Basic Electrical Engineering (TEE 101)

Lecture 20: Complex Numbers and Phasors

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Content

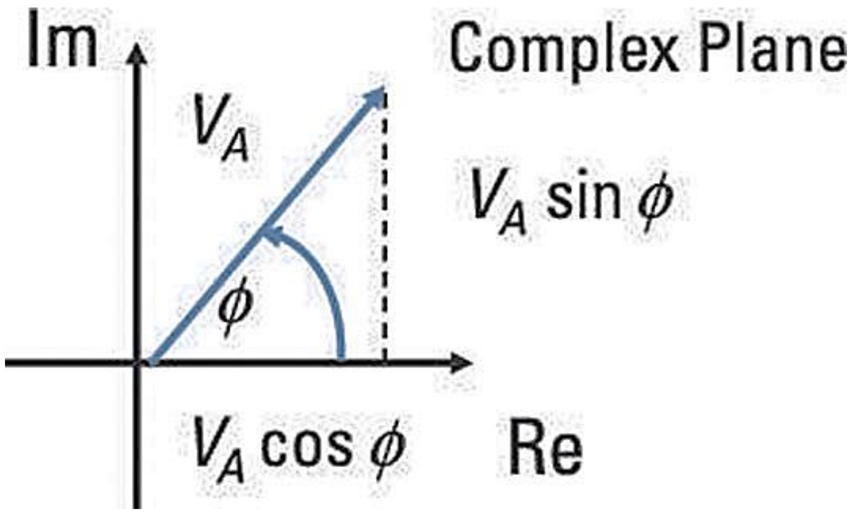
This lecture covers:

- **Representation of Phasors as a complex quantity**
- **Representation of Phasors in Rectangular and polar form**
- **j operator**

A ***phasor*** is a complex number in polar form that can be applied to the circuit analysis.

a **complex number** consists of a real part and an imaginary part.

There are two basic forms of complex number notation: ***polar*** **and** ***rectangular***



In polar form, a complex number is denoted by the *length* and the *angle* of its vector.

- **The length indicates the magnitude of the phasor.**
- **Angle indicates its phase (or angular direction)**

In Rectangular form, the complex number is represented by its horizontal (x-axis) and vertical (y-axis) components.

- **The horizontal component is the real part of the complex number, and**
- **The vertical component is the imaginary part.**

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$8.49 \angle 45^\circ$

$8.06 \angle -29.74^\circ$

$(8.06 \angle 330.26^\circ)$

Note: the proper notation for designating a vector's angle is this symbol: $\angle$

$5.39 \angle 158.2^\circ$

$7.81 \angle 230.19^\circ$

$(7.81 \angle -129.81^\circ)$

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j - Operator

The **j-operator** has a value exactly equal to √-1,

In electrical engineering this type of number is called an “imaginary number” and to distinguish an imaginary number from a real number the letter “ j ” known commonly in electrical engineering as the **j-operator**, is used.

the j-operator is commonly used to indicate the anticlockwise rotation of a vector

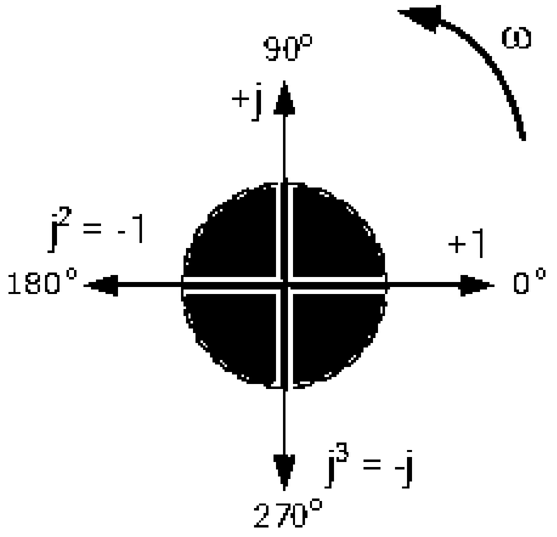
Vector Rotation of the j-operator

$$90^{0} \text{ rotation: } \quad j^{1} = \sqrt{-1} = +j$$

$$180^{0} \text{ rotation: } \quad j^{2} = \left(\sqrt{-1}\right)^{2} = -1$$

$$270^{0} \text{ rotation: } \quad j^{3} = \left(\sqrt{-1}\right)^{3} = -j$$

$$360^{0} \text{ rotation: } \quad j^{4} = \left(\sqrt{-1}\right)^{4} = +1$$



Addition of complex Quantities

Let there are two complex quantities

$A = x_1 + j y_1$

$B = x_2 + j y_2$

$A + B = (x_1 + j y_1) + (x_2 + j y_2)$

$A + B = (x_1 + x_2) + j (y_1 + y_2)$

i.e Real part is added with Real part and Imaginary part is added.

Subtraction of complex Quantities

Let A and B are subtracted then,

$A - B = (x_1 + j y_1) - (x_2 + j y_2)$

$A - B = (x_1 - x_2) + j (y_1 - y_2)$

or

$A - B = (x_1 - x_2) - j (y_2 - y_1)$

i.e Real is subtracted from real and imaginary is subtracted from imaginary

Thank You