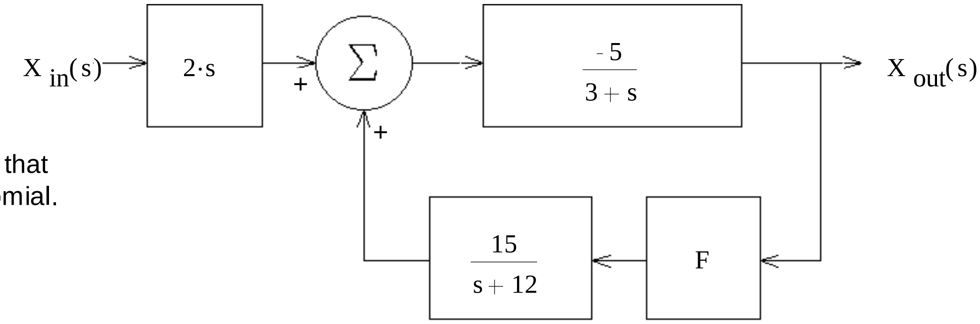
ECE 2210 Exam 3 given: Spring 21

1. (20 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

$$\mathbf{H}(s) = \frac{\mathbf{X}_{\mathbf{out}}(s)}{\mathbf{X}_{\mathbf{in}}(s)} = ?$$



SHOW YOUR WORK
Simplify your expression for **H(s)** so that the denominator is a simple polynomial.

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

c) If F is **Greater** 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 of the zero(s).

2. (24 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the transfer function below. Accurately draw it on the graph provided.
You **must** show and use the method from the class notes to get the Bode plot. That is, show things like the corner frequency(ies) , the approximations of the transfer function in each frequency region, calculations of dB, etc..

$$H(f) := \frac{200\cdot kHz\cdot(10\cdot Hz + 0.5\cdot j\cdot f)}{j\cdot f\cdot\left(10\cdot kHz + \frac{j\cdot f}{3}\right)}$$

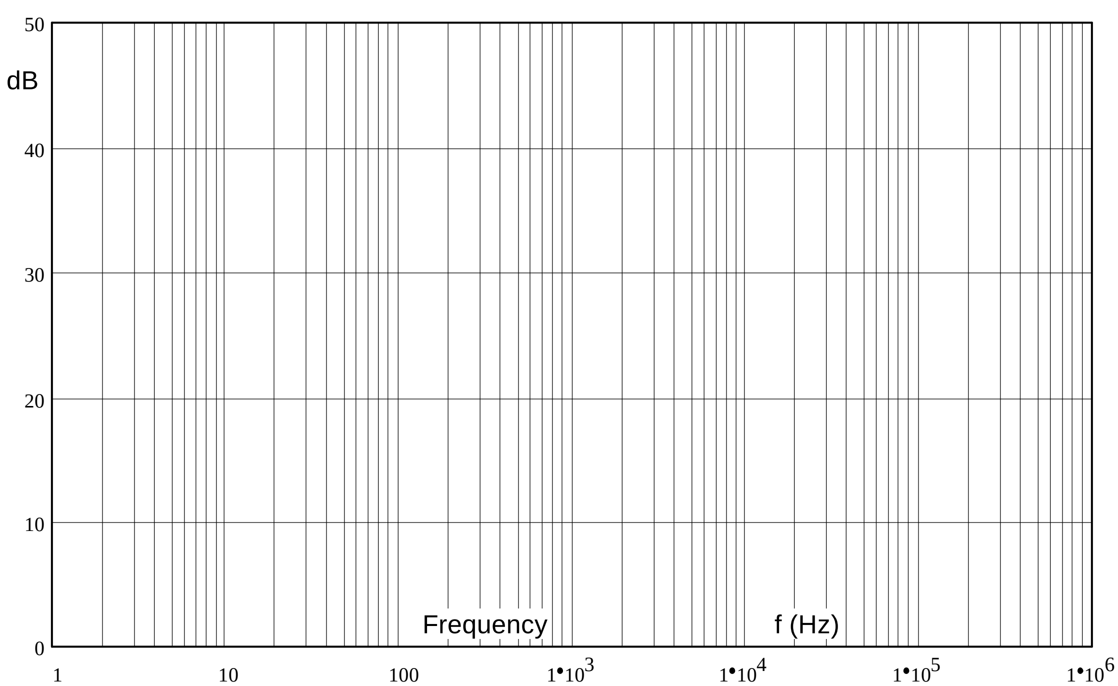
Indicate which corner frequency(ies) are **<u>poles</u>** and/or **<u>zeroes</u>** .

