1λ → 40 X = 40 mm

19/30

University of Jordan
Elect. Eng. Dept.

Mid Exam. **Electromagnetics 0903351** **13/8/2017**

0156387 رعد محمد زكريا ابو السعود 60

Q.1 (18 Points)

Match a load Z_L=25+j25 Ω to a transmission line of Zo=40Ω λ = 40*mm*
(X is distance from load in **mm** and Ls is stub length in **mm** and Z_o is transformer characteristic impedance). ***Show your work on smith charts***

	Inductive stub	9.2 mm	4.72 mm
	S.C series stub	X= [illegible]	Ls= [illegible]
	O.C series stub	X=9.2 mm	Ls= 14.72 mm
	S.C parallel stub	X= 11.84 mm	Ls= 4.8 mm
	O.C parallel stub	X= 11.84 mm	Ls= 14.8 mm
	Capacitive stub		
	S.C series stub	X= 19.2 mm	Ls= 5.28 mm
	O.C series stub	X= 1.9 mm	Ls= 5.284 mm
	S.C parallel stub	X= 19.2 mm	Ls= 5.28 mm
	O.C parallel stub	X= 19.2 mm	Ls= 15.28 mm
	λ/4 Transformer	X= 5.52 mm	Z_o = 61.9 Ω

16

$Z_L = 25 + j25$

$Z_o = 40$

$z_L = 0.625 + 0.625j$

$\lambda = 40$ mm

Parallel

$L_1 = 0.298\lambda$ $L_2 = 0.48\lambda$

