(1) (a) $Z_L = 60 + j40\ \Omega \Rightarrow \bar{Z}_L = \frac{60+j40}{50} = \frac{Z_L}{Z_0} = 1.2 + j0.8$ (point P)

$|\Gamma| = \frac{|OP|}{|OQ|} = \frac{2.75}{7.78} = 0.353$ and θ is the angle between $|OS|$ & $|OP|$

$\Rightarrow \Gamma = 0.353 \angle 56^\circ$

The Complete Smith Chart

Black Magic Design

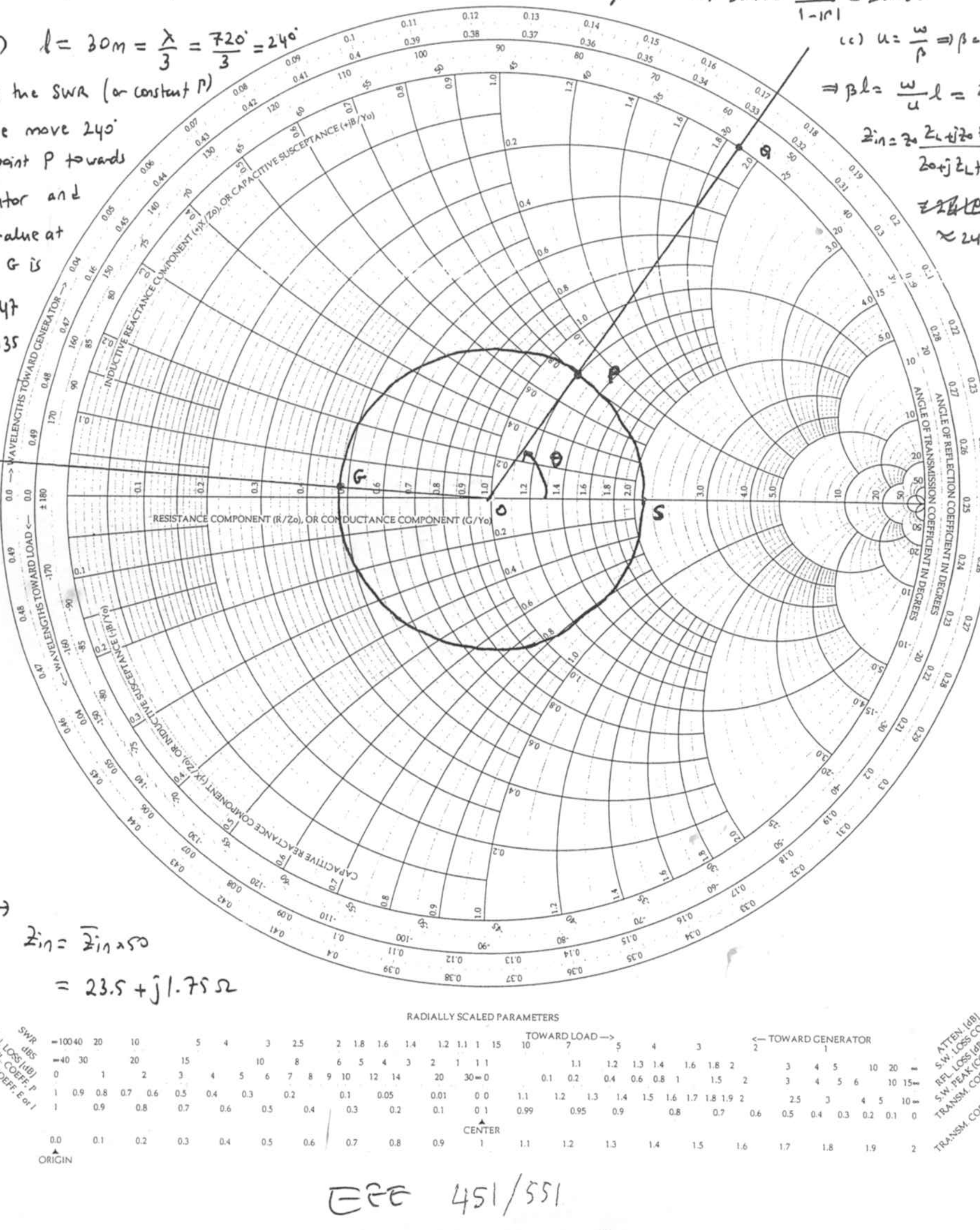
(b) SWR is the value at point S

$\Rightarrow$ SWR $\simeq 2.1$

(c) $l = 30m = \frac{\lambda}{3} = \frac{720^\circ}{3} = 240^\circ$

on the SWR (or constant Γ) circle move 240° from point P towards generator and the value at point G is

$\bar{Z}_{in} = 0.47 + j0.035$



$Z_{in} = \bar{Z}_{in} \times 50$

$= 23.5 + j1.75\ \Omega$

Solution without Smith Chart

(a) $\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0}$

$= \frac{60+j40-50}{60+j40+50} \simeq 0.3523 \angle 56^\circ$

(b) SWR $= \frac{1+|\Gamma|}{1-|\Gamma|} = 2.088$

