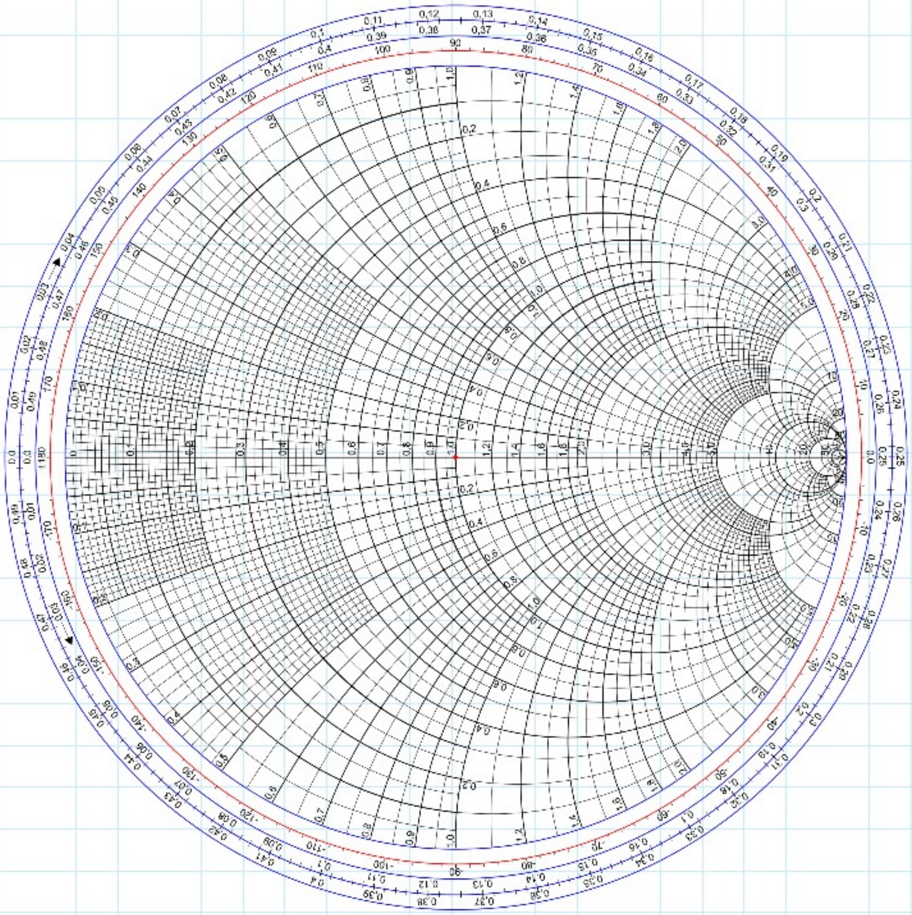
Lec-22

Wednesday, May 20, 2020 8:40 AM

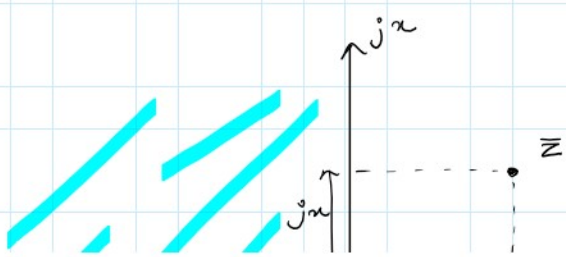
Smith chart.



Smith Chart

- Solves impedances (normalized impedance) on a transmission line.
- Compact way of representation
- Better than calculating
- Has a long lasting effect.

