

Reading

Textbook: *Elements of Electromagnetics*, 7th Ed.
Matthew N. O. Sadiku
Oxford University Press

Assignment: Read Chapter 10.

Lectures: Topic 7
From *Electromagnetic Field Theory*
<https://empossible.net/academics/emp3302/>

Transmission Line Parameters

A twisted pair transmission line has the following RLGC parameters: $R = 180 \text{ m}\Omega/\text{m}$, $L = 495 \text{ nH}/\text{m}$, $G = 3.00 \text{ }\mu\Omega^{-1}/\text{m}$, $C = 8.25 \text{ pF}/\text{m}$ and is operating at 100 MHz.

Problem #1 – Attenuation Coefficient α and Phase Constant β

Determine the attenuation coefficient α and the phase constant β for the twisted pair line.

Problem #2 – Characteristic Impedance Z_0

Determine the complex characteristic impedance Z_0 of the twisted pair line.

Problem #3 – Transmission Line Classification

Determine if this transmission line is lossless, weakly absorbing, and/or distortionless. Justify your answer.

Transmission Line Scattering

Problem #4 – Reflection Coefficient Γ

A lossless transmission line with a characteristic impedance of $Z_0 = 100 \text{ }\Omega$ is connected to a capacitive load with a capacitance of 25 nF. What is the reflection coefficient of the interface if a 5 GHz signal is supplied?

Problem #5 – Voltage Standing Wave Ratio

What is the voltage standing wave ratio (VSWR) of the interface?

Impedance Transformation

Problem #6 – Matched Transmission Line

A generator supplying a 20.0 GHz signal needs to be connected to a load through a transmission line. The characteristic impedance of the transmission line is $75 \text{ }\Omega$ and the load $300 \text{ }\Omega$. Assuming no loss and assuming the transmission line resides in air, design a quarter wave transform to be inserted between the transmission line and the load so the generator supplies 100% of its power to the load. Provide the length l and the characteristic impedance Z_{ar} of the quarter wave transformer.