Note Title 11/5/2007

Lecture 21

From Sections 8.1 & 8.2

Solve: E8.1, E8.2, 8.2, 8.4, 8.7

Sinusoidal Signals

* A sinusoid is defined by 3 parameters, amplitude, frequency, and phase

$$v(t) = A_v \cos(\omega t + \phi)$$

A_v: volts ω: rad/s ϕ: rad

Example

plot the sinsoidal waveforms

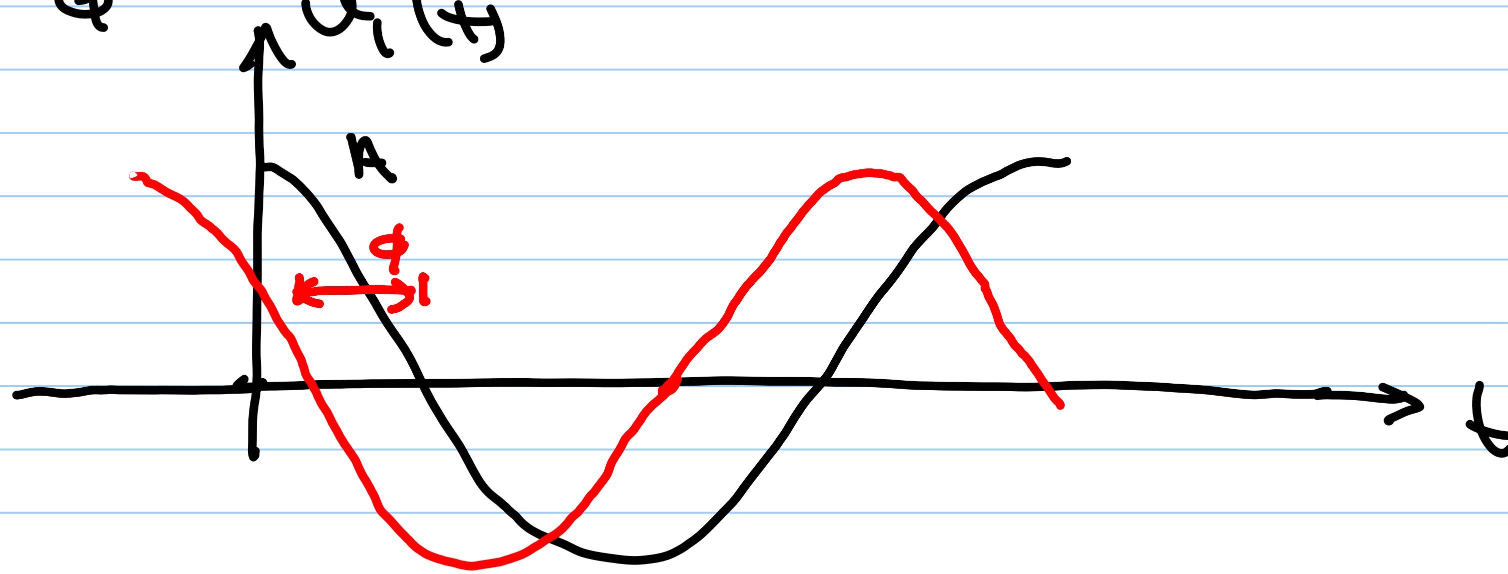
$$v_1(t) = 3\sin(120\pi t + 60^\circ)\ V$$

