

EE332 Introduction to Power Systems Engineering
Solutions HW 1

Text problems

2.1

Given $A1 := 5 \cdot e^{j \cdot 60 \text{deg}}$ $A2 := -3 - 4j$

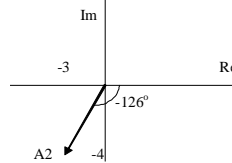
Use $Ae^{j\alpha} = A \cos(\alpha) + j A \sin(\alpha)$; Mathcad and your calculator do this automatically

$$A1 = 2.5 + 4.33i$$

Use $a+jb = \sqrt{a^2 + b^2} / \tan^{-1}(b/a)$; or, in Mathcad use Absolute value function $||$ and $\arg()$ function

$$|A2| = 5 \quad \arg(A2) = -126.87 \text{ deg}$$

$A2$ has negative real and imaginary part which puts it in the third quadrant of the complex plane



Use $a+jb + c+jd = a+c + j(b+d)$ then polar form

$$\underline{A} := A1 + A2 \quad A = -0.5 + 0.33i \quad |A| = 0.599 \quad \arg(A) = -126.87 \text{ deg}$$

Use $(a+jb)(c+jd) = (ac-bd)+j(ad+bc)$ or $a/\alpha \cdot b/\beta = ab / \alpha+\beta$

$$A1 \cdot A2 = 9.821 - 22.99i$$

$$A5 := \overline{A2}$$

$$A5 = -3 + 4i$$

The overbar is matcadese for comple conjugate
The operation reverses the sign on the imaginary part
 $(a+jb)^* = a-jb$

since $|A5| = 5 \quad \arg(A5) = 2.214 \text{ rad}$

The exponential or Euler form is $5 e^{j 2.214}$

2.2 a. For a sinusoid $rms = peak/\sqrt{2}$

Phasor $I := 400 \cdot e^{-j \cdot 30deg}$ $I = 346.41 - 200i$

b.

Phasor $I := \left(\frac{5}{\sqrt{2}} \cdot e^{j \cdot 15deg} \right)$ $I = 3.415 + 0.915i$

c. Let us denote the two terms in the given current by $c1(t)$ and $c2(t)$. Remember I want to avoid using 'i' as a variable denoting current

Now $c1(t) = 4\cos(\omega t - 30deg)$ is the phasor $C1 := \left(\frac{4}{\sqrt{2}} \right) \cdot e^{j \cdot -30deg}$

$c2(t) = 5\sqrt{2} \sin(\omega t - 15deg) = 5\sqrt{2} \cos(\omega t - 75deg)$ is the phasor $C2 := (5) \cdot e^{j \cdot -75deg}$

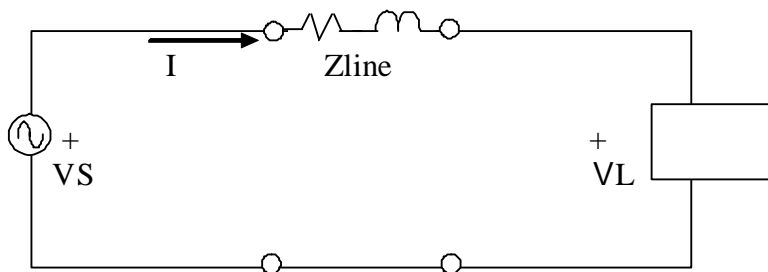
$\cos(\alpha - 90) = \sin(\alpha)$

adding the two phasors the total current phasor is

$C1 + C2 = 3.744 - 6.244i$

2.9 $V_s := 120 + 0j$ $I := 60 + 0j$ $Z_{line} := 0.1 + 0.5j$

$V_{load} := V_s - Z_{line} \cdot I$ $|V_{load}| = 117.881 \text{ V}$ $\arg(V_{load}) = -14.744 \text{ deg}$



The information below is slightly dated.

3 Look at your (or a friends) electric bill

What is the monthly energy use? 1221 kwh (Feb)

What is the rate? 12.75 c/KWH+ customer charge \$5.94+tax

What are the components of the rate? Generation, Transmission, Distribution,
(8.95c/kwh)+Fuel/Purchased Power adjustment (1.536c/kwh)

Are there surcharges? Fuel/Purchased Power

4.The NM transmission system is part of WECC

Do a web search to answer the following questions

(<http://www.wecc.biz/documents/daily/2005/Aug/20050826.pdf>)

<http://www.wecc.biz> ; <http://www.eia.doe.gov/>

- What is the generation capacity (MW) in WECC

- What is the generation mix (% nuclear, hydro, etc.)

GENERATION AS OF DECEMBER 31, 2013(MW)

| Generation | NWPP | RMPA | AZ/NM/SNV | CA/MX | WECC |
|--------------|---------------|---------------|---------------|---------------|----------------|
| Hydro-Conv. | 48,230 | 902 | 4,463 | 7,537 | 61,132 |
| Hydro-P.S. | 240 | 410 | 245 | 3,900 | 4,795 |
| Steam-Coal | 18,335 | 6,991 | 10,256 | 2,024 | 37,606 |
| Steam-Oil | 0 | 0 | 80 | 0 | 80 |
| Steam-Gas | 2,613 | 227 | 2,313 | 14,271 | 19,424 |
| Nuclear | 1,170 | 0 | 4,009 | 4,450 | 9,629 |
| Comb. Turb. | 4,108 | 1,893 | 3,429 | 6,451 | 15,881 |
| Comb. Cycle | 14,538 | 2,580 | 16,639 | 20,043 | 53,800 |
| Geothermal | 248 | 0 | 620 | 2,183 | 3,051 |
| Int. Comb. | 275 | 247 | 4 | 32 | 558 |
| Other | 1,352 | 348 | 145 | 1,077 | 2,922 |
| Total | 91,109 | 13,598 | 42,203 | 61,968 | 208,878 |

What is the highest transmission line voltage in WECC 500 kV

Where do EHV (345 kV) lines serving the Las Cruces originate—

Springerville, AZ, Greenlee, AZ, both come through Deming

Albuquerque, NM

