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EE 211

For KCST

EE101 - EE112 - EE211 - EE201 - EE212 - EE312 - EE341 - EE342 - EE351 - EE352 - EE365 - EE410 - EE441 - EE442 - EE443 - EE451

فالكم A

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<< Sinusoidal Voltage representation >>

$$v(t) = V_m \cos(\omega t + \theta)$$

$$v(t) = V_m \sin(\omega t + \theta)$$

} حفظ

V_m ⟶ Peak amplitude unit V

ω ⟶ angular frequency unit rad/s

$\omega = 2\pi f$ ، $\omega = \frac{2\pi}{T}$

f ⟶ Frequency unit Hz

T ⟶ Time period unit sec

θ ⟶ Phase angle unit degree

↳ في حالة عدم وجود رقم للزاوية

في المعادلة يبقى ⟵ $\theta = 0$

$f = \frac{1}{T}$

ملحوظة: يجب أن تكون الدالة المثلثية دائماً موجبة والدالة التي يجب العمل عليها هي ds وبجانب ذلك يتم التحويل.

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* التحويلات :

$$-\sin wt = \sin(wt \pm 180^\circ)$$

$$-\cos wt = \cos(wt \pm 180^\circ)$$

$$\cos wt = \sin(wt + 90^\circ)$$

$$-\cos wt = \sin(wt - 90^\circ)$$

$$-\sin wt = \cos(wt + 90^\circ)$$

$$\sin wt = \cos(wt - 90^\circ)$$

* ملحوظة :

يجب دائماً التحويل إلى cos موجبة إذا كانت المعادلة غير ذلك ولا يتم العمل على sin إلا إذا طلب في السؤال ان الحل يكون على sin كالتالي (in terms of sin) .

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Ex 1:

When $v(t) = 12 \cos(50t + 10^{o})$

Find amplitude, phase, angular frequency, period and frequency (in terms of sin).

<< Solution >>

$$V(t) = 12\cos(50t + 10^{\circ}) = 12\sin(50t + 10^{\circ} + 90^{\circ})$$

$$V(t) = 12\sin(50t + 100^{\circ})$$

* amplitude $(V_m) = 12$

* phase $(\theta) = 100^{\circ}$

* angular frequency $(\omega) = 50$ rad/s

* period $(T) \Rightarrow \omega = \frac{2\pi}{T} \longrightarrow T = \frac{2\pi}{\omega} = \frac{2\pi}{50} = 0.1257$

$$T = 0.1257 \text{ sec}$$

* frequency $(f) \Rightarrow \omega = 2\pi f \longrightarrow f = \frac{\omega}{2\pi} = \frac{50}{2\pi}$

$$f = 7.96 \text{ Hz}$$

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Ex 2:

Given a sinusoid $\sin(4\pi t - 60^{o})$

Find amplitude, phase, angular frequency, period and frequency (in terms of sin).

<< Solution >>

* amplitude = 5

* phase = -60°

* angular frequency = 4π rad/s

* period $\Rightarrow w = \frac{2\pi}{T} \longrightarrow T = \frac{2\pi}{w} = \frac{2\pi}{4\pi} = 0.5\,s$

$T = 0.5\,s$

* frequency $\Rightarrow w = 2\pi f \longrightarrow f = \frac{w}{2\pi} = \frac{4\pi}{2\pi} = 2\,Hz$

$f = 2\,Hz$

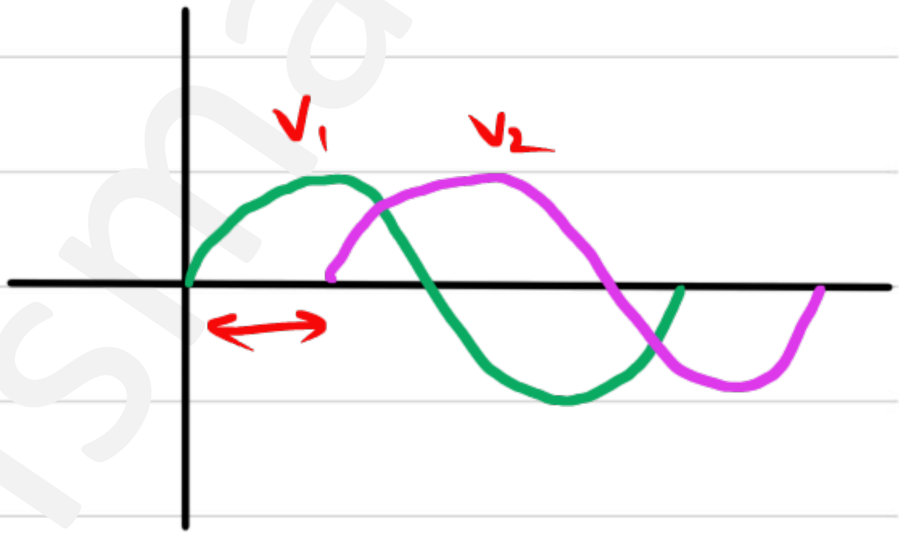
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* Consider two sinusoids:

$$V_1(t) = V_{1m}\cos(\omega t + \theta_1)$$

$$V_2(t) = V_{2m}\cos(\omega t + \theta_2)$$

$$\theta_{12} = \theta_1 - \theta_2$$



① If $\theta_1 - \theta_2 > 0$

V_1 leads V_2 or V_2 lags V_1

يتقدم — يتأخر

② If $\theta_1 - \theta_2 < 0$

V_2 leads V_1 or V_1 lags V_2

③ If $\theta_1 - \theta_2 = 0$

V_1 and V_2 are in phase

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Ex 3:

Calculate the phase angle (in terms of sin) and state which one is leading.

$$v_1 = -10 \cos(\omega t + 50^0)$$

$$v_2 = 12 \sin(\omega t - 10^0)$$

<< Solution >>

$$V_1 = -10 \cos(\omega t + 50^\circ) = 10 \sin(\omega t + 50^\circ - 90^\circ)$$

$$V_1 = 10 \sin(\omega t - 40^\circ)$$

$$V_2 = 12 \sin(\omega t - 10^\circ)$$

$$\text{Phase angle} = \theta_1 - \theta_2$$

$$= -40 - (-10)$$

$$= -40 + 10 = -30^\circ < 0$$

$\therefore$ V_2 leads V_1

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Ex 4:

Find the phase angle between the two currents (in terms of sin)

where

$$i_1 = -4 \sin(377t + 55^0)$$

$$i_2 = 5 \cos(377t - 65^0)$$

Does i_1 lead or lag i_2 ?

<< Solution >>

$$i_1 = -4 \sin(377t + 55^\circ) = 4 \sin(377t + 55^\circ - 180^\circ)$$

$$i_1 = 4 \sin(377t - 125^\circ)$$

$$i_2 = 5 \cos(377t - 65^\circ) = 5 \sin(377t - 65^\circ + 90^\circ)$$

$$i_2 = 5 \sin(377t + 25^\circ)$$

Phase angle $= \theta_1 - \theta_2$

$$= -125 - 25$$

$$= -150^\circ < 0$$

$\therefore i_1$ lag i_2

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