$$v_2(t) = 10\cos(150t - 120^\circ)\ V$$

$$i_1(t) = 0.5\cos(120\pi t + 270^\circ)\ V$$

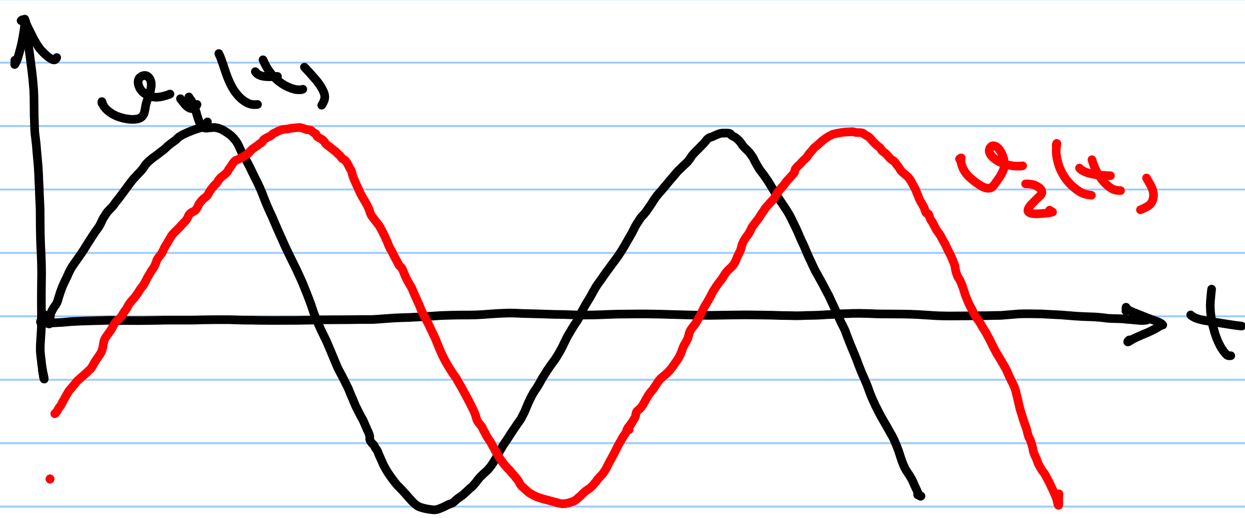
Lead-Lag relationships

* The signal $v_2(t) = A\cos(\omega t + \phi)$ leads the signal $v_1(t) = A\cos(\omega t)$ by ϕ

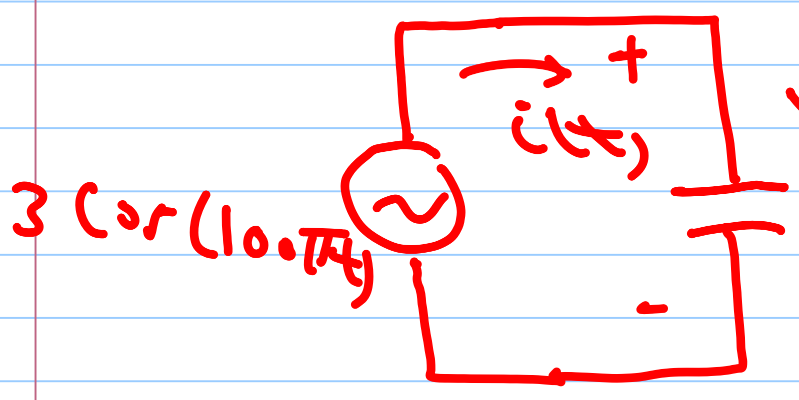


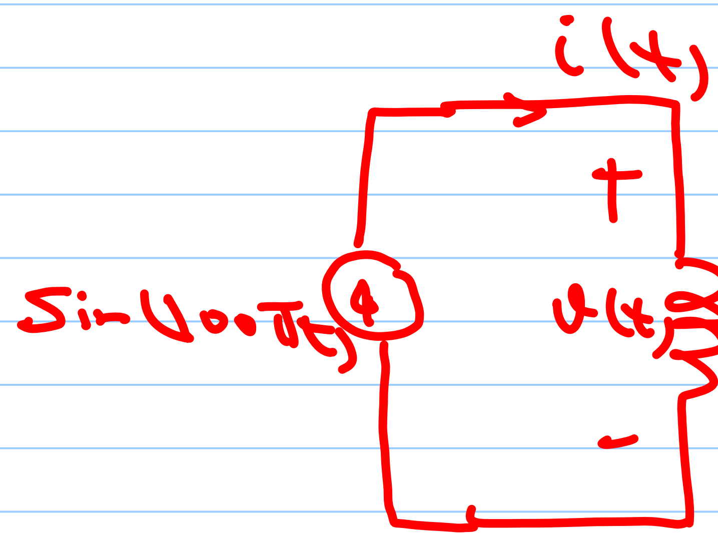
Lead-Lag Relations (Cont'd)

* The signal $v_2(t) = A\sin(\omega t - \phi)$ Lags the signal $v_1(t) = A\sin(\omega t)$ by an angel ϕ



