K. J. Somaiya College of Engineering, Mumbai-77
(A Constituent College of Somaiya Vidyavihar University)

Batch: A2 Roll No.: 16010322014
Experiment / assignment / tutorial No. 7
Grade: AA / AB / BB / BC / CC / CD / DD

27/10/25
Signature of the Staff In-charge with date

TITLE: Design of matching network for given load using lumped elements.

AIM: To Design lumped elements (L and C) matching network for given load using Open source "Smith simulation software".

OUTCOME: Analyse and design microwave transmission lines and matching circuits.

Example 1.

Design a single stub matching network for a load of 120+j35 Ω load using single open circuit shunt stub.
Assume characteristics impedance of transmission line & stub as 50 Ω.

Example 2.

Design a matching network for microstrip antenna connected to coaxial cable whose characteristic impedance is 50 Ω input impedance for antenna in 60+j25 Ω
Design single stub using shunt short circuit stub.

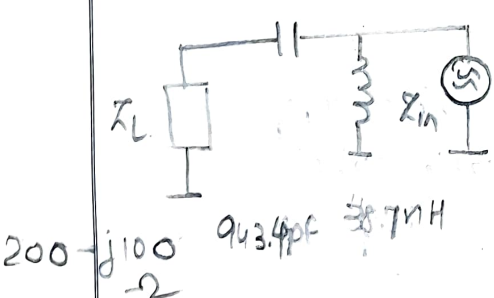
Result:

Sr No.	Theoretical		Simulated	
	Type of element 1 and Value of element 1 From the load end	Type of element 2 and Value of element 2 From the load end	Type of element 1 and Value of element 1 From the load end	Type of element 2 and Value of element 2 From the load end
Example 1	Parallel capacitor 0.95pF	Series Inductor 38.9nH	Parallel capacitor 0.943pF	Series Inductor 38.7nH
Example2	Series capacitor 15.9 pF	Parallel Inductor 3.98 nH	Series Capacitor 15.8pF	Parallel Inductor 4nH

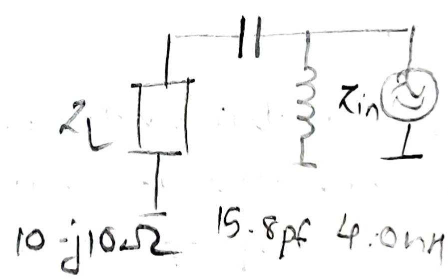
Signature of faculty in-charge

Circuit diagram:

Example 1



Example 2



Design by theoretical method:

...mple 1

...sign L section matching N/W to match series RC load with an impedance $Z_L = (200 - j100)\,\Omega$ to a $100\,\Omega$ line at frequency of 500 MHz

