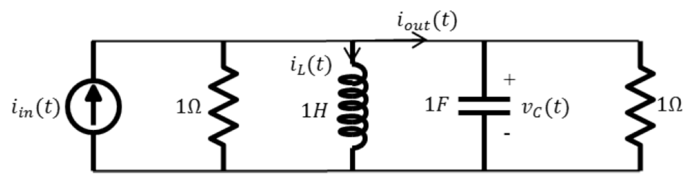
Set A

Consider the circuit shown below, where the excitation is $i_{in}(t) = 2\,sin(30t - 50°)\,A$. Assume that none of the elements carry energy at initial conditions.

A. Find Thevenin's equivalent across the terminals of the rightmost 1Ω resistor (exclude the resistor while calculating Thevenin's equivalent).

B. Using Thevenin's equivalent model, find the time domain current $i_{out}(t)$ and $v_C(t)$.

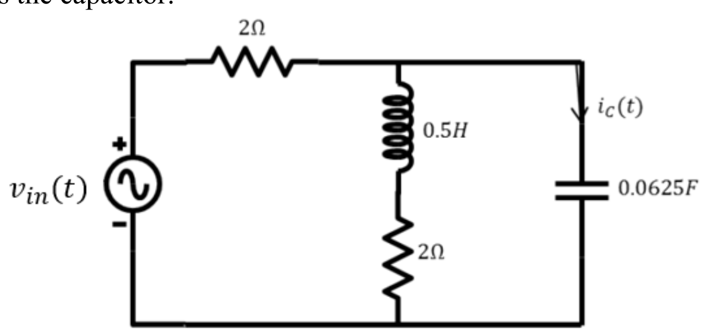


Set B

Consider the circuit shown below, where the excitation is $v_{in}(t) = 12\,sin(1t - 60°)\,V$. Assume that none of the elements carry energy at initial conditions.

A. Find Thevenin's equivalent across the terminals of the capacitor (exclude the capacitor while calculating Thevenin's equivalent).

B. Using Thevenin's equivalent model, find the time domain current $i_C(t)$ passing through the capacitor and voltage $v_C(t)$ across the capacitor.

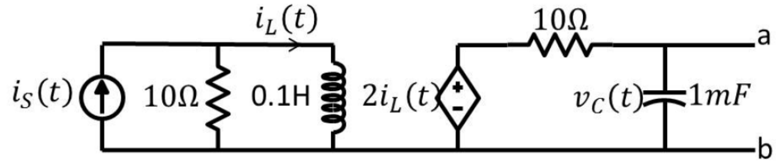


Set C

Consider the circuit shown below, where the excitation is $i_{in}(t) = 10cos(50t)\,A$. Assume that none of the elements carry any energy at initial conditions.

A. Find Thevenin's equivalent across the terminals of the capacitor (exclude the capacitor while calculating Thevenin's equivalent).

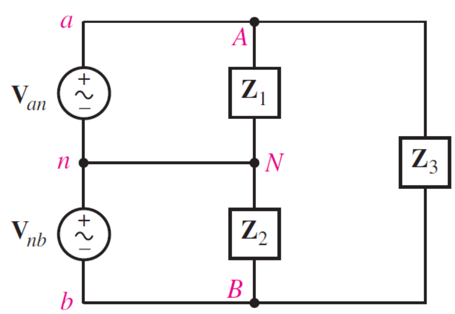
B. Using Thevenin's equivalent model, find the time domain current $i_L(t)$ and $v_C(t)$.



Set A

Questions 1 [CO2]: Consider a single-phase three-wire system, as shown in the figure. The source is balanced and is operating at 60 Hz. $\mathbf{V}_{an}$ is 110 + j0 V rms. Assume the loads as Z_1 = 50 + j0 Ω, Z_2 = 100 + j45 Ω and Z_3 = 100 – j90 Ω. Write all answers with units.

