Teknik Transmisi Radio

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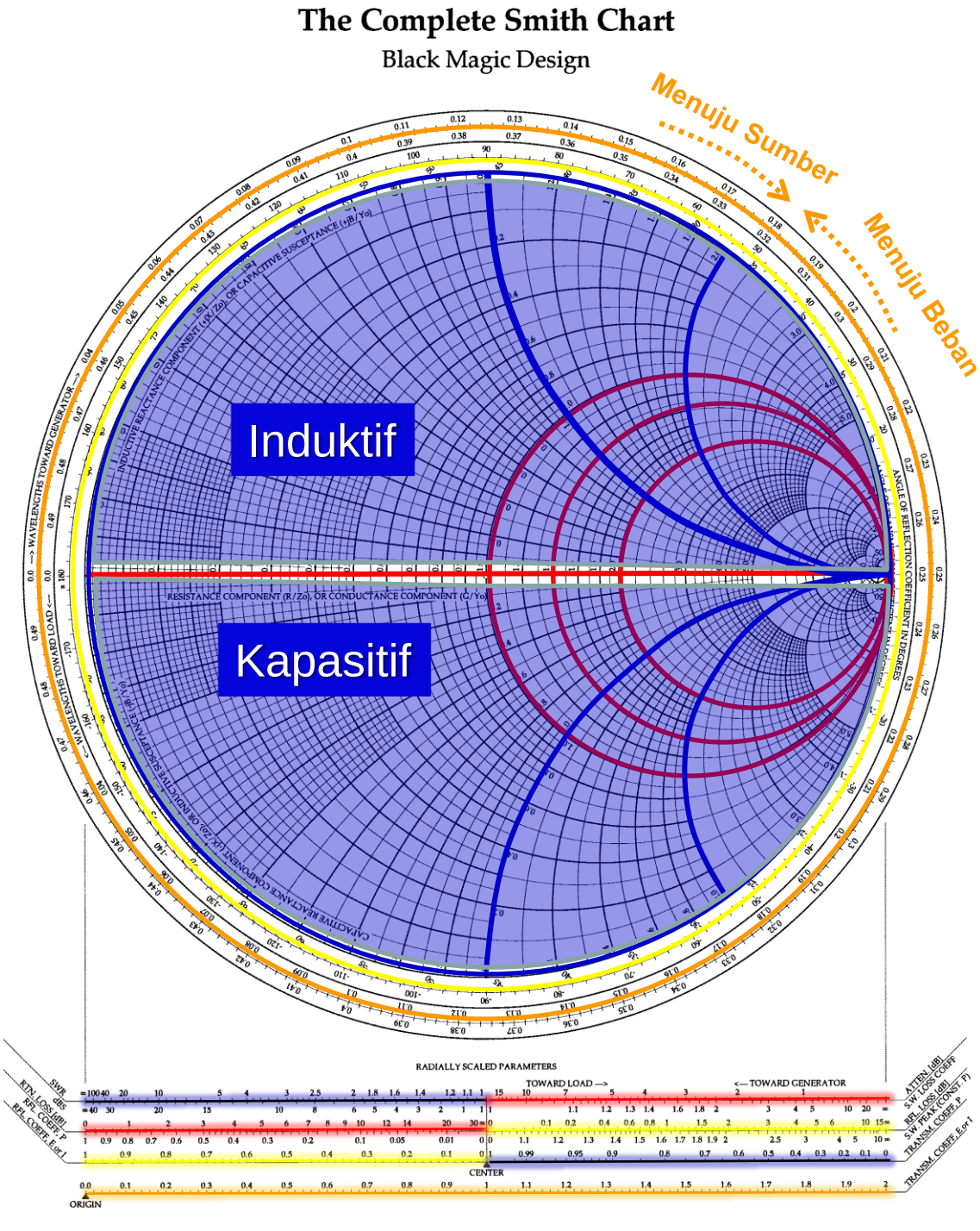
8. SMITH CHART

(Pengenalan dan Aplikasinya)



PENGENALAN SMITH CHART

Skala Resistansi (bagian Real)

Skala Reaktansi (bagian imajiner)

Skala Sudut Koefisien Pantul dan Koefisien Terus

Skala Posisi Jarak dalam Saluran transmisi (dalam λ)

Skala SWR –Skala logaritmik SWR (dBs)

