

EE 382 Applied EM Quiz #4 (Spring 2018)

Name Key Aπ

Instructions: Open book & notes. Show all work for full credit.

Little Debbie attaches a load of $21.99 - j40.84 \Omega$ to a lossless, transmission line with a characteristic impedance of $20\pi \Omega$ and phase velocity of $0.6\pi \times 10^8$ m/s operating at 100π MHz. She needs to match this load to the transmission line using a series inductor located as close as possible to the load. Using a Smith chart, find the wavelength, normalized load impedance, normalized match impedance, inductance required, and distance from the load to the match point (in wavelengths and cm). Show and clearly label all work and related parameters on the Smith chart.

$$\lambda = \frac{v}{f} = \frac{0.6\pi \times 10^8}{100\pi \times 10^6} = 0.6 \text{ m} = \underline{60 \text{ cm}}$$

$$\eta_L = \frac{Z_L}{Z_0} = \frac{21.99 - j40.84}{20\pi} = \underline{0.35 - j0.65 \text{ } \Omega}$$

→ Plot η_L on Smith chart and draw circle, centered on chart, thru η_L

→ Note where circle crosses the $r=1$ circle w/ a negative/capacitive reactance

$$\Rightarrow \underline{\eta_m = 1 - j1.55 \text{ } \Omega}$$

→ The distance from η_L to η_m in "WAVELENGTHS TOWARD GENERATOR" is $(0.0978 + 0.323)\lambda = \underline{0.4208\lambda}$
or $0.4208(60 \text{ cm}) = \underline{25.248 \text{ cm}}$

→ we need $\frac{j\omega L}{Z_0} + -j1.55 = 0$ to match

$$\hookrightarrow L = 1.55 \frac{20\pi}{2\pi(100\pi \times 10^6)} = \underline{49.338 \text{ nH}}$$

wavelength = 60 cm normalized load impedance = 0.35 - j0.65 Ω

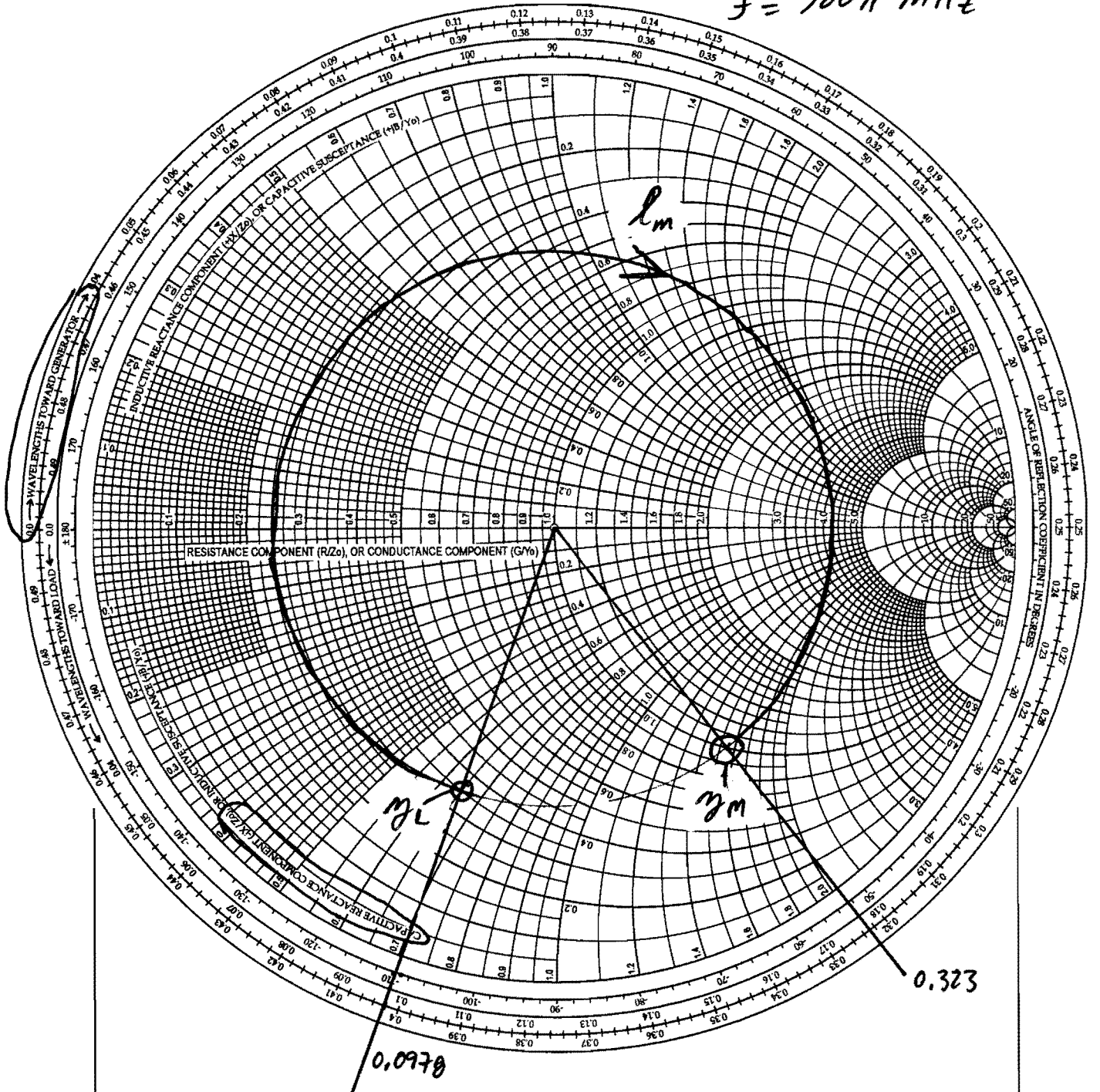
normalized match impedance = 1 - j1.55 Ω inductance = 49.338 nH

