University of Michigan
EECS 311: Electronic Circuits
Fall 2008

PROBLEM SET 1

Issued 9/10/2008
Due in Lecture 9/17/2008

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

P1.1 Do problems J&B 1.24, 1.25, 1.26, and 1.29. Leave your answers in terms of circuit parameters (R_1, R_2, v_s, etc.). Do not substitute in values for the components as directed by the problems.

P1.2 Refer to the circuit shown in J&B Figure P1.38 (p 39) for this problem.

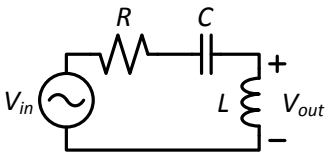
a) Substitute $R_1 = 2R,\ R_2 = 4R,\ R_3 = R$ and use superposition to solve for v_o in terms of v_1 and v_2. Do not substitute any values for the components. Show your work.

b) Assume v_1 and v_2 may only take on the discrete values of either 0 or V_{ref}. Make a table of the 4 possible combinations of v_1 and v_2 (i.e. $0,0;\ 0,V_{ref};\ V_{ref},0;\ V_{ref},V_{ref}$), calculating v_o for each combination.

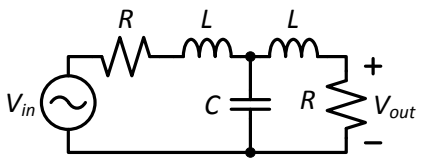
Assuming the values of v_1 and v_2 may be controlled by digital controls, what does this circuit implement?

P1.3 Find the transfer function $V_{out}(s)/V_{in}(s)$ for each of the following circuits.

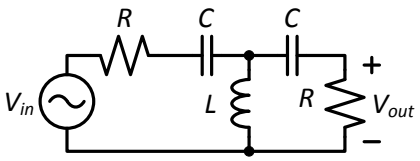
a)



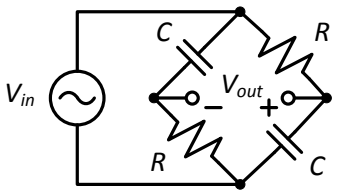
b)



c)



d)



P1.4 Sketch the Bode plot and step response 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: $\frac{V_{out}}{V_{in}} = \frac{1}{1+s\frac{1}{Q\omega_n}+\left(\frac{s}{\omega_n}\right)^2}$