* Lecture 4 *

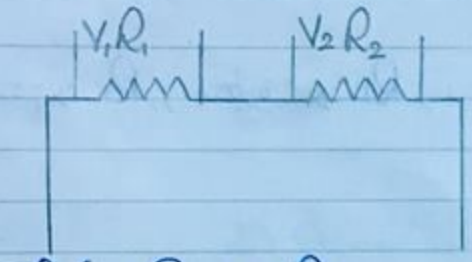
Electronics

- Low pass filter:

- it is a filter that passes signals with a frequency lower than a certain value. « Cut off value »

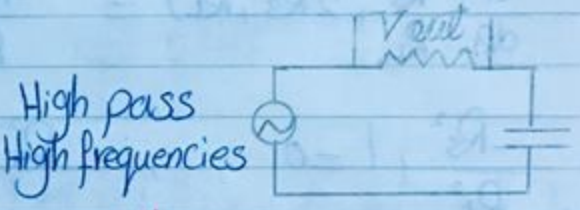
- هو مرشح يقوم بتمرير الإشارات ذات الترددات المنخفضة ويقوم بتقليل شدة الإشارات ذات الترددات الأعلى من تردد الإيقاف.

$$* f_c = \frac{1}{\pi \sqrt{LC}}$$



If : $R_2 \gg R_1$

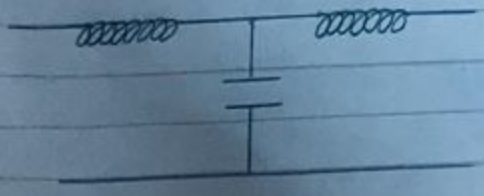
$\therefore V_2 \gg V_1$



* Design high pass filter and low pass filter.

* L_C Circuits *

T_network



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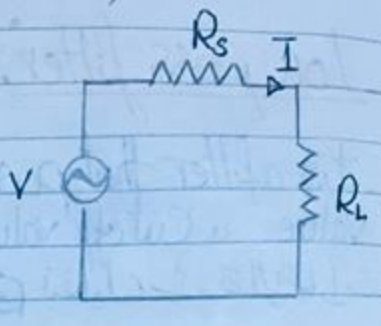
ΠT_network

- each of them is used in Low, High filters.

* Prove that M.P.T Takes place when the resistance of the Load is equal to the resistance of the Source.

R_s : internal resistance
R_L : Load resistance



Proof: $I = \frac{V}{R_s + R_L}$, $P = IV = I^2 R_L$

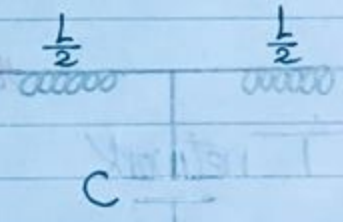
$$\therefore P = \left(\frac{V^2}{R_s^2 + 2R_sR_L + R_L^2}\right) R_L = \frac{V^2}{\frac{R_s^2 + 2R_sR_L + R_L^2}{R_L}} = \frac{V^2}{\frac{R_s^2}{R_L} + 2R_s + R_L}$$

, P is max. when $\left(\frac{R_s^2}{R_L} + 2R_s + R_L\right)$ is min. , R_L → متغيرة , R_s → ثابتة

$$\therefore \frac{d}{dR_L}\left(\frac{R_s^2}{R_L} + 2R_s + R_L\right) = \frac{-R_s^2}{R_L^2} + 1$$

$$\frac{-R_s^2}{R_L^2} + 1 = 0 \quad , \therefore -R_s^2 = -R_L^2 \quad , \therefore \boxed{R_s = R_L} \text{ matching case}$$

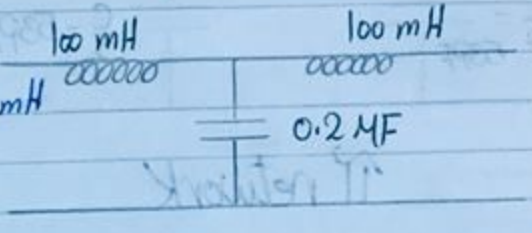
Low pass filter in L-C Circuits :-



* $f_c = \frac{1}{\pi\sqrt{LC}}$ → Cut off frequency

* $R_0 = \sqrt{\frac{L}{C}}$ → nominal "characteristic" Impedance مقاومة الفلتر

* Determine the cutoff frequency and nominal impedance for low pass T-Connected Circuit

