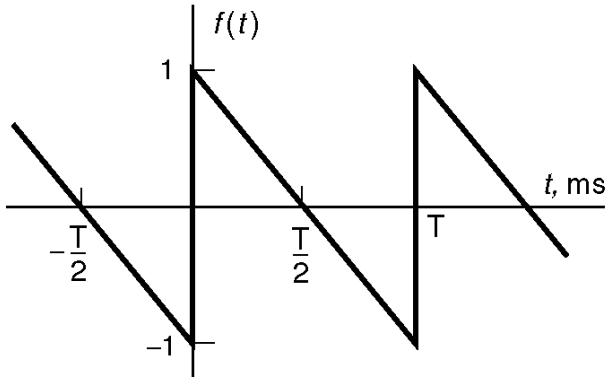
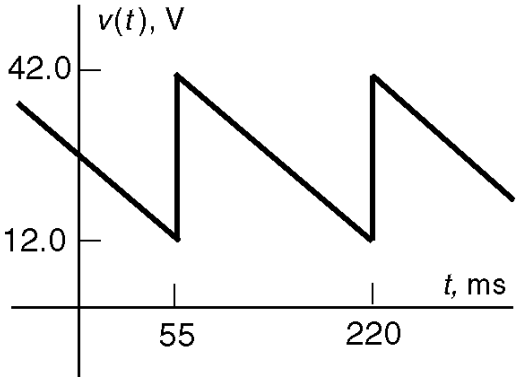
EE221 Final Exam - Spring 2014

Name _____ Student #_____

1.

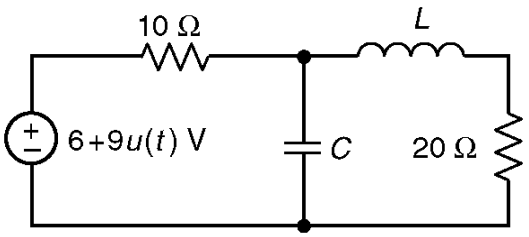


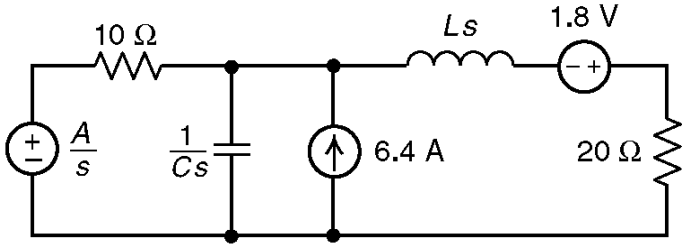


The Fourier series of $f(t)$ is $f(t)=\frac{2}{\pi}\sum_{n=1}^{\infty}\frac{\sin(n\omega_f t)}{n}$ where $\omega_f=\frac{2\pi}{T}$. The Fourier series of $v(t)$ can be represented as $v(t)=a_0+\frac{A}{\pi}\sum_{n=1}^{\infty}\frac{\sin(n\omega_0(t-t_d))}{n}$. Determine the values of a_0, A, ω_0 and t_d.

a_0 = ____27____ V, A = ____30____ V, ω_0 = ____38____ krad/s and t_d = ____55____ ms.

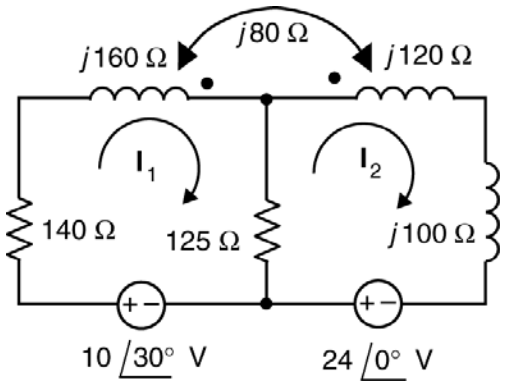
2. Consider this circuit represented both in the time domain and also in the complex-frequency domain (the *s*-domain).