$Y_{stub} = +0.92$

$Z_{stub} = +1.95$ → S.C = 0.12λ ; O.C = 0.37λ

$Y_{stub} = -0.92$

$Z_{stub} = +1.95$ → S.C = 0.132λ ; O.C = 0.392λ

$L_1 = 0.138$

z_{in} — z_L

$z_{tr} = \sqrt{2.4 * 40 * 40}$

$= 61.9\ \Omega$

$L_2 = 0.32\lambda$

$z_{tr} = 96\ \Omega$

Sereies

$L_1 = 0.1595 - 0.112$

$= 0.0475\lambda = 1.9$ mm

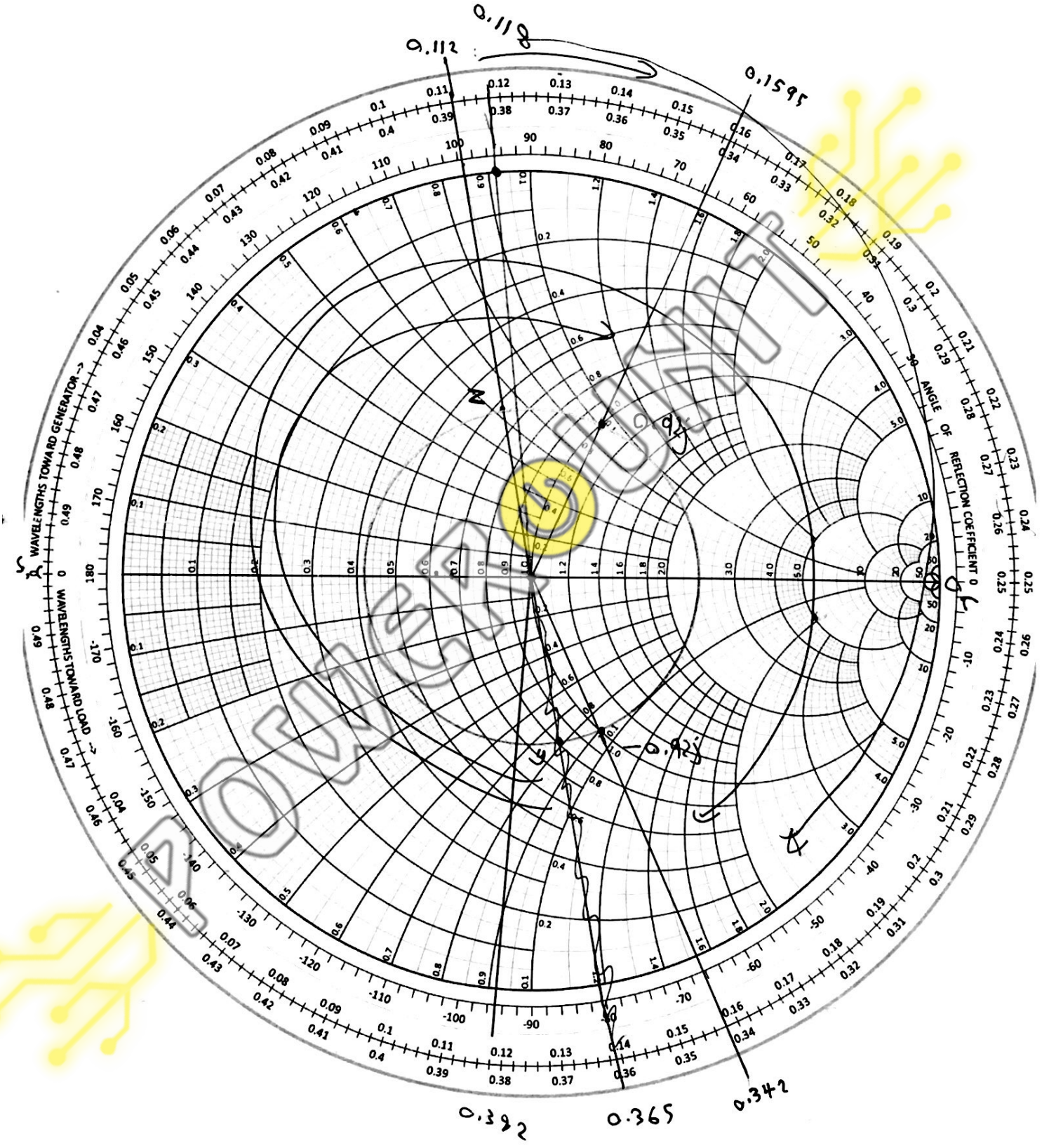
$L_2 = 0.342 - .112$

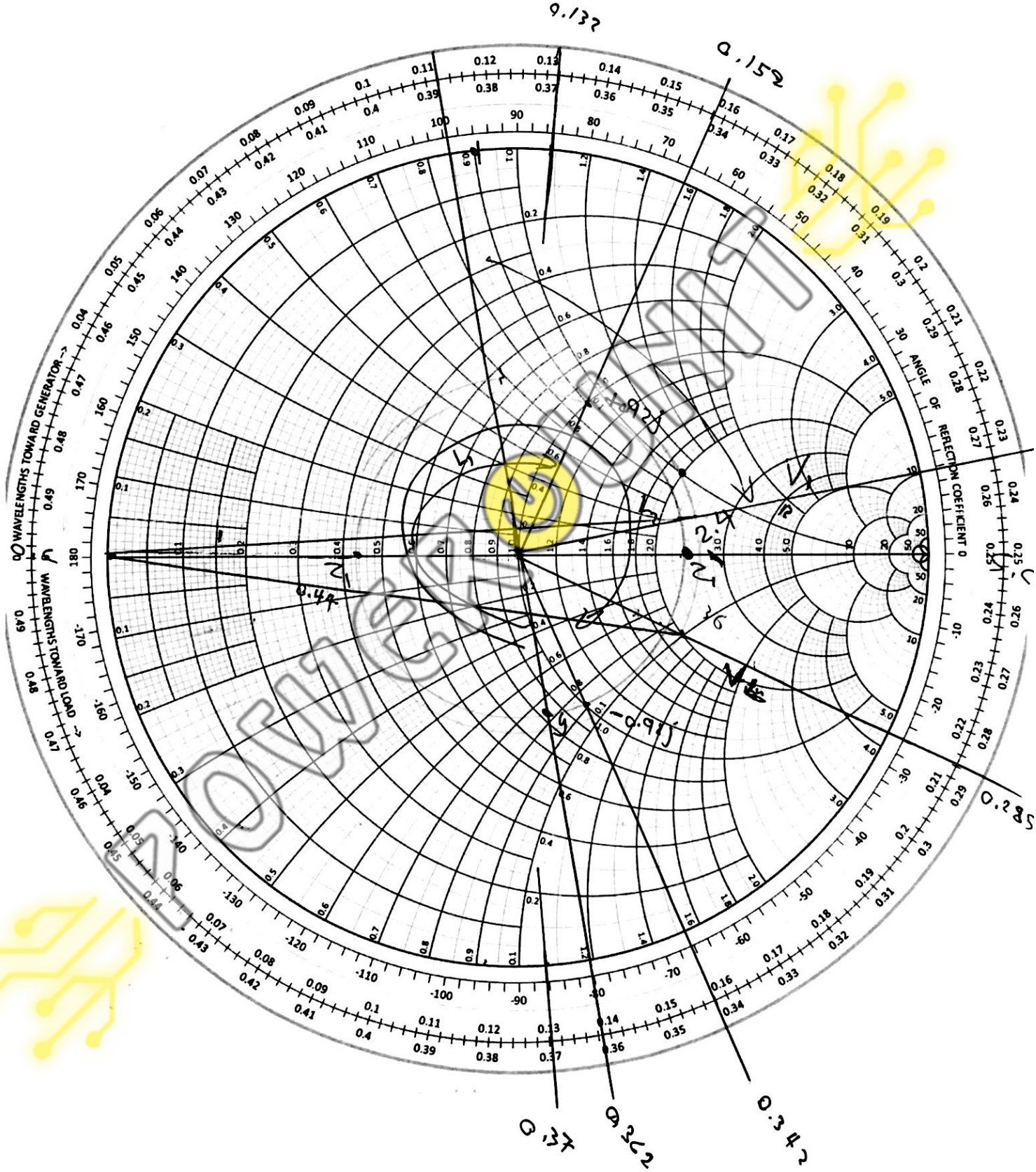
$= 0.23\lambda$

L_1: $+0.92j$ → S.C 0.119λ (~~0.1595~~) ; O.C 0.369λ (~~0.4095~~)

L_2: $-0.91j$ → S.C 0.392λ ; O.C ~~0.092~~ 0.132λ

$z = 0.625 + 0.625j$





$\omega = 2\pi f = 3.45 \times 10^{10}$ $\beta = \omega\sqrt{\mu\epsilon_0}$ $\beta = \frac{\omega}{c} = \frac{110\pi}{3}$ $C = 0.2$

Q.2 (4 Points)

In free space at 5.5GHz the direction of propagation is in **ar**=(0.6**ax** +c**ay**) if the electric field is in the +z direction and the maximum measured value of electric field is 4uV/m, Find *c*, E and H.

