

Alexander & Sadiku Practice Problem 10.1
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> restart

Handy functions for dealing with phasors

> $j := I$

$$j := I \tag{1}$$

> $polard := (mag, angd) \rightarrow polar(mag, angd * Pi / 180)$

$$polard := (mag, angd) \rightarrow polar\left(mag, \frac{1}{180} angd \pi\right) \tag{2}$$

> $argumentd := (num) \rightarrow argument(num) * 180 / Pi$

$$argumentd := num \rightarrow \frac{180 argument(num)}{\pi} \tag{3}$$

> **listphasors := proc (plist) local k**
for k from 1 to nops(plist[]) do
 printf("%s = %f < %f deg\n", lhs(plist[][k]), evalc(abs(rhs(plist[][k]))),
 evalc(argumentd(rhs(plist[][k]))))
end do end proc:

Circuit equations

> $KCLn1 := -Ia + \frac{(V1 - 0)}{R1} + (V1 - V2) \cdot j \cdot \omega C = 0$

$$KCLn1 := -Ia + \frac{V1}{R1} + I(V1 - V2) \omega C = 0 \tag{4}$$

> $KCLn2 := (V2 - V1) \cdot j \cdot \omega C + \frac{(V2 - 0)}{j \cdot \omega C \cdot L} + \frac{(V2 - b \cdot Vx)}{R2} = 0$

$$KCLn2 := I(V2 - V1) \omega C - \frac{IV2}{\omega L} + \frac{V2 - b Vx}{R2} = 0 \tag{5}$$

> $CTRL := Vx = V1$

$$CTRL := Vx = V1 \tag{6}$$

Solve circuit equations

> $MySoln := solve(\{KCLn1, KCLn2, CTRL\}, [V1, V2, Vx])$

$$MySoln := \left[\left[V1 = \frac{IR1(I\omega^2 CLR2 - IR2 + \omega L) Ia}{-\omega^2 CLR2 + R2 + IR2\omega CR1 + I\omega L - \omega^2 LCR1 + \omega^2 Lb CR1}, \right. \right. \tag{7}$$

$$V2 = - \frac{Ia L \omega R1 (\omega CR2 - Ib)}{-\omega^2 CLR2 + R2 + IR2\omega CR1 + I\omega L - \omega^2 LCR1 + \omega^2 Lb CR1}, Vx$$

$$\left. = \frac{IR1(I\omega^2 CLR2 - IR2 + \omega L) Ia}{-\omega^2 CLR2 + R2 + IR2\omega CR1 + I\omega L - \omega^2 LCR1 + \omega^2 Lb CR1} \right]$$

Define lists for known values

> $Vals := R1 = 2, R2 = 4, L = 2, C = 0.2, \omega = 2, Ia = polard(10, 0), b = 3$

$$Vals := R1 = 2, R2 = 4, L = 2, C = 0.2, \omega = 2, Ia = polar(10, 0), b = 3 \tag{8}$$

Find numerical solutions

> *MySoln* := *subs*(*Vals*, *MySoln*)

MySoln := [[*V1* = (0.5660377358 + 0.9811320755 I) polar(10, 0), *V2*
= (1.792452830 + 2.773584906 I) polar(10, 0), *Vx* = (0.5660377358
+ 0.9811320755 I) polar(10, 0)]]

(9)

Find phasors

> *listphasors*(*MySoln*)

V1 = 11.327042 < 60.018361 deg

V2 = 33.023719 < 57.127091 deg

Vx = 11.327042 < 60.018361 deg

Conclusion: $v_1(t) = v_x(t) = 11.327 \cos(2t + 60.01 \text{ deg})$, $v_2(t) = 33.02 \cos(2t + 57.13 \text{ deg})$