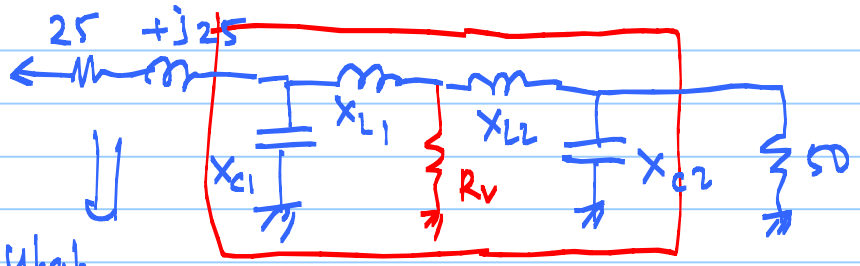
SITT 2010

3. Impedance Matching

Sebuah rangkaian penyesuai impedansi **tipe Π** yang mampu **menahan frekuensi tinggi** akan digunakan untuk menyesuaikan impedansi sumber sebesar **25 + j25 Ω** dengan beban **50 Ω** pada frekuensi 50 MHz dengan faktor kualitas **Q = 5**.

a. **Gambarkan** rangkaian penyesuai impedansi tersebut !

b. Dengan menggunakan **Smith Chart**, hitung nilai **komponen** penyusunnya !

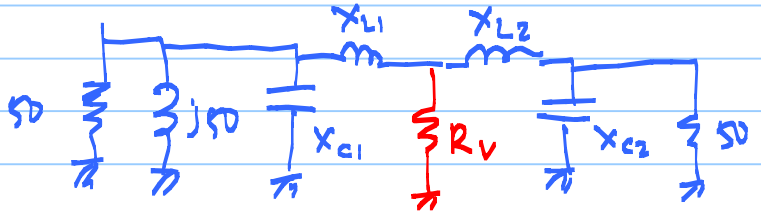


Ubah Paralel

$Q_s = \frac{X_s}{R_s} = \frac{25}{25} = 1$

$R_p = R_s(1+Q^2) = 50$

$X_p = X_s\left(1+\frac{1}{Q^2}\right) = 50$



$Q = \sqrt{\frac{50}{1,92} - 1} = 5$

$Q = \sqrt{\frac{R_{besar}}{R_V} - 1} \rightarrow R_V = \frac{R_{besar}}{1+Q^2} = \frac{50}{1+5^2} = 1,92$

$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{50}{1,92} = 26,04$

$X_{C2} = 26,04$

$C_2 = \frac{1}{2\pi \cdot 50 \cdot 10^6 \cdot 26,04} = 122,2\ pF$

$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = Q \times R_V$

$= 5 \times 1,92 = 9,6$

$X_{L2} = 9,6$

$L_2 = \frac{9,6}{2\pi \cdot 50 \cdot 10^6} = 30,6\ nH$

$$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = 5 \times 1{,}92 = 9{,}6$$

$$X_{L1} = 9{,}6$$

$$L_1 = \frac{9{,}6}{2\pi 50.10^6} = 30{,}6\ nH$$

$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{50}{5} = 10$$

$$-jx_{p1} = -j10$$

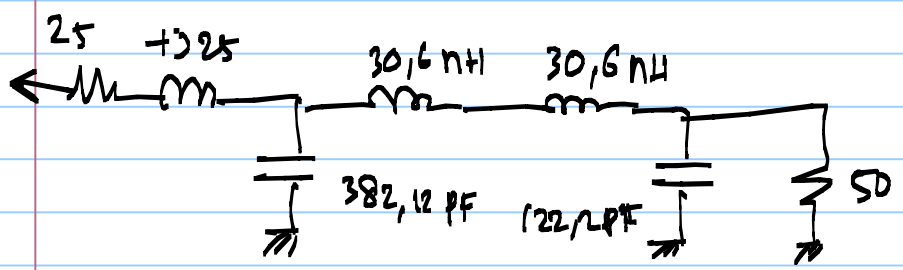
$$-j10 = \frac{j50 \times (-jX_c)}{j50 - jX_c} = \frac{50X_c}{j50 - jX_c} = -j10$$