(c) $u = \frac{\omega}{\beta} \Rightarrow \beta = \frac{\omega}{u}$

$\Rightarrow \beta l = \frac{\omega}{u} l = \frac{2\pi}{3} = 120^\circ$

$Z_{in} = Z_0 \frac{Z_L + jZ_0 \tan(\beta l)}{Z_0 + jZ_L \tan(\beta l)}$

$\simeq 24.01 \angle 3.22^\circ$

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Solutions to HW # 5

(2)

(2) $\left.\begin{array}{l} Z_0 = 40\,\Omega \\ Z_L = 20\,\Omega \end{array}\right\} \Rightarrow \bar{z}_L = 0.5\,\Omega$

$f = 1\,\text{GHz} \Rightarrow \lambda = \lambda_0 = \frac{c}{f} = 30\,\text{cm}.$

(a) $Z_{in} = 40 - j28 \Rightarrow \bar{z}_{in} = 1 - j0.7$

$l_1 = 0.349\lambda_0 = 0.349 \times 30$

$\Rightarrow \boxed{l_1 = 10.47\,\text{cm}.}$

(b) $Z_{in_2} = 48 + j16$

$\Rightarrow \bar{z}_{in_2} = Z_{in_2}/Z_0 = 1.2 + j0.4$

no intersection with the constant $|\Gamma|$ circle

$\Rightarrow$ impossible.