Determine the values of *A*, *C* and *L*: *A* = ___15___V, *C* = ___1.6___F, and *L* = ___9____H .

3. Here's a circuit represented in the frequency domain. Noticing that $\mathbf{I}_1$ and $\mathbf{I}_2$ are mesh currents, we can represent this circuit in the frequency domain, by the mesh equations



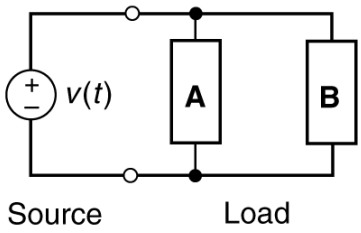
$$\begin{bmatrix} a+jb & -125+jc \\ d-j80 & 125+je \end{bmatrix}\begin{bmatrix} \mathbf{I}_1 \\ \mathbf{I}_2 \end{bmatrix}=\begin{bmatrix} 10\angle 30^\circ \\ 24\angle 0^\circ \end{bmatrix}$$

where *a*, *b*, *c*, *d* and *e* are real constants.

Determine the values of *a*, *b*, *c*, *d* and *e.*

a = __265___ Ω, *b* = ___160__ Ω, *c* = ___−80__ Ω, *d* = ___−125___ Ω and *e* = ___220___ Ω

4. This circuit consists of a source driving a load that consists of the parallel connection of two loads. The voltage source voltage is



$$v(t) = 106\cos(15t)\ \text{V}$$

Load A receives 51.6249 + *j*27.3308 VA

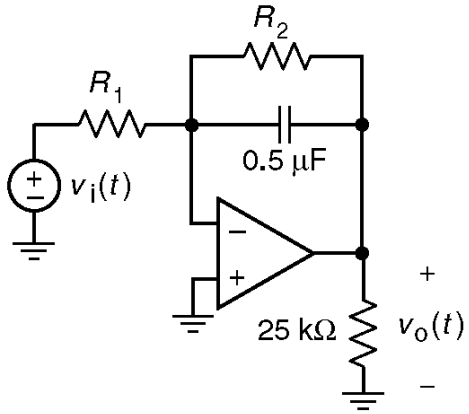
Load B receives 46.7193 W at a power factor of 0.7295 lagging

Determine the complex power supplied by the source

S = ___98.34___ + *j* ___71.13___ VA

5. The network function of the circuit is

$$\mathbf{H}(\omega)=\frac{\mathbf{V}_{\mathrm{o}}(\omega)}{\mathbf{V}_{\mathrm{i}}(\omega)}=\frac{-5}{1+j\dfrac{\omega}{10}}$$



Determine the values of R_1 and R_2:

R_1 = ___40____ kΩ and R_2 = ___200__ kΩ

6. The input to a circuit is $v_{\mathrm{i}}(t)=2.5+c_1\cos(12t+\theta_1)+8\cos(24t+30°)$ V

The output of that circuit is $v_{\mathrm{o}}(t)=c_0+19.5\cos(12t-28.7°)+c_2\cos(24t+\theta_2)$ V

The transfer function of the circuit is $H(s)=\dfrac{V_{\mathrm{o}}(s)}{V_{\mathrm{i}}(s)}=\dfrac{-50}{s+10}$

Determine the values of c_0, c_1, θ_1, c_2 and θ_2:

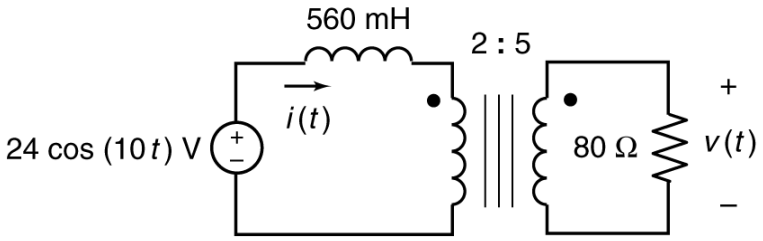
c_0 = __–12.5__, c_1 = __6.092__, θ_1 = __–158.1__°, c_2 = _15.385_ and θ_2 = __142.6__°

