ECE 10, Winter 2023, Homework #6

Problem 1: Consider the circuit shown in Figure 1. Determine its sinusoidal steady state Norton's equivalent for:
(a) $v_1(t) = 2\cos(t)$, and
(b) $v_1(t) = 2\cos(\sqrt{2}t)$, and
(c) $v_1(t) = 2\cos(2t)$
(5 + 5 + 5 = 15 points)

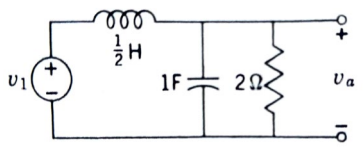

Fig. P12-11.

Figure 1

Problem 2: Refer to Figure 2 for this problem. Find the Thevenin's equivalent of this network looking into the pair of terminals whose voltage labeled $\underline{V}_O$.
(15 points)

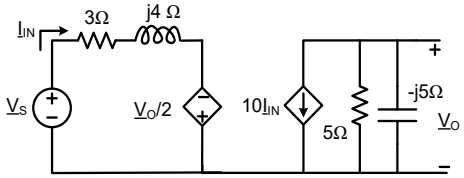

Figure 2

Problem 3: Refer to Figure 3 for this problem. Assume that the current source is $i_B(t) = 20\cos(10^4 t - 60^o)$.
(a) Find the steady state value of $V_x(t)$ by using superposition in the phasor domain. Assume that the voltage source is $v_a(t) = 10\cos(10^4 t)$.
(b) Repeat part (a), but now assume that the voltage source is $v_a(t) = 10\cos(10^3 t)$ instead. **Note**: When all the independent sources in a network do not have the same frequency, phasor domain is not defined and superposition can't be applied in the phasor domain. However, superposition is still valid in the time domain, and so, for each independent source, employ the phasor technique to determine its contribution to $V_x(t)$.
(10 + 10 = 20 points)

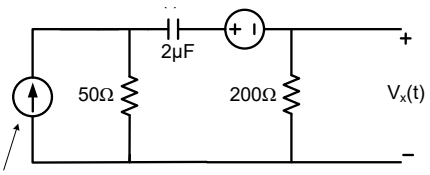

Figure 3

Problem 4: Refer to Figure 4 for this problem. This is called an autotransformer. Assume that the transformer has perfect magnetic coupling i.e. $k = 1$, zero resistance in the primary and secondary coils, and L = 1mH.
(a) Draw a phasor domain model for the circuit.
(b) Compute $\underline{V}_a$ using loop current analysis.
(c) Repeat part (a) but now assume that L is infinitely large. **Hint**: The transformer becomes ideal under these assumptions.
(5 + 10 + 10 = 25 points)

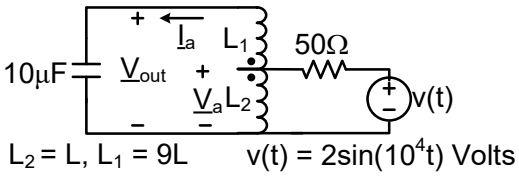

Figure 4

Problem 5: Refer to Figure 5 for this problem. Calculate the driving point impedance looking into the terminals x and y.
(10 points)

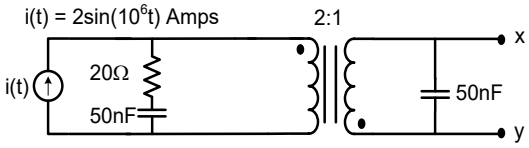

Figure 5

Problem 6: Refer to Figure 6. Suppose $\underline{V}_{xy} = 2e^{j0}$. Calculate the phasor of the voltage across the 9 Ohm resistor.
(15 points)

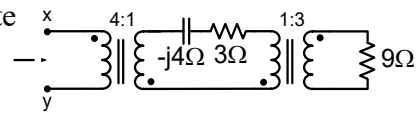

Figure 6