Magnitude plot

$|H(f)|$

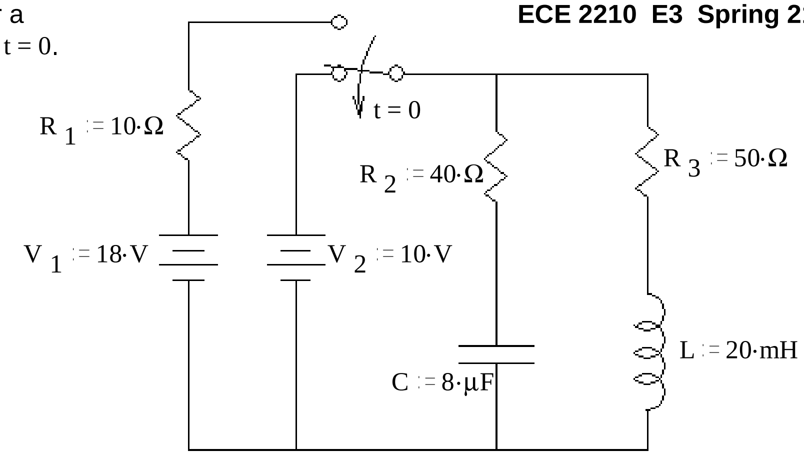
Straight-line approximation ____

Actual _ _ _ _



b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function $|H(f)|$ on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw arrow(s)) and write down the actual magnitude(s) at that (those) point(s).

3. (28 pts) The switch has been the upper position for a long time and is switched down (as shown) at time $t = 0$.



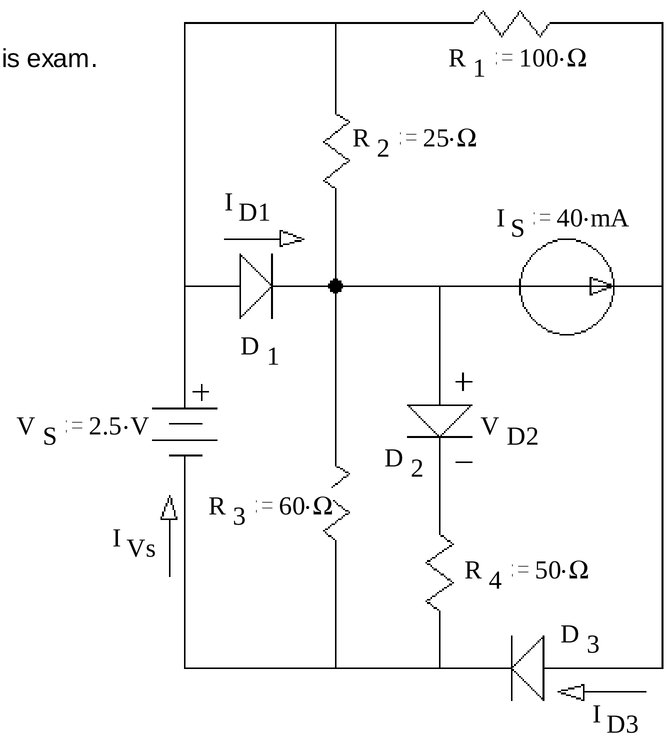
a) What are the final conditions of i_L and the v_C?
$i_L(\infty) = ?$ $v_C(\infty) = ?$

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.

Use constant-voltage-drop models for the diodes and LEDs on this exam.

4. (28 pts) Assume that diode D_2 does **NOT** conduct.
Assume that diodes D_1 and D_3 **DO conduct.**



a) Stick with these assumptions even if your answers come out absurd. Find the following:
V_{D2} = ? I_{D1} = ? I_{D3} = ? I_{Vs} = ?

b) Based on the numbers above, was the assumption about D_1 correct? Circle one: yes no
How do you know? (Specifically show a value which is or is not within a correct range.)

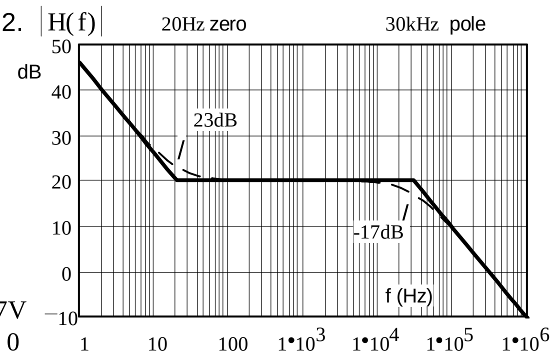
c) Based on the numbers above, was the assumption about D_2 correct? Circle one: yes no
How do you know? (Show a value & range.)

d) Based on the numbers above, was the assumption about D_3 correct?
Circle one: yes no How do you know?

Answers

1. a) $2\cdot s\cdot\frac{-5\cdot(s+12)}{s^2+15\cdot s+36+75\cdot F}$ b) 0.27 c) underdamped d) -12 0

2. $|H(f)|$



3. a) $10\cdot V$ $200\cdot mA$ b) $300\cdot mA$ $-250\cdot\frac{A}{sec}$ c) $15\cdot V$ $-15625\cdot\frac{V}{sec}$

4. a) $1.8\cdot V$ $42\cdot mA$ $58\cdot mA$ $88\cdot mA$ b) yes $42\cdot mA>0$ c) no $1.8\cdot V>0.7V$ d) yes $58\cdot mA>0$