List position:

Exam
Systems theory BET3

in the bachelor's degree program in electrical engineering at FHWS

WS 2019

Prof. Dr. R. Brain

Duration:	**90 minutes**	
Aids:	**only permitted calculators and the distributed collection of formulas**	
Max. points:	**90 pts.**	(13 + 17 + 11 + 12 + 13 + 15 + 9)
Tasks:	**7**	(on 8 sheets)

Name first Name:	
Matriculation number:	

Hints:

- Write your name on each sheet!
- Do not remove staples!
- Lower grinding is graded with 5.0, i.e. “failed”!

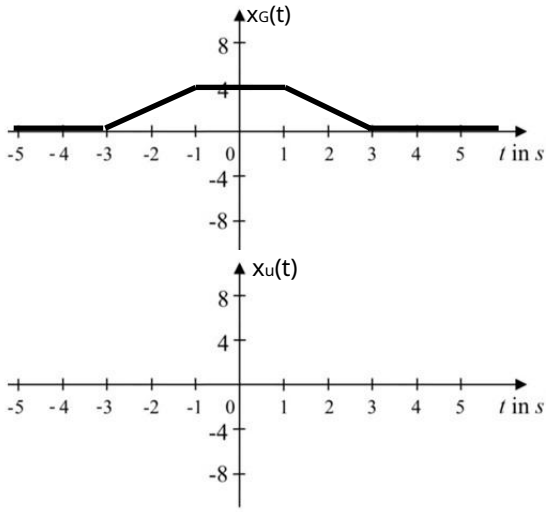
Grade:	
First examiner:	
Second examiner:	

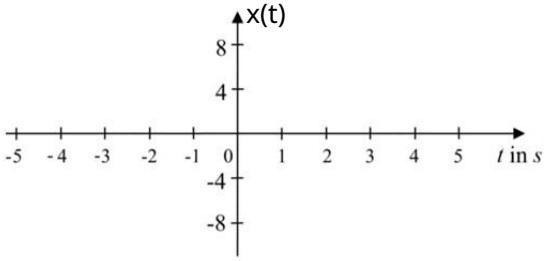
Good luck!

Task 1

Points: 13

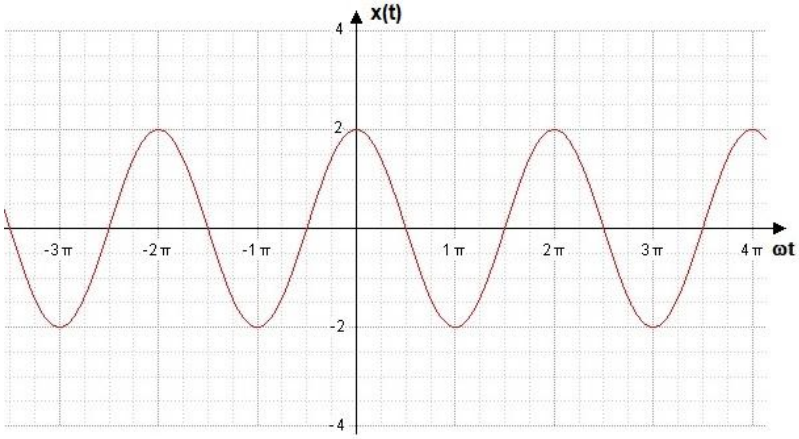
Only the even part x is known$_G$(t) one<u>causal</u> Signal x(t). How must the odd part x_u(t) look so that x(t) is actually causal? To answer, draw x_u(t) and x(t).





