

ME 352: Dynamics of Physical Systems and Electric Circuits

Problem Set No. 8

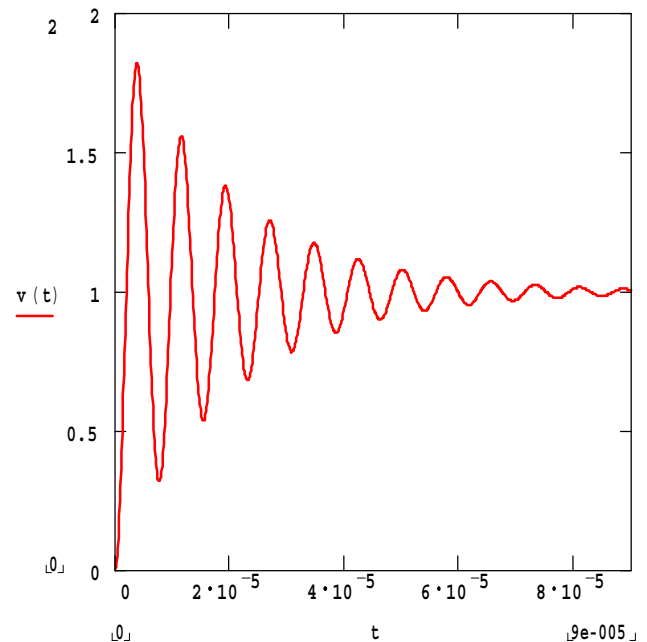
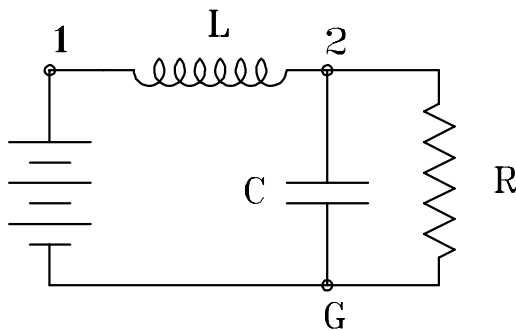
Due Wednesday, April 25, 2001

Reading : Rowell and Wormley, pp. 226-233, pp. 276-320, pp. 395-413.**Problems:** Rowell and Wormley: 9.20, 9.22, 9.23, 12.1, 12.6, 12.8.

Problem: An RLC circuit is shown below. The capacitance is $0.5 \mu\text{F}$, the resistance is 20Ω , but the inductance is unknown. A test was run to determine the inductance from the dynamic response of the circuit. The capacitor was discharged and the circuit was open before a unit step input was applied by closing a switch between the one volt battery and the inductor. The unit step response of the voltage across the capacitor in response is plotted and tabulated below.

Derive the system equation that relates the input voltage to the voltage across the capacitor and determine the unknown inductance. The log decrement formula for the damping ratio ζ is:

$$\zeta = \frac{\frac{1}{n-1} \left(\ln \frac{x_1}{x_n} \right)}{\sqrt{4\pi^2 + \left(\frac{1}{n-1} \left(\ln \frac{x_1}{x_n} \right) \right)^2}}$$



	t (sec)	v(t)
Max 1	3.88 E-6	1.825
Min 1	7.76 E-6	0.32
Max 2	1.164 E-5	1.560
Min 2	1.552 E-5	0.539
Max 3	1.940 E-5	1.379
Min 3	2.328 E-5	0.688
Max 4	2.716 E-5	1.257
Min 4	3.104 E-5	0.789
Max 5	3.492 E-5	1.173
Steady-State	Infinity	1