Tutorial – 1
Circuit Theory and Device (ECE 215)

1. A mechanical system is modeled by a series *RLC* circuit. It is desired to produce an overdamped response with time constants 0.1ms and 0.5ms. If a series 50-kΩ resistor is used, find the values of *L* and *C*.
2. An oscillogram can be adequately modeled by a second-order system in the form of a parallel *RLC* circuit. It is desired to give an underdamped voltage across a 200Ω resistor. If the damping frequency is 4 kHz and the time constant of the envelope is 0.25s, find the necessary values of *L* and *C*.
3. Following circuit is the electrical analog of body functions used in medical schools to study convulsions. The analog is as follows:

C_1 = Volume of fluid in a drug

C_2 = Volume of blood stream in a specified region

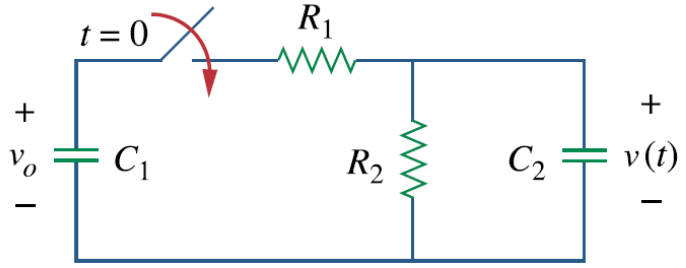
R_1 = Resistance in the passage of the drug from the input to the blood stream

R_2 = Resistance of the excretion mechanism, such as kidney, etc.

v_0 = Initial concentration of the drug dosage

$v(t)$ = Percentage of the drug in the blood stream

Find $v(t)$ for $t > 0$ given that $C_1 = 0.5\mu\,\text{F}$, $C_2 = 5\mu\,\text{F}$, $R1 = 5\,\text{M}\Omega$, and $v_0 = 60u(t)\text{V}$.



4. Following circuit shows a typical tunnel-diode oscillator circuit. The diode is modeled as a nonlinear resistor with $i_D = f(v_D)$ i.e., the diode current is a nonlinear function of the voltage across the diode. Derive the differential equation for the circuit in terms of v and i_D .