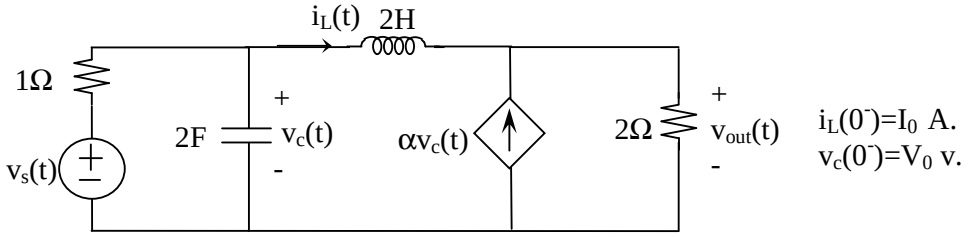
EE202 Homework Due:22/5/2008

1)



For the circuit given above,

a) Obtain s-domain circuit.
b) Find $V_{out}(s)$. Show the zero-state and zero-input components in your solution.
c) Find α such that **–1** and **–1/2** are natural frequencies of the circuit.
d) Find V_0 and I_0 such that zero input response for $v_{out}(t)$ is of the form
$v_{out}(t) = \left[3e^{-t} + C\right]u(t)$
where C is constant. Also, find the value of C.
e) Obtain transfer function $H(s)=V_{out}(s)/V_s(s)$.

2) An R,L,C bandpass circuit is given with C=5 μF, center frequency w_0=5000 rad/s and quality factor Q=10. It is also known that capacitor voltage Vc is,

$V_C(jw_0) = \frac{1}{jw_0 RC} V_{in}(jw_0)$ at resonance frequency.

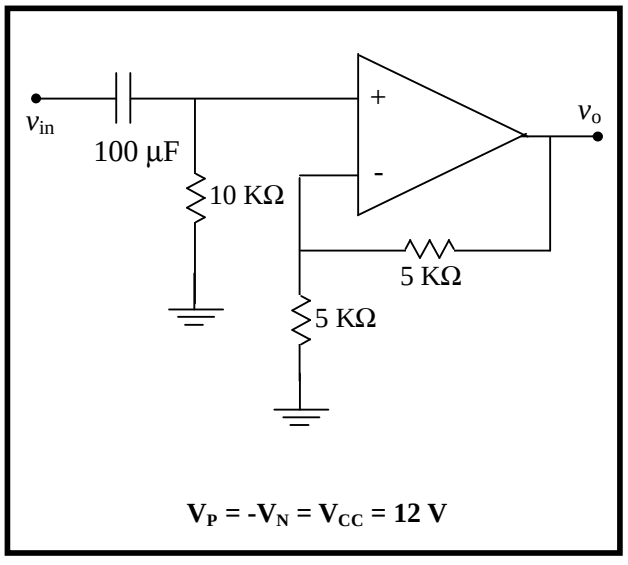
a) Draw the RLC circuit indicating the input and output ports and explain your reasoning for such a circuit.
b) Find the element values, R and L.
c) Find the bandwidth B, and cutoff frequencies, w_{c1} and w_{c2}.
d) Find the transfer function and plot the approximate magnitude plot of the transfer function indicating the critical values in your plots.

3) a) Find $H(s) = \frac{V_o(s)}{V_{in}(s)}$ (Assume that op-amp is ideal and operates in linear region.)

b) Plot the pole-zero diagram.
c) Draw the approximate magnitude plot of the frequency response.
d) What kind of a filter does H(jω) describe?
e) Find and **PLOT** the steady state output voltage $v_o(t)$ when the input is
   I. $v_{in}(t)$ = 10 cos (1000t) V
   II. $v_{in}(t)$ = 10 cos (10000t) V

<u>In this part, you have to take the nonlinear operation of the opamp into account</u>!

f) Consider the input $v_{in}(t)$ = 8 cos (ωt) V. Find the range of ω so that the output, $v_o(t)$, will be sinusoidal in the steady state.



4) Given the following circuit, it has been found that when the current source is turned off (killed)

$$H_v(s)=\frac{I_L(s)}{V_s(s)}=\frac{s-3}{s+3}$$

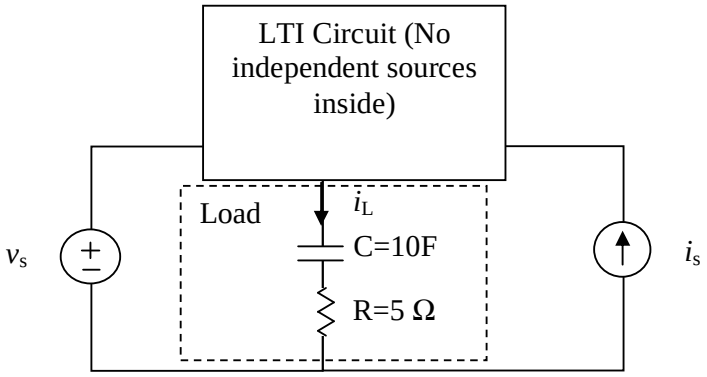
And when the voltage source is turned off

$$H_I(s)=\frac{I_L(s)}{I_S(s)}=\frac{s}{s+3}$$

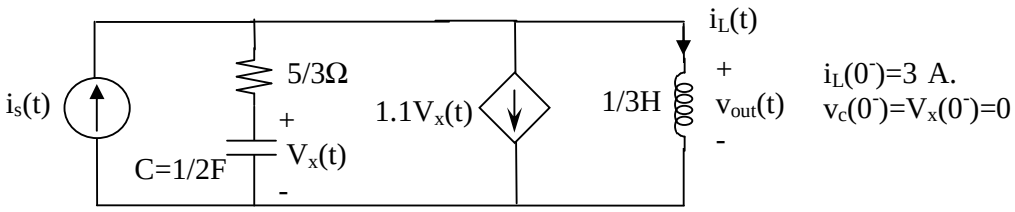
Find the average power absorbed by the load in the sinusoidal steady state for the following cases.

a) Case I: vs(t)=3Cos(3t+45^o), V, is(t)=2Cos(3t), A

b) Case II: vs(t)=5Cos(3$\sqrt{}$3t+30^o), V, is(t)=4Sin(3t+20^o), A



5) For the circuit given below,



Find the $v_{out}(t)$ if $i_s(t)$ is given as in the figure, by using the Laplace domain analysis.