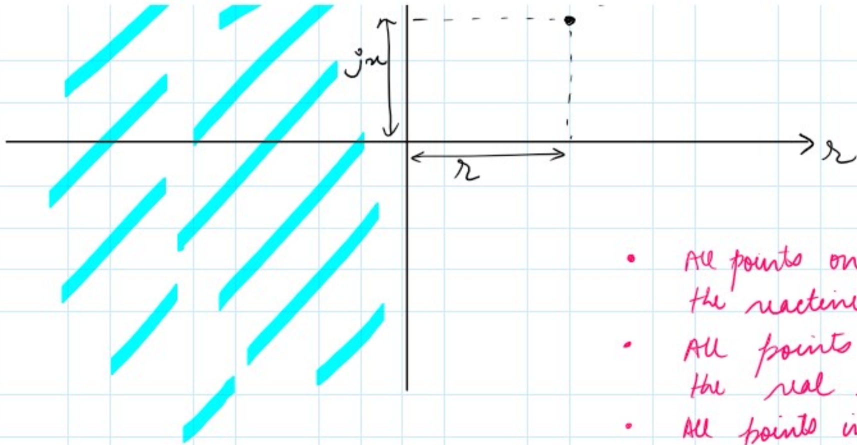
Complex Impedance Plane



$$\bar{Z} = \frac{Z}{Z_0} = r + jx$$

Z_0 → Real quantity

Real quantity



- All points on the imaginary axis represents the reactive load
- All points on the real axis represents the real load.
- All points in right half plane represents all possible points on a transmission line.

Reflection coefficient $\boxed{\Gamma = \frac{Z - Z_0}{Z + Z_0} = \frac{\bar{Z} - 1}{\bar{Z} + 1}}$

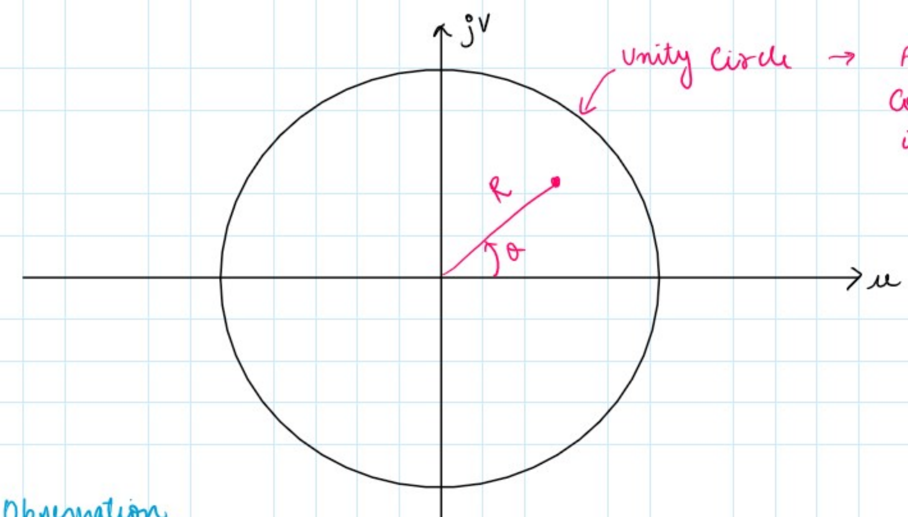
$$\underset{\text{Complex}}{\Gamma} = \frac{r + jx - 1}{r + jx + 1} = \underbrace{u + jv}_{} = \underbrace{R e^{j\theta}}_{\text{Polar form}}$$

$$\boxed{\bar{Z} = \frac{1 + \Gamma}{1 - \Gamma}}$$

- If we know $\bar{Z}$, then we can get Γ
- If we know Γ, then we can get $\bar{Z}$

There is a 1 to 1 transformation b/w Γ & $\bar{Z}$

Complex Γ plane

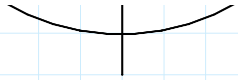


Unity circle → All possible reflection coefficients points will be inside this circle.

$|\Gamma| \leq 1$

$\Gamma = Re^{j\theta} = u + jv$

Observation



Observation

- All points on the impedance plane can be uniquely mapped onto the complex Γ plane.

$$\bar{Z} = r + jx = \frac{1+\Gamma}{1-\Gamma}$$

$$r + jx = \frac{1 + u + jv}{1 - u - jv}$$ Rationalize, seperate real & imaginary parts.

$$r + jx = \frac{(1+u+jv)(1-u+jv)}{(1-u-jv)(1-u+jv)}$$

$$r + jx = \frac{(1+u)(1-u) + jv(1+u) + jv(1-u) - v^2}{(1-u)^2 + v^2}$$

Real Part:

$$r = \frac{(1+u)(1-u) - v^2}{(1-u)^2 + v^2}$$

$$\Big\downarrow \text{ Rearrange.}$$

$$u^2 - 2\left(\frac{r}{1+r}\right)u + v^2 + \frac{r-1}{r+1} = 0$$ Constant resistance Circle.

Equation of circle

Centre : $\left(\frac{r}{r+1}, 0\right)$

Radius $= \frac{1}{r+1}$

Locus of all reactance points for a given value of r.