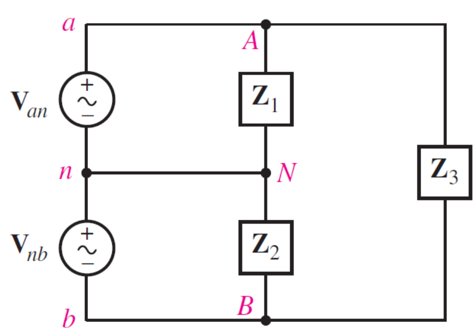
(a) Find time-domain voltages $v_{an}(t)$ and $v_{bn}(t)$. Write your answers in terms of the cosine function with positive magnitude. [1]
(b) Find the instantaneous power delivered to each load. [5]
(c) Find the total average power supplied to loads. [2]
(d) Represent load Z_3 by a series combination of two passive elements. [2]



Set B

Questions 1 [CO2]: Consider a single-phase three-wire system, as shown in the figure. The source is balanced and is operating at 60 Hz. $\mathbf{V}_{an}$ is 110 + j0 V rms. Assume the loads as Z_1 = 50 + j0 Ω, Z_2 = 100 + j45 Ω and Z_3 = 100 – j90 Ω. Write all answers with units.

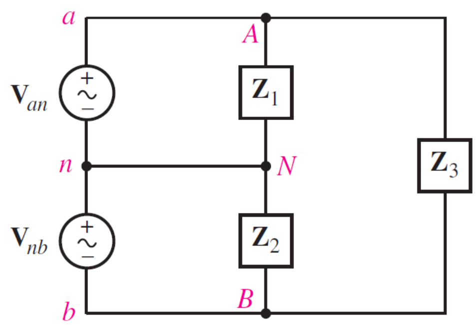
(a) Find phasor currents I_{aA} and I_{Bb}. [5]
(b) Find time-domain currents $i_{aA}(t)$ and $i_{Bb}(t)$. [1]
(c) Find phasor current I_{nN}. [2]
(d) What would you change in the load to make I_{nN} equal to zero? Find the values of passive elements needed to implement this change. [2]



Set C

Questions 1 [CO2]: In the following figure, suppose the loads are $Z_1 = 100 + j0\ \Omega$, $Z_2 = 200 + j90\ \Omega$ and $Z_3 = 200 - j180\ \Omega$. The balanced single-phase three-wire source operates at 50 Hz, and $\mathbf{V}_{an}$ is 110 + j0 V rms. Write all answers with units.

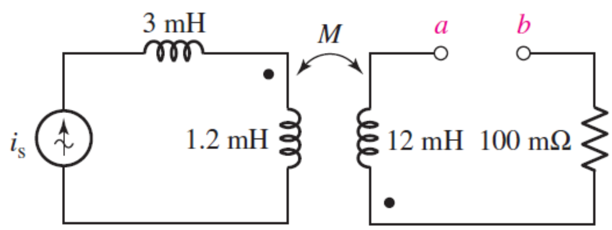
(a) Find complex power delivered to each load. Write your answers in rectangular form. [5]
(b) Find the average power delivered to each load. [1]
(c) Find the total time-averaged power and total apparent power delivered by sources. [2]
(d) Calculate the power factor of the total load and the power factor of the source. [2]



Set A

Questions 1 [CO2]: Consider the circuit represented in the figure. The coupling coefficient k = 0.75 and the source current i_s = 5 cos 200t mA.

(a) Draw the circuit in the frequency domain. Specify all impedances in the circuit.
(b) Calculate total energy stored at t = 0 if a-b is open-circuited.
(c) Calculate total energy stored at t = 0 if a-b is short-circuited.



Set B

Questions 1 [CO2]: Consider the circuit represented in the figure.

(a) Draw the circuit in the frequency domain. Specify all impedances in the circuit.
(b) Obtain and simplify the mesh current equations.
(c) Calculate the average power delivered to each resistor. [To help with calculations, the calculated value of the leftmost mesh current is provided as $0.74\angle-73.2°$ A.]