distance = 0.4208 λ = 25.248 cm

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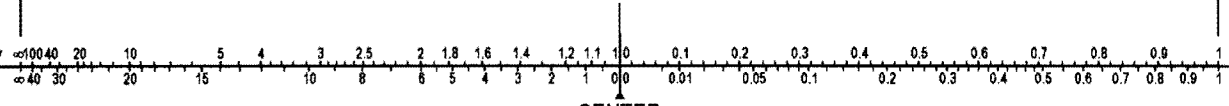
Simple
Smith Chart

$Z_0 = 20\pi \Omega$
 $u = 0.6\pi \times 10^8 \text{ m/s}$
 $f = 100\pi \text{ MHz}$



RADIALLY SCALED PARAMETERS

SWR (VSWR)
SWR (dB)



REFL. COEFF. V or I
REFL. COEFF. P

EE 382 Applied EM Quiz #4 (Spring 2018)

Name Key Bπ

Instructions: Open book & notes. Show all work for full credit.

Archimedes attaches a load of $11.78 + j35.34 \Omega$ to a lossless, transmission line with a characteristic impedance of $15\pi \Omega$ and phase velocity of $0.7\pi \times 10^8$ m/s operating at 100π MHz. He needs to match this load to the transmission line using a series inductor located as close as possible to the load. Using a Smith chart, find the wavelength, normalized load impedance, normalized match impedance, inductance required, and distance from the load to the match point (in wavelengths and cm). Show and clearly label all work and related parameters on the Smith chart.

$$\lambda = \frac{u}{f} = \frac{0.7\pi \times 10^8}{100\pi \times 10^6} = 0.7 \text{ m} = \underline{70 \text{ cm}}$$

$$z_L = \frac{Z_L}{Z_0} = \frac{11.78 + j35.34}{15\pi} = \underline{0.25 + j0.75 \Omega}$$

→ Plot z_L on Smith chart and draw circle, centered on Smith chart, through z_L

→ Note where circle crosses $r=1$ circle w/ a negative / capacitive reactance

$$\Rightarrow \underline{z_m = 1 - j2.12}$$

→ The distance from z_L to z_m in "WAVELENGTHS TOWARD GENERATOR" is $(0.310 - 0.1056)\lambda = \underline{0.2044 \lambda}$
OR $0.2044(70 \text{ cm}) = \underline{14.308 \text{ cm}}$

