Electronic Circuits

Final Examination

10:20am ~ 12:00pm, Jan. 16, 2009

1. Fig. 1 is the equivalent circuit of an inverting amplifier constructed with an op-amp. The op-amp's input, output resistances and gain are r_i, r_o and A. Use v_1 and v_2 as the unknown node voltages to find:
   (a) **[8]** corresponding matrix equation $[M][v]=[i_s]$.
   (b) **[7]** v_{out}/v_{in} as a function of A.

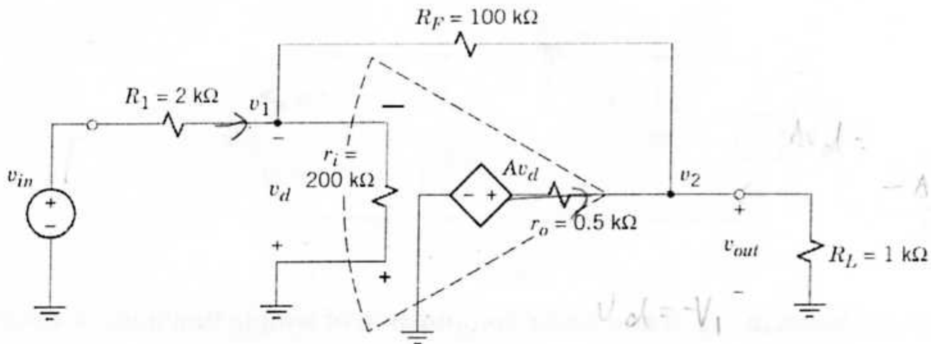

Fig. 1

2. **[15]** Find $v(t)$ for $t>0$ in Fig. 2 when $C=\frac{1}{60}\text{F}$ and $v_s(t)=\begin{cases}-16\text{V} & t<0 \\ 20\cos 2t\ \text{V} & t>0\end{cases}$.

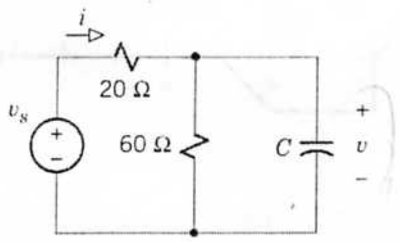

Fig. 2

3. A circuit consisting of a coil with inductance 10mH and winding resistance 20Ω is connected in parallel with a capacitor, a resistor and a generator with an rms voltage 120V. Find:
   (a) **[5]** the value of the capacitance that will cause the circuit to be in resonance at 150kHz.
   (b) **[5]** the current through the coil at resonance.
   (Hint: it is the current through the inductor and the winding resistor.)
   (c) **[5]** the Q of the circuit.

4. **[7]** Let the source network in Fig. 4 (see next page) have $R=2\text{k}\Omega$, $L=4\text{mH}$, $C=250\text{pF}$, and $v_s=8\cos 10^7 t$ V . Find the load impedance Z that draws maximum power, and calculate the resulting value of $P_{\max}$.

NOTE: There are problems in the back.

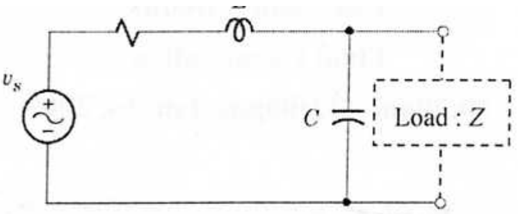

Fig. 4

[8] Find i_1 and i_2 in the circuit in Fig. 5 when $C = \frac{1}{200}$ F, $L = 0.5$H, $R = 20\Omega$, $i = 4\cos(10t + \pi)$A, and $v = 40\cos 20t$ V.

(Hint: the frequencies of both sources are different.)

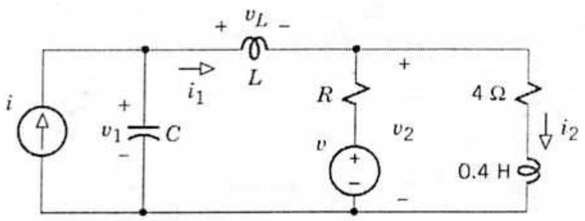

Fig. 5

[15] Express $f(t)$ shown in Fig. 6 as a linear combination of simple functions to obtain $F(s)$.

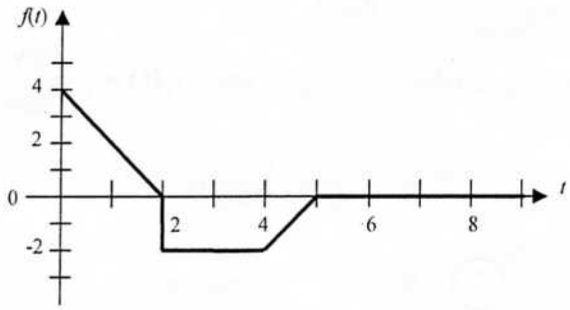

Fig. 6

For the circuit shown in Fig. 7 with $t > 0$,

(a) **[2]** find the initial values for inductor current, $i_L(0^-)$, and capacitor voltage, $v_C(0^-)$.

(b) **[3]** draw the s-domain diagram of Fig. 7 while using Thevenin's model for inductor and capacitor.

(c) **[10]** use mesh analysis to determine the output voltage in s-domain, $V_o(s)$.

(d) **[10]** obtain the output voltage in time domain, $v_o(t)$.

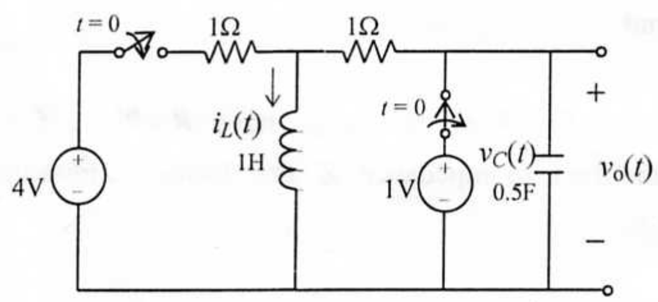

Fig. 7