Mid Term I

E927500
Circuit Analysis
April 22, 2015

A. (3×12=36 points) Explain or answer each of the following statements or terms " ".

1. Comparison between "Phasor" and "Fourier transform".

2. $\int v dt$ (time domain) $\Rightarrow \dfrac{\mathbf{V}}{j\omega}$ (phasor domain) by the Fourier trnasform.

3. An inductor acts like a short circuit to a dc signal, and a capacitor can reject a dc signal.

4. Compare "negative feedback" with "positive feedback" in op amp circuit.

5. In Fig. 1, the output is taken across the capacitor. Does the output voltage $v_o(t)$ across the capacitor lead the input voltage $v_i(t)$?

6. Capacitance multiplier is used to create a large capacitance. Explain $C_{eq} = \left(1+\dfrac{R_2}{R_1}\right)C$ in Fig. 2.

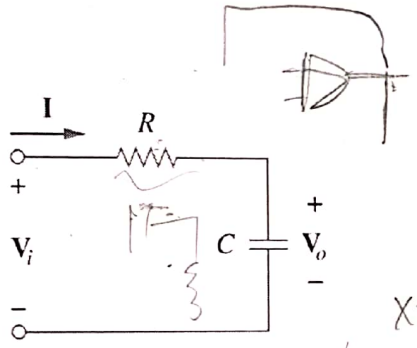

Fig. 1

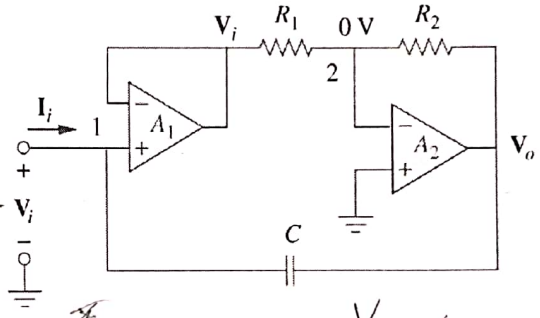

Fig. 2

7. $\dfrac{1}{2}|\mathbf{V}|^2 = \dfrac{1}{2}\mathbf{V}\times\mathbf{V}^* = \mathbf{V}_{rms}\times\mathbf{V}^*_{rms}$

8. Apparent power is measured in volt-amperes or VA to distinguish it from the average or real power which is measured in watts.

9. Maximum average power is transferred to a purely real load when the load resistance is the norm of the Norton impedance as seen from the load terminals, i.e. $R_L = |\mathbf{Z}_N|$.

10. Comparison between "self-inductance" and "mutual-inductance".

11. $M = k\sqrt{L_1 L_2}$, where coupling coefficient $k = c_M / \sqrt{c_1 c_2}$.

12. Comparison between "linear transformer" and "ideal transformer".

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B. (5+9=14 points) Phasor & Superposition Theorem:

(a) Derive the differential equations for Fig. 3 and (b) to solve for $v_o(t)$ in phase domain $\mathbf{V}_o$.

C. (10+5+5=20 points) Norton Equivalent Circuit & Maximum Average Power Transfer:

(a) Determine the Norton equivalent of the circuit in Fig. 4 as seen from terminals *a-b*. (b) Find the load impedance $\mathbf{Z}_L$ that absorbs the maximum average power. (c) Calculate P_{max}.

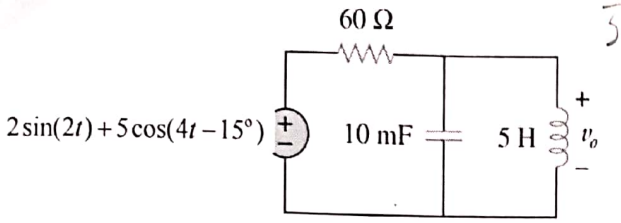

Fig. 3

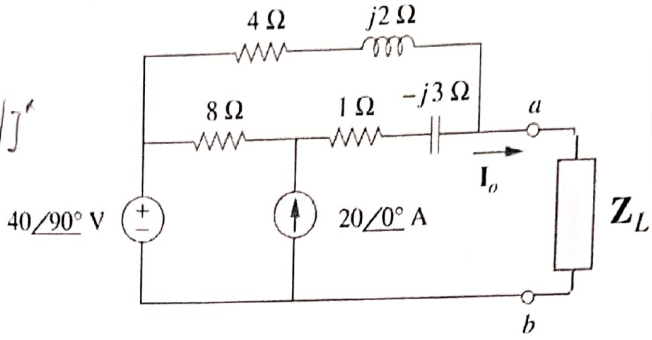

Fig. 4

D. (15 points) Op Amp AC Circuits: Determine $v_o(t)$ in the op amp circuit in Fig. 5 if $v_s = 2\cos 2000t$.

E. (15 points) Mutual Inductance: Find current $\mathbf{I}_o$ in Fig. 6.

F. (3+3+4=10 points) Power Factor Correction:

Refer to the circuit shown in Fig. 7. (a) What is the power factor? (b) What is the average power dissipated? (c) What is the value of the capacitance that will give a unity power factor when connected to the load?

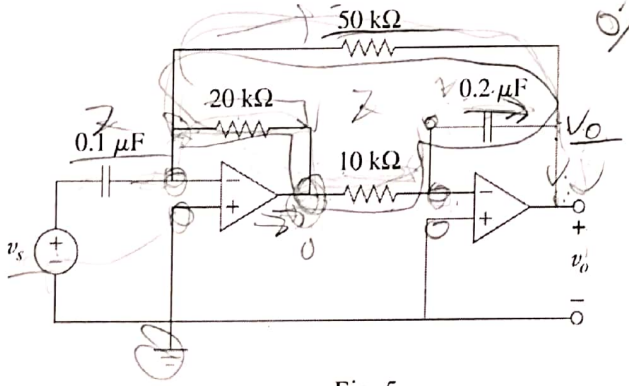

Fig. 5

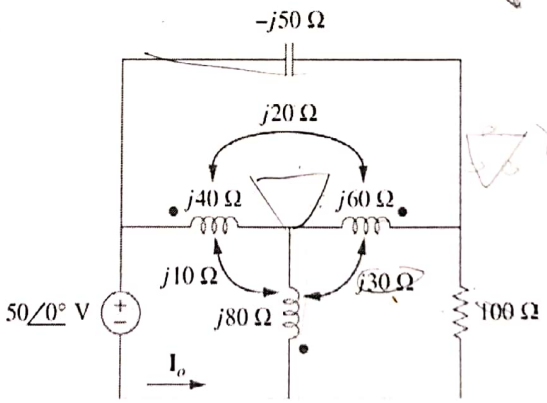

Fig. 6

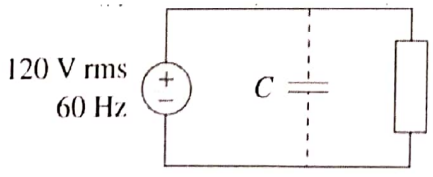

Fig. 7

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