Skala Return Loss(dB) – Koefisien Pantul Daya

Skala Magnitude Koefisien Pantul tegangan atau Arus

Skala Magnitude Koefisien Terus Tegangan atau Arus

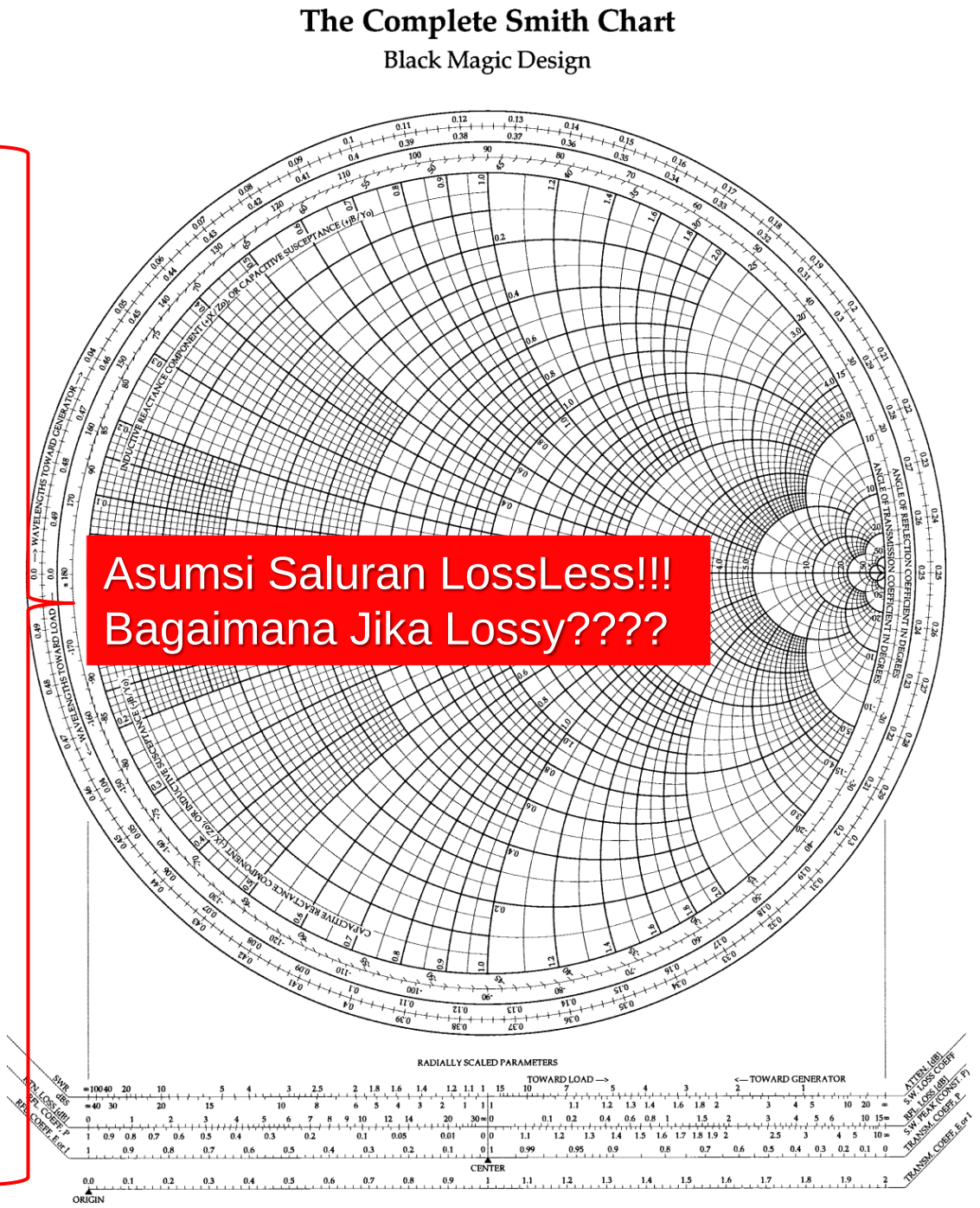
Skala Redaman (dB) →Untuk Saluran Lossy

Skala Missmatch Loss (dB)

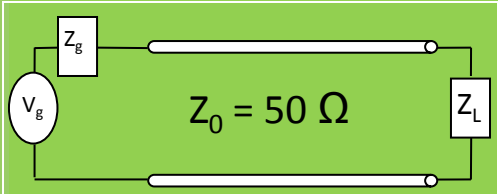
Skala Koefisien Terus Daya

USING SMITH CHART : What Can We Do??

- Mengeplot Impedansi Beban dan Admitansi Beban
- Menentukan SWR, Koefisien Pantul, Return Loss, Missmatch Loss pada titik di saluran transmisi.
- Menentukan Impedansi Input (Zin) jika beban diketahui, sekaligus menentukan Koefisien pantul input, return loss input dll.
- Menentukan Impedansi Beban jika Impedansi Input diketahui.
- Menentukan Panjang saluran jika Kondisi di beban dan di input saluran diketahui
- Merancang Trafo λ/4
- Merancang Stub Tunggal (seri/paralel)
- Merancang Stub Ganda (Seri/paralel)
- Merancang Lumped Elemen-Matching Impedance
- Dll



Mengeplot Impedansi dan Admitansi beban



Plot ZL dan YL jika :

1. ZL = SC
2. ZL = OC
3. ZL = 100 + J100 **Ω**
4. ZL= 100 –J100 **Ω**
5. ZL = 75 **Ω**
6. ZL = -J25 **Ω**

Note :

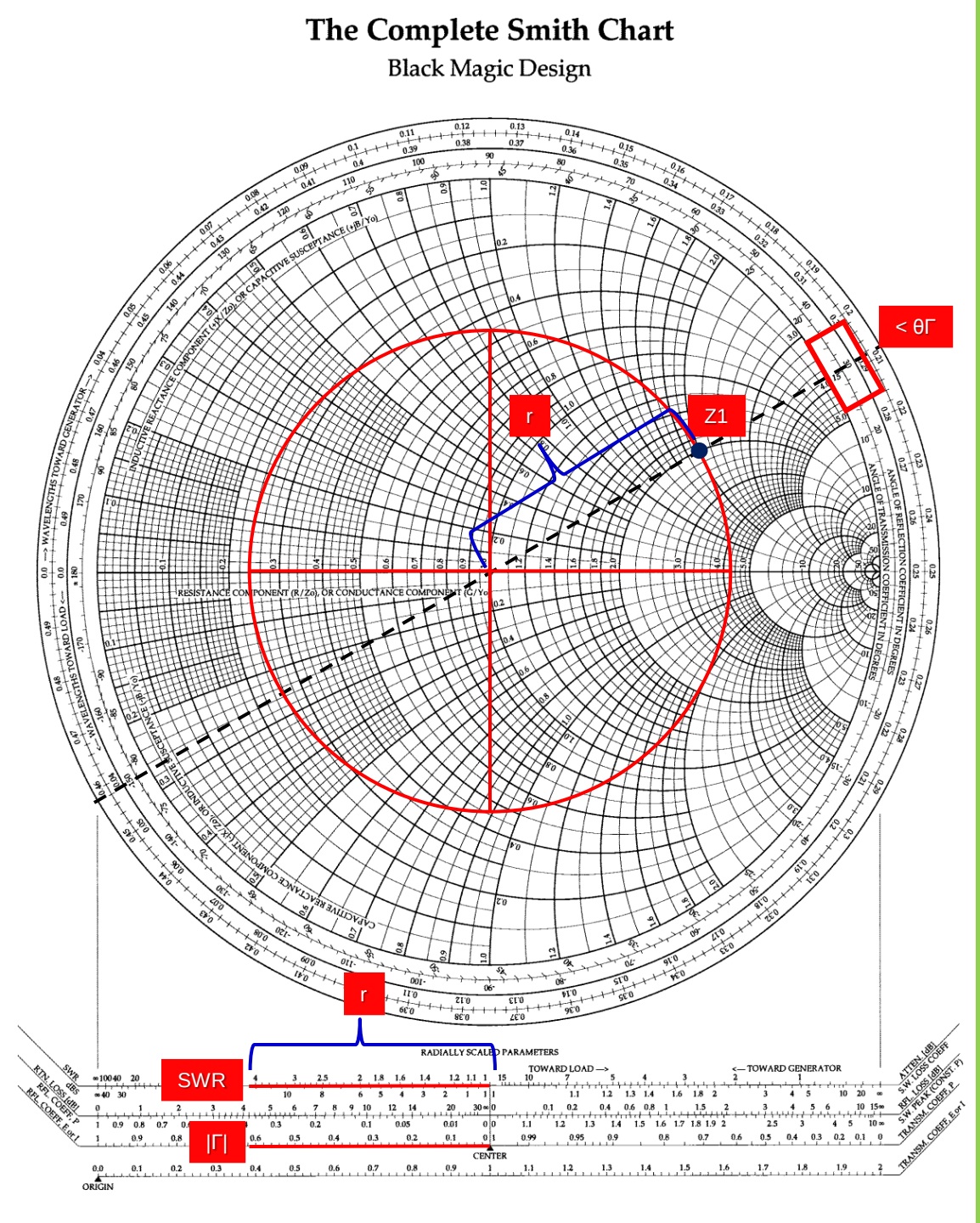
Sebelum diplot pada smith chart, Impedansi harus dinormalisasi terlebih dulu terhadap Z0

$$ZL_N = \frac{ZL}{Z0}$$

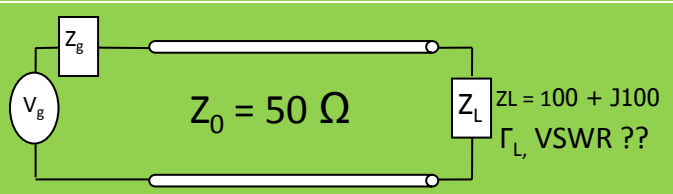
Begitu juga dengan Admitansi harus dinormalisasi terlebih dulu terhadap Y0

$$YL_N = \frac{YL}{Y0}$$

Proses Denormalisasi harus dilakukan untuk mendapat impedansi/admitansi yang sebenarnya