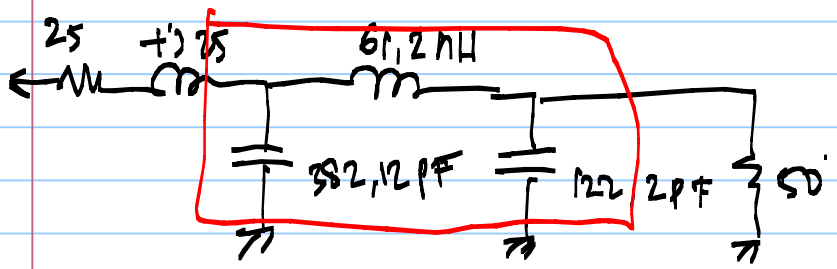
$$50X_c = 500 - 10X_c$$

$$60X_c = 500$$

$$X_c = \frac{500}{60} = 8{,}33$$

$$C_1 = \frac{1}{2\pi.50.10^6.8{,}33} = 382{,}12\ pF$$

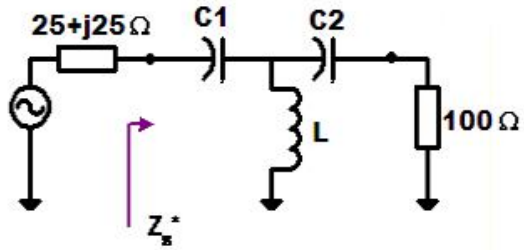


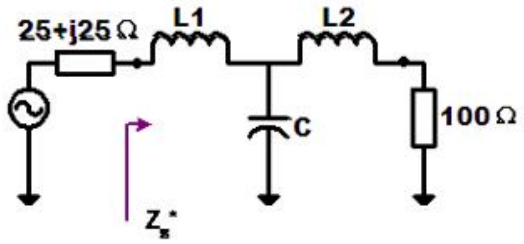


3. **Impedance Matching**

Rancanglah **IMC T-section** dengan **Smith Chart** yang menyepadankan sumber sebesar **(25 + j25) Ω** dengan beban **100 Ω**, pada frekuensi **100 MHz**, dengan faktor kualitas **Q = 2**, dengan ketentuan pengerjaan sebagai berikut :

- Untuk **NIM nomor ganjil** rangkaian harus **bersifat LPF** dan
- Untuk **NIM nomor genap** rangkaian harus **bersifat HPF**.



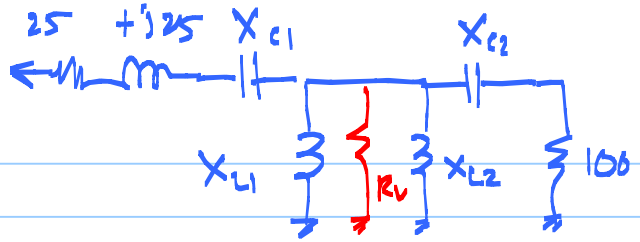


a) Pilih **rangkaian** yang sesuai dengan **NIM** anda, **selain dua kemungkinan gambar di atas !**
b) Tentukan **titik-titik dan pergeseran**nya pada **Smith Chart**, untuk menghitung besarnya induktor dan kapasitor yang diperlukan;
c) Hitung besarnya **induktor** dan **kapasitor** tersebut diatas.

$Q_p = \frac{R_s}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{125}{2} = 62{,}5$

