Information Technology University, Lahore, Pakistan

Electrical Network Analysis (EE-241)

Assignment # 3, Spring 2021

Submission Deadline: Thursday April 29, 2021 (11:59 pm) Maximum Marks: 100

- Solve all the 10 problems. (Each problem carries 10 marks).
- Use A-4 Size blank pages to solve all the problems.
- Write down your roll numbers on the first page at the top right corner.
- Scan your document carefully with the right sequence before uploading.
- **No plagiarism will be tolerated.**

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1. A sinusoidal voltage is given by the expression $v(t) = 20\cos(10t + 45°)$.
   (a) What is the time period of the voltage (in milliseconds)? [2]
   (b) What is the fequency (in Hertz)? [2]
   (c) What is the magnitude of voltage at $t = 10\,\text{ms}$? [2]
   (d) What is the *rms* value of v? [2]
   (e) Write the voltage v(t) in phasor form $\mathbf{V}$. [2]

2. Determine the angle by which v lags the current if $v = 10\cos(25t - 50°)$.
   (a) $i_1 = 10\cos(25t)$ [2]
   (b) $i_2 = 10\cos(25t - 78°)$ [2]
   (c) $i_3 = 10\cos(25t + 38°)$ [2]
   (d) $i_4 = 10\sin(25t - 19°)$ [2]
   (e) $i_5 = 10\sin(25t + 39°)$ [2]

3. Find the time-domain expression corresponding to each phasor:
   (a) $\mathbf{V} = 20.53\,\underline{/-48°}\,\text{V}$ [2]
   (b) $\mathbf{I} = (10\,\underline{/45°} - 40\,\underline{/30°})$ [4]
   (c) $\mathbf{V} = 10 + j40 - 15\underline{/15°}$ [4]

4. Use the concept of phasor to combine the following sinusoidal functions into a single trignometric expression:
   (a) $x(t) = 90\sin(50t - 20°) + 60\cos(50t - 70°)$ [2]
   (b) $y(t) = 10\cos(\omega t + 30°) - 10\sin(\omega t) + 10\cos(\omega t + 150°)$ [4]
   (c) $z(t) = 20\sin(2000t + 40°) - 10\cos(2000t - 60°)$ [4]

5. The current in a 10 mH inductor is $10 \cos(25t - 80°)$ mA. Calculate

   (a) the inductive reactance. [2]

   (b) the impedance of the inductor. [2]

   (c) the phasor voltage **V**. [2]

   (d) the steady-state expression for $v(t)$. [2]

   (e) the value of the voltage at t = 10 ms. [2]

6. The voltate across a 47 µF capacitor is $30 \cos(2000t + 20°)$ V. Calculate

   (a) the capacitive reactance. [2]

   (b) the impedance of the capacitor. [2]

   (c) the phasor current **I**. [2]

   (d) the steady-state expression for $i(t)$. [2]

   (e) the value of the current at t = 2 ms. [2]

7. (a) Insert an appropriate complex source into the circuit represented in Figure 1 and use it to determine the steady-state expression for $i_C(t)$ and $v_C(t)$. [5]

   (b) Use the phasor method to verify the results of part (a). [5]

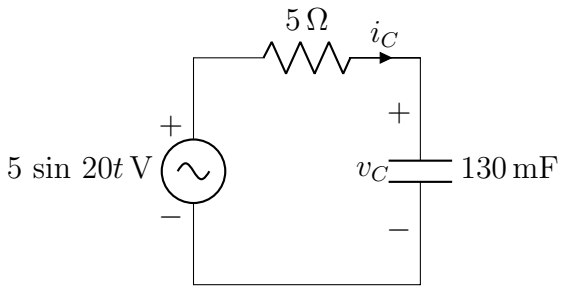

Figure 1: Circuit for problem 7

8. (a) Find the steady-state expression for $v_\circ$ in the circuit of Figure 2 if $i_g(t) = 50 \cos 10000t$ mA. [5]

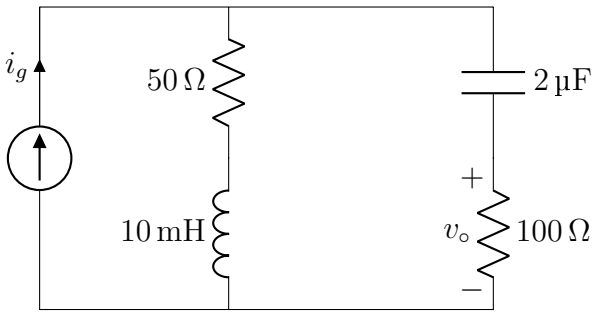

Figure 2: Circuit for problem 8a

   (b) The circuit in Figure 3 is operating in the sinusoidal steady-state. Find the value of frequency (in Hertz) if [5]

$$i(t) = 20 \sin(\omega t + 20°) \text{ V},$$
$$v(t) = 20 \cos(\omega t - 16°) \text{ mA}.$$