The Complete Smith Chart

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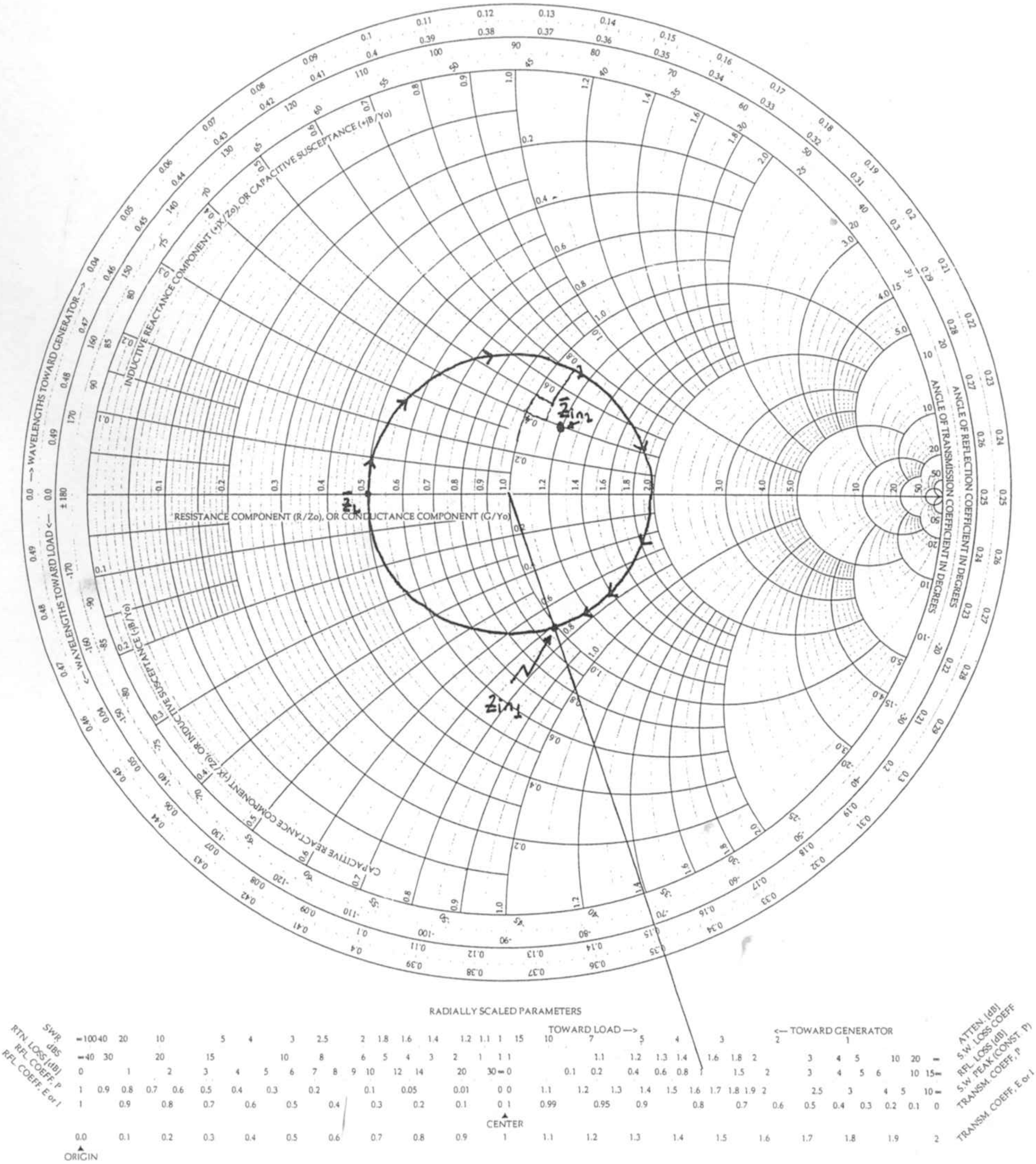

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Solutions to HW #5

(3) $d_{min} = \frac{\lambda}{2} \Rightarrow \lambda = 4$ cm. Because the reflection coefficient (Γ) and Z_{in} repeat $\lambda/2$, we can consider the load terminals to be effectively located at any of the voltage minima locations listed in step (i). Thus, if we say that the load is at 4.2 cm, then the data from step (ii) shows that the next voltage minimum away from the load occurs at 2.72 cm, giving $l_{min} = 4.2 - 2.72 = 1.48$ cm.