$X_{L1} = 62{,}5$

$L_1 = 62{,}5 / 2\pi \cdot 100 \cdot 10^6 = 99{,}5\ nH$



HPF

$Q = \sqrt{\frac{R_v}{R_{kecil}} - 1} \rightarrow R_v = R_{kecil}(1+Q^2)$

$= 25(1+2^2)$

$= 125$

$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = 2 \times 25$

$= 50$

$-jX_{ct} = -j50$

$-j50 = +j25 - jX_{c1}$

$-jX_{c1} = -j75$

$C_1 = \frac{1}{2\pi \cdot 100 \cdot 10^6 \cdot 75} = 21{,}2\ pF$

$$Q = \sqrt{\frac{R_V}{R_{bruta}} - 1} = \sqrt{\frac{125}{100} - 1} = 0{,}5$$

$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{125}{0{,}5} = 250$$

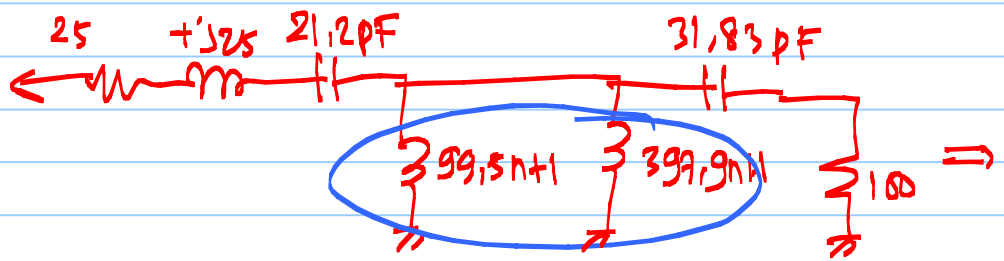
$$X_{L2} = 250$$

$$L_2 = \frac{250}{2\pi \cdot 100 \cdot 10^6} = 397{,}9\ nH$$

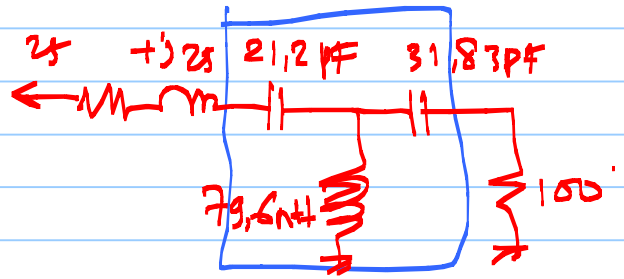
$$Q_1 = \frac{X_1}{R_1} \rightarrow X_1 = Q \times R_1 = 0{,}5 \times 100 = 50$$

$$X_{C2} = 50$$

$$C_2 = \frac{1}{2\pi \cdot 100 \cdot 10^6 \cdot 50} = 31{,}83\ pF$$

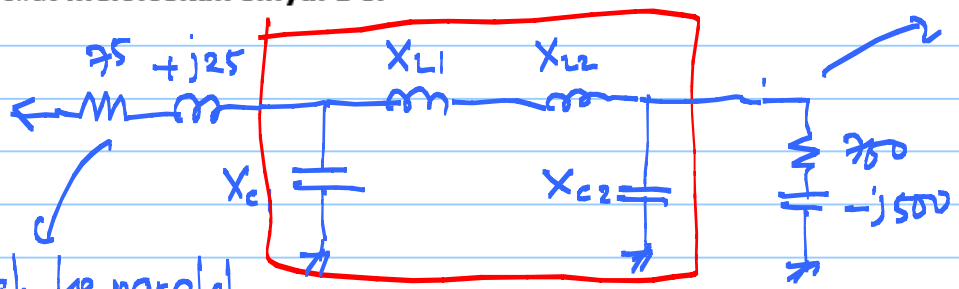


$$L_t = \frac{99{,}5 \times 397{,}9}{99{,}5 + 397{,}9} = 79{,}6\ nH$$



SITT 2007

3. Rancanglah **IMC-Π section** yang menyepadankan sumber sebesar **(75+j25)Ω** dan beban sebesar **(750-j500) Ω** dengan **faktor kualitas 5!** Rangkaian dirancang bekerja pada frekuensi **75 MHz** dan bersifat **meloloskan sinyal DC.**



ubah ke paralel

$Q_s = \frac{X_s}{R_s} = \frac{25}{75} = 0{,}33$

$R_p = R_s(1+Q^2) = 83{,}2$

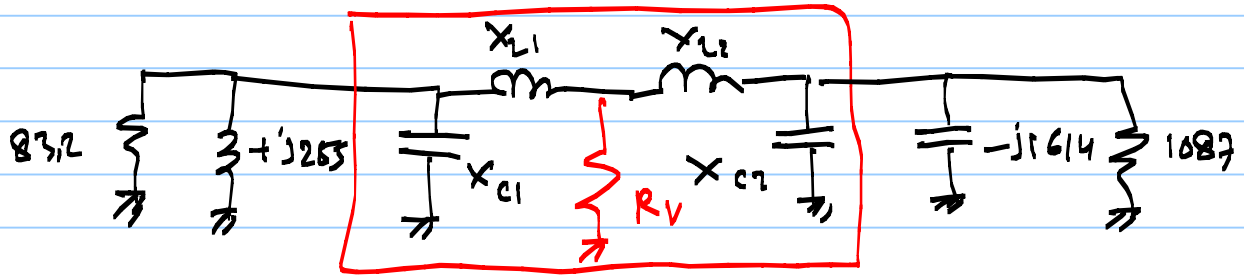
$X_p = X_s\left(1+\frac{1}{Q^2}\right) = 255$

