$$K = |K| e^{j\phi}$$

$$\frac{a}{b} = |K| e^{j\phi}$$

$$a = b|K| e^{j\phi}$$

$$V_x = b e^{j\beta y} + b|K| e^{j\phi} e^{-j\beta y}$$

$$= b e^{j\beta y} \{1 + |K| e^{j\phi} e^{-j2\beta y}\}$$

taking only modulus

$$|V_x| = |b| \{1 + |K| e^{-j(2j\beta y - \phi)}$$

for V_{max}

$$2\beta y_{max} - \phi = 2n\pi$$

$$|V_{max}| = |b| \{1 + |K|\}$$

for V_{min}

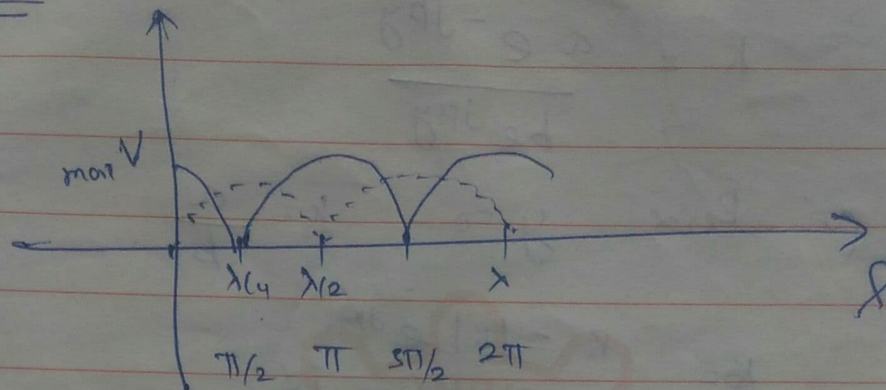
$$2\beta y_{min} - \phi = (2n+1)\pi$$

$$|V_{min}| = |b| \{(1-K)\}$$

$$\boxed{S = \frac{1+|K|}{1-|K|}}$$

first min and max at $n = 0$

open ckt load



$\lambda/2$

Incident I, and reflected I equal 0

from load $\lambda/4$

$\lambda/2$

$Z_{sc} = j \tan \beta l$

βl

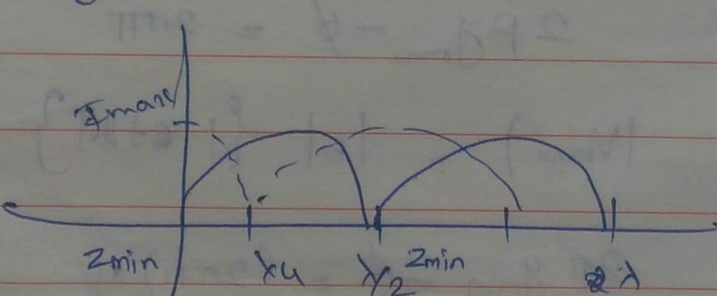
$= j\infty$

$\frac{2\pi}{\lambda} \times \frac{\lambda}{2}$

$= j0$

$= \pi = 0$

$= -j\infty$



$\lambda 2$

$j\infty$

* Properties of Smith chart *

$SWR = \frac{1+|K|}{1-|K|}$

* Normalised Impedance

R - circle   X - circles.

K - 0 ↔ 1

S 1 ↔ ∞

$Z_0 = 300\Omega$

$Z_R = 180 + j150$

Normalised $Z_r = \frac{180 + j150}{300} = 0.6 + j0.5$

0.6 R

0.5 X

* Determine SWR

O centre   R = 1

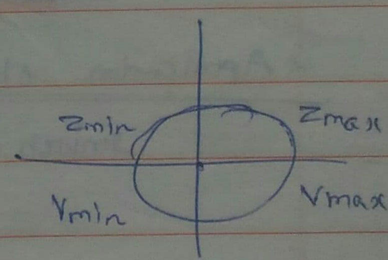
circle right hand intersection VSWR. (S)

* Determination of K in mag and direction

0.38 Distance of 0.6 + j0.5 from centre.

113° angle $|K| = 0.38$

* Location of V max and Vmin



$Z_{max} = 2.2 + j0$

$Z_{min} = 0.46 + j0$

Voltage min from the load 0.0925λ

first voltage max at $(0.0925 + 0.25)\lambda$

$= 0.3425\lambda$

Impd In version

open circuit and short ckt line

right hand side of horizontal axis

Value R & X ∞

Z = ∞

open ckt termination

ZR ∞

Left side horizontal axis

$R = 0 \quad x = 0 \quad Z_R = R + jx$

$Z_R = 0$

short ckt termination on left side.