Menentukan SWR, koefisien pantul, RL, Mismatch Loss Dll

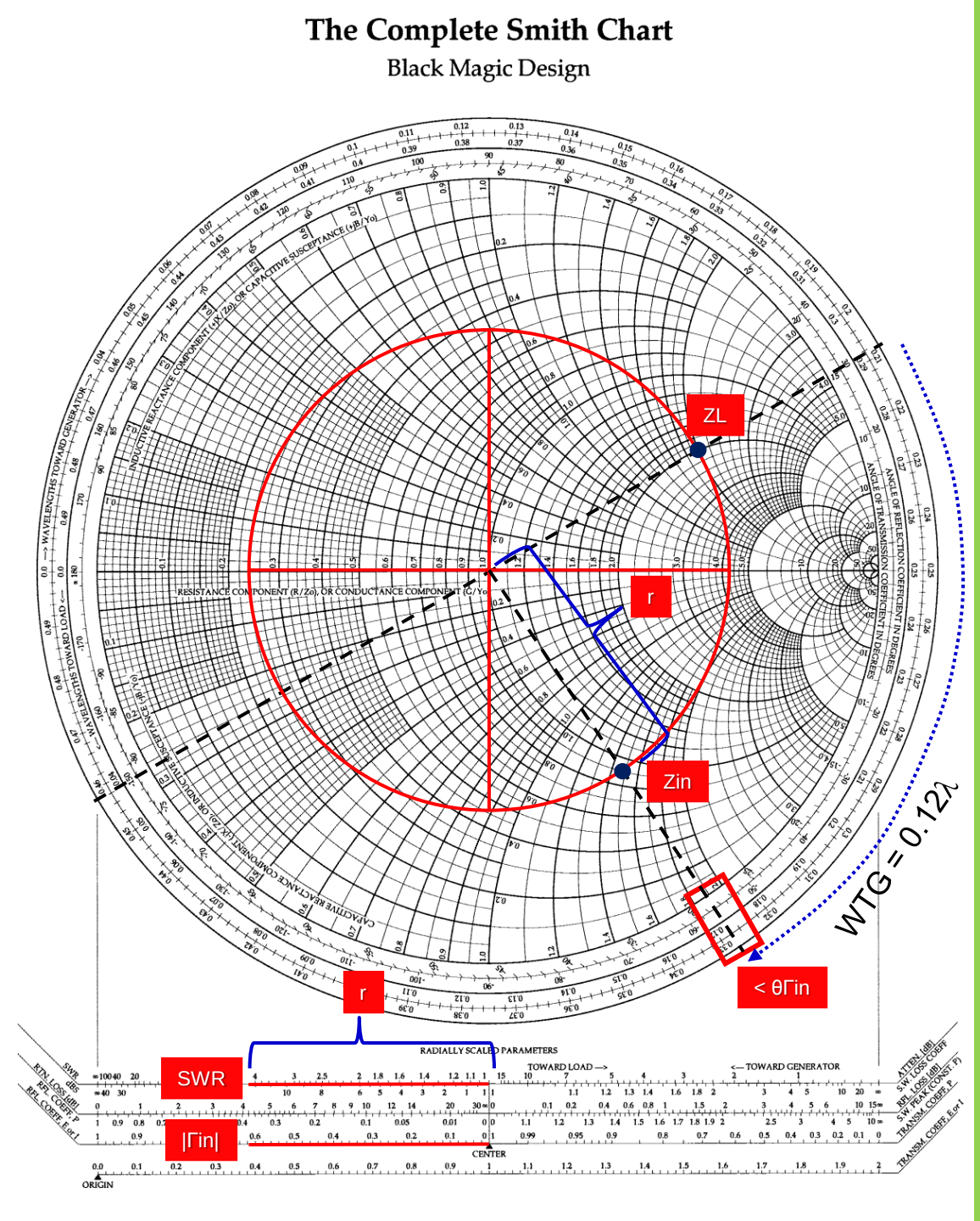


Suatu saluran transmisi Z0 =50 **Ω** diterminasi dengan beban ZL = 100 + J100.
Tentukan VSWR dan Koefisien pantul di Beban?

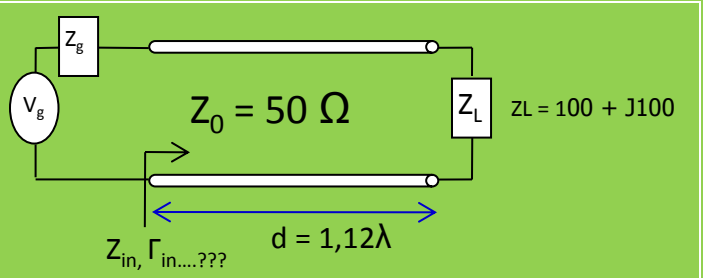
Solusi

$VSWR = 4{,}2$

$\Gamma_L = 0{,}62\angle 30°$



Menentukan Impedansi Input (Zin) dan Koefisien pantul input (Γin)