ubah ke paralel

$Q_s = \frac{X_s}{R_s} = \frac{500}{750} = 0{,}67$

$R_p = R_s(1+Q^2) = 1087$

$X_p = X_s\left(1+\frac{1}{Q^2}\right) = 1614$



$Q = \sqrt{\frac{R_{besar}}{R_V} - 1} \rightarrow R_V = \frac{R_{besar}}{1+Q^2} = \frac{1087}{1+5^2} = 41{,}8$

$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{1087}{5^2} = 43{,}48$

$$X_p = \frac{X_{C2} \cdot 1614}{X_{C2} + 1614} = 43{,}48 \rightarrow X_{C2} = \frac{70.176{,}72}{1614 - 43{,}48} = 44{,}68$$

$$C_2 = \frac{1}{2\pi 75.10^6 \cdot 44{,}68} = \boxed{47{,}5\,pF}$$

$$Q_S = \frac{X_S}{R_S} \rightarrow X_S = Q \times R_S = 5 \times 41{,}8 = 209$$

$$X_{L2} = 209$$

$$L_2 = \frac{209}{2\pi \cdot 75.10^6} = \boxed{443{,}5\,nH}$$

$$Q = \sqrt{\frac{R_{val}}{R_V} - 1} = \sqrt{\frac{83{,}2}{41{,}8} - 1} = 0{,}99$$

$$Q_S = \frac{X_S}{R_S} \rightarrow X_S = Q \times R_S = 0{,}99 \times 41{,}8 = 41{,}4$$

$$X_{L1} = 41{,}4$$

$$L_1 = \frac{41{,}4}{2\pi 75.10^6} = \boxed{87{,}85\,nH}$$

$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{83{,}2}{0{,}99} = 84$$

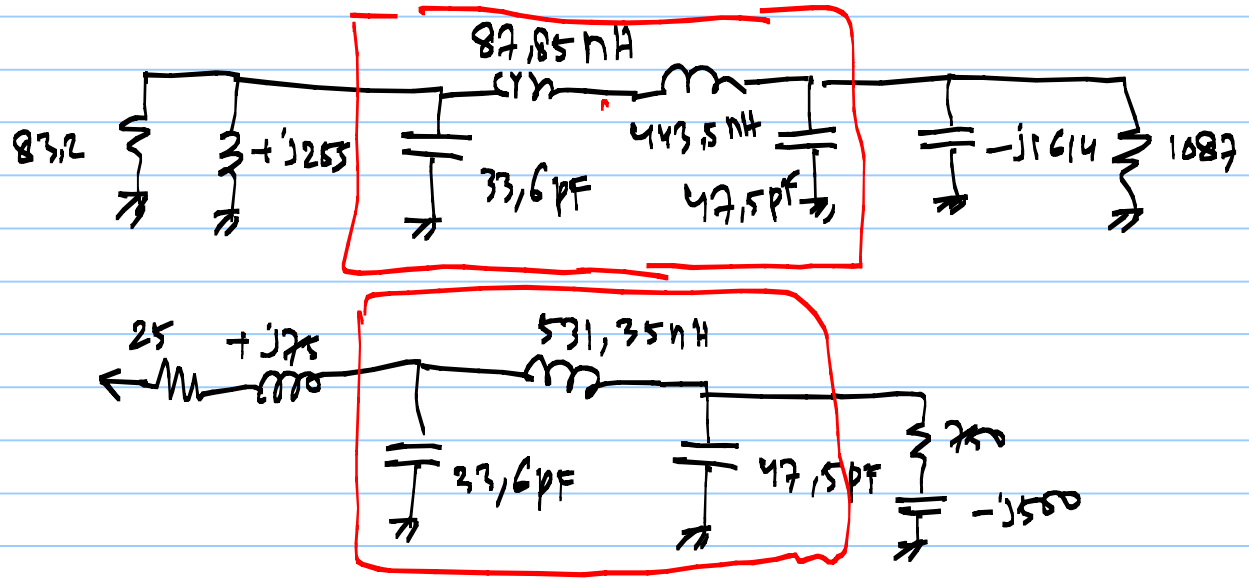
$$X_{ct} = 84$$

$$-jX_{ct} = -j84$$

$$-jX_{ct} = \frac{+j255 \times (-jX_{c1})}{j255 - jX_{c1}} = -j84 \rightarrow 21420 - j84X_{c1} = j255X_{c1}$$