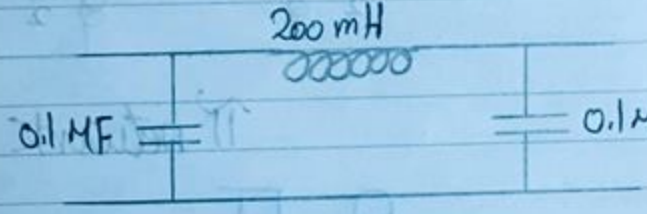


$\rightarrow f_c = \frac{1}{\pi\sqrt{LC}}$, $\frac{L}{2} = 100\,mH$, $\therefore L = 200\,mH$

$$f_c = \frac{1}{\pi\sqrt{200\times10^{-3}\times0.2\times10^{-6}}} = 1.6\ KHz$$

$$, R = \sqrt{\frac{L}{C}} = \sqrt{\frac{200\times10^{-3}}{0.2\times10^{-6}}} = 1000\,\Omega = 1\,K\Omega$$

- Convert T-network to π network:



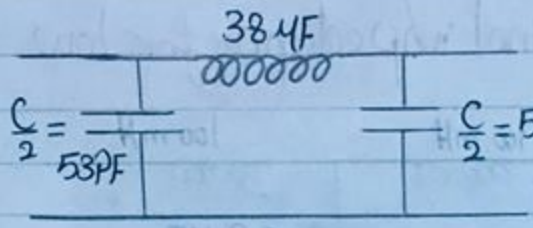
- الشرط الذي يلزم توافره في الدائرة لتعمل كفلتر بكفاءة هو شرط التكافؤ matching Condition

* Prove that: $L = \frac{R_o}{\pi f_c}$, $C = \frac{1}{\pi R_o f_c}$

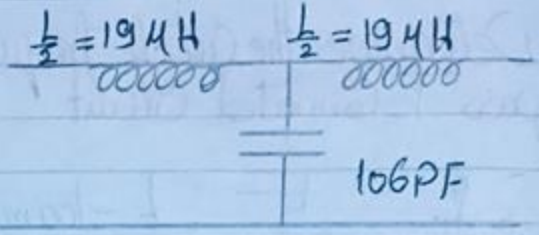
* A filter Circuit of nominal impedance 600 Ω and its Cutoff frequency = 5 mega Hz , Design low pass filter in T, π Configuration

$$\rightarrow L = \frac{R_o}{\pi f_c} = \frac{600}{\pi\times5\times10^{6}} = 3.8\times10^{-5}\ H = 38\ \mu H$$

$$, C = \frac{1}{\pi R_o f_c} = \frac{1}{\pi\times600\times5\times10^{6}} = 1.06\times10^{-10}\ F\times10^{12} = 106\ PF$$

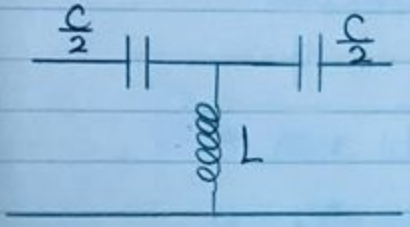


π network

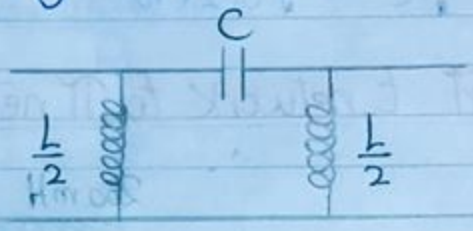


T network

2) High pass filter. it is a filter that passes signals with a frequency higher than a certain value.



T network



π network

* $f_c = \frac{1}{4\pi\sqrt{LC}}$
* $R_o = \sqrt{\frac{L}{C}}$
* $L = \frac{R_o}{4\pi f_c}$
* $C = \frac{1}{4\pi R_o f_c}$

* Sheet: Determine a filter network passes a Single wavelength «frequency» تمرير تردد واحد فقط