University of Wisconsin - Madison
Department of Electrical and Computer Engineering

ECE334 - State Space Systems Analysis
Spring 2006

Problem Set 1

Distributed: Thursday, 26 January, 2006
Due: Thursday, 9 February, 2006

Problem 1

Write a differential equation describing the dynamic behaviour of voltage $v(t)$ for the circuit shown in Figure 1. (Hint: The differential equation is easily obtained using the Laplace transform of the circuit. You may work in the time domain if you prefer though.)

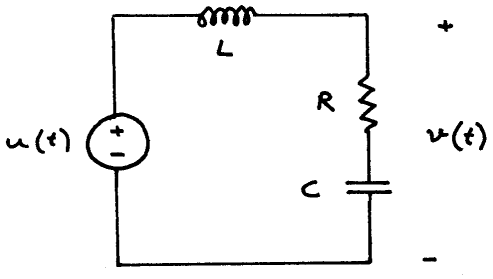

Figure 1: Circuit for Problem 1.

Problem 2

Form the state space realization for the circuit using the capacitor voltage and the inductor current as the two states.

Problem 3

Rewrite the differential equation of part (1) in state space form, using the controllable canonical realization.

Problem 4

How do the states in part (2) relate to the states in part (3)? Express this relationship mathematically.

Problem 5

Let $L = 1$ H and $C = 2$ F. Determine a value of R that gives overdamped behaviour. Set the input $u(t) = 0$ and plot the phase portrait for this case. Show the quiver diagram, together with

trajectories for various initial conditions.

Problem 6

Repeat part (5) for a value of R that gives underdamped behaviour.

Problem 7

Compare the forms of behaviour displayed in parts (5) and (6).