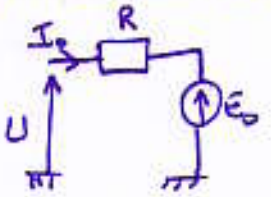
BTS 2000 TPIL.

A) Etude du moteur

I. Essai à vide

$U = 200V$, $I_0 = 17,5mA$, $n_0 = 3400 tr/min$.

• A.1.1. Calcul de E_0 :



$U - RI_0 - E_0 = 0$.

$E_0 = U - RI_0$.

$= 220 - 42 \times 17,5.10^{-3} = 199V$.

$E_0 = 199V$.

• A.1.2. Calcul de P_0 : $P_0 = UI_0 = 3,3W$

• A.1.3. Calcul de P_{J_0} : $P_{J_0} = RI_0^2 = 42 \times (17,5.10^{-3})^2 = 0,01286W$

$P_{I_0} = 12,9 mW$

• A.1.4. Calcul de P_c : Bilan de puissance :

$P = UI = RI^2 + p_c + p_u$.

A vide : $p_u = 0$

$P_0 = UI_0 = RI_0^2 + p_c$.

donc $p_c = UI_0 - RI_0^2 = I_0(U - RI_0)$

$p_c = 3,49W$.

• A.1.5. Calcul de I_p : $P_c = I_p \Omega$ $I_p = \frac{P_c}{\Omega} = \frac{P_c}{\frac{2\pi n_0}{60}}$ $I_p = 0,0098 N.m$

II. Essai en charge

$U = 200V$, $I = 0,8A$

• A.2.1. Calcul de E :

$E = U - RI = 200 - 42 \times 0,8 = 166,4V$

• A.2.2. Calcul de n_c : A vide : $E_0 = k\phi n_0$; En charge : $E = k\phi n$ } $n = \frac{E}{E_0} n_0 = \frac{166}{199} \times 3400$

$n = 2843 N.m$

• A.2.3. Calcul de Γ_{em} : $P_{em} = E_I = \Gamma_{em} \Omega$

$\Gamma_{em} = \frac{E_I}{\Omega} = \frac{EI}{\frac{N2\pi}{60}} = 0,447 N.m$

• A.2.4. Calcul de Γ_u :

Bilan de puissance : $p_u + p_c + RI^2 = UI$

$p_u = \Gamma_u \Omega = UI - p_c - RI^2$

$\Gamma_u = \frac{U_I - P_c - RI^2}{\frac{2\pi n}{60}} = 0,435 N.m$.

A.2.5. Calcul du Rendement η_3 :

$$\eta_3 = \frac{P_u}{P_{abs}} = \frac{P_u}{UI} = \frac{I_u l}{UI}$$

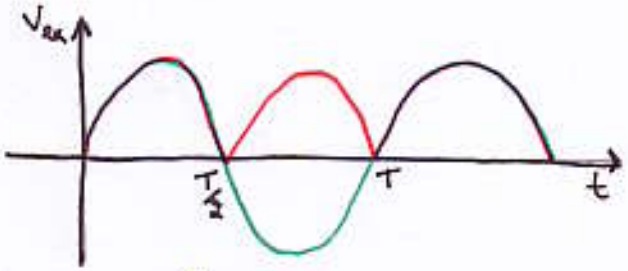
$\eta_3 = 0{,}809$. $\eta_3 = 80{,}9\% \simeq 81\%$

B) Etude de l'alimentation du moteur $f = 50\,Hz$ $V = 220\,V$

I. Alimentation de l'inducteur

.B.1.1. Voir courbe.

- Si $i > 0$ alors D_1 et D_3 conduisent (D_2 et D_4 Bloquées) donc $V_{ex} = U$.
- Si $i < 0$ alors D_2 et D_4 " (D_3 et D_1 ") donc $V_{ex} = -V$



.B.1.2.

