Chalmers University of Technology
Department of Signals and Systems

ESS101 Modelling and simulation

Examination date August 17, 2010

Time: 14.00 – 18.00

Teacher: Paolo Falcone, 772 1803

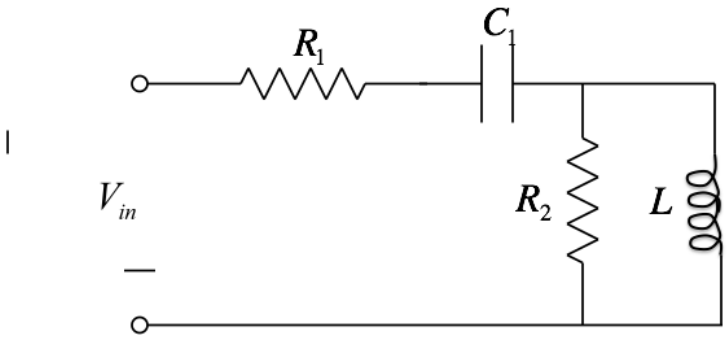
Allowed material during the exam: Mathematics Handbook and small calculator (not a PC).

The exam consists of 4 exercises of a total of 25 points. Nominal grading is according to 12/17/21 points. You need 12 points to pass the exam with grade 3, 17 points to pass with grade 4 and 21 to pass with grade 5. Solutions and answers should be written in English, unambiguous and well motivated, but preferably short and concise.

Results are announced on the notice board at the latest Aug 24. You can discuss with teacher and TAs the grading of your exam on August 27 at 14.30-15.30 at the Department of Signals and Systems.

Exercise 1 (10 p)

Consider the electrical circuit in the figure below.



(a) Derive the bond graph and mark the causality. (2p)

(b) Derive a blocks diagram. (3p)

(c) Replace the voltage source by a current source and solve again the problems at the points a) and b). (3p)

(d) What is the most convenient method, between bond graphs and block diagrams, to describe the considered electric circuit? Motivate the answer. (2p)

Exercise 2 (5 p)

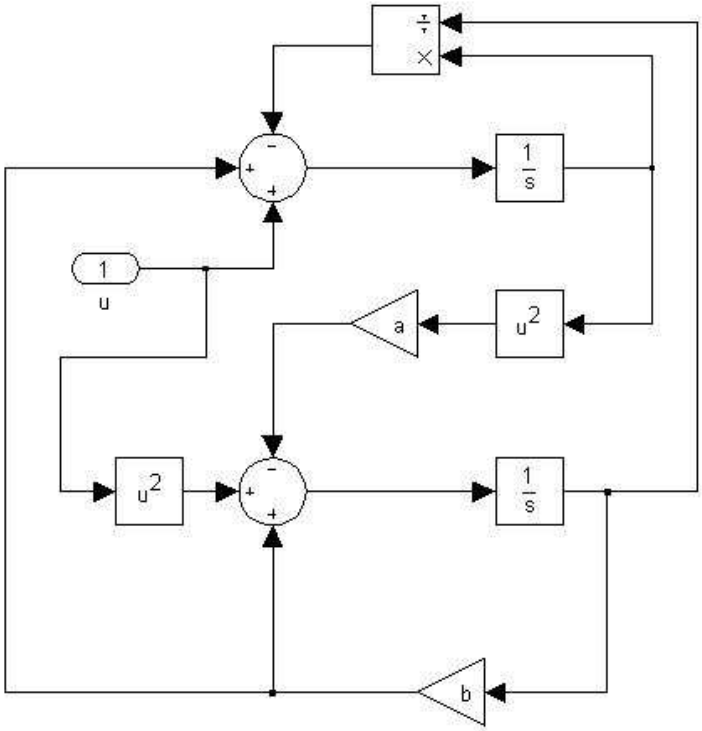
Calculate the spectrum of the voltage signal at the capacitor of an RC series circuit, with $R = 10\ k\Omega$ and $C = 10\mu F$, when the input voltage is a white noise signal with variance 1.

Exercise 3 (5 p)

Consider the block scheme in the figure below.

(a) Write the state space model underlying the block scheme. (2p)

(b) Write the modelica code implementing the model. (3p)



Exercise 4 (5 p)

Consider the system

$$y(t) + ay(t-1) = bu(t-1) + e(t)$$

where $e(t)$ is white noise.
Estimate the parameters a and b, by assuming that

1. the data used for parameters identification is generated through the system

   $$y(t) = 0.6u(t-1) + 0.3u(t-2) + v(t)$$

   where $u(t)$ and $v(t)$ are white noises with variances 1 and 2, respectively, and uncorrelated,

2. the number of samples tends to infinite.