The Complete Smith Chart

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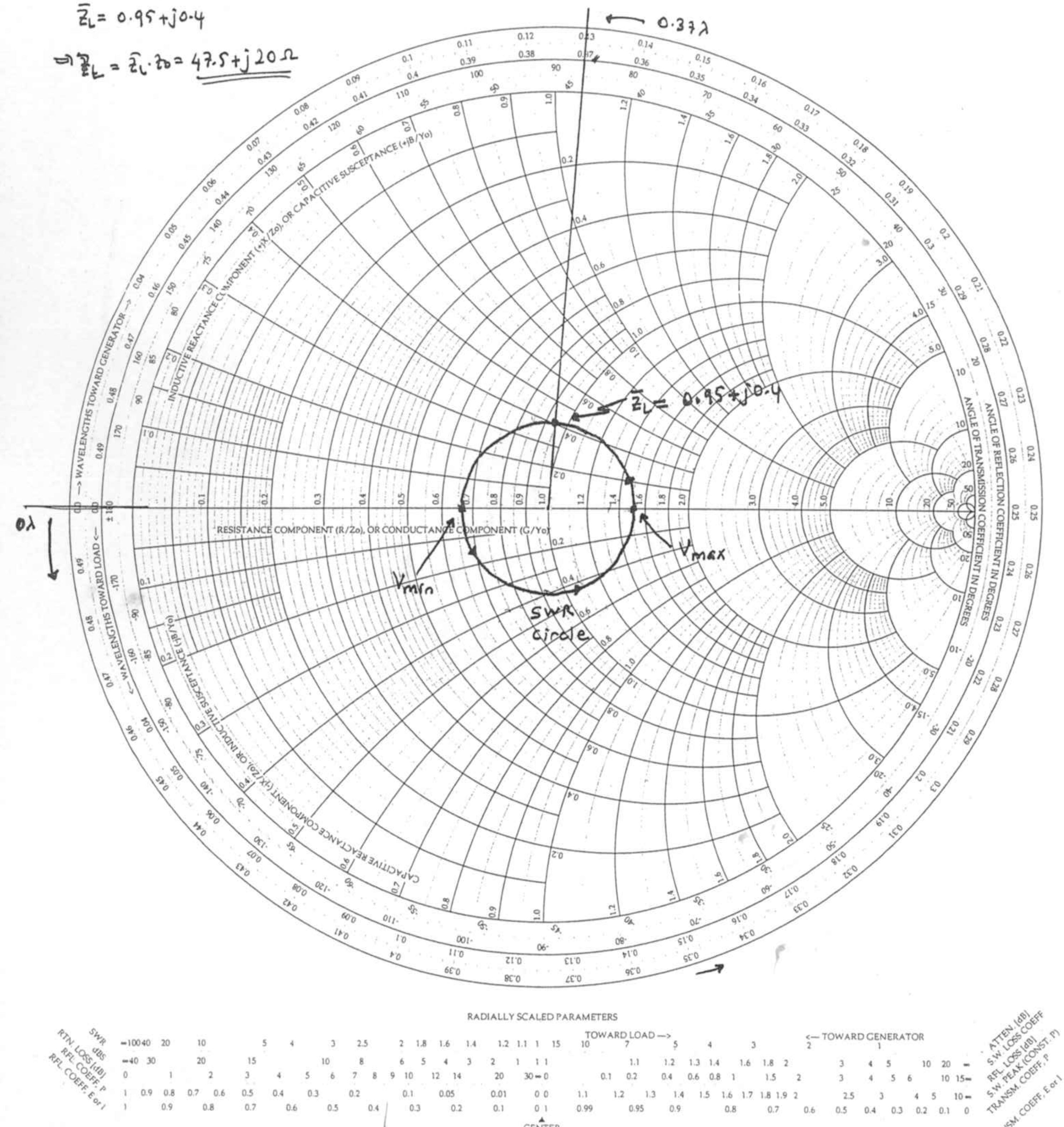
$\Rightarrow l_{min} = 1.48/4 = 0.37\lambda$

$\bar{z}_L = 0.95 + j0.4$

$\Rightarrow Z_L = \bar{z}_L \cdot Z_0 = \underline{47.5 + j20\,\Omega}$



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Solutions to HW #5

(4) $R_0 = 50\,\Omega$, $SWR = 3$, $\lambda = 2 \times 20\,cm = 40\,cm = 0.4\,m \Longrightarrow |\Gamma| = 0.5$ (4)

$d = 0.05\,m \equiv 0.125\lambda$ (move from V_{min} point toward load by 0.125λ)

$\Rightarrow \bar{z}_L = 0.6 - j0.8 \Rightarrow Z_L = 50\,\bar{z}_L = 30 - j40\,\Omega$ & $\theta_{\Gamma_L} = -\pi/2 \Longrightarrow \Gamma = -j0.5$