① $$\overline{V_{ex}} = \frac{1}{\frac{T}{2}} \int_0^{\frac{T}{2}} V\sqrt{2} \sin \omega t \, dt = \frac{2V\sqrt{2}}{T} \left[-\frac{\cos \omega t}{\omega} \right]_0^{\frac{T}{2}}$$

$$\overline{V_{ex}} = \frac{2V\sqrt{2}}{\frac{2\pi}{\omega} \times \omega} \times \left(-\cos \frac{2\pi}{T} \times \frac{T}{2} + \cos 0 \right) = \frac{V\sqrt{2}}{\pi} (1+1) = \frac{2V\sqrt{2}}{\pi} = 198\,V$$

② $$U_{ex}^2 = \frac{1}{\frac{T}{2}} \int_0^{\frac{T}{2}} (V\sqrt{2} \sin \omega t)^2 \, dt$$

$$= \frac{2}{T} \times V^2 \times 2 \times \int_0^{\frac{T}{2}} \left(\frac{1}{2} (1 - \cos 2\omega t) \, dt \right) = \frac{2V^2}{T} \left[t - \frac{\sin 2\omega t}{2\omega} \right]_0^{\frac{T}{2}}$$

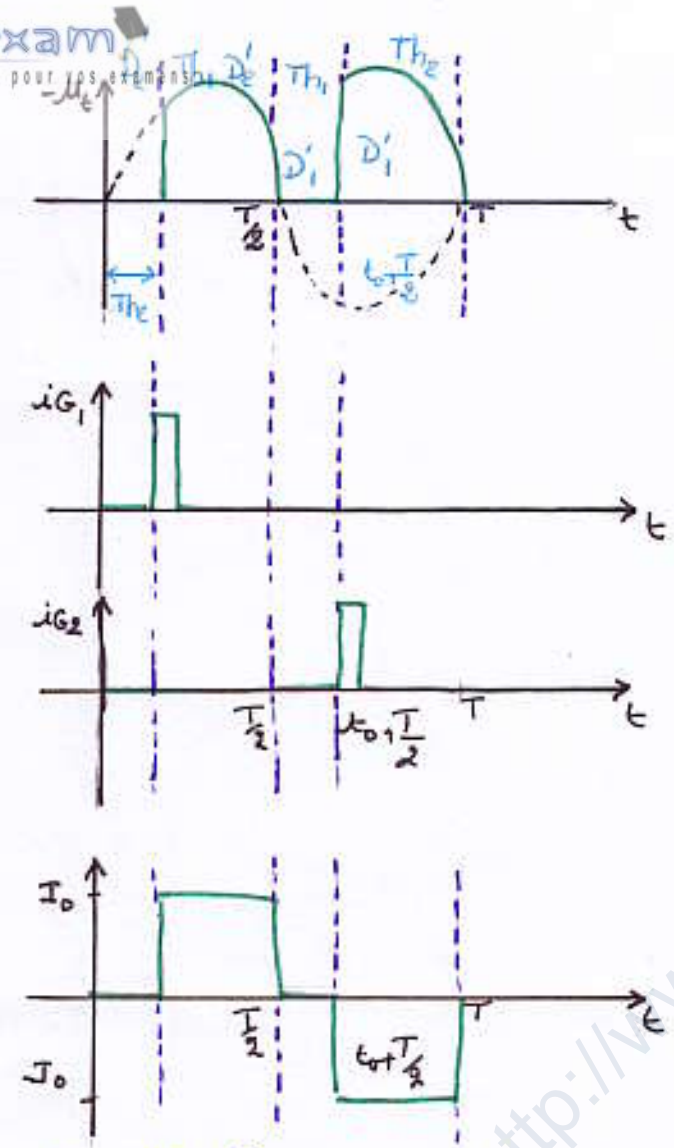
$$U_{ex}^2 = \frac{2V^2}{T} \left(\frac{T}{2} - \frac{\sin \left(2 \times \frac{2\pi}{T} \times \frac{T}{2} \right)}{2 \times \frac{2\pi}{T}} - 0 + \frac{\sin 0}{2 \times \frac{2\pi}{T}} \right)$$

$$U_{ex}^2 = V^2 \left(1 - \frac{\sin 2\pi}{2\pi} \right)$$

$$U_{ex}^2 = V^2 \qquad U_{ex} = V.$$

II. Alimentation de l'induit.

.B.2.1. Voir page suivante.



