University of Michigan
EECS 311: Electronic Circuits
Fall 2009

PROBLEM SET 1

Issued 9/9/2009
Due in Lecture 9/16/2009

J&B refers to the course text: "Microelectronic Circuit Design (3rd Edition)," by Richard Jaeger and Travis Blalock.

P1.1 Review circuit analysis concepts, dependent sources, Thevenin equivalent, and Norton equivalent circuits. Do problems J&B 1.20, 1.22, 1.24 through 1.27.

P1.2 Review the Laplace transform, transfer functions, and filter responses. Do problems J&B 10.37, 10.40, and 10.43 through 10.48.

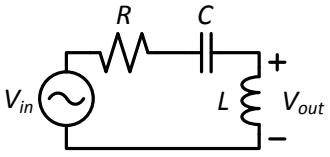
P1.3 Review complex numbers and phasor analysis. For problems J&B 10.43 through 10.46, assume the amplifiers in each of these problems are driven by a source $v_{in}(t) = \cos(2\pi \times 1000t)$. Using the voltage gain $A_v(s)$ given in each problem, solve for the output voltage $v_{out}(t) = A_v(j\omega) \cdot v_{in}(t)$. Your answers should be in the form of $v_{out}(t) = \boldsymbol{A}\cos(2\pi \times 1000t + \boldsymbol{\theta})$.

P1.4 Review the initial value theorem and final value theorem. For problems J&B 10.43 through 10.46, solve for the initial value and final value of the step response of the amplifier in each problem. You may use Matlab to check your answers.

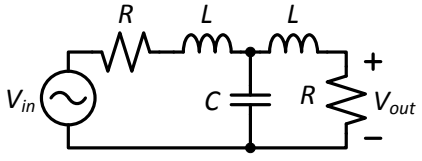
```
% J&B Problem 10.43
s = tf('s');
Av = 2*pi*1e7*s / (s + 20*pi) / (s + 2*pi*1e4);
step(Av);
```

P1.5 Find the transfer function $V_{out}(s)/V_{in}(s)$ for each of the following circuits.

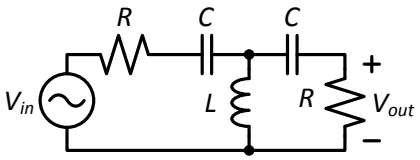
a)



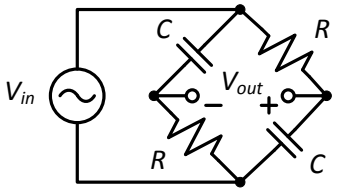
b)



c)



d)



P1.6 Sketch the Bode plots for each of the following transfer functions. The Bode plot should include magnitude and phase, plotted against frequency in rad/s on a log scale.

a) $\frac{V_{out}}{V_{in}} = \frac{1}{1+\frac{s}{10^3}}$

b) $\frac{V_{out}}{V_{in}} = \frac{1}{\left(1+\frac{s}{10^3}\right)\left(1+\frac{s}{10^6}\right)}$

c) $\frac{V_{out}}{V_{in}} = \frac{\frac{s}{10^3}}{1+\left(\frac{s}{10^3}\right)^2}$

d) $\frac{V_{out}}{V_{in}} = \frac{1}{1+s\frac{1}{10\cdot 10^3}+\left(\frac{s}{10^3}\right)^2}$

Hint: $\frac{V_{out}}{V_{in}} = \frac{1}{1+s\frac{1}{Q\omega_n}+\left(\frac{s}{\omega_n}\right)^2}$

P1.7 Do the following problems in J&B, assume ideal opamps.

a) J&B 11.37
b) J&B 11.39 (find voltage gain only)
c) J&B 11.42
d) J&B 11.45 (part a) only)
e) J&B 11.49