→ We need $\frac{j\omega L}{Z_0} + -j2.12 = 0$ to match

$$\hookrightarrow L = 2.12 \frac{15\pi}{2\pi(100\pi \times 10^6)} = \underline{50.61 \text{ nH}}$$

wavelength = 70 cm normalized load impedance = $0.25 + j0.75 \Omega$

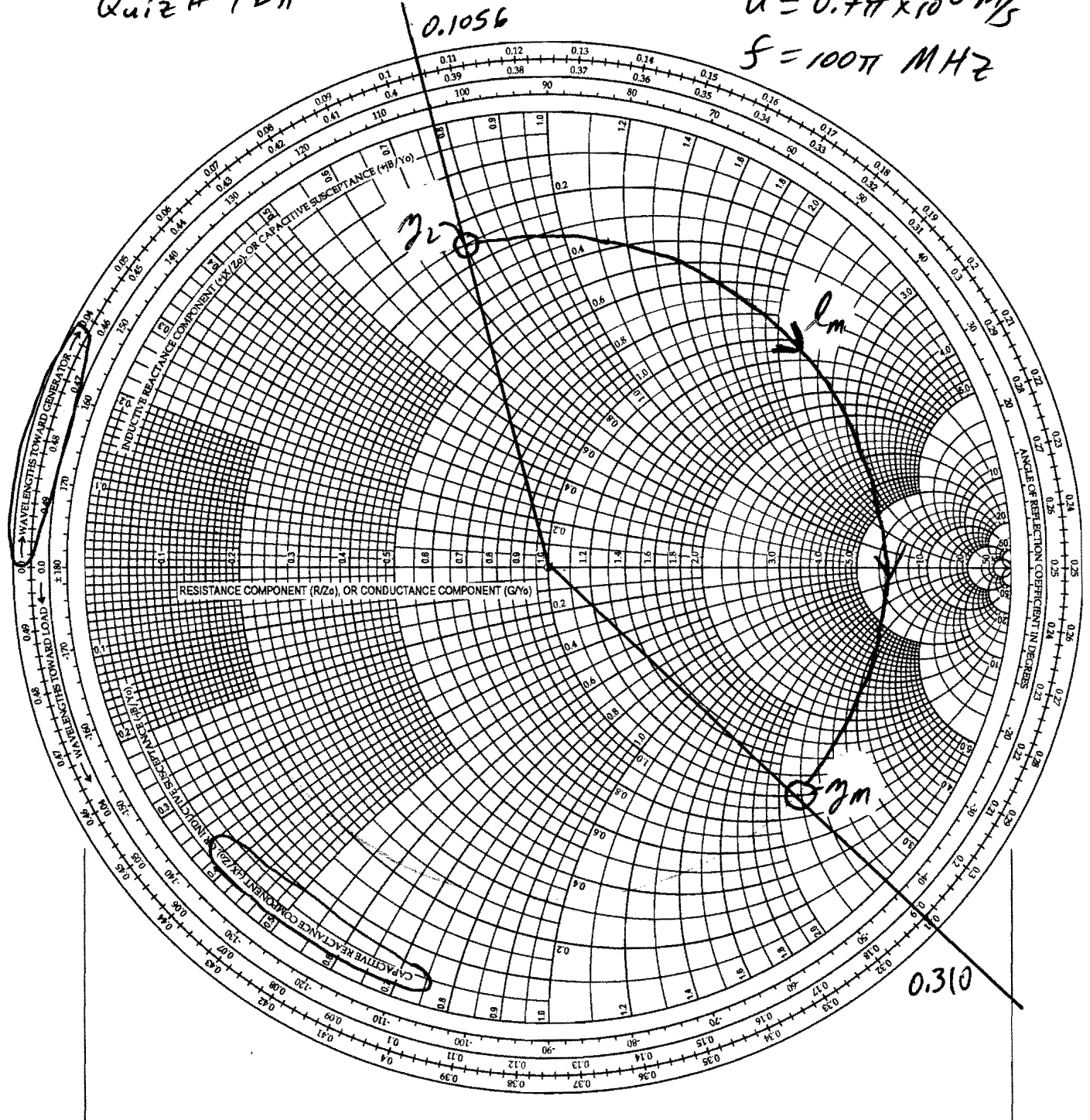
normalized match impedance = $1 - j2.12 \Omega$ inductance = 50.61 nH

distance = 0.2044λ = 14.308 cm

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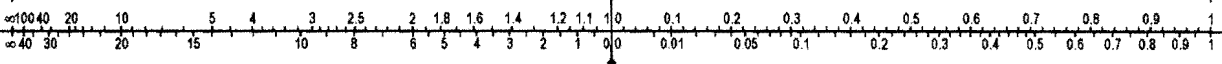
Simple
Smith Chart

$Z_0 = 15 \pi \Omega$
 $u = 0.7 \pi \times 10^8 \text{ m/s}$
 $f = 100 \pi \text{ MHz}$



RADIALLY SCALED PARAMETERS

SWR (VSWR)
SWR (dB)



CENTER

REFL. COEFF. V or I
REFL. COEFF. P