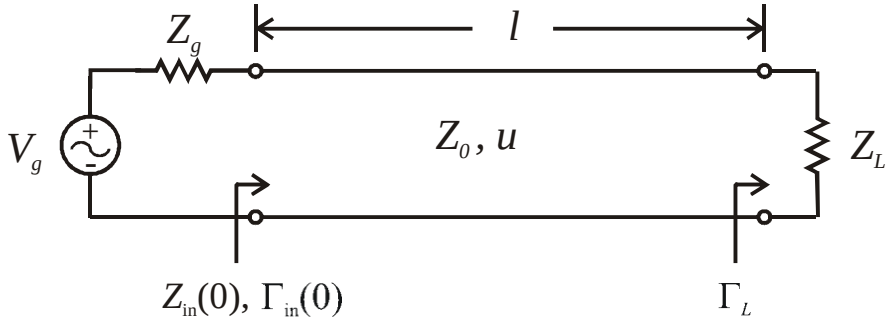
EE382 Applied EM Quiz #3 (Spring 2018)

Name KEY A

Closed book, notes, and calculators. Show all work, including that on Smith Chart, for credit.

Consider a lossless transmission line circuit where $Z_0 = 100\,\Omega$, $f = 500$ MHz, $u = 2 \times 10^8$ m/s, $l = 2.285\lambda$, and $Z_L = 30 - j70\,\Omega$. Using a **Smith Chart, compass, & straight-edge**, find the load & input reflection coefficients (i.e., Γ_L & $\Gamma_{in}(0)$), normalized input impedance $z_{in}(0)$, input impedance $Z_{in}(0)$, and VSWR. Clearly label all points/work on Smith chart. Express **impedances in rectangular form** and **reflection coefficients in polar form** (e.g., $A\angle\theta°$).



- Normalize load impedance $z_L = Z_L/Z_0 = (30 - j70)/100 \Rightarrow z_L =$ **$0.3 - j0.7\,\Omega/\Omega$**.
- Plot z_L on Smith Chart. Use straight-edge to draw line from center of Smith chart through z_L and 'ANGLE OF REFLECTION COEFFICIENT IN DEGREES' scale to get $\Rightarrow$ **$\angle\Gamma_L = -106.8°$**.
- Use compass & scales at bottom of Smith Chart to get **$|\Gamma_L| = 0.67$** & **VSWR = 5.05.**
- Use compass to draw circle of $|\Gamma| = 0.67$, centered on Smith chart, through z_L.
- Move 0.285λ from z_L point on Smith chart toward the generator on circle of $|\Gamma| = 0.67$. Mark and read $\Rightarrow z_{in}(0) =$ **$1 + j1.8\,\Omega/\Omega$**.
- Use straight-edge to draw line from center of Smith chart through $z_{in}(0)$ and the 'ANGLE OF REFLECTION COEFFICIENT IN DEGREES' scale. Read the angle to be **$\angle\Gamma_{in} = 48.2°$**.
- Calculate $Z_{in}(0) = z_{in}(0)\,Z_0 = (1 + j1.8)100 =$ **$100 + j180\,\Omega$**.

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For comparison, analytic results:

$\Gamma_L = 0.6705\angle -106.699°$, $\Gamma_{in}(0) = 0.6705\angle 48.101°$, $Z_{in}(0) = 99.357 + j180.156\,\Omega$,

VSWR = 5.069

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$\Gamma_L =$ **$0.67\angle -106.8°$** $\Gamma_{in}(0) =$ **$0.67\angle 48.2°$** $z_{in}(0) =$ **$1 + j1.8\,\Omega/\Omega$**

$Z_{in}(0) =$ **$100 + j180\,\Omega$** VSWR = **5.05**

Simple Smith Chart

$Z_0 = 100\ \Omega$

$u = 2 \times 10^8$ m/s

$f = 500$ MHz