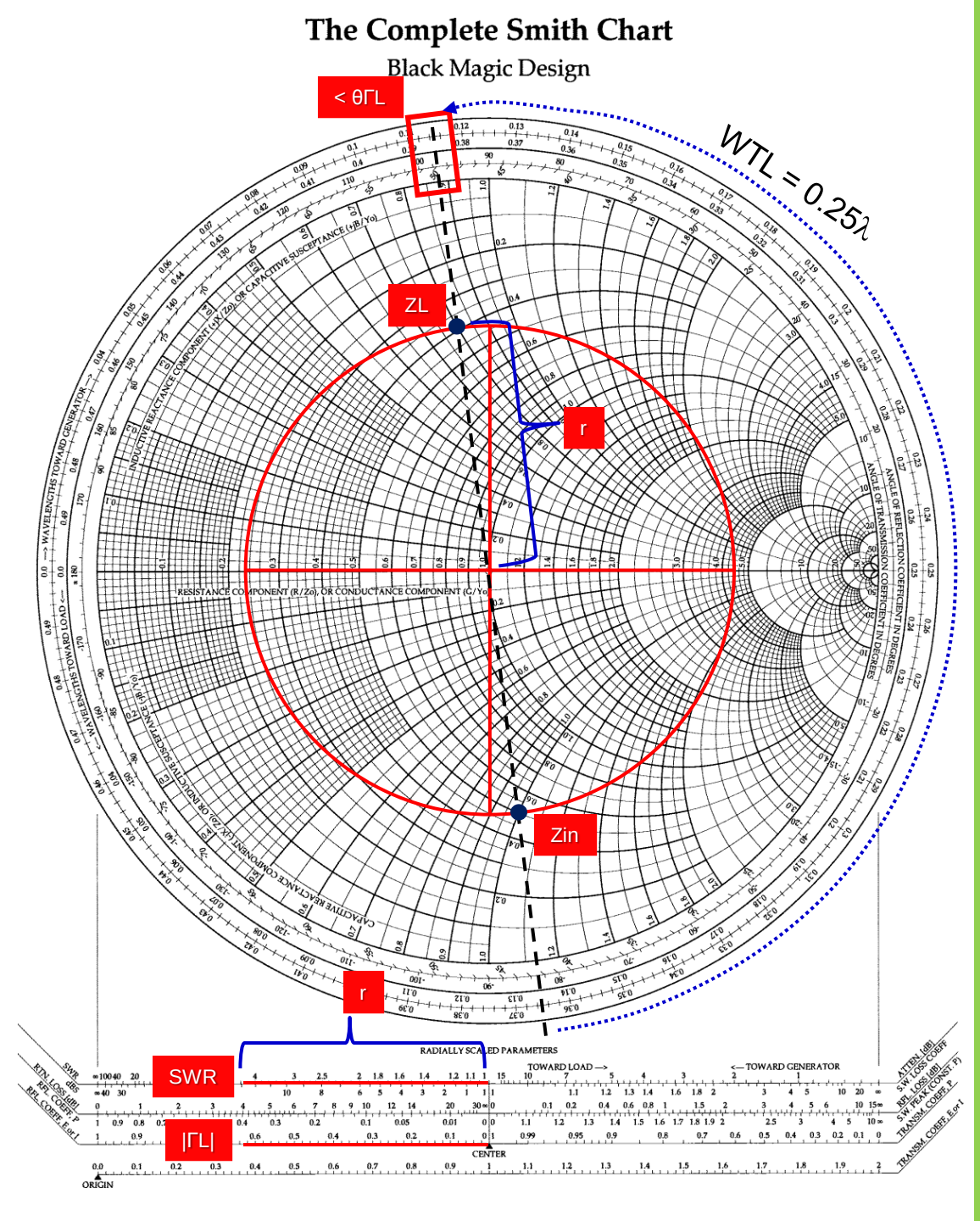


Suatu saluran transmisi Z0 =50 **Ω** diterminasi dengan beban ZL = 100 + J100.
Tentukan Impedansi Input (Zin) dan Koefisien pantul input **(Γin)** pada jarak 1,12λ dari beban?

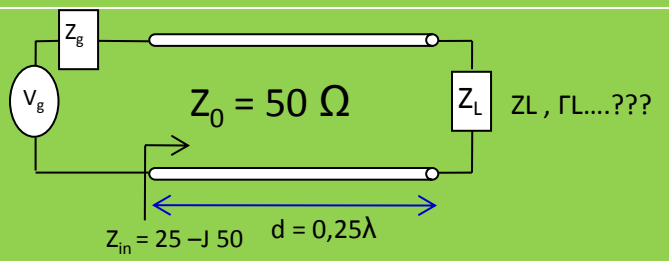
Solusi

$$Zin_n = 0{,}9 - J1{,}5 \Rightarrow Zin = (0{,}9 - J1{,}5) \times 50$$
$$\Rightarrow Zin = 45 - J75$$

$$\Gamma_{in} = 0{,}62 \angle -56°$$



Menentukan Impedansi beban dan koefisien pantul beban Jika Impedansi Input (Zin) Diketahui



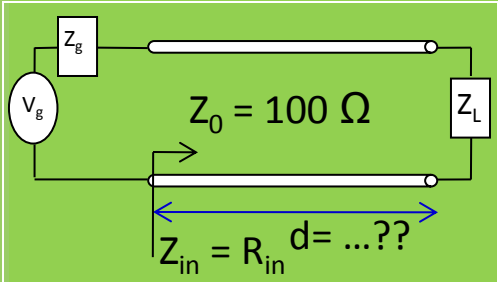
Suatu saluran transmisi Z0 =50 **Ω** diketahui impedansi input sebesar 25 – J50.
Tentukan Impedansi Beban (ZL) dan Koefisien pantul di beban **(ΓL)** Jika panjang saluran 0,25λ?

Solusi

$$ZL_n = 0{,}4 + J0{,}8 \Rightarrow ZL = (0{,}4 + J0{,}8) \times 50$$
$$\Rightarrow ZL = 20 + J40$$

