EE 205 Circuit Theory

Lab 1

Steady State Phasor Circuit Analysis

1. Fundamental Concepts:

For a sinusoidal electrical quantities, a phasor is a rotating helix on the complex plane and given by

$$Ae^{j(\omega t+\phi)}$$

where

A=amplitude, ω=radian frequency, ϕ=phase, t=time, $j=\sqrt{-1}$, e=2.71828…

Thus, everything is constant except t. As time progresses, the phasor rotates as an helix.
The connection with sinusoidal excitations come from the Euler's identity as

$$Ae^{j(\omega t+\phi)} = Acos(\omega t+\phi) + jAsin(\omega t+\phi)$$

or

$$Acos(\omega t+\phi) = Re(Ae^{j(\omega t+\phi)})$$

and

$$Asin(\omega t+\phi) = Im(Ae^{j(\omega t+\phi)}).$$

Furthermore, since all circuit equations containing R, L, and C are linear, the time dependence "ωt" term can be neglected in phasor expression, because it remains the same throughout the computations. Thus, we have

$$cos(\omega t+\phi) = Re(Ae^{j\omega t}e^{j\phi})$$

and

$$Asin(\omega t+\phi) = Im(Ae^{j\omega t}e^{j\phi})$$

where

$$Ae^{j\phi}$$

Is called the phasor of the sinusoid $cos(\omega t+\phi)$ or $sin(\omega t+\phi)$.

Consequently, when we apply circuit analysis techniques such as the Ohm's law, KVL and KCL, we can obtain complex expressions for the resistance of capacitors and inductors. They are called "impedances".

For a capacitor,

$$Z_C = \frac{1}{j\omega C}\ \Omega$$

And for an inductor,

$$Z_L = j\omega L\ \Omega$$

2. Lab Procedure:

   Implement an RC circuit in Proteus, and find the steady state capacitor voltage as in Fig 1 and Fig 2 ?

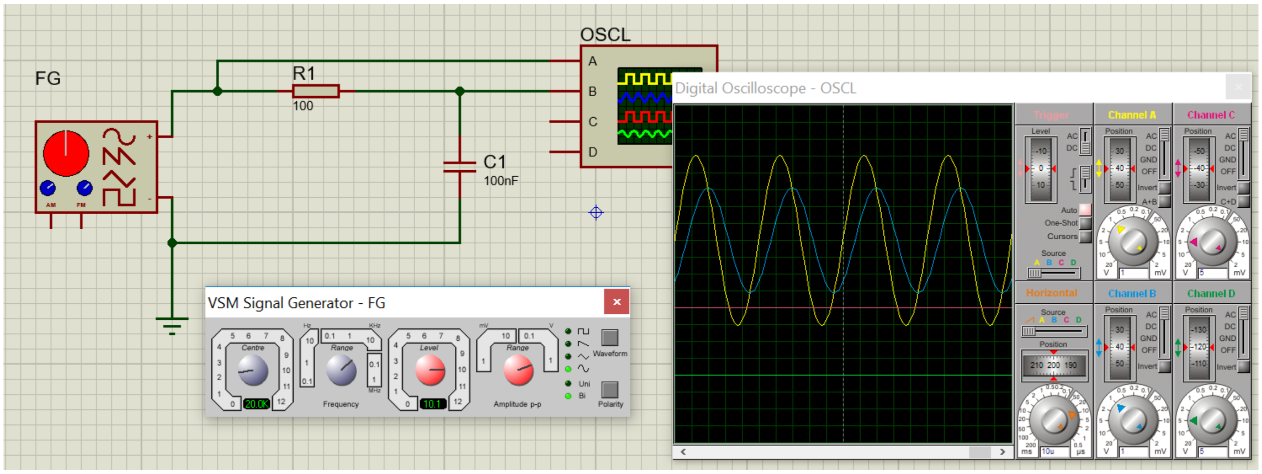

Fig1. RC circuit steady state analysis

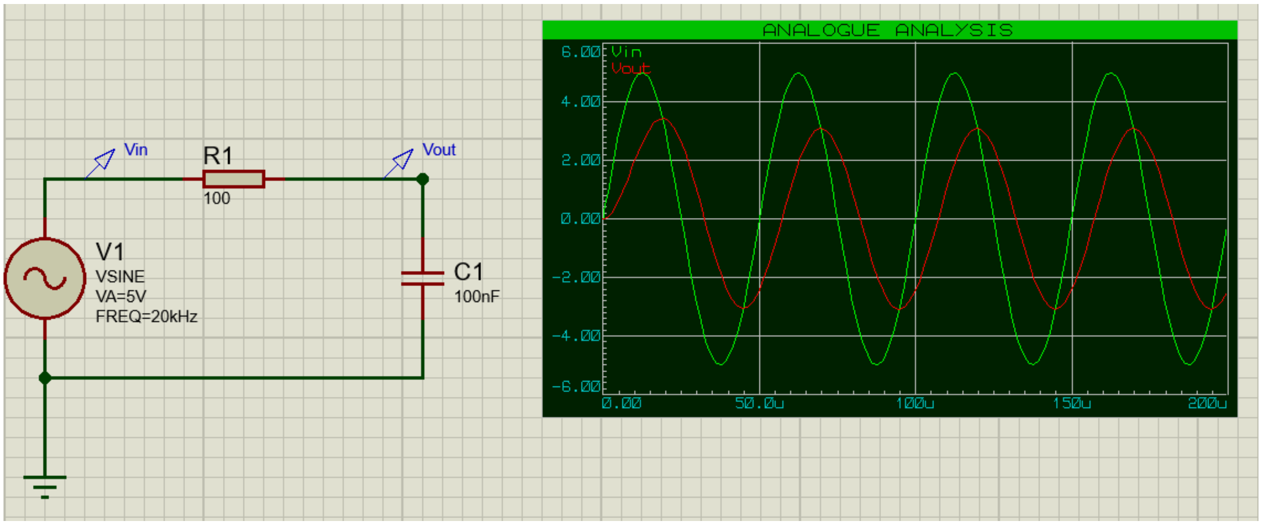

Fig2. RC circuit steady state analysis II