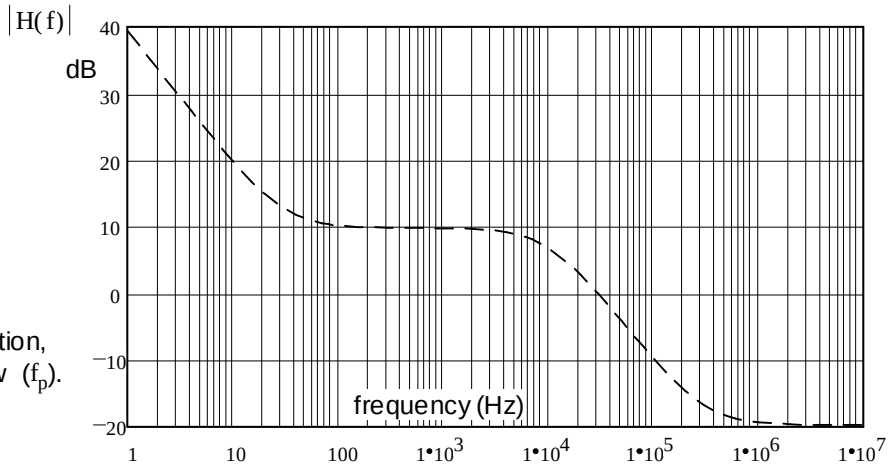
ECE2210 Exam 3 given: Spring 08

(The space between problems has been removed.)

1. (16 pts) A frequency response curve is shown below (dashed line).



   a) Draw the Bode plot of H(f) (the straight-line approximation) right on the curve.

   b) List any and all corner frequencies that you can find from the graph above.

   c) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) below (f_p).

   d) If there are any corners in the Bode plot associated with **zeroes** in the transfer function, list list that/those corner frequency(ies) below (f_z).

   e) This Bode plot is for what type of filter? Circle the best answer.

   i) low pass ii) high pass iii) band pass iv) band reject

   v) sludge vi) coffee vii) can't tell

2. (20 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$$0 = s^2 + 40\cdot s + 400 \qquad R := 10\cdot\Omega \qquad L := 80\cdot mH \qquad C := 60\cdot\mu F$$

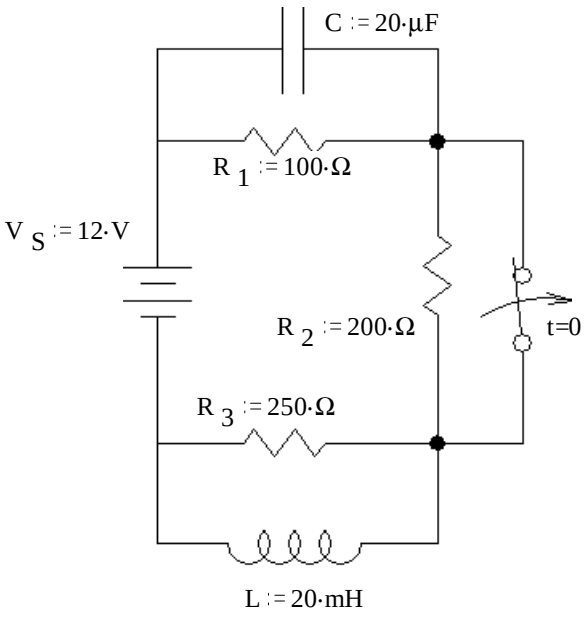
   Further analysis yields the followiing initial and final conditions:

$i_L(0) = 18\cdot mA$ $v_L(0) = -6\cdot V$ $v_C(0) = 8\cdot V$ $i_C(0) = -120\cdot mA$

$i_L(\infty) = 10\cdot mA$ $v_L(\infty) = 0\cdot V$ $v_C(\infty) = 2\cdot V$ $i_C(\infty) = 0\cdot mA$

   Write the full expression for $v_C(t)$, including all the constants that you find. $v_C(t) = ?$ Include **units** in your answer

3. (24 pts) The switch has been open for a long time and is closed (as shown) at time $t = 0$.



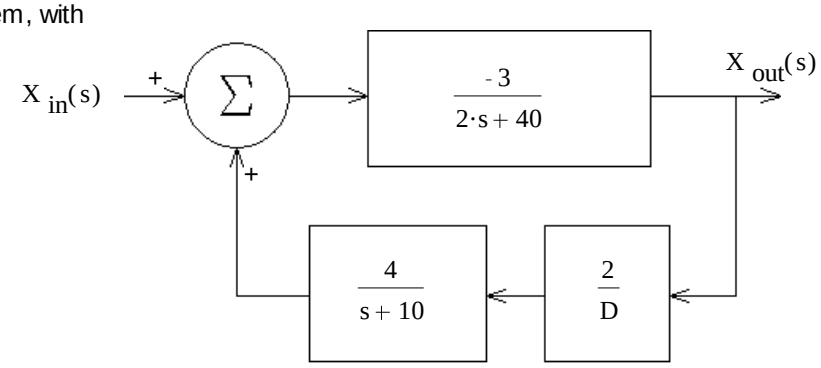
   a) What are the final conditions of i_L and the v_C?
   $i_L(\infty) = ?$ $v_C(\infty) = ?$

   b) Find the initial condition and initial slope of i_L that you would need to have in order to find all the constants in $i_L(t)$. Don't find $i_L(t)$ or it's constants, just the initial conditions.

   c) Find the initial condition and initial slope of v_C that you would need to have in order to find all the constants in $v_C(t)$. Don't find $v_C(t)$ or it's constants, just the initial conditions.