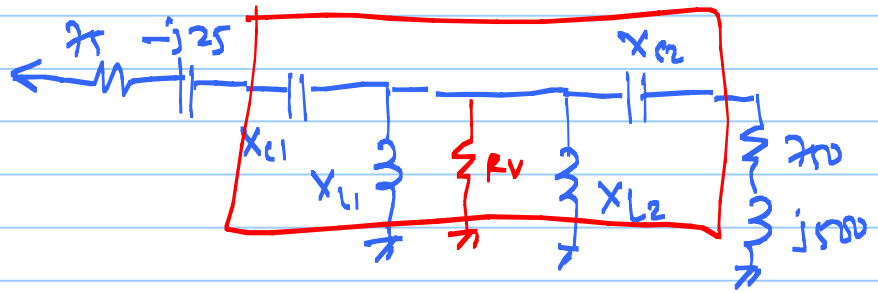
$$X_{c1} = \frac{21420}{j(84+255)} = -j63{,}2$$

$$C_1 = \frac{1}{2\pi \cdot 75 \cdot 10^6 \cdot 63{,}2} = 33{,}6\ pF$$



b. Rancanglah **IMC-T section** yang menyepadankan sumber sebesar **(75-j25)Ω** dan beban sebesar **(750+j500) Ω** dengan **faktor kualitas 5!** Rangkaian dirancang bekerja pada frekuensi **75 MHz** dan bersifat **menghambatnsinyal DC.**

DSTT 2013



$$Q = \sqrt{\frac{R_v}{R_{kecil}} - 1} \Rightarrow R_v = R_{kecil}(1+Q^2)$$
$$= 75(1+5^2) = 1950$$

$$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = 5 \times 75 = 375$$

$$X_{ct} = -j375$$
$$X_{C1} = -j375 + j25 = -j350$$
$$C_1 = \frac{1}{2\pi 75.10^6 .350} = 6{,}1\ pF$$

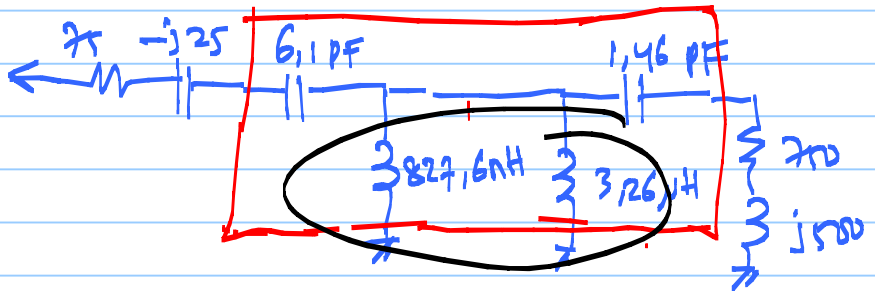
$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{1950}{5} = 390$$
$$X_{L1} = 390$$
$$L_1 = \frac{390}{2\pi .75.10^6} = 827{,}6\ nH$$

$$Q = \sqrt{\frac{R_v}{R_{kecil}} - 1} = \sqrt{\frac{1950}{750} - 1} = 1{,}27$$

$$Q_p = \frac{R_p}{X_p} \rightarrow X_p = \frac{R_p}{Q} = \frac{1950}{1,27} = 1535,4$$

$$X_{L_2} = 1535,4$$

$$L_2 = \frac{1535,4}{2\pi\, 75.10^6} = 3,26\ nH$$



$$L = \frac{0,8276 \cdot 3,26}{0,8276 + 3,26} = 0,66\ nH$$

$$Q_s = \frac{X_s}{R_s} \rightarrow X_s = Q \times R_s = 1,27 \times 750 = 952,5$$

$$-jX_L = -j952,5$$

$$-jX_C = -j952,5 - j500 = -j1452,5$$

$$C_2 = \frac{1}{2\pi\, 75.10^6 \cdot 1452,5} = 1,46\ pF$$