• B.2.2. $\bar{U} = \frac{220\sqrt{2}}{\pi}(1+\cos\theta_0)$

Si $\bar{U} = 150\,V$ $\quad 150 = \frac{220\sqrt{2}}{\pi}(1+\cos\theta_0) \Rightarrow \frac{150\pi}{220\sqrt{2}} - 1 = \cos\theta_0$

$\theta_{rad} = \arccos\left(\frac{150\pi}{220\sqrt{2}} - 1\right) = 1{,}03\,rad = 59°$

c) Mesure du couple. $\quad \Delta R = \frac{k' F R_0}{S}$ $\quad k' = 10^{-10}\,m^2/N$ $\quad S = 5.10^{-4}\,m^2$

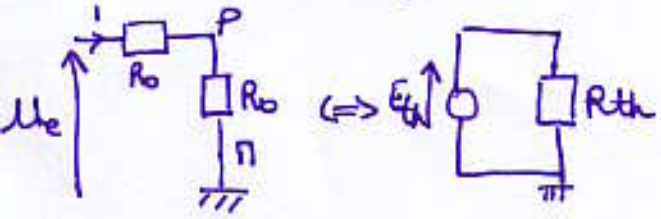
• C.1 : Calcul de R_0 :

La jauge est assimilée à un fil résistif $\rho = 10^{-6}\,\Omega/m$ $\quad I = 5.10^{-3}\,m$

$R_0 = \rho\frac{l}{S} = 250\,\Omega$

• C.2. Calcul de ΔR : $\quad F = 500\,N$ $\quad \Delta R = \frac{k' F R_0}{S} = \frac{10^{-10} \times 500 \times 250}{5.10^{-4}} = 25\,m\Omega$

• C.3. NET du dipole PM :



$R_{th} = \frac{R_0}{2}$

$E_{th} = \frac{R_0 u_e}{2R_0} = \frac{u_e}{2}$

$$E'_{th} = \frac{R u_e}{R+R_0}$$

$$R'_{th} = \frac{R R_0}{R+R_0}$$

- C.5. AOP idéal $i_+ = i_- = 0$

AOP en linéaire : $\varepsilon = 0$ $V^+ = V^-$

or $V^+ = \frac{R_3 u_2}{R_3+R_2}$ et $V^- = \frac{u_1 R_3 + V_3 R_1}{R_3+R_1}$

donc $\frac{R_3 u_2}{R_3+R_2} = \frac{R_3 u_1 + R_1 V_s}{R_1+R_3}$ et $u_s = \frac{R_3(R_1+R_3)}{R_1(R_3+R_2)} u_2 - \frac{R_3}{R_1} u_1$

- C.6. $u_s = 10^3 \left(\frac{R-R_0}{R+R_0}\right) u_e$ $\quad R = R_0 + \Delta R$

$$u_s = 10^3 \left(\frac{R_0 + \Delta R - R_0}{R_0 + \Delta R + R_0}\right) u_e = 10^3 \left(\frac{\Delta R}{2R_0 + \Delta R}\right) u_e$$

$$u_s = 10^3 \left(\frac{1}{1+2\frac{R_0}{\Delta R}}\right) u_e = 10^3 \left(\frac{1}{1+2R_0 \times \frac{S}{kFR_0}}\right) u_e$$

$$u_s = 10^4 \left(\frac{1}{1+\frac{2S}{k'F}}\right) \qquad u_s = 10^{-3} F \text{ avec } R_0 \gg \Delta R$$

AN : $u_s = 10^4 \left(\frac{1}{1+\frac{2 \times 5 \cdot 10^{-4}}{10^{-10} \times 500}}\right) = 0{,}499\ V$

$u = 0{,}5\ V$.