EE 210
Review Problems for Hour Exam 3 **November 15, 2012**

1. The characteristic equation for a given circuit is given by

$$S^2 + 3S + K = 0$$

Find the range of values for K for which the system is *over damped.* Show all work.

2. Consider the characteristic equation given by

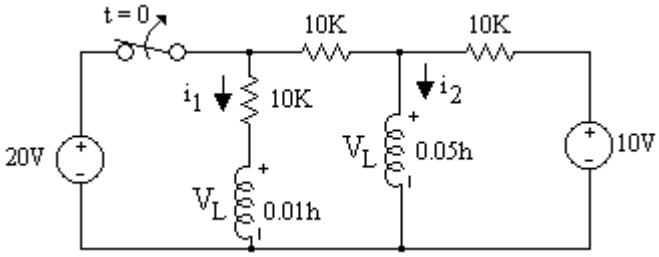
$$S^2 - 8S + 15 = 0$$

It is impossible for this equation to represent a real circuit consisting of a resistor, capacitor, and an inductor. Why not?

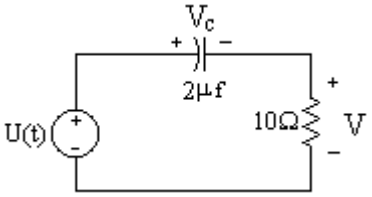
3. For the circuit below find the value of i_1 and i_2 at t = 0^+, 0^-, and at ∞.

$i_1(0^-)$ = _____
$i_1(0^+)$ = _____
$i_1(\infty)$ = _____

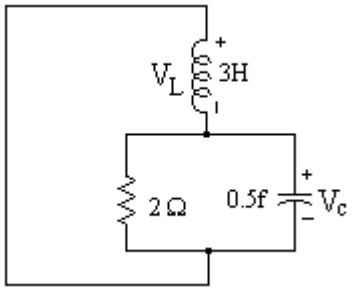
$i_2(0^-)$ = _____
$i_2(0^+)$ = _____
$i_2(\infty)$ = _____



4. For the circuit below find the equation for V(t) for t > 0. Show all work.



5. Write, but do not solve, the differential equation which describes the capacitor voltage in the circuit below.

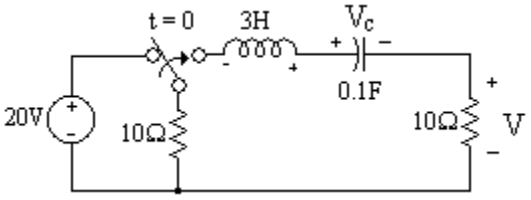


6. If an RLC circuit has a solution of the form:

$$v(t) = A_1 e^{s_1 t} + A_2 e^{s_2 t}$$

It is possible that this solution can give rise to sinusoidal oscillation. Explain how this equation gives rise to sinusoids.

7. Answer the questions below about the circuit shown.



A) Is this a series or parallel RLC circuit?_____

B) For t = 0+ what is the capacitor voltage?

_____

C) For t = 0+ what is the inductor current?

_____

D) Write the characteristic equation

_____

E) What are the roots of the characteristic equation?

Root 1 = _____

Root 2 = _____

F) What is the value of ω_0_____

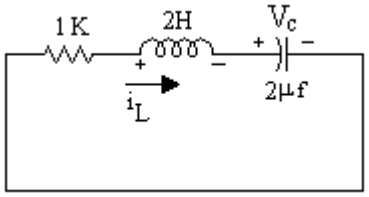
G) What is the value of ω_d_____

H) Write the equation for V_c for t > 0. It is not necessary to solve for the value of the constants.

_____

8. Suppose you have a series RLC circuit and the resistor value has been chosen so that the system is critically damped. If the same R, L, and C are used in a parallel RLC circuit will the parallel circuit be over damped, critically damped, under damped, or is it impossible to determine without knowing the values of R, L, and C? Give an explanation of your answer.

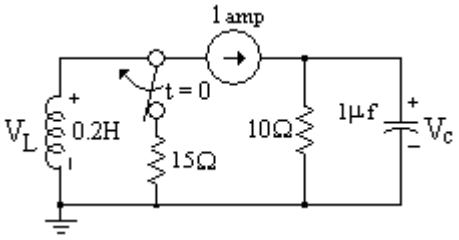
9. Given the series RLC circuit below where $i_L(0)$ = 1ma and $V_c(0)$ = 5 volts. Find $\left.\frac{dV_c}{dt}\right|_{t=0+}$ and $\left.\frac{di_L}{dt}\right|_{t=0+}$ Show all work.



