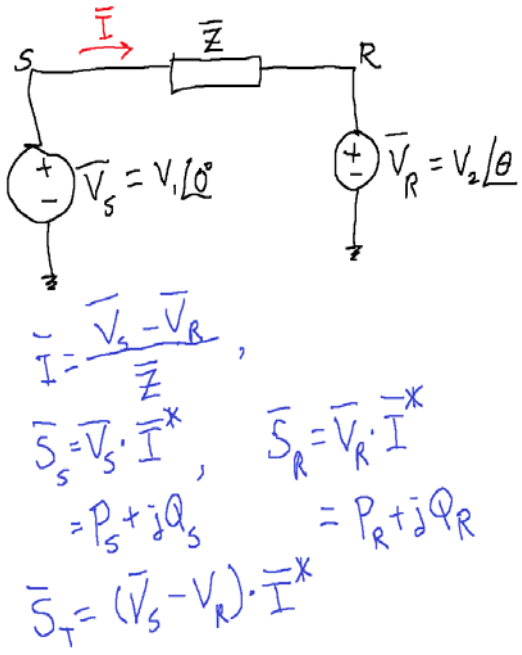
Pre-Lab 6 Power Flow Between Two Sources

This lab is different from previous labs in that it has two 3-phase sources. In previous labs, we have a source (sender) and a load. The present lab has two sources: a source at the sender and the other source as the receiver. In DC system, if we attach two sources with the same voltage at the sender and the receiver sides, there is no current flow in the line between two sources. However in the AC system, even though two sources have the same RMS voltage, by the phase angle change, the instantaneous voltage levels at a given moment are different, making current flow in the line. We will discuss about that further referring the figure below as well as an example calculation when the two sources have the same magnitude, but the receiver side source has 10 degrees behind the sender.



Example Calculation for Prelab6

Euler(x)=cos(x) + j sin(x)

$$Euler(AngDeg) := e^{AngDeg \cdot \frac{\pi}{180} \cdot i}$$

$V1 := 20000$ $V2 := 20000$

Transmission line impedance

$Z := 0 + 100 \cdot i$

Source at the sender

$VS := V1 \cdot Euler(0) = 20000$

Source at the receiver

$VR := V1 \cdot Euler(-10) = 19696.1551 - 3472.9636 \cdot i$

Current in the transmission line

$$I := \frac{VS - VR}{Z} = 34.7296 - 3.0384 \cdot i$$

$|I| = 34.8623$ $\arg(I) \cdot \frac{180}{\pi} = -5$ *degrees*

Complex Power at the sender

complex conjugate function

$cc(var) := \mathrm{Re}(var) - \mathrm{Im}(var) \cdot i$

$SS := (-VS) \cdot cc(I) = -6.9459 \cdot 10^5 - 60768.988 \cdot i$

$PS := \mathrm{Re}(SS) = -6.9459 \cdot 10^5$ supplying

$QS := \mathrm{Im}(SS) = -60768.988$ *supplying*

Complex Power at the receiver

$SR := VR \cdot cc(I) = 6.9459 \cdot 10^5 - 60768.988 \cdot i$

$PR := \mathrm{Re}(SR) = 6.9459 \cdot 10^5$ *consuming*

$QR := \mathrm{Im}(SR) = -60768.988$ *supplying*

Complex power in the transmission line

$ST := (VS - VR) \cdot cc(I) = 1.2154 \cdot 10^5 \cdot i$

$PT := \mathrm{Re}(ST) = 0$ 0 no consumption

$QT := \mathrm{Im}(ST) = 1.2154 \cdot 10^5$ *Absorption*

1. In the example calculation shown above right, if the phase angle of the sender is 30 degrees and that of the receiver is 15 degrees, while keeping the same magnitude as in the example, calculate the complex power at the sender, the receiver, and in the transmission line, if the transmission impedance is the same as the example.

2. In the example calculation shown above right, if the phase angle of the sender is 0 degrees and that of the receiver is 90 degrees, while keeping the same magnitude as in the example, calculate the complex power at the sender, the receiver, and in the transmission line, if the transmission impedance is the same as the example.