7. The current $i(t)$ and voltage $v(t)$ labeled on the circuit drawing are

$$i(t) = E\cos(10t - 23.63°) \text{ Amps}$$

and $$v(t) = F\cos(10t - 23.63°) \text{ V}$$

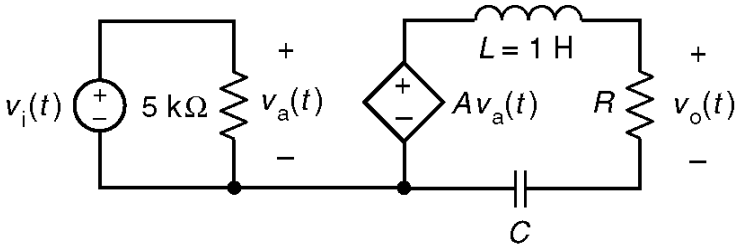
Determine the values of E and F:



E = ____1.718____ A and F = ____54.98_____ V

8. The input to the circuit is the voltage of the voltage source, $v_i(t)$. The output is the voltage $v_o(t)$. The transfer function of the circuit is

$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{7s}{s^2 + 10s + 25}.$$

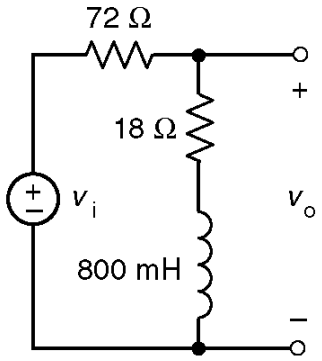


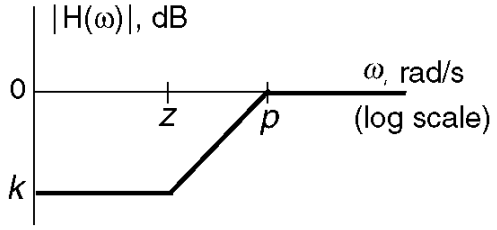
Determine the values of A, C and R: A = ___0.7___V, C = ___40___**mF**, and R = ___10____Ω **.**

The impulse response of the circuit is $v_o(t) = (a + bt)e^{-ct}u(t)$. Determine the values of the coefficients a, b, and c.

a = _____7_____, b = _____–35_____ and c = _____5____.

9. Consider this circuit and the corresponding magnitude Bode plot. The input to this circuit is the voltage, v_i, of the voltage source. The output is the voltage v_o.





The transfer function of this circuit is: $H(s) = \dfrac{\mathbf{V}_o(s)}{\mathbf{V}_i(s)} = \dfrac{s+a}{s+b}$

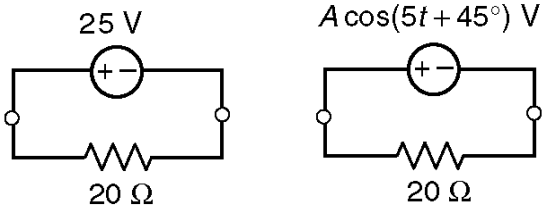
Determine the values of the transfer function coefficients *a* and *b*:

a = ___22.5___rad/s, and *b* = ___112.5____rad/s **.**

Determine the values of the constants *k*, *p* and *z* used to label the Bode plot:

k = ___–14___**dB**, *p* = ___112**.**5___rad/s and *z* = ___22**.**5____rad/s.

10. The sources in these two circuits supply equal values of average power, P_{ave}. Determine the values of *A*, the amplitude of the sinusoidal voltage, and P_{ave}.



A = ___35.36___ V and P_{ave} = ___31.25__ W