Movement along the periphery of chart

CW → wavelength towards generator

full rotation 0.5 λ (or) λ/2

• Impedance repeats itself every λ/2 distance.

Matched load

$R = 1 \quad R = Z_0$

$R/Z_0 = 1$ matched condition

$Z_r = \frac{Z_R}{Z_0} = 1 + j0$ x zero.

$Z_R = Z_0$

Centre of chart is matched load. $Z_R = Z_0$

Application of smith chart of

Smith chart also used as admittance chart

$y = g - jb$

g → normalised conductance

b → Normalised susceptance.

Conversion of Impedance to admittance

λ/4 Impedance Inversion $Z' = 1/y$

$P = (0.6 + j0.5)$

$Q = (0.98 - j0.82)$

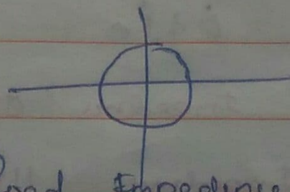
* Determination of I/p Impedence :-

Z_L given Z_{in} Calcted from Smith

Z_L find Z_{in}

travel towards Generator ⟳ CW

SWR Circle



2 with Normalised I/p Impedence.

* Determination of load Impedence :-

If SWR and first voltage min from the load given

Determine SWR of $Z_R = 800 + j0.0$ with $Z_0 = 400\Omega$

$Z_R = 650 - j475$

$Z_R = 2.0$ (or)

SWR $= 2$

$S = 2$

$= 1.625 - 1.18j$

$\boxed{S = 2.747}$

Using Smith chart Convert ~~Imp~~ Z to Y.

$0.5 + j0.3$

$2 - j0.5$

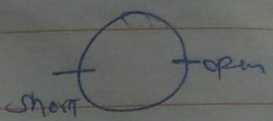
$1.5 - j0.1$

$0.48 + j0.11$

lossless line with $Z_0 = 70\Omega$ terminated in an open Ckt, Determine the sending end Impedence for the following length of line.

(i) $\lambda/8$ (ii) $\lambda/4$ (iii) $\lambda/2$

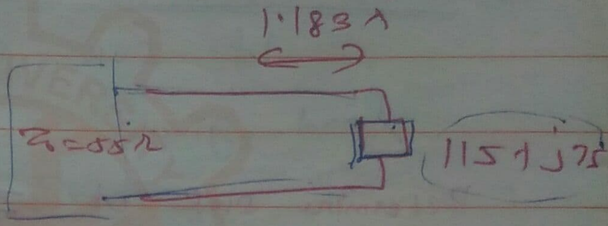
0.125λ $\quad 0 \mp j1.0$



0.5λ $\quad \infty + j\infty$

0.25λ $\quad 0 + j0$

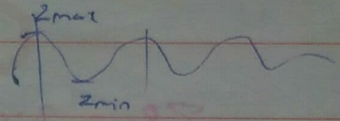
Find the sending end Impedance of the line with $Z_0 = 55\Omega$ load Impedance $115 + j75\Omega$ length of line 1.183λ



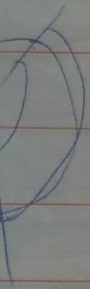
$Z_0 = 55\Omega$

$Z_R = 115 + j75\,\Omega$

$l = 0.183\lambda$



$Z_0 = \dfrac{115 + j75}{55} = 2.09 + j1.36$



at 0.215λ

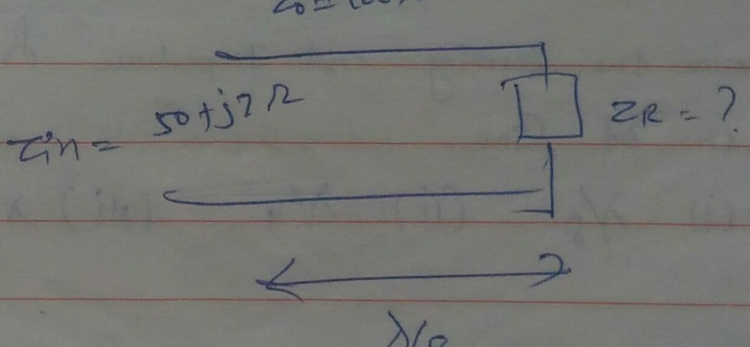
$$\begin{array}{r} 0.215 \\ 0.183 \\ \hline 0.398 \end{array}$$

$(0.48 - j0.65)$

$55(0.48 - j0.65)$

$\boxed{26.4 - j35.75}$

Find the load Impedance at the end of $\lambda/8$ line if sending end Impedance $(50 + j72)$ with $Z_0 = 100\Omega$.