Nature of load → series RC

$Z_L = 200 - j100\,\Omega$

$Z_0 = 100\,\Omega$

$f = 500\,MHz$

Normalized susceptance

$b = \frac{B}{Y_0} = Z_0$

$x = \frac{X}{Z_0}$ → Normalized reactance

I) b is -ve $L = \frac{Z_0}{2\pi f b}$

b is +ve $C = \frac{b}{2\pi f Z_0}$

x is -ve $C = \frac{1}{2\pi f x Z_0}$

x is +ve $L = \frac{x Z_0}{2\pi f}$

$Z_L' = \frac{200 - j100}{100}$

$= 2 - j\,\Omega$

V) $Z_L = R - jX_C$

$R = 200\,\Omega$

$X_C = 100$

$\frac{1}{2\pi f C} = 100$

$C = 3.18\,pF$

$y_d = 0.4 + j0.5\,\Omega$

$jB = y_d - y_2$

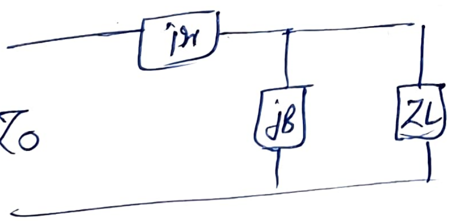
$= j0.3$

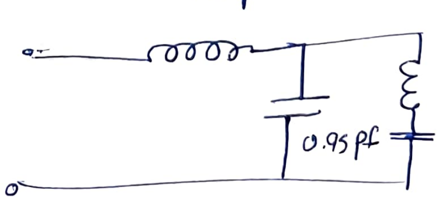
II) $Z_L = 2 - j1$

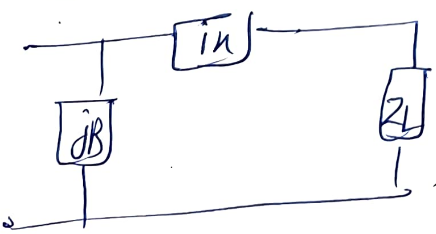
III) $1 + jx$, inside the circle

$C = \frac{B}{2\pi f Z_0} = \frac{0.3}{2\pi(500 \times 10^6) \times 100}$

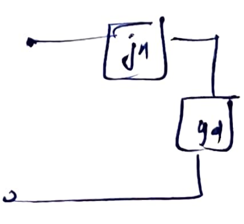
$= 0.95\,pF$







IV) $



$z_d = 1 - j1.2$

$jx = j1.2$

$L = \frac{x Z_0}{2\pi f} = 38.2\,nH$

$y_L = 0.4 + j0.2\,\Omega$

Example 2

Design lumped element matching n/w for

$Z_L = 10 - j10\,\Omega$

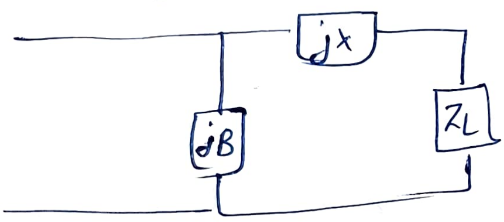
$Z_0 = 50\,\Omega$

$f = 1\,GHz$

$$\bar{Z}_L' = \frac{Z_L}{Z_0} = \frac{10 - j10\,\Omega}{50\,\Omega}$$

$$= 0.2 - j0.2\,\Omega$$

Since, $\bar{z}_L$ lies outside circle, hence matching ckt can be drawn →



$Z_d = jx + \bar{Z}_L$

$Z_d = jx + \bar{Z}_L$ (1+jβ circle)

$= 0.2 - 0.4$

$= -j\,0.2$

b is −ve → $L = \frac{Z_0}{2\pi f_0}$

b is +ve → $C = \frac{b}{2\pi f Z_0}$

x is −ve → $C = \frac{1}{2\pi f x Z_0}$

x is +ve → $L = \frac{x Z_0}{2\pi f}$

$y_d = 1 + 2j$

$jB + y_d = 1$

$jB = 1 - y_d$

$= 1 - 1 - 2j$

$jB = -2j$

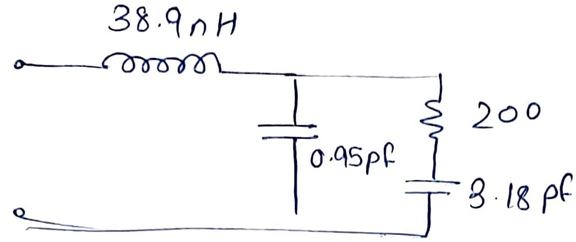
$$C = \frac{1}{2\pi} \times \frac{1}{10^9} \times \frac{1}{0.2 \times 50}$$

$= 15.9\,pF$

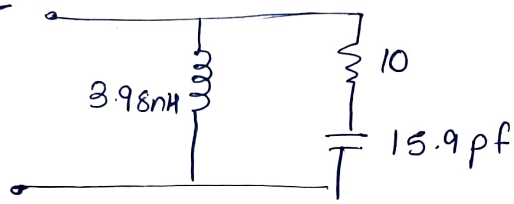
$$L = \frac{Z_0}{2\pi f_b} = \frac{50}{2\pi \times 10^9 \times 2}$$