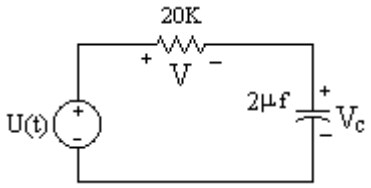
10. For the circuit at right determine the capacitor voltage and the inductor current at t = 0^+. Show all work.

$V_C(0^+)$ = _____

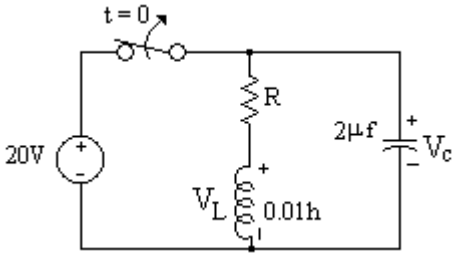
$i_L(0^+)$ = _____



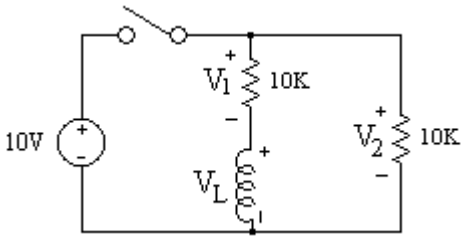
11. The step response of the circuit at right is given by $v_c(t) = (1 - e^{-t/\tau})$. What is the response if the the input becomes a unit ramp function? Show your work.



12. For the system at right find the range of values of R necessary for a critical damping. Show all work.



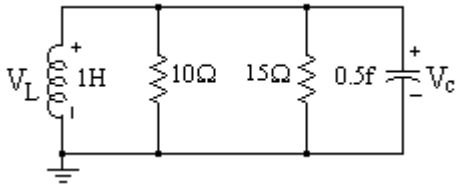
13. For the circuit at right the switch closes at t = 0. Find the expression for $v_L(t)$ for t > 0. Take L = 0.01 Henries. Show all work.



14. Is the system represented by the differential equation below, underdamped, overdamped, or critically damped? Show your work.

$$2\frac{d^2v}{dt^2} + 4\frac{dv}{dt} + 12v = 32$$

15. What is the characteristic equation for the differential equation that represents the following circuit. Show all work.



16. Suppose a series RLC circuit is arranged such that the step response is critically damped. As the components age assume that the capacitor and inductor remain constant but the resistor's value increases. Will the step response become overdamped, underdamped, or remain unchanged? Justify your answer. Lone answers without explanation will not be counted as correct.

17. The voltage across a capacitor for a particular RLC circuit is given by the equation:

$$V_c(t) = A_1 e^{S_1 t} + A_2 e^{S_2 t} + 5.4$$

where $S_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$ and $\alpha = 12$ and $\omega_0 = 10$ and $V_c(0) = 10,\ \ i_c(0) = 0.2,$ and C = 0.02 farads

Answer the following questions and show all your work for full credit.

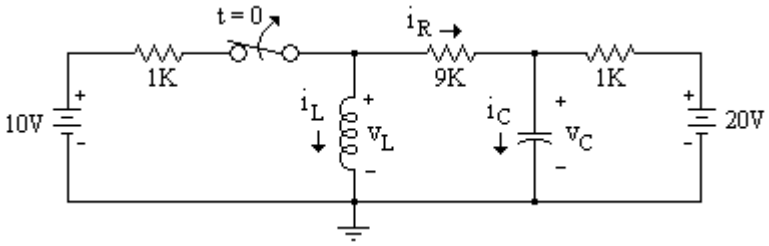
A) Is this system overdamped, underdamped, or critically damped?

B) What is the steady state solution for V_c?

C) Find the values of A_1 and A_2.

18. For the circuit below find the value of each of the parameters shown. Let C = 1μf and L = 0.5H. Show all work.

$I_L(0^+)$ = _____
$V_L(0^+)$ = _____
$I_C(0^+)$ = _____
$V_C(0^+)$ = _____
$I_R(0^+)$ = _____



19. Given the following differential equation: $\frac{d^2 i}{di^2} + \frac{R}{L}\frac{di}{dt} + \frac{i}{LC} = \frac{10}{LC}$. If C = 0.001μf and L = 0.1H find the value of R necessary for critical damping.

20. Write, but do not solve, the differential equation for V_c for the circuit below for t > 0.