Homework 7

Due date:
May 14th, 2018
Turn in your homework in class

Rules:

- Please try to work on your own. Discussion is permissible, but identical submissions are unacceptable!
- Please show all intermediate steps: a correct solution without an explanation will get zero credit.
- Please submit on time. No late submission will be accepted.
- Please prepare your submission in English only. No Chinese submission will be accepted.

1. (9%) Simplify the following expressions and give the answer with rectangular form and polar form.

   (a) $\frac{(5+j8)+(-2+j11)*j5}{(6+3j)*(-2-8j)-(3+6j)/(4-j8)}$

   (b) $\frac{(5\angle 60° - 96\angle -105°)*(-20+j8)}{(8-j9)*(10\angle 45°)}$

   (c) $(\frac{-45-j18}{8-j6})^2/\sqrt{(15+j9)/(14+j6)}$

2. (7%) Simplify the following expressions by using phasors:
   (a) $i_1(t) = 40\,cos(\omega t - 48°) + 89\,cos(\omega t + 87°)\,A$
   (b) $i_2(t) = 88\,sin(\omega t + 65°) - 756\,cos(\omega t + 44°)\,A$
   (c) $i_3(t) = 218\,cos(8t) - 950\,sin(8t)\,mA$
   (d) $v_1(t) = 64\,sin(8t - 95°) + 24\,sin(8t + 23°)\,V$
   (e) $v_2(t) = 50\,sin(100t - 65°) + 45\,cos(100t + 20°) + 30\,sin(100t - 80°)\,mV$
   (f) $v_3(t) = 4\,cos(55t + 66°) + 4\,cos(55t - 66°)\,V$
   (g) $v_4(t) = 25\,sin(35t) - 50\,cos(35t)\,\mu V$

3. (8%) Find steady state solution of $v(t)$ or $i(t)$ in the following integro differential equations using the phasor approach:
   (a) $v(t) + \int 54v(t)dt = 25\,cos(6t)$.
   (b) $2\frac{dv(t)}{dt} + 8v(t) + 3\int v(t)dt = 50\,sin(8t - 30°)$.
   (c) $8i(t) + \frac{7di(t)}{dt} = 560\,cos(6t + 75°)$.
   (d) $50\int i(t)dt + 2i(t) + \frac{di(t)}{dt} = 6\,cos(3t - 66°)$.

4. (8%) The voltage applied to the circuit shown in Figure 4 at *t=0* is $50\,cos(90t + 36°)\,V$. The circuit resistance is 60Ω and the initial current in the 25mH inductor is zero.

   (a) Find $i(t)$ for $t \geq 0$.

   (b) Write the expressions for the transient and steady-state components of $i(t)$.

   (c) What are the maximum amplitude, frequency(in radians per second), and phase angle of the steady-state current?

   (d) By how many degrees are the voltage and the steady-state current out of phase?

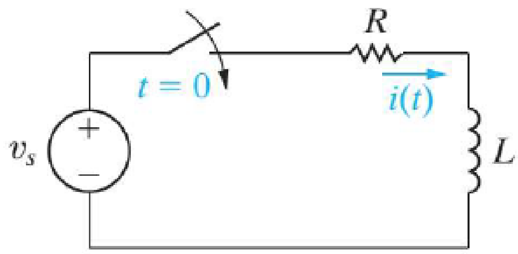

Figure 4

5. (10%) Determine the equivalent impedance:
   (a) Z_1 at ω=300rad/s in Figure 5-a.
   (b) Z_2 at 1000Hz in Figure 5-b.
   (c) Z_3 at 800Hz in Figure 5-c.
   (d) Z_4 in Figure 5-d.
   (e) Z_5 at $\omega = 10^4$rad/s in Figure 5-e.

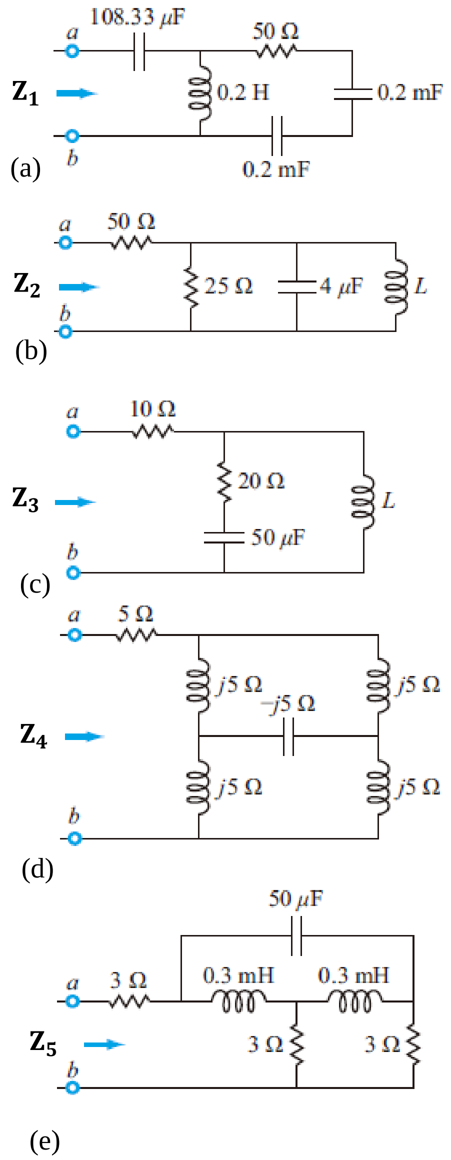

Figure 5

6. (9%) Determine $i_x(t)$ by using mesh method in the circuit of Figure 6, given that $v_s(t) = 6cos5 \times 10^5 t$ V.

