Signals and Systems 7.5 p ECTS for IT-Master

Date: 9 a.m. -1 p.m. Wednesday the 26 of october 2005 at Halmstad University
Hall: T158
Permissible aids: Formulas and tables from the course, Mathematics Handbook for Science and Engineering *(Beta),* + calculator + a dictionary translating from english to your native language.
Max result: 25p
Grade limits:
In order to pass the exam : 12p - is required to get grade E according to the ECTS grading system.15p – grade D, 18p – grade, 21p - grade B, 24p- grade A
Below 12p you get grade F.
Bonus points: from matlab exercises can be added to your written exam result.
Solution to the exam: see the homepage of the course
Inspection of the exam: 1 p.m. Friday the 28 of october in hall D509.
Teacher: Thomas Munther, phone: 16 71 15, room D209
Visit to the hall: at least twice during the exam.
Examinations instructions: You are strictly forbidden to speak with other students and to bring other aids (aside from the above mentioned) to the hall during the examination. The only persons you are allowed to ask are the staff and the teacher.
Please give thorough explanations and motivations in your answers.

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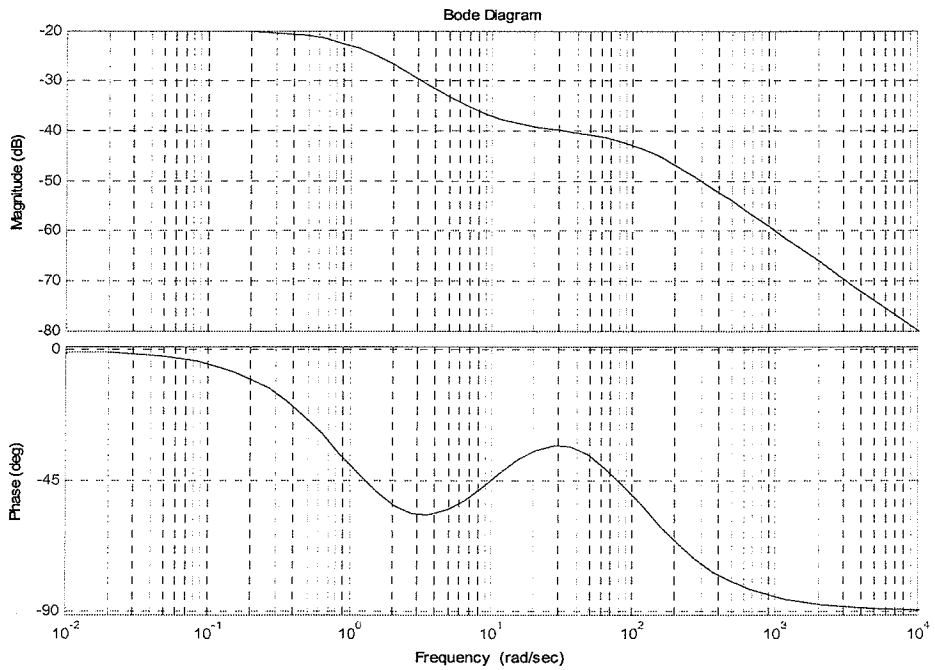
1. Try to decide a plausible transfer function if the following Bode plot is given ! (3p)



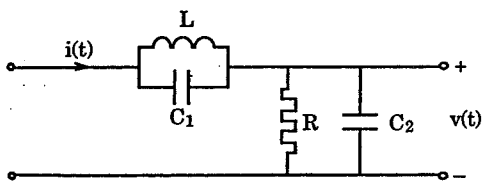
2. a) Give an example of a stable and causal discrete time system. (3p)
   b) Give an example of a continuous time system that has memory, linearity and causality !
   c) Investigate the following properties in the system below:
   stability, causality, memory, linearity and time-invariance !
   $y(t)=[\sin(6t)]x(t)$

3. Decide the magnitude and phase response for a LTI system described by the differential equation : $d^2y(t)/dt^2 + 5dy(t)/dt + 4y(t) = 2\,dx(t)/dt$ (3p)
   x(t) is the input and y(t) the output. Use the Bode diagram on page 4.

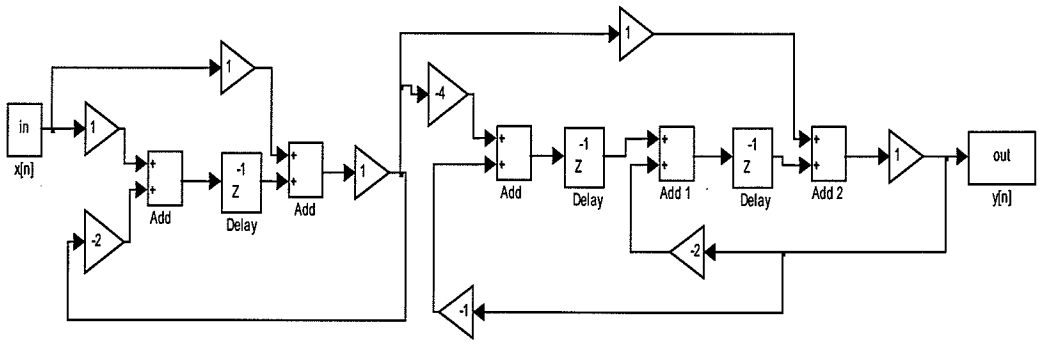
4. a) Explain the concepts of superposition and homogeneity ! (4p)
   b) Explain amplitude modulation !
   c) What advantages does a digital filter have compared to analog filters ?
   d) Give some characteristic properties of a FIR filter ?