<u>Example</u>



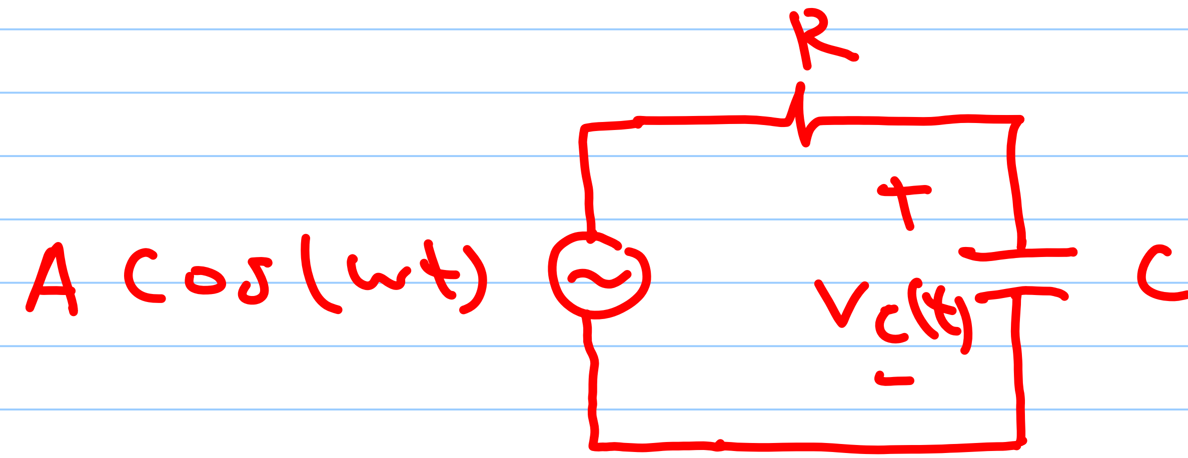


For these two circuit plot both $v(t)$ and $i(t)$

Linear Circuits

* A Linear circuit does not change frequency.
* All steady state responses (voltages or currents) of such circuit are sinusoidal
* They only differ in amplitude and phase

Example



* Write the differential equation of this circuit
* By assuming a steady state solution of the form $v_c(t) = A_c \cos(\omega t + \phi_c)$ find $v_c(t)$.

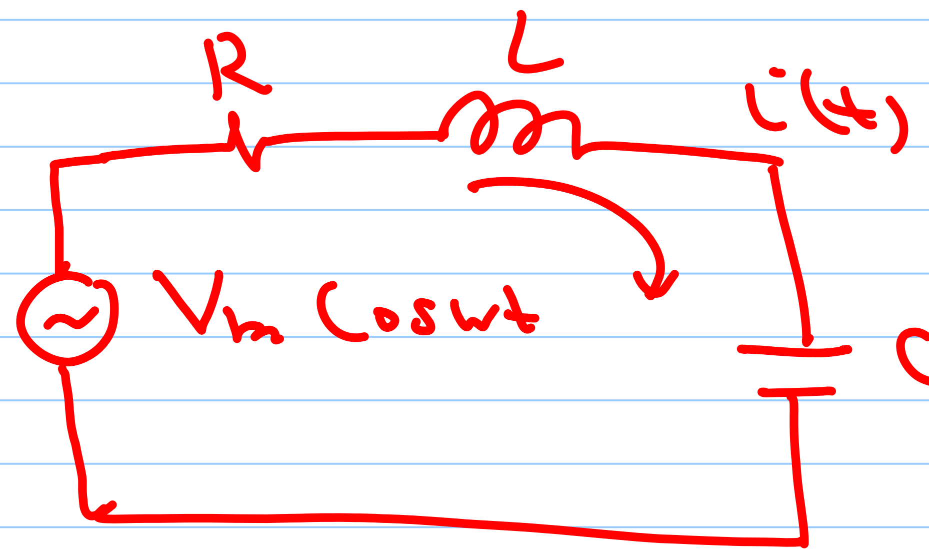
Complex Forcing Function

* Euler's equation $e^{j\omega t} = \cos\omega t + j\sin\omega t$

$\Rightarrow \cos\omega t = \mathrm{Re}(e^{j\omega t})$

* A linear circuit can be analyzed using the complex response and then take the real part of the response only!

Example



* Solve for the steady state current using complex forcing functions