$f = 5.5G$

$|E| = 4$

$E = E_0 \cos(\omega t - \beta r)(+a_z)$

$E = 4\cos(\omega t - \beta(0.6x + cy)(+a_z)$

$a_e \times a_h = a_r$

$+z \times a_h = 0.6a_y + ca_x$

$a_e \times a_r = -a_h$

$+z \times (0.6a_x + ca_y) = -a_h$

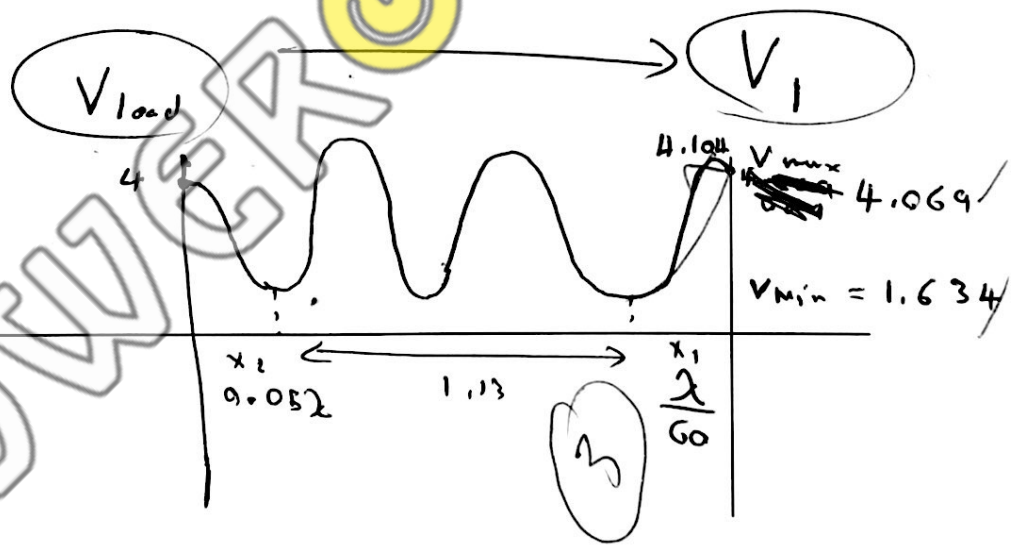
$-y\,a_6 + -cx = -a_h$

$a_h = 0.6y + cx$

$c = 0.2$

Q.3 (4 Points)

Draw the voltage and current Standing waves in a transmission line of Z_{TL}=50Ω for a load of Z_L=100-j50 Ω. V_L=4V. (draw for 1.2λ)



1.634 ← min = 4.7cm

max = 11.8cm

← 4.104

$Z_{TL} = 50\Omega$

$Z_L = 100 - j50$

$z = 2 - j$

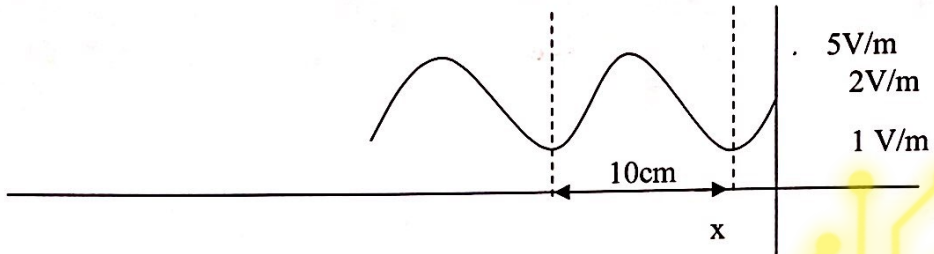
$\frac{V_L}{V_1} = \frac{V_{L\,cm}}{V_{1\,cm}}$

$\frac{4}{V_1} = \frac{11.5}{11.7}$

$V_1 = 4.069$

Q.4 (4 Points)

Given the following standing wave, find x and the characteristic impedance for the second media.



x=

η_2=

$\frac{\lambda}{2} = 10 \Rightarrow \lambda = 20$

$1 + \Gamma = 5$

$1 - \Gamma = 1$

$1 + \Gamma \geq 5 - 5\Gamma$

$-4 + 6\Gamma \geq 0 \Rightarrow \Gamma \geq \frac{4}{6}$

$E_0(1 + |\Gamma|) \geq 5$

$E_0(1 - |\Gamma|) = 1$