}{T'} = 2,5 \text{ rad/s}} \qquad \omega_0 < \omega_1$$



Q36.

Déterminons la pulsation unitaire ω_0

$$|FTBO(j\omega_0)| = 1$$

$$\frac{KNB_3}{\omega_0(1 + (T\omega_0)^2)} = 1$$

$$T\omega_0^2 + \omega_0 - K'NB_3 = 0$$

$$0,4\omega_0^2 + \omega_0 - 1,25 = 0$$

donc $\omega_{01} = -2,78$ et $\omega_{02} = 0,28$

d'où $\boxed{\omega_0 = 0,28 \text{ rad/s}}$

Lagnaa nada