**NEW YORK CITY COLLEGE OF TECHNOLOGY**

**TCET TELECOMMUNICATION ENGINEER DEPARTMENT**

**TCET 2220: TRANSMISSION SYSTEM**

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**SMITH CHART**

**FINAL PROJECT BY SALAM SECK**

**Project 1**

**Guidelines: Please type all the solutions! For the Smith Chart use Tools/ Typewriter to inset symbols or text. Email and UPLOAD your project 1 on your ePortfolio. In addition to this poject you also need to upload Project 2 and the reflections on the seminars/workshops/field trips, and email them to me.**

1. A 0.334λ long Z0=50 Ω T-line is terminated in a load ZL=100-j100 Ω. Calculate and use the Smith Chart to find:

a)ΓL;

**zL =** $\frac{ZL}{Z0 }$ **=** $\frac{100-J100}{50 }$ **= 2 – j2** $Ω$the value is shown in P1 on the Smith chart, and the operating circle in then constructed.

The initial coordinate on the ‘’ Wavelengths toward generator’’ scale is about **0.291λ.** We must rotate clockwise by **0.35λ,** so this would call for a final coordinate of **0.291λ + 0.35λ = 0.641λ.** However, this value exceeds **0.5λ,** so we subtract **0.5λ** to obtain a coordinate of **0.641λ – 0.5λ = 0.141λ.** The corresponding point is **P2** on the Smith chart. The value of the impedance is read as: **zin =0.55 + j1.18**

The VSWR is read from the intersection of the operating circle with the right half of the real line and is approximately: **S = 4.4**

The magnitude of the reflection coefficient is determined as:

**𝝘L =** $\frac{S-1}{S+1}= \frac{4.4-1}{4.4+1}=0.63$

The angle of the reflection coefficient at the load is about **-300.** Thus, the reflection coefficient at the load is about: **𝝘’L = 0.63˪-300 = [(**$\frac{\left(-30\right)(π)}{180}$**) = -0.523]**

 **𝝘’L = 0.63˪-0.523;** where the latter angle is **-0.523rad.**

b)VSWR;

The VSWR is read from the intersection of the operating circle with the right half of the real line and is approximately: **S = 4.4**

c)Zin seen by the source.

The corresponding actual impedance is:

**Zin = (50) (0.55 + j1.18) = 27.5 + j59**$ Ω$

1. Suppose a Z0=50 Ω T-line is is terminated in a 100 Ω load. Determine the aquired impedance of a quarter-wave matching section of T-line.

**Find Z1: Z1 =** $\sqrt{Z0 x ZL}$ **=** $\sqrt{50 x 100}$ **= 70.71Ω**

1. Suppose a 50 Ω coaxial cable made with a Teflon dielectric, that must operate at 800MHz T-line is terminated in a ZL=10 - j15 Ω. Use the Smith Chart to
2. Create a matching network by adding a reactive element at a suitable location along the T-line:

**ZL = 10 – j15Ω**

**F = 800MHz**

**Z0 = R0 = 50Ω**

**zL =** $\frac{ZL}{Z0}$ **=** $\frac{10-j15}{50}$ **= 0.2 – j0.3Ω**

1. determine the length of the coaxial line between the load and the capacitor:

At point **P3**, the normalized addmitance is about **ynew = 1 - j1.58**

The required value of admittance for the stub **P4** is **ynew = + j1.58**

**d = 0.5λ – 0.291λ= 0.209λ + 0.141λ = 0.35 λ**

**l = 0.178λ – 0.141λ = 0.036λ**

1. determine the value of the series capacitor added to provide an impedance match:

**1.58j = Xc**

**1.58j =** $\frac{j}{wc}$

**1.58j =** $\frac{j}{2πfc}$

**1.58 =** $\frac{1}{2πfc}$

**C =** $\frac{1}{1.58 (2π\left(800MHz\right))}$

**C = 1.26pf**

1. You would like to match a 170Ω load to a 50 Ω T-Line.



(a) Determine the characteristic impedance required for a quarter-wave transformer.

**R10 =** $\sqrt{50 x 170 }$ **= 92.19Ω**

**Zs = 92.19 [**$\frac{170+j92.19\tan((\frac{π}{2}))}{92.19+j170\tan((\frac{π}{2}))}$**]**

**Zs = 42.66Ω**

1. Consider a 6 cm long 75 Ω transmission line terminated in a 125 Ω load and having a matched source impedance (*Zs* = 25 Ω). Propagation velocity on the T-Line is 0.1*c*. The source is a 0.4 ns square pulse of amplitude 4V.

**V+1 =** $\frac{V0 Z0}{Zs+Z0}$ **=** $\frac{\left(4 \right)(125)}{25+125}$ **= 3.33V**

**VL =** $\frac{\left(V +1\right)\left(1+ ΓL\right)}{1-(Γs ΓL)}$ **=** $\frac{\left(3.33\right)(1+0.62)}{1-0}$ **= 5.39V**

**V-1= (V+1) (**$ΓL)$ **= (3.33) (0.62) = 2.06V**

**VOLTAGE STEADY STATE IS:**

**V+1 + V-1 = 3.33V + 2.06V = 5.39V**

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