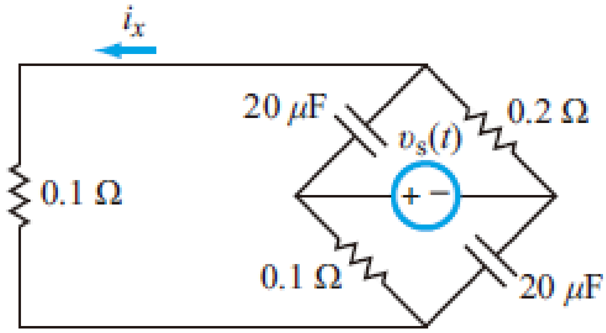

Figure 6

7. (9%) Find the value of ω at which $v_s(t)$ and $i_s(t)$ in the circuit of Figure 7 are in-phase (in-phase means that there is no imaginary part in the total Z_{eq}).

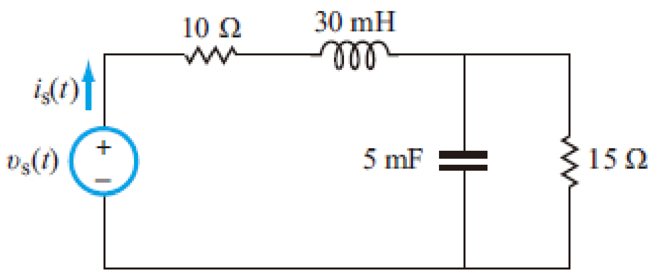

Figure 7

8. (9%) The input signal in the op-amp circuit of Figure 8 is given by

$$v_{in}(t) = 0.5cos2000t \text{ V}.$$

Obtain an expression for $v_{out}(t)$ and then evaluate it for $R_1 = 2k\Omega, R_2 = 10k\Omega,$ and $C = 0.1\ \mu$F.

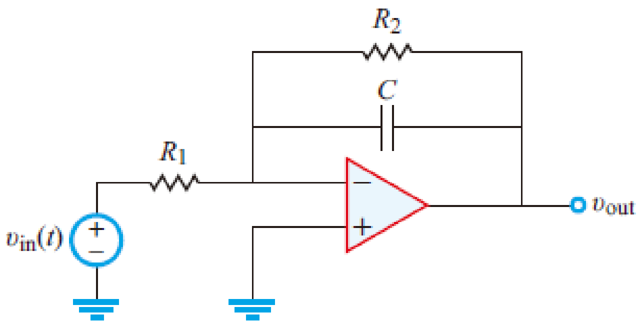

Figure 8

9. (9%) The circuit in Figure 9 is in the phasor domain. Determine and plot its Thevenin equivalent circuit at terminals *(a,b)*.

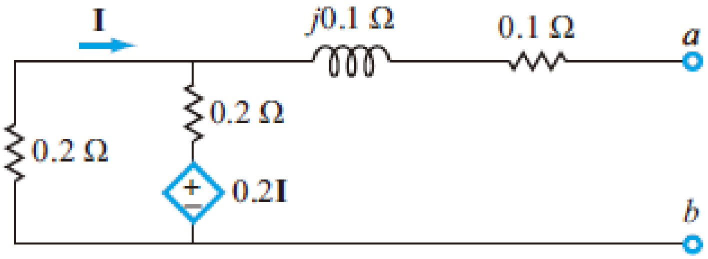

Figure 9

10. (12%) Find v_0 in the circuit of Figure 10 using superposition.

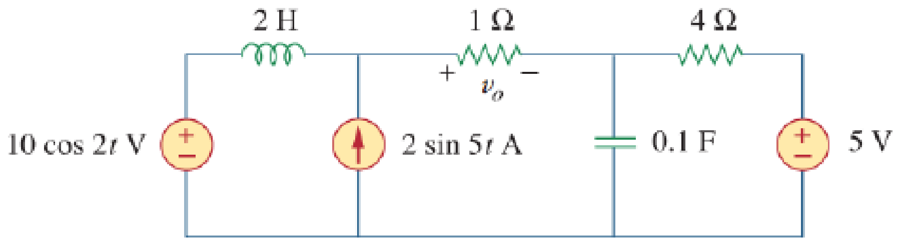

Figure 10

11. (10%) The input circuit shown in Figure 11 contains two sources, given by

$$i_s(t) = 2\cos 10^3 t \ A$$
$$v_s(t) = 8\sin 10^3 t \ V$$

This input circuit is to be connected to a load circuit that provides optimum performance when the impedance Z of the input circuit is purely real. The circuit includes a "matching" element whose *type* and *magnitude* should be chosen to realize that condition. What should those attributes (type and magnitude) be?

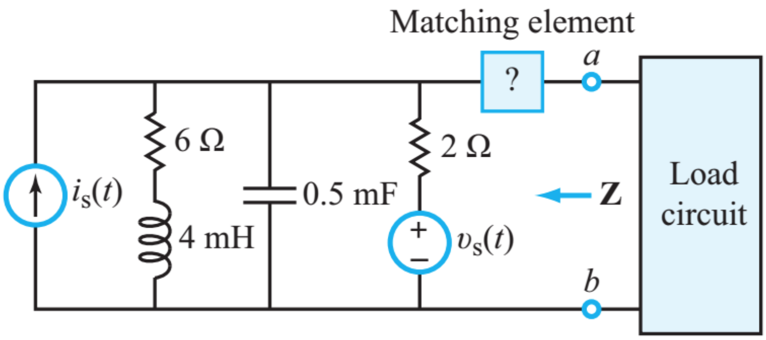

Figure 11