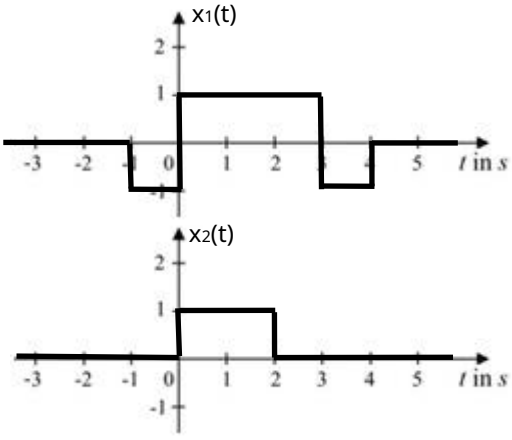
3

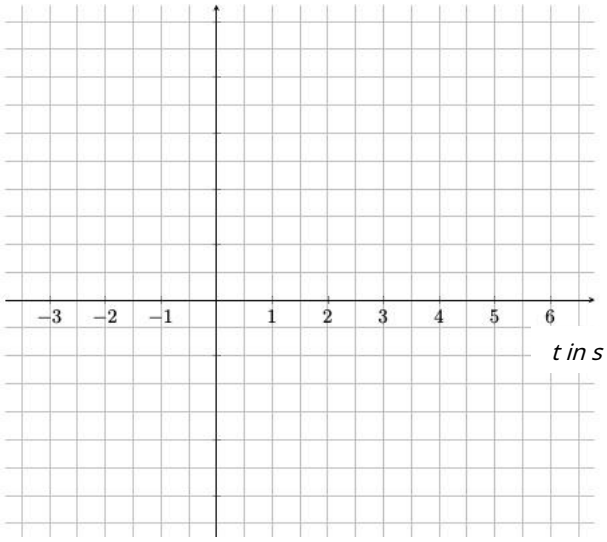
Is this infinite cos signal x(t) an energy or a power signal?
Now draw the square function of x(t) into the graph. What energy/power does x(t) have?



3

Draw the convolution product of the two signals below including the axis label.





5

How many poles does the all-pass contained in the stable system G(s) have?

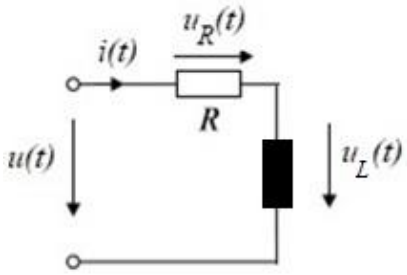
Number of poles all-pass:

2

exercise 2 **Points: 17**

The system shown below is to be modeled:
Let the input variable u be the voltage u(t), the output variable y be the**Current i(t).**
First calculate the first four steps of the model building process known from the lecture, i.e. what you are looking for is:).

In the fifth step, you draw a functional simulation model.



7

Modeling (step four from the lecture) led to the following model equations:

Specify the four matrices A, B, C and D of the corresponding state space representation:

4

Specify the causal signal x(t) which has the following Laplace transform: ———

3

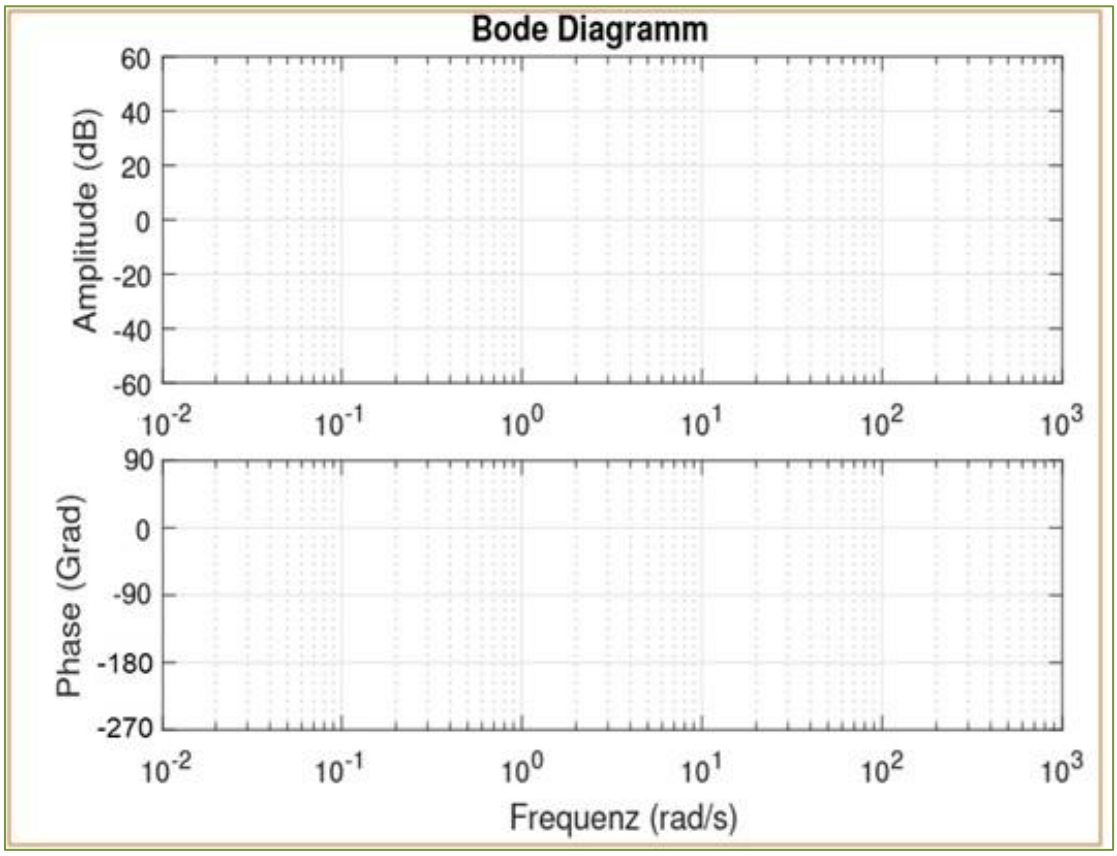
Specify the causal discrete-time signal x[k], which has the following z-transform: ———