$= 3.98\,nH$

Ex 1



Ex 2

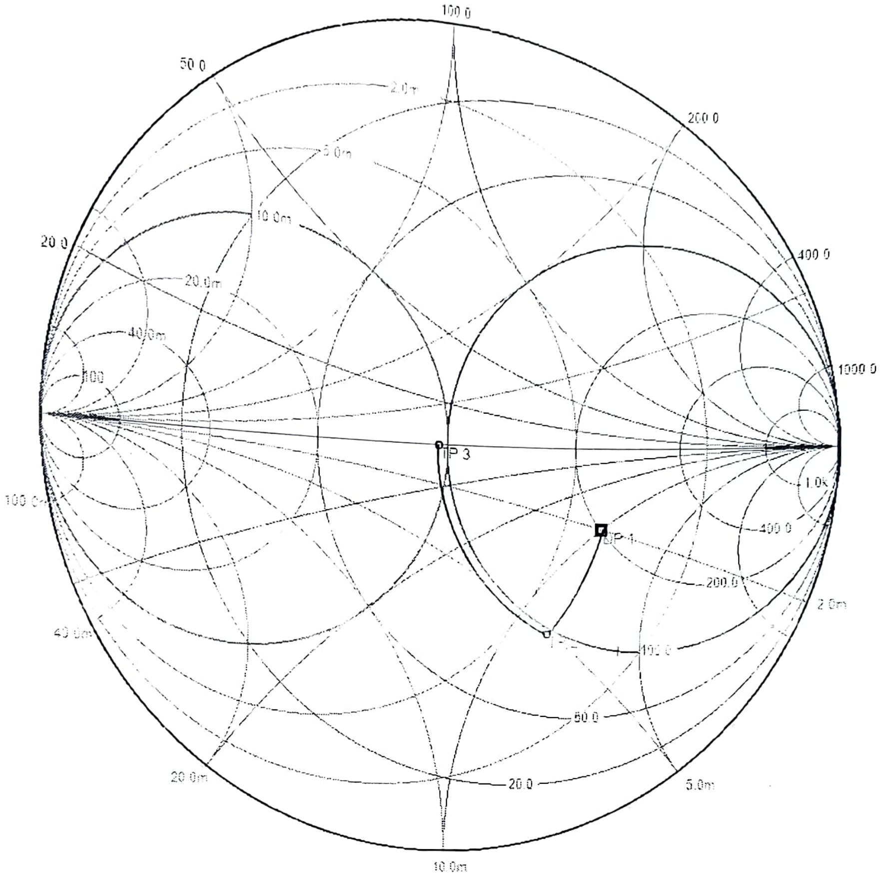


Conclusion:

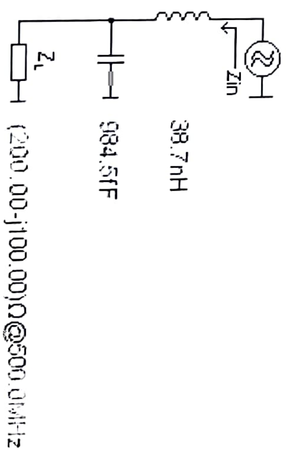
(Compare results by Smith chart method and Simulation)

In this experiment, we have designed lumped elements (L and C) matching network for given load using open source "Smith simulation Software" and also verified the results theoretically. It has been observed that there was a slight change in the results after simulation in software as compared to theoretical calculations but they are close enough.

Q1



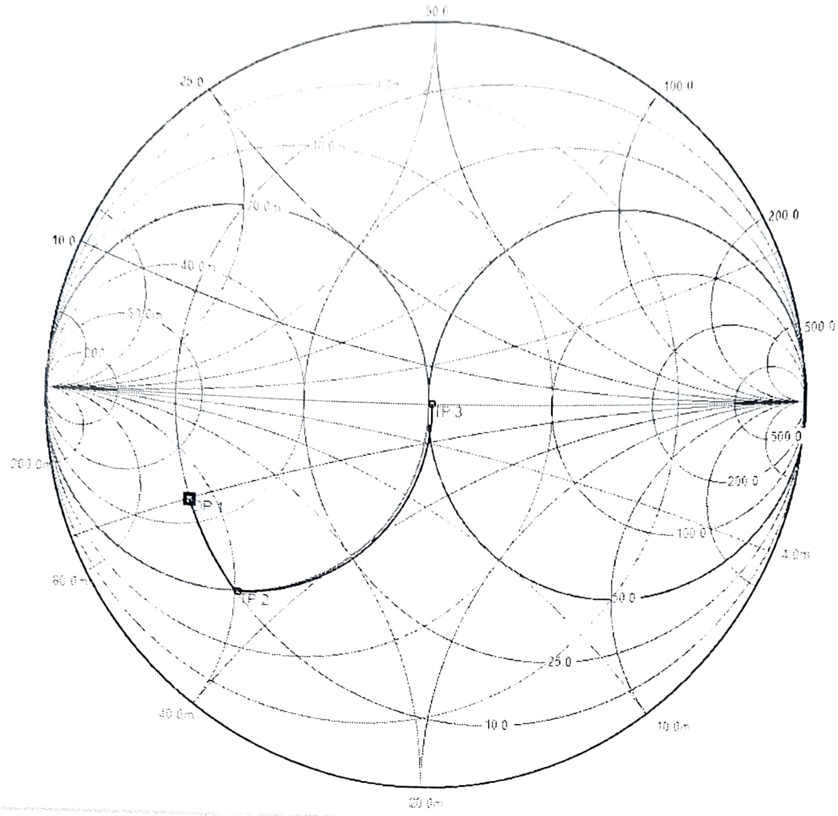
Schematic



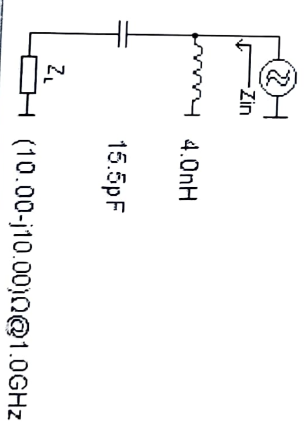
Datapoints

Start DP	Point	Z	Q	Frequency
✓	DP 1	(200.000 - j100.000) Ω	Q=0.500	500.000MHz
	TP 2	(95.380 - j121.440) Ω	Q=1.273	500.000MHz
	TP 3	(95.380 - j0.000) Ω	Q=0.000	500.000MHz

Q2



Schematic



Datapoints

Start DP	Point	Z	Q	Frequency
✓	DP 1	(10.000 - j10.000) Ω	Q=1.000	1.000GHz
	TP 2	(10.000 - j20.275) Ω	Q=2.027	1.000GHz
	TP 3	(51.105 + j0.262) Ω	Q=0.005	1.000GHz