4. (18 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

$$H(s) = \frac{X_{out}(s)}{X_{in}(s)} = ?$$



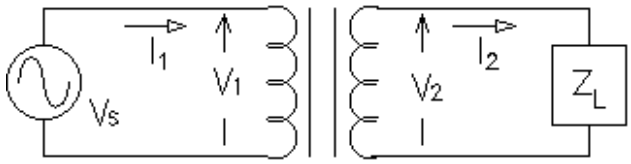
Simplify your expression for $H(s)$ so that the denominator is a simple polynomial.

b) Find the value of D to make the transfer function critically damped.

c) If D is **less** than this value the system will be: underdamped or overdamped Circle one

d) Does the transfer function have a zero? Answer no or find the s value(s) of the zero(s).

5. (22 pts) A transformer is rated at $480V / 120V, 1.8kVA$. Assume the transformer is ideal and all voltages and currents are RMS.



a) What is the current rating of the primary?

b) What is the current rating of the secondary?

c) The secondary has 100 turns of wire. How many turns does the primary have?

d) $\mathbf{V_L} := 110 \cdot V$ How big is the source voltage ($|\mathbf{V_S}|$)?

$|\mathbf{Z_L}| = 10 \cdot \Omega$

$pf := 85 \cdot \%$ lagging

$\mathbf{V_L} := 110 \cdot V$

e) The secondary load (Z_L) has a magnitude of $10\ \Omega$ at a power factor of 85%, lagging. Find the secondary current, $\mathbf{I_2}$ (magnitude **and <u>angle</u>**).

f) Find the primary current, $\mathbf{I_1}$ (magnitude **and <u>angle</u>**).

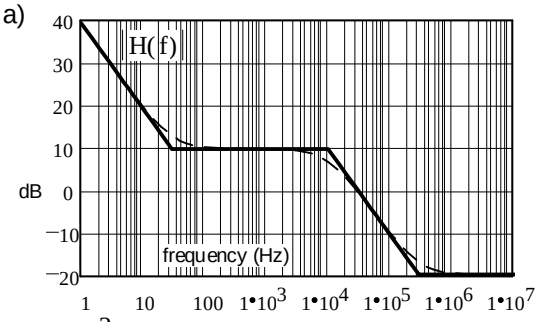
g) How much average power does the load dissipate?

h) How much average power does the power source ($\mathbf{V_S}$) supply?

i) What is the load as seen by $\mathbf{V_S}$? (magnitude **and <u>angle</u>**)

<u>Answers</u>

1. a)



b) $f_{z1} := 30 \cdot Hz$
$f_p := 10 \cdot kHz$
$f_{z2} := 300 \cdot kHz$

c) $f_p := 10 \cdot kHz$

d) $f_{z1} := 30 \cdot Hz$
$f_{z2} := 300 \cdot kHz$

e) i) low pass

2. $v_C(t) := 2 \cdot V + 6 \cdot V \cdot e^{-\frac{20}{sec} \cdot t} - 1880 \cdot \frac{V}{sec} \cdot t \cdot e^{-\frac{20}{sec} \cdot t}$

3. a) $120 \cdot mA$ $12 \cdot V$

b) $40 \cdot mA$ $400 \cdot \frac{A}{sec}$

c) $4 \cdot V$ $1600 \cdot \frac{V}{sec}$

4. a) $\frac{-\frac{3}{2} \cdot (s + 10)}{s^2 + 30 \cdot s + 200 + \frac{12}{D}}$

b) 0.48

c) underdamped

d) $s = -10$

5. a) $3.75 \cdot A$ b) $15 \cdot A$ c) 400 d) $440 \cdot V$

e) $11 \cdot A$ $-31.8 \cdot deg$ f) $2.75 \cdot A$ $-31.8 \cdot deg$

g) $1029 \cdot W$ h) $1029 \cdot W$ i) $160 \cdot \Omega$ $31.8 \cdot deg$

ECE 2210 Exam #3
Arn Stolp
Name _____
Scores:
Pgs 1&2 _____ of a possible 36 points
Pgs 3&4 _____ of a possible 42 points
Pgs 5&6 _____ of a possible 22 points
Total _____ of a possible 100 points