$$\Gamma_L = 0{,}63 \angle 97°$$

Mencari Panjang Saluran

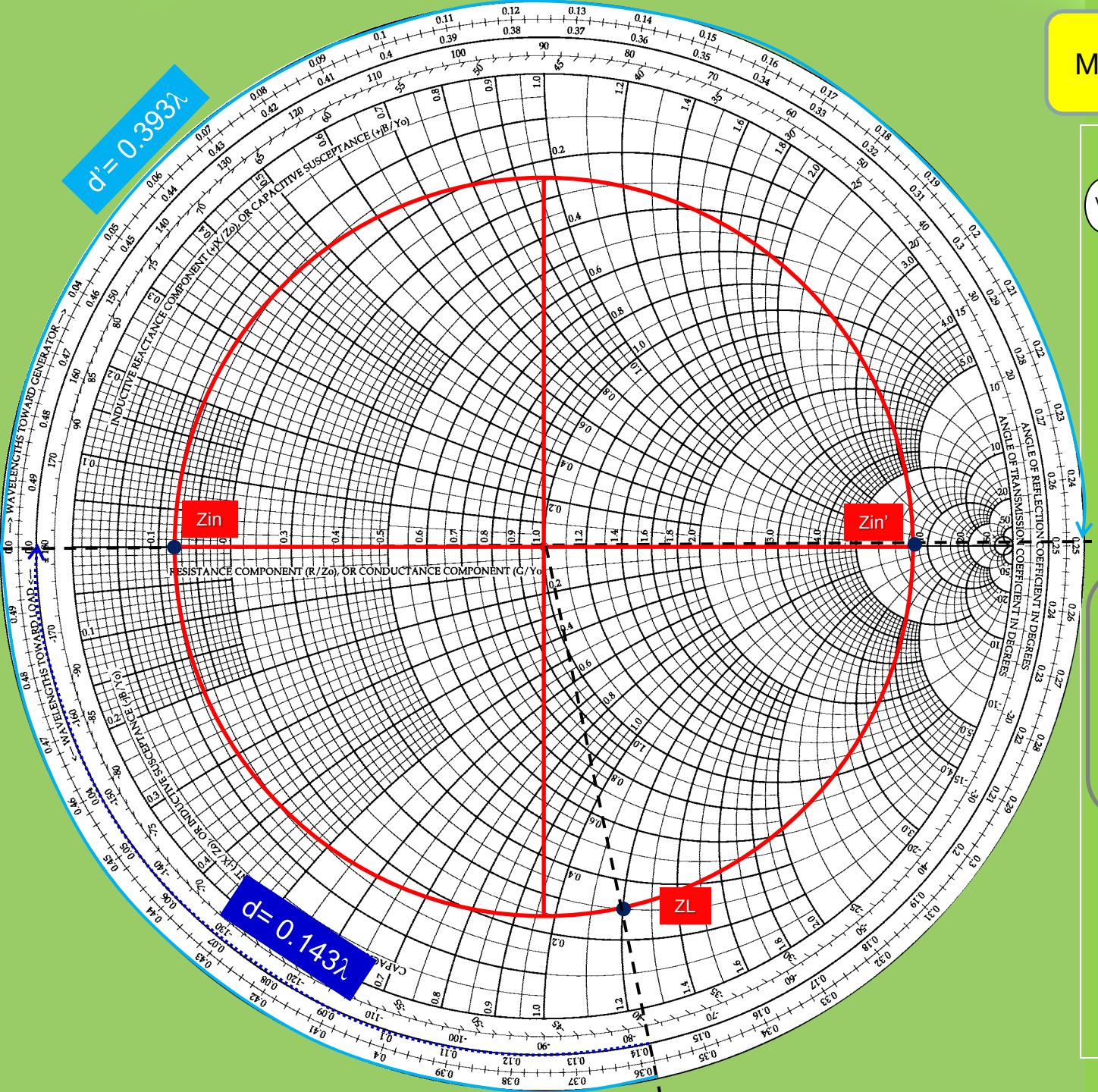


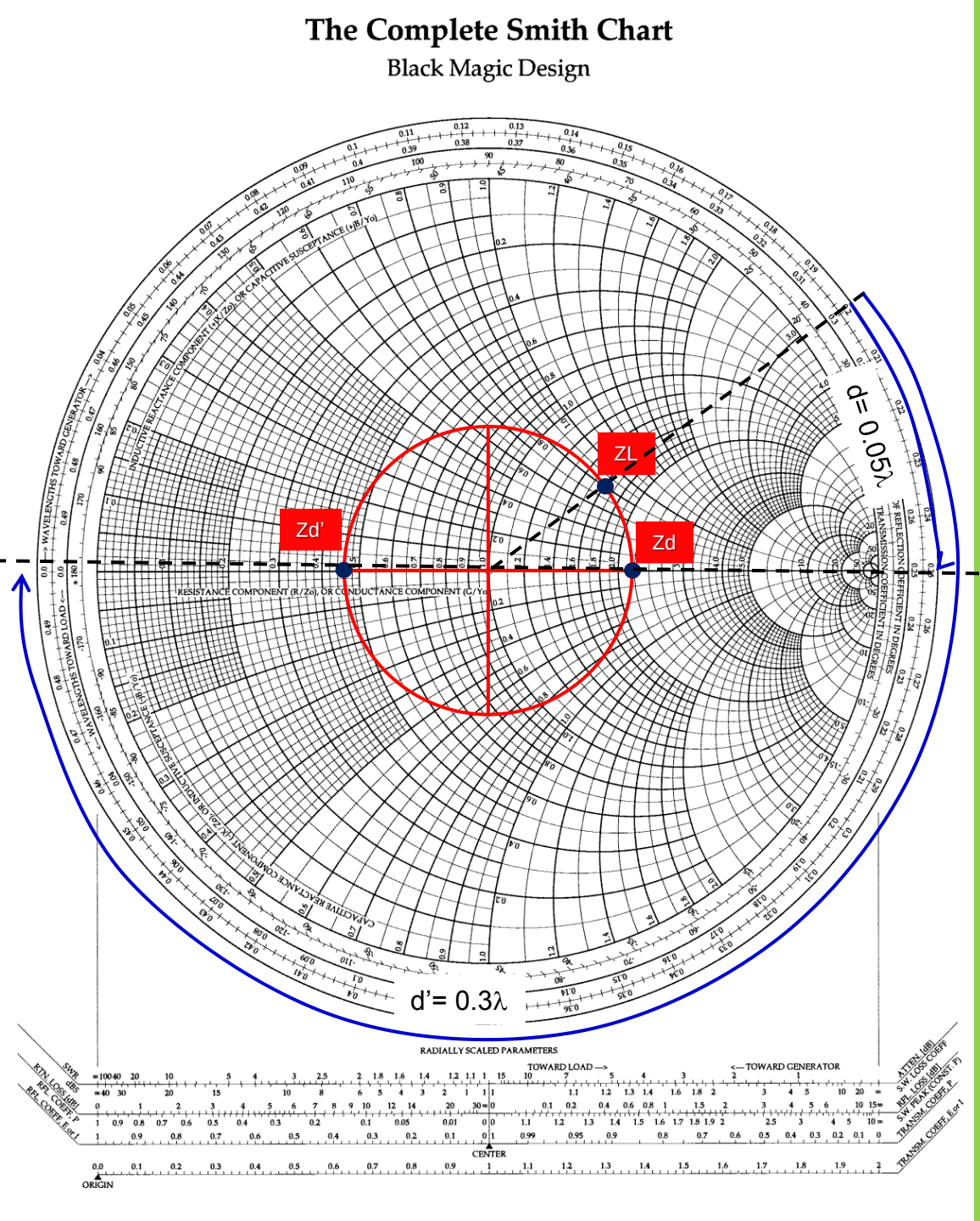
Suatu saluran Z0=100**Ω,** diterminasi dengan beban 30-J120. Tentukan Panjang Saluran agar Zin Resistif Murni?

Solusi

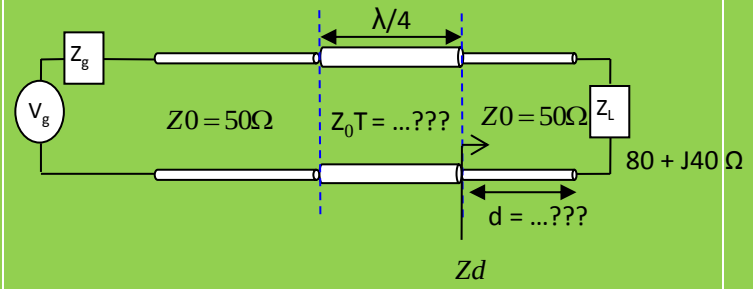
$d = 0{,}143\lambda$

$d' = 0{,}393\lambda$





Mendesain Matching Impedance dengan Trafo λ/4 satu tingkat



Suatu saluran transmisi Z0 =50 **Ω** Diterminasi dengan beban 80 + J40. Desain matching Impedance dengan trafo **λ**/4 (tentukan jarak pemasangan trafo dan impedansi karakteristik trafo yang diperlukan?

