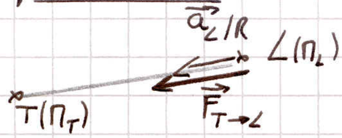
CC2

Questions de cours

i)




ii) RFD $\vec{a}_L = \frac{v_L^2}{r} \vec{e}_m$ (pas de composante tangentielle)

$\vec{F}_{T\to L} = -G\frac{M_T M_L}{r^2}\frac{\vec{TL}}{TL} = \frac{G M_T M_L \vec{e}_m}{r^2}$

$M_L \vec{a}_{L/R} = \sum \vec{F}_{ext}$ donne $\cancel{M_L}\frac{v_L^2}{\cancel{r}} = \frac{G M_T \cancel{M_L}}{r^{\cancel{2}}}$

soit $v_L = \sqrt{\frac{G M_T}{r}}$

iii) identité masse grave ≡ masse inerte   iv) AN $v_L = 1{,}020$ km/s

Problème   $R = 100\,\Omega$, $L = 10$ mH ; $C = 0{,}5\,\mu F$

$e(t) = e_m \cos(\omega t + \phi_e) \Rightarrow i(t) = i_m \cos(\omega t + \phi_i)$

1) $e_m$ : amplitude tension (V)

$i_m$ : amplitude courant (A)

$\phi_e, \phi_i$ : phase/origine (rad)

$\omega$ : pulsation (rad.s$^{-1}$)

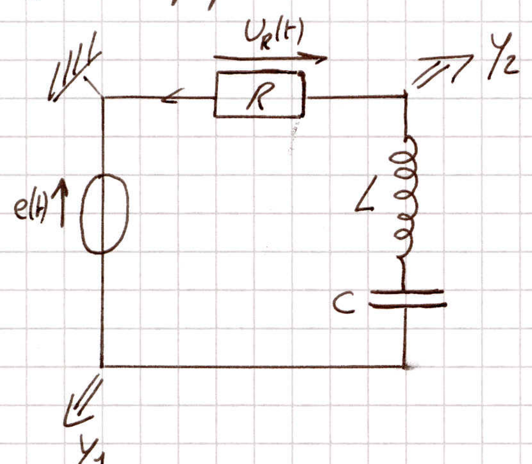
2) a) $U_R(t) = R\,i(t)$

$U_L(t) = L\frac{di(t)}{dt}$

$u_C(t) = \frac{1}{C}\int i(t)\,dt$

b) $e(t) = u_R(t) + u_L(t) + u_C(t)$ soit $R i(t) + L\frac{di(t)}{dt} + \frac{1}{C}\int i(t)dt = e(t)$

$u_R(t)$ est proportionnel au courant $u_R(t) = R\,i(t) \to i(t) = \frac{U_R(t)}{R}$




3) Formalisme complexe a) $e(t) = e_m\cos(\omega t + \phi_e) \Rightarrow \underline{e}(t) = \underline{e}_m e^{j\omega t}$ avec $\underline{e}_m = e_m e^{j\phi_e}$

$i(t) = i_m \cos(\omega t + \phi_i) \Rightarrow \underline{i}(t) = \underline{i}_m e^{j\omega t}$ avec $\underline{i}_m = i_m e^{j\phi_i}$

b) Equation complexe en $\underline{i}(t)$

$$R\,\underline{i}(t) + L\,\frac{d\underline{i}(t)}{dt} + \frac{1}{C}\int \underline{i}(t)\,dt = \underline{e}(t)$$

c) $\frac{d\underline{i}(t)}{dt} = j\omega\,\underline{i}_m\,e^{j\omega t}$

$$\int \underline{i}(t)\,dt = \frac{1}{j\omega}\,\underline{i}_m\,e^{j\omega t} = \frac{-j}{\omega}\,\underline{i}_m\,e^{j\omega t}$$

d) $R\,\underline{i}_m + jL\omega\,\underline{i}_m - \frac{j}{C\omega}\,\underline{i}_m = \underline{e}_m \Rightarrow \underline{i}_m = \frac{\underline{e}_m}{R + j\left(L\omega - \frac{1}{C\omega}\right)}$

4) a) $\underline{Z}_R = R$ ; $\underline{Z}_L = jL\omega$ ; $\underline{Z}_C = \frac{1}{jC\omega} = \frac{-j}{C\omega}$

$$\underline{Z} = \underline{Z}_R + \underline{Z}_L + \underline{Z}_C = R + j\left(L\omega - \frac{1}{C\omega}\right)$$

Module $\Rightarrow |\underline{Z}| = \sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}$

Argument $\Rightarrow \phi_Z = \arg \underline{Z} = \arctan\left(\frac{L\omega - \frac{1}{C\omega}}{R}\right)$

b) $\underline{Y} = \frac{\underline{i}(t)}{\underline{e}(t)} = \frac{1}{\underline{Z}} = \frac{1}{R + j\left(L\omega - \frac{1}{C\omega}\right)}$ car $\underline{e}(t) = \underline{Z}\,\underline{i}(t)$

Module $\Rightarrow |\underline{Y}| = \frac{1}{\sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}} = \frac{1}{|\underline{Z}|}$

Argument $\Rightarrow \phi_Y = \arg \underline{Y} = -\arctan\left(\frac{L\omega - \frac{1}{C\omega}}{R}\right) = -\phi_Z$

c) $\omega = \omega_0 \Rightarrow |\underline{Y}|_{max} = \frac{1}{R}$ $\quad L\omega_0 = \frac{1}{C\omega_0} \Leftrightarrow \omega_0 = \frac{1}{\sqrt{LC}}$

résonance.

5) Fonction de transfert $\underline{T}(f) = \frac{\underline{U}_R(t)}{\underline{e}(t)} = \frac{R\,\underline{i}(t)}{\underline{Z}\,\underline{i}(t)} = \frac{R}{\underline{Z}} = \frac{R}{R + j\left(L\omega - \frac{1}{C\omega}\right)}$

Facteur de qualité $Q = \frac{L\omega_0}{R}$ et $x = \frac{\omega}{\omega_0}$

$\omega_0 = 14{,}142\ 10^3$ rad/s.

AN: $Q = 1{,}414$

$$= \frac{1}{1 + j\left(\frac{L\omega}{R} - \frac{1}{RC\omega}\right)} = \frac{1}{1 + j\left(\frac{L\omega\,\omega_0}{R\,\omega_0} - \frac{1}{RC\omega}\frac{\omega_0}{\omega_0}\right)}$$

$$= \frac{1}{1 + j\left(Qx - \frac{Q}{x}\right)} = \left[1 + jQ\left(x - \frac{1}{x}\right)\right]^{-1}$$

6) Gain G a) $G(dB) = 20\lg|T(x)| = 20\lg\left[\frac{1}{1 + Q^2\left(x - \frac{1}{x}\right)^2}\right]^{1/2} = -10\lg\left[1 + Q^2\left(x - \frac{1}{x}\right)^2\right]$

b) Echelle log $\Rightarrow$ large domaine spectral $\quad X = 0 \quad G = 0$ (valeur max) | filtre passe-bande

$\quad = \pm\infty \quad \pm 20X$