E927500 Electric Circuit Analysis Spring 2017

Midterm Exam I

March 22, 2017

Rules and Regulations: It is permitted to bring one paper of A4 size with handwritten formulas. There is a time limit of two hours and fifty minutes.

Problems for Solution:

1. Please determine whether each of the following statements is *True* or *False*.

   (a) (4%) Phasor domain is also called as frequency domain.

   (b) (4%) The reactance $Z = -3j$ is inductive. impedance

   (c) (4%) When a circuit has sources operating at different frequencies, we can add the individual responses directly in phasor domain according to the superposition theorem.

   (d) (4%) Capacitor is regarded as an open circuit at DC.

   (e) (4%) Let the phasor of $v(t) = V_m \cos(\omega t + \phi)$ be $\mathbf{V} = V_m \angle \phi$. Then, the phasor of

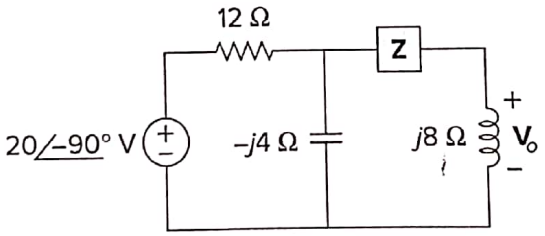
   $$v_1(t) = \frac{d^2 v(t)}{dt^2}$$

   is $\mathbf{V}_1 = \omega^2 \mathbf{V}$.

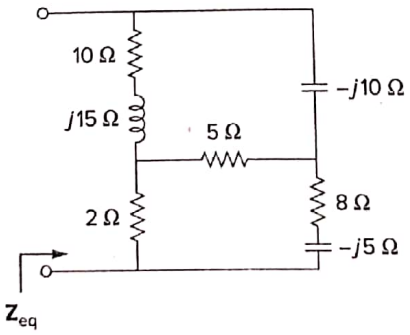
2. (10%) Find $v(t)$ in the following integrodifferential equation using the phasor approach:

   $$\frac{dv(t)}{dt} + 5v(t) + 4\int v(t)\,dt = 20\sin(4t + 10°).$$

3. (10%) Find $\mathbf{Z}$ in the network of the following figure, given that $\mathbf{V}_o = 4\angle 0°$ V.



4. (10%) Find the equivalent impedance Z_{eq} of the circuit as shown below.



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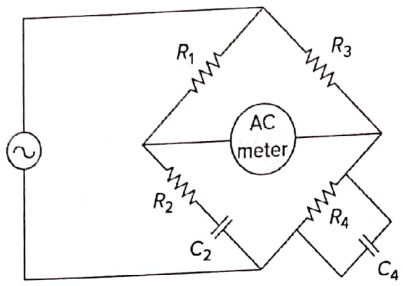
5. Let the impedance $Z = R + jX$ and the corresponding admittance $Y = 1/Z = G + jB$.

   (a) (5%) Please express R and X, respectively, in terms of G and B.

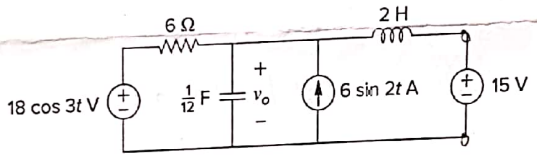
   (b) (5%) Thank E94045020 for providing this problem. Assume $G, B > 0$. Please give the polar form of Z in terms of G and B.

6. (10%) The AC bridge circuit of the following figure is called a Wien bridge. It is used for measuring the frequency f of a source. If the bridge is balanced, show that

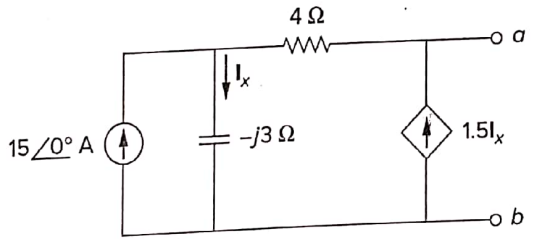
$$f = \frac{1}{2\pi\sqrt{R_2 R_4 C_2 C_4}}.$$



7. (10%) Solve for $v_o(t)$ in the following circuit using the superposition principle.



8. (10%) Find the Thevenin equivalent at terminal a-b of the circuit as shown below.



9. (10%) Thank E94046220 for providing this problem.

At what frequency will the output voltage $V_o(t)$ in figure be equal to the input voltage $V_i(t)$?

(a) 0 rad/s (b) 1 rad/s (c) 4 rad/s
(d) ∞ rad/s (e) none of the above

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