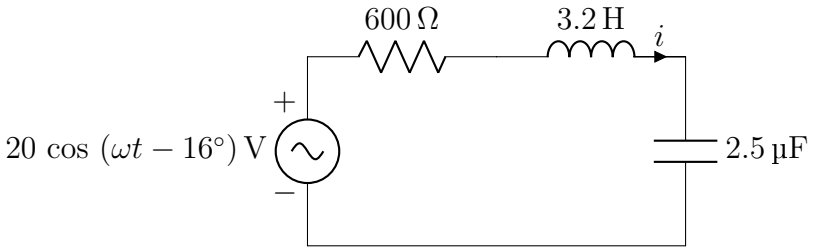

Figure 3: Circuit for problem 8b

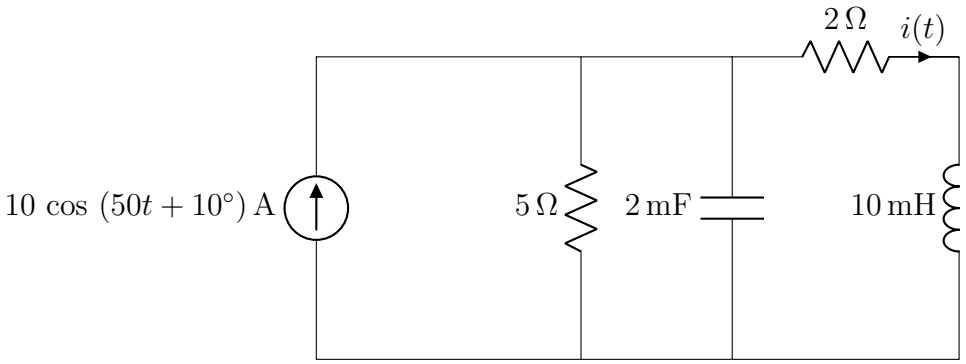

Figure 4: Circuit for problem 9a

9. (a) Use phasor-based analysis to obtain an expression for i(t) in the circuit of Figure 4. [5]

   (b) The sinusoidal voltage source in the circuit in Figure 5 is 40 sin 500t V. Find and draw the Thevenin equivalent with respect to terminals $a - b$. [5]

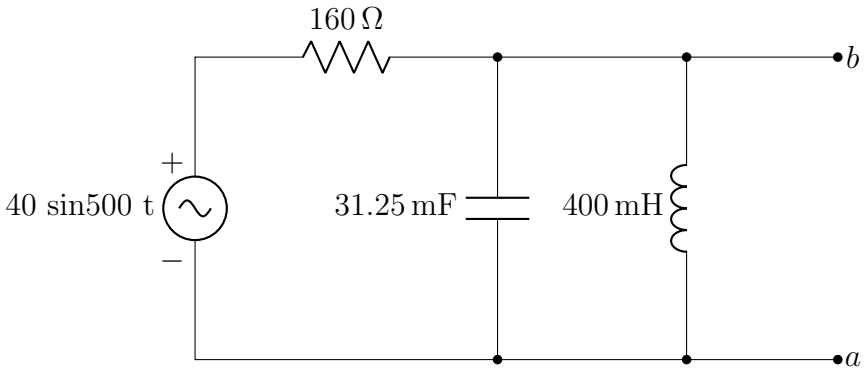

Figure 5: Circuit for problem 9b

10. For the circuit shown in Figure 6,

    (a) Use nodal analysis to determine the two nodal voltages v_1(t) and v_2(t). [5]

    (b) Use superposition theorem to verify the results of part (a). [5]

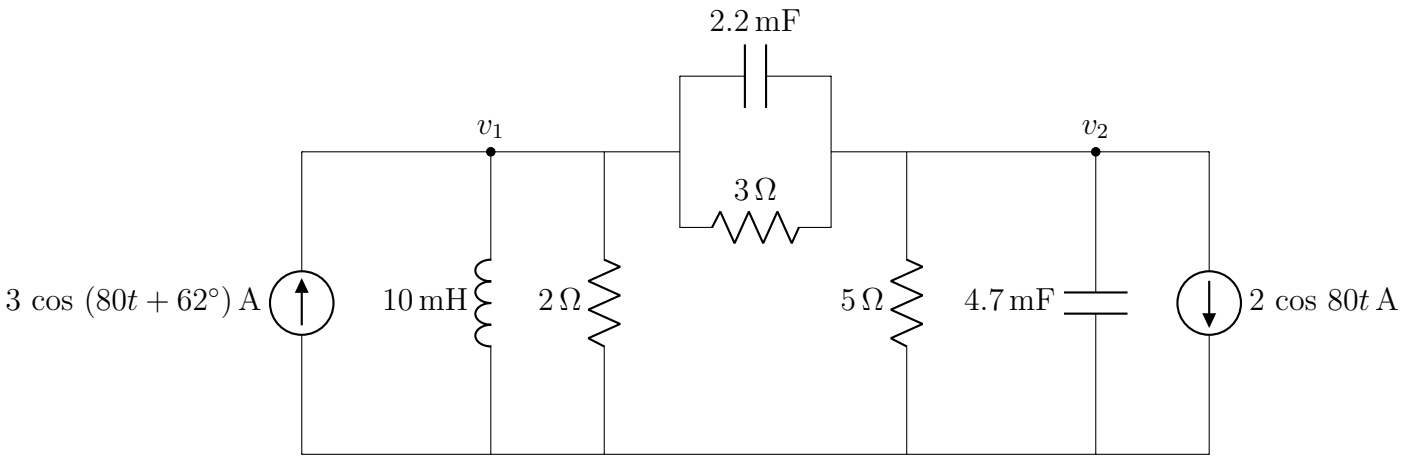

Figure 6: Circuit for problem 10