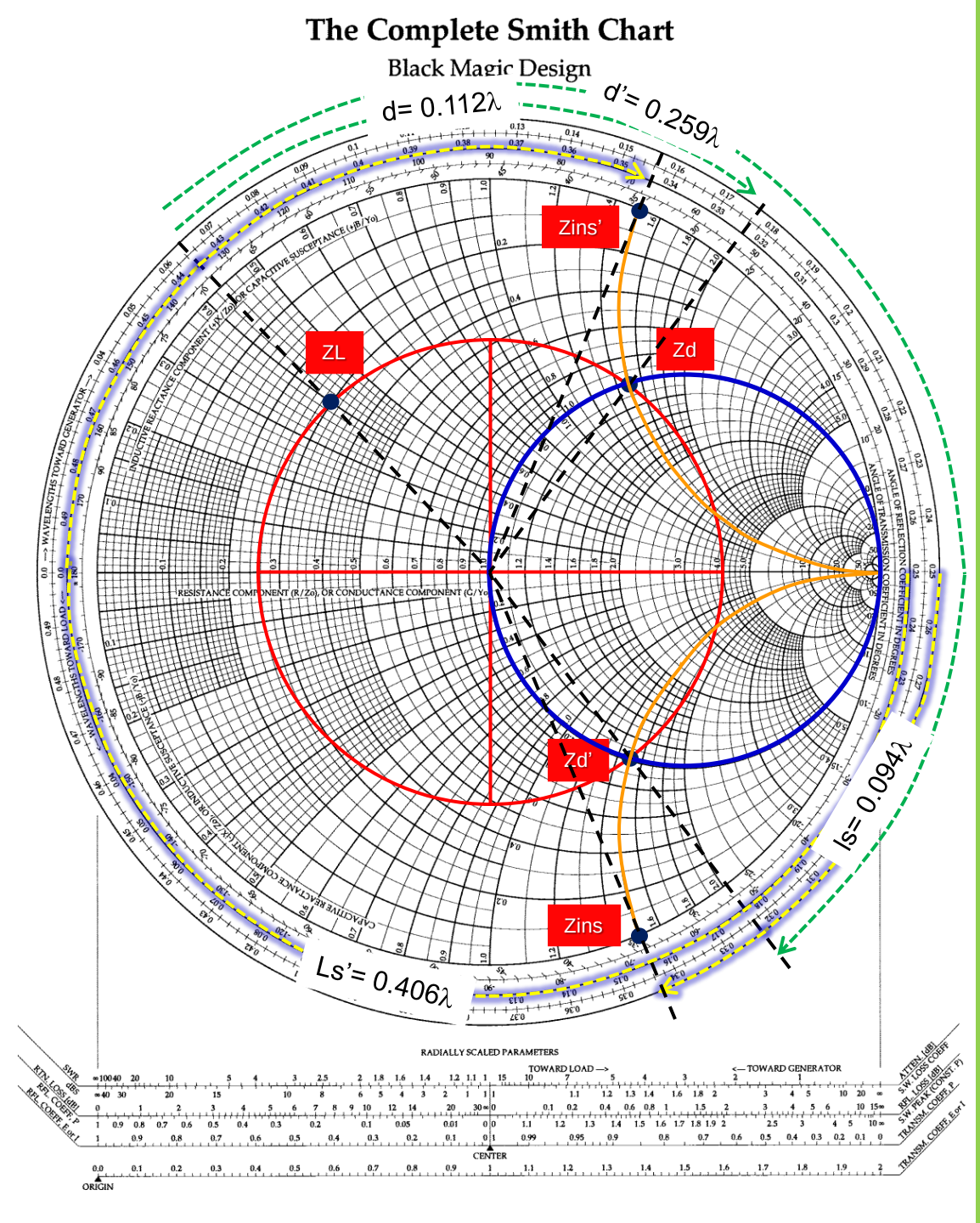
Solusi

$d = 0{,}05\lambda$

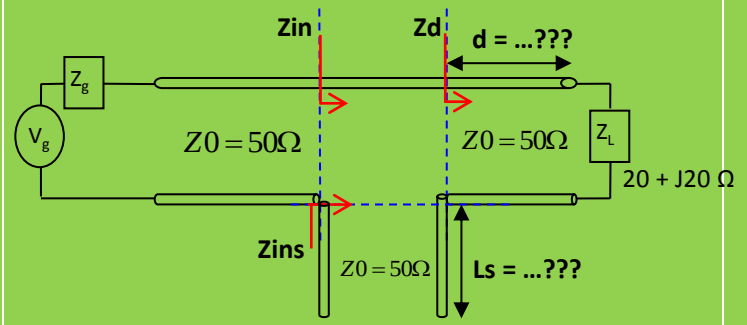
$d' = 0{,}3\lambda$

$Zd_n = 2{,}2 \Rightarrow Zd = 110\ \Omega \Leftrightarrow Z_0T = \sqrt{110 \times 50} = 74{,}16\ \Omega$

$Zd_n' = 0{,}46 \Rightarrow Zd' = 23\ \Omega \Leftrightarrow Z_0T' = \sqrt{23 \times 50} = 33{,}91\ \Omega$



Mendesain stub tunggal seri Open Circuit



Suatu saluran transmisi Z0 =50 **Ω** Diterminasi dengan beban 20 + J20. Desain matching Impedance dengan stub tunggal seri OC (tentukan jarak pemasangan stub (d) dan panjang stub (ls)?