$\frac{2+0.5}{2.05} =$

$Z_0 = 100\Omega$

$Z_{in} = 50 + j\Omega$

$Z_{in} = \frac{Z_{in}}{Z_0} = \frac{50+j7}{100}$

$= 0.5 + 0.07j$ at 0.015λ

Wavelength toward load.

$\cancel{0.015}$
$\cancel{0.125}$ $\lambda/8$
$\cancel{0.110}$

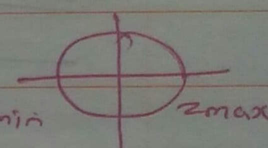
0.125
0.015
0.110

λ another $0.73 - j0.53$

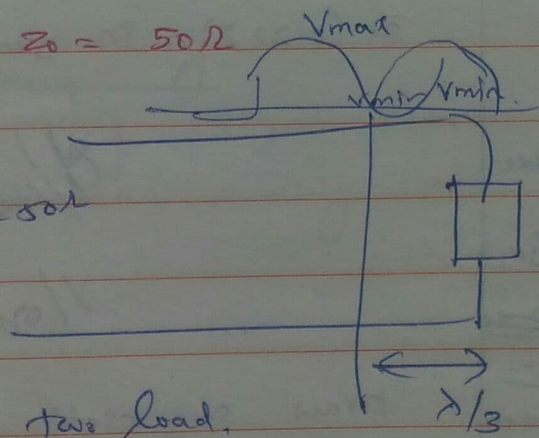
$\boxed{Z_R = 73 - j53}$

Ex

the VSWR is 5 with voltage min occurring $\lambda/3$ from load. Determine load Impedence $Z_0 = 50\Omega$



$Z_{min} = \frac{1}{VSWR}$



toward load.

$Z_{min} = \frac{1}{VSWR}$

$= \frac{1}{5}$

$= 0.2$

toward load 0.33λ

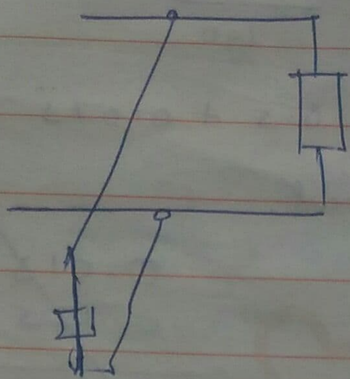
$0.77 + j1.48$

$50(0.77 + j1.48)$

$\boxed{Z_R = 38.5 + j74}$

12. Single stub matching #1

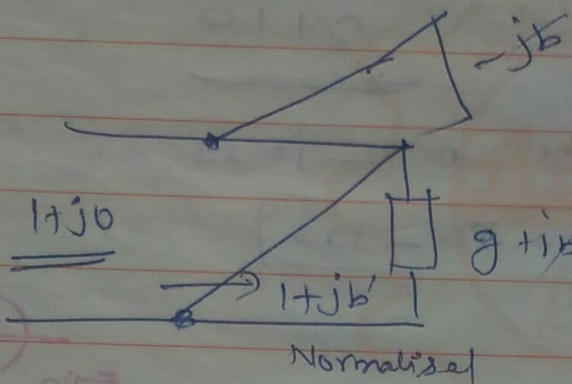
Stub at, R, L, C, length in by $\lambda/2$



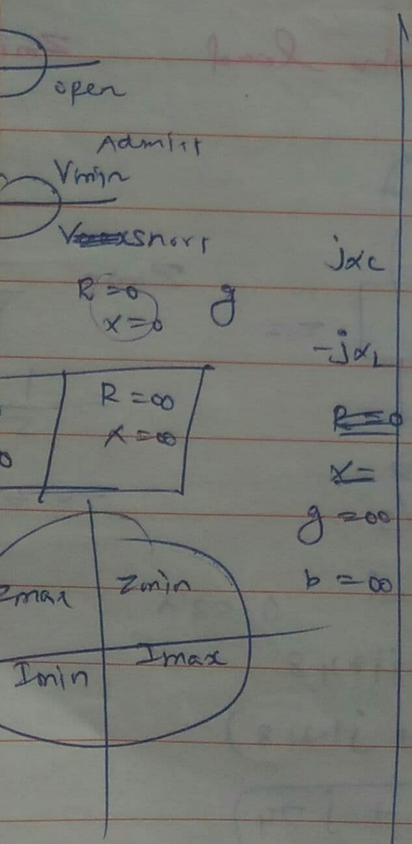
2.75 + 1.75

location of stub = ?

and length of stub = ?