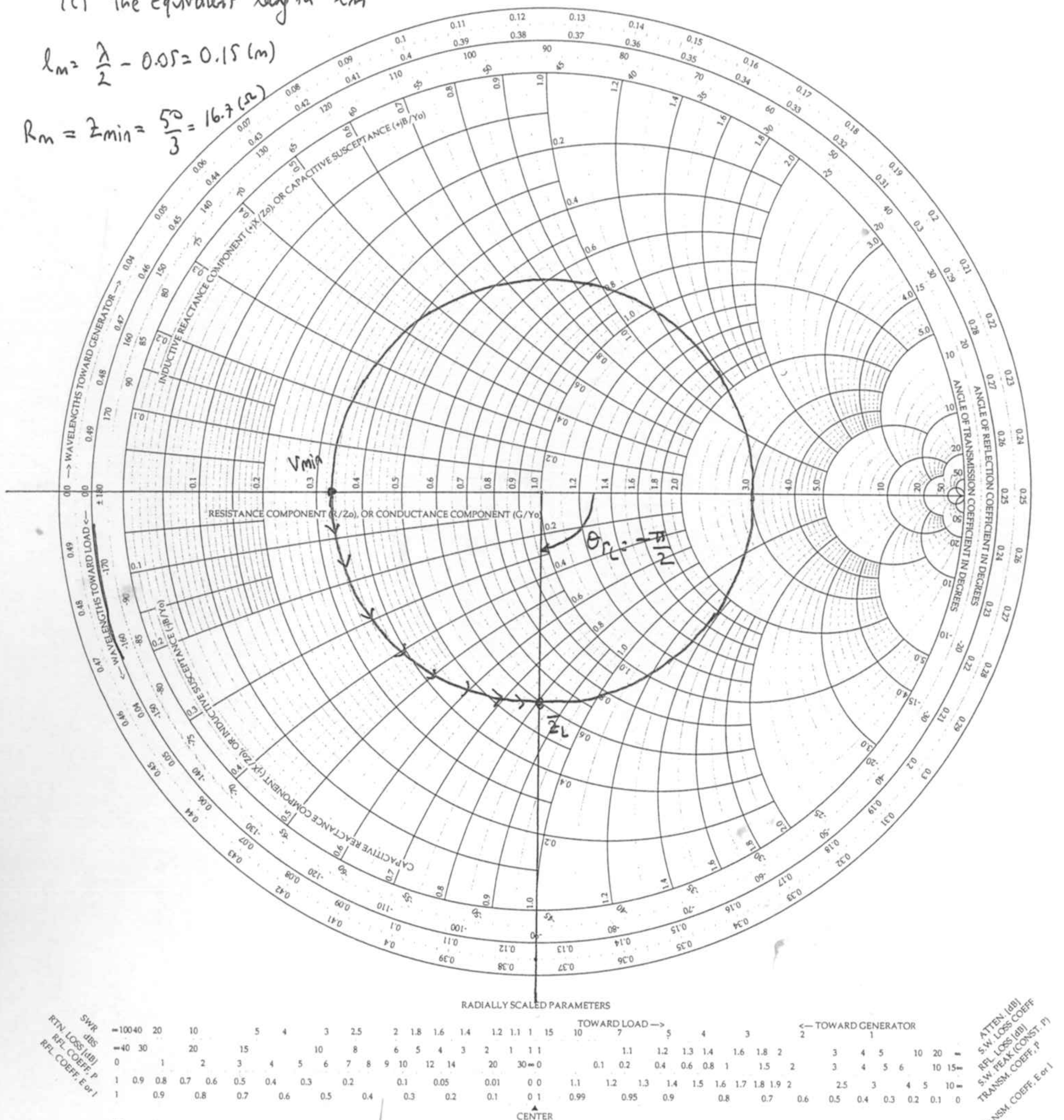
The Complete Smith Chart

Black Magic Design

(c) The equivalent length l_m

$l_m = \frac{\lambda}{2} - 0.05 = 0.15\ (m)$

$R_m = Z_{min} = \frac{50}{3} = 16.7\ (\Omega)$



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Solutions to HW #05