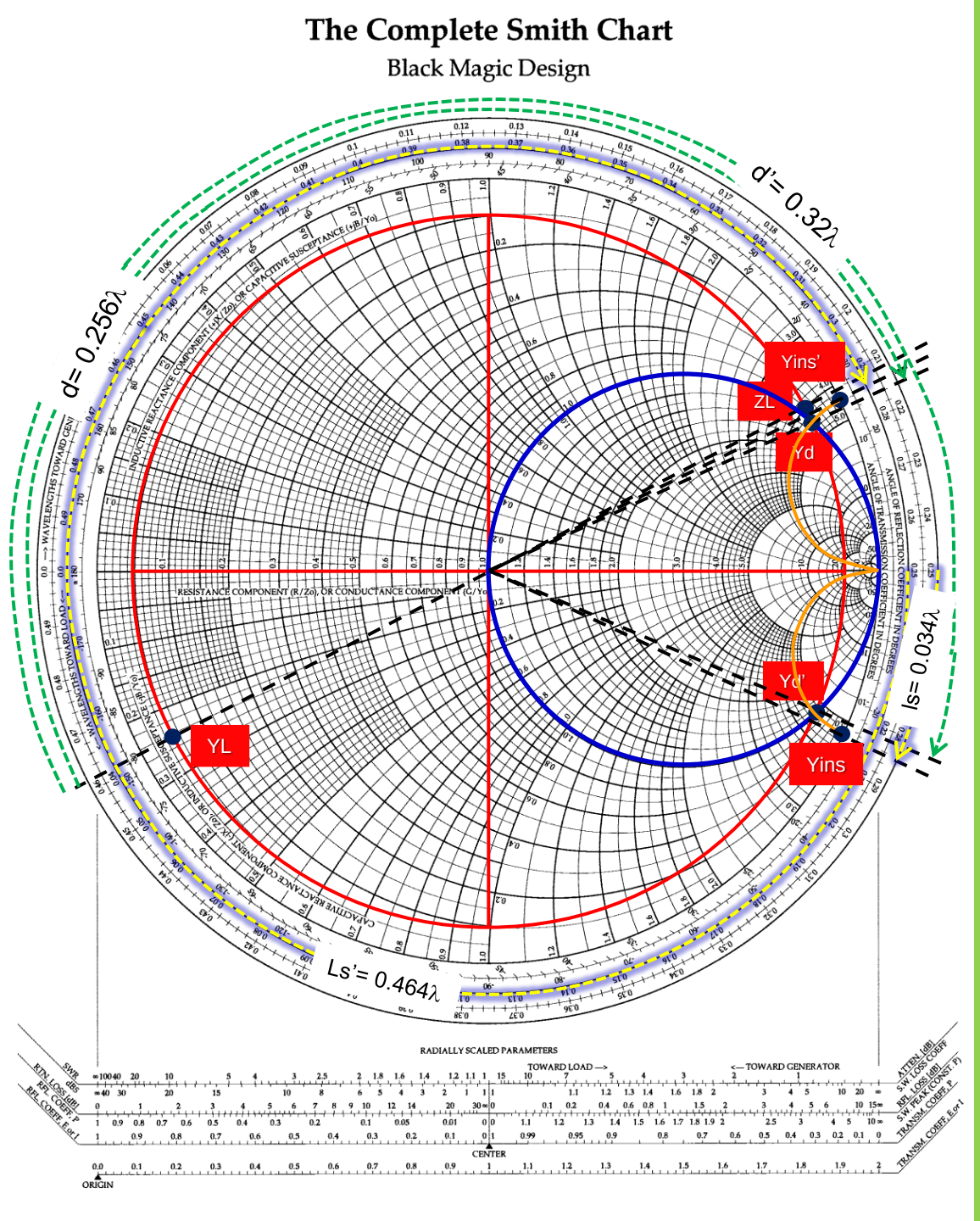
Solusi

$d = 0{,}112\lambda$

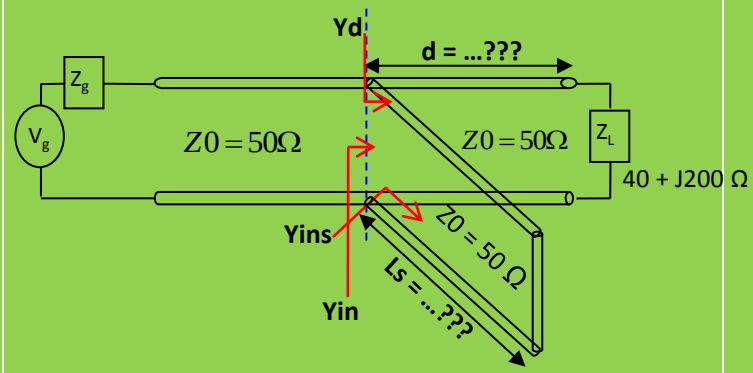
$d' = 0{,}259\lambda$

$ls = 0{,}094\lambda$

$ls' = 0{,}406\lambda$



Mendesain stub tunggal Parallel Short Circuit

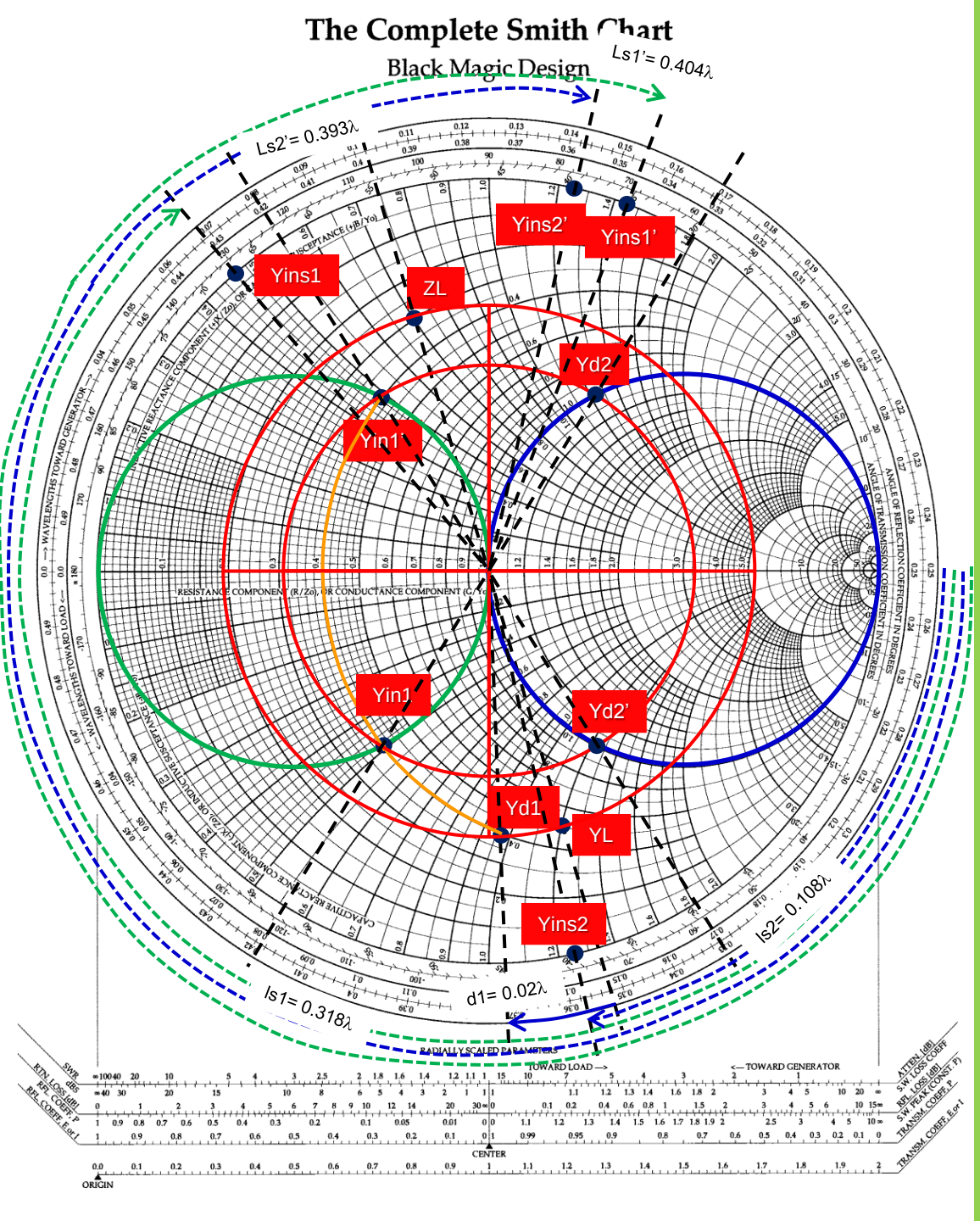


Suatu saluran transmisi Z0 =50 **Ω** Diterminasi dengan beban 40 + J200. Desain matching Impedance dengan stub tunggal parallel SC (tentukan jarak pemasangan stub (d) dan ipanjang stub yang diperlukan (ls)?