5. In the electrical circuit below the components has the following values: (4p)
   $R=500\Omega$, $L=1/14.2$ H, $C_1=0.1\mu F$ and $C_2=10\mu F$
   We can of course ourselves decide what input and output signal we consider.
   a) Calculate the impedance V(s)/I(s) !
   b) What poles and zeros do we have in the impedance (or transfer function) ?
   c) Decide the impulse response !
   d) What kind of filter do we face here ?

Guidance: Everything is not what it seems to be !

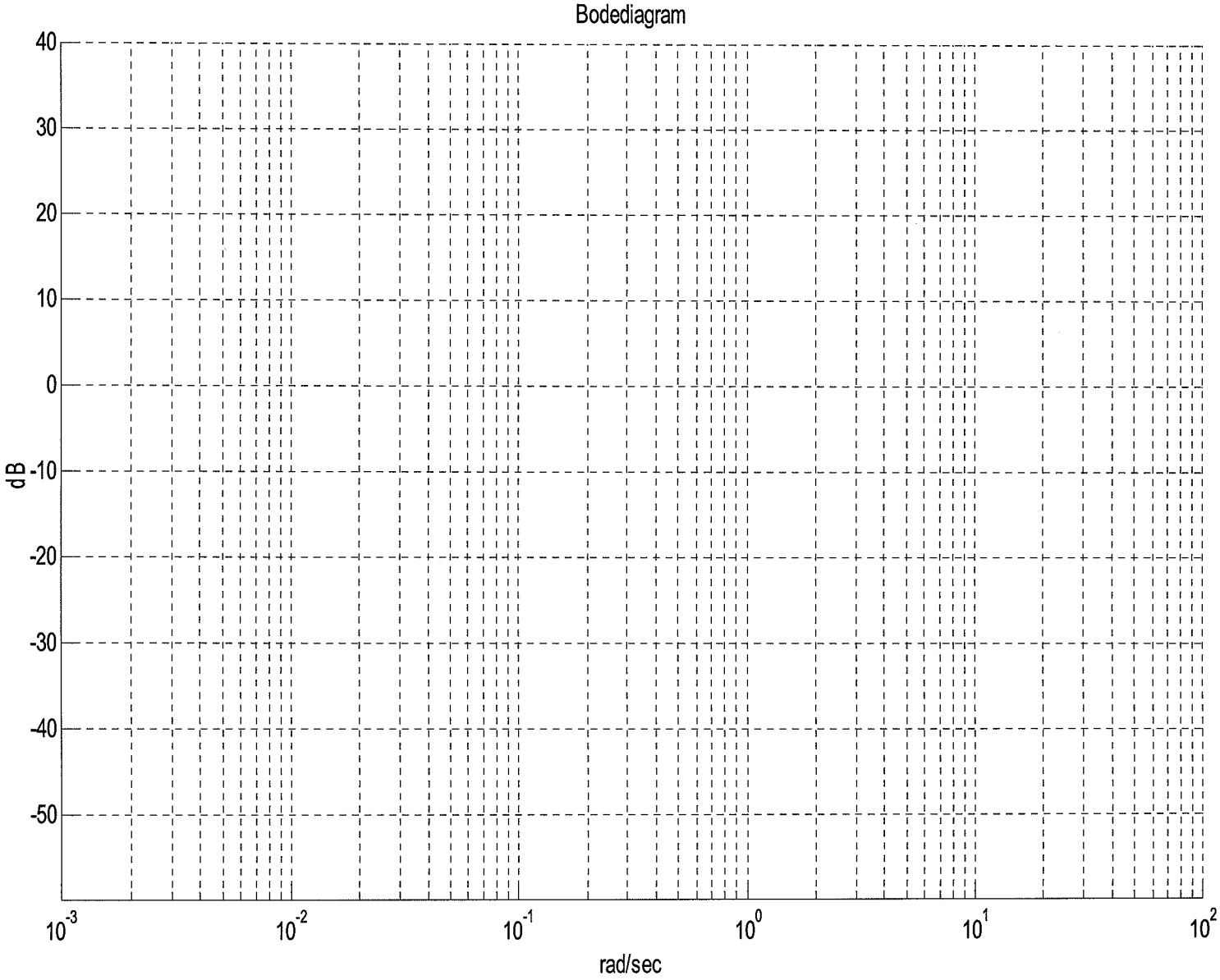


6.
Determine the difference equation , impulse response and step response for the discrete time system ! (3p)



7. Decide the output y[n] from a causal system desribed by the difference equation (5p)
y[n] – 0.6y[n-1] = 0.4x[n], when the input is as follows: x[n]=sin(n*π/2)*u[n].
The output should be splitted into one transient and one stationary part.

8. A causal discrete time filter is described by : y[n]- 1/3*y[n-1]=x[n] – 1/2*x[n-1] (5p)
Decide the stable discrete time inverse filter !
Give its step response for the first 7 samples !


Bodediagram
40
30
20
10
0
-10
-20
-30
-40
-50
dB
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
rad/sec