Resistive on conductance portion is there.



Note $2.75 + j1.75$ at (0.22λ) in smith

$Y/G_0 = 1$ circle

$Y/G_0 =$

Draw SWR circle 1+

and y/G_0 circle $(1 + j1.5)$

locate stub +

stub susceptance as $+j1.5$

$$\cancel{\begin{array}{r} 0.5 \\ -0.324 \\ \hline \end{array}}$$

Inductive susceptance -1.5 0.324

location of stub $\begin{array}{r} 0.324 \\ -0.220 \\ \hline 0.102 \end{array}\ \lambda$

location of stub

length of stub

$+j1.5$

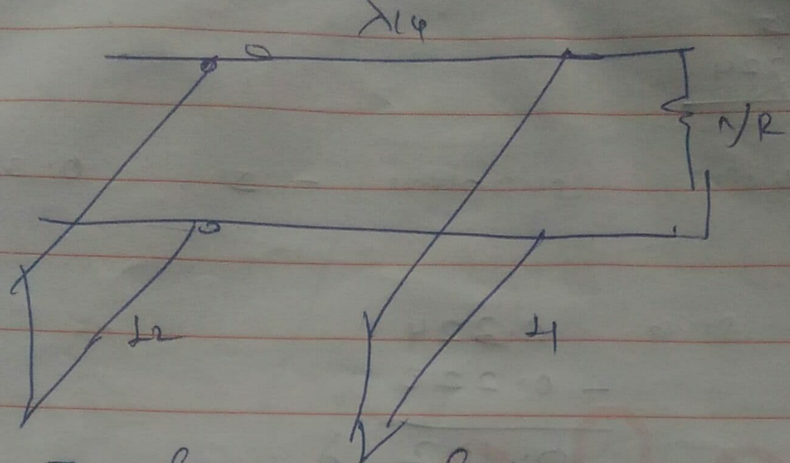
$\begin{array}{r} 0.25\ \lambda \\ 0.156\ \lambda \\ \hline 0.406\ \lambda \end{array}$

length of stub

Double Stub matching

Any changes location of stub changing in single stub matching Here 2 stubs $90'$ $\lambda/4$ distance

(Impedance Inversion)



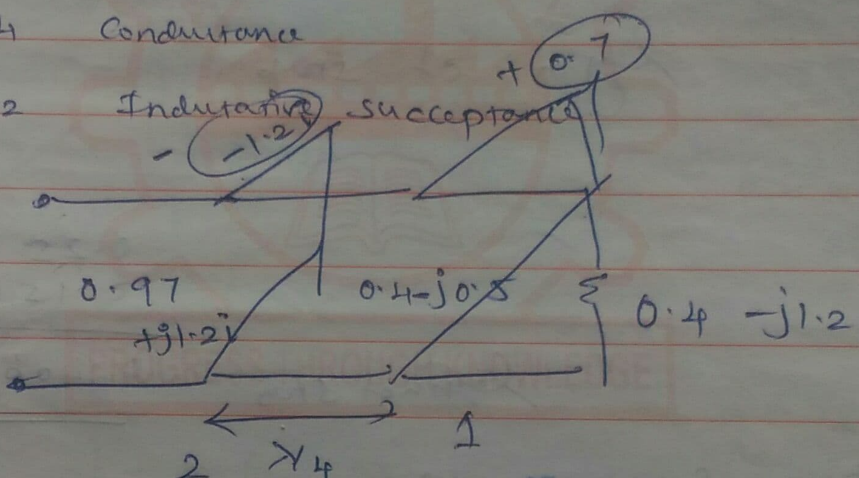
−j1.2

The line with load admittance of

$Y/G_0 = 0.4 - j1.2$

0.4 Conductance

−j1.2 Inductive succeptance



Unity circle concept

Plot 0.4 −j1.2.

Stub 1 should not alter conductance

Hence

0.4 −j0.5 transfer

+0.7

Length of stub 1 equal to — Stub with susceptance 1 of +0.7

+0.7 Cut at 0.098λ
+ 0.25 λ
0.348 λ

Now Impedance to Admittance

by Image circle

Note

$0.4 - j0.5 j$ to

$0.97 + 1.2 i$

another stub at $-1.2 i$

Cancel

Hence

Cut at. 0.36λ
-0.25λ

length of 0.11λ

2nd
(Second stub)