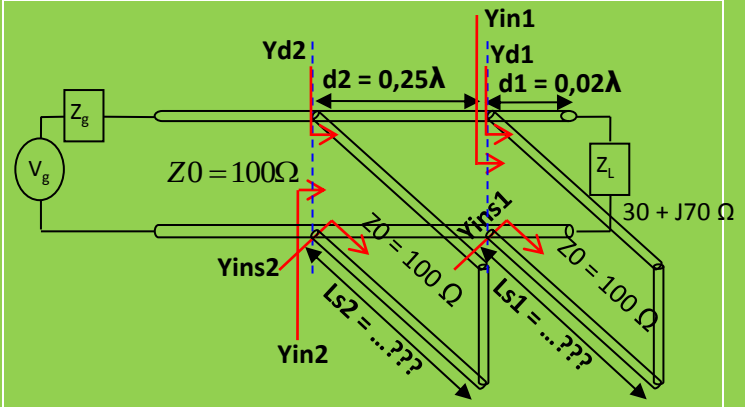
Solusi

$$d = 0{,}256\lambda$$
$$d' = 0{,}32\lambda$$

$$ls = 0{,}034\lambda$$
$$ls' = 0{,}464\lambda$$



Mendesain stub ganda Parallel Short Circuit



Suatu saluran transmisi Z0 =100 **Ω** Diterminasi dengan beban 30 + J70. Desain matching Impedance dengan stub ganda parallel SC(tentukan panjang stub 1 (ls1) dan stub 2 (ls2)?

Solusi

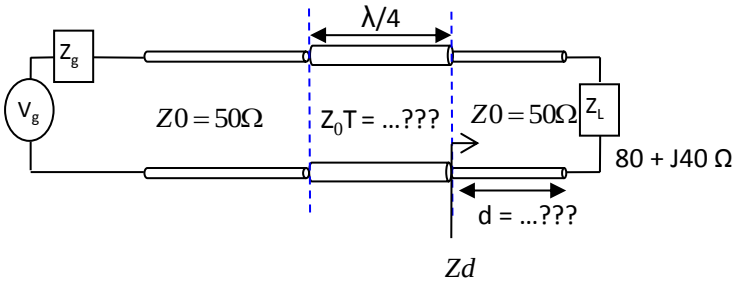
$Yd1 = 0,4 - j0,95$
$Yin1 = 0,4 - j0,49$
→ $Yins1 = j0,46$

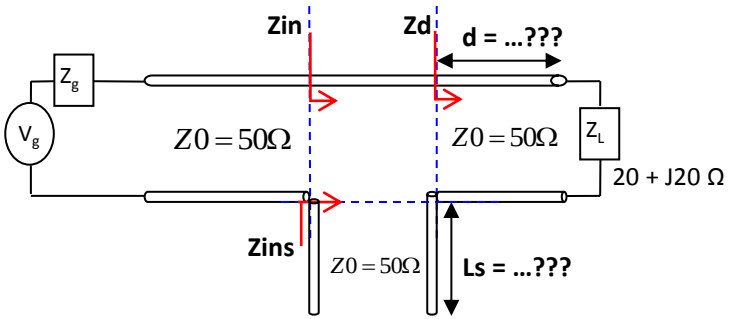
$Yd1 = 0,4 - j0,95$
$Yin1' = 0,4 + j0,49$
→ $Yins1 = j1,44$

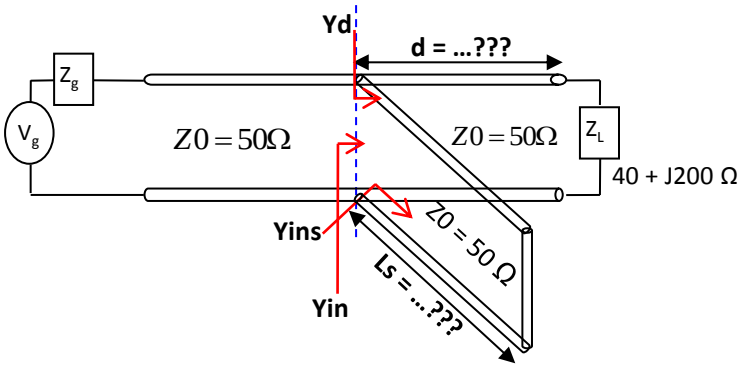
$Yd2 = 1 + j1,25 \Rightarrow Yins2 = -j1,25$
$Yd2' = 1 - j1,25 \Rightarrow Yins2' = j1,25$

$ls1 = 0,318\lambda$
$ls1' = 0,404\lambda$

$ls2 = 0,108\lambda$
$ls2' = 0,393\lambda$


λ/4
Zg
Vg
Z0 = 50Ω
Z0T = ...???
Z0 = 50Ω
ZL
80 + J40 Ω
d = ...???
Zd


Zin
Zd
d = ...???
Zg
Vg
Z0 = 50Ω
Z0 = 50Ω
ZL
20 + J20 Ω
Zins
Z0 = 50Ω
Ls = ...???


Yd
d = ...???
Zg
Vg
Z0 = 50Ω
Z0 = 50Ω
ZL
40 + J200 Ω
Yins
Z0 = 50 Ω
Ls = ...???
Yin

Latihan (PR)

1. A load, ZL= 50 + j100Ωis connected to a lossfree line with Zo=50Ω and ε_r= 2.25. The frequency is 2000 MHz.
   a) What will be the input impedance for a line length of 1,5 cm?
   b) The line length is adjusted so that the input impedance is purely resistive. What will the be the line length and input impedance (two cases)?
2. A lossfree line with Zo = 100Ωterminates in a load impedance of Z.This gives a standing-wave ratio of 4 and a first voltage maximum at a distance of λ/4 from the load.
   a) Calculate Z
   b) What will be the input impedance, Zin, and the line length (expressed in wavelengths) if it is adjusted so that Zin is purely resistive (two values of Zin)?
3. signal generator has an internal impedance of 50 Ω. It needs to feed equal power through a lossless 50 Ω transmission line to two separate resistive loads of 64 Ω and 25 Ω at a frequency of 10 MHz. Quarter-wave transformers are used to match the loads to the 50 Ω line.
   (a) Determine the required characteristic impedances
   (b) Determine the physical lengths of the quarter-wavelength lines assuming the phase velocities of the waves traveling on the them is 0.5c.
4. 50 Ωlossless transmission line is connected to a load impedance ZL=35-j47.5 Ω. Find the position **d** and length **l** of a short-circuit stub required to match the load at a frequency of 200 MHz. Assume that the transmission line is a coaxial line filled with a dielectric material for which εr= 9
5. Match a load impedance, Zl=50+j50Ω, to a line with Zo=50Ω, using two shunt-stubs (lines with an adjustable short-circuited position). One stub is placed at the load end and the other at a distance from it of λ/8.

Questions???