3

Task 3 **Points: 11**

Asymptotically draw the Bode diagram of the system: ———— 7

You can also use pencil for construction.
The course of the**Total asymptote**must with one**clearly visible color**<u>**clearly**</u> **be recognizable**!



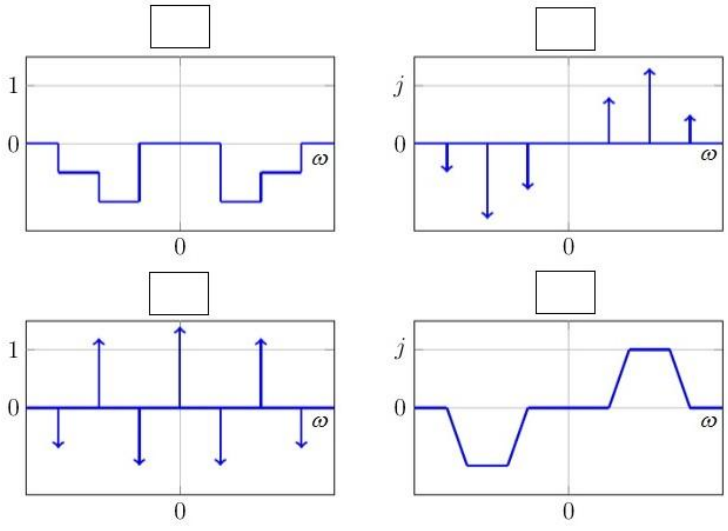
On the right you see four spectra. What type of time signal does each spectrum belong to (qualitatively) – enter the appropriate letters in the rectangles on the right: 4

A) The time signal is real, odd and non-periodic

B) The time signal is real, even and non-periodic

C) The time signal is real, even and periodic

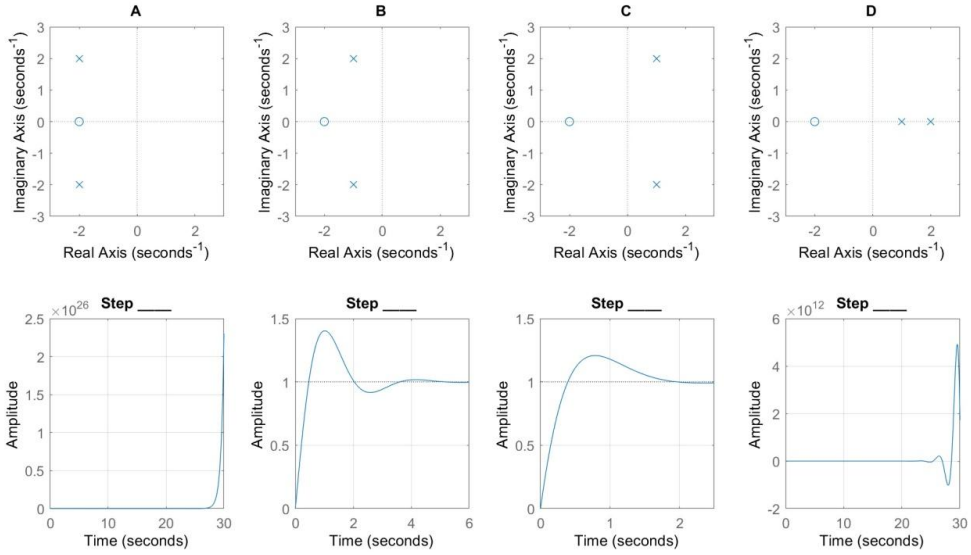
D) The time signal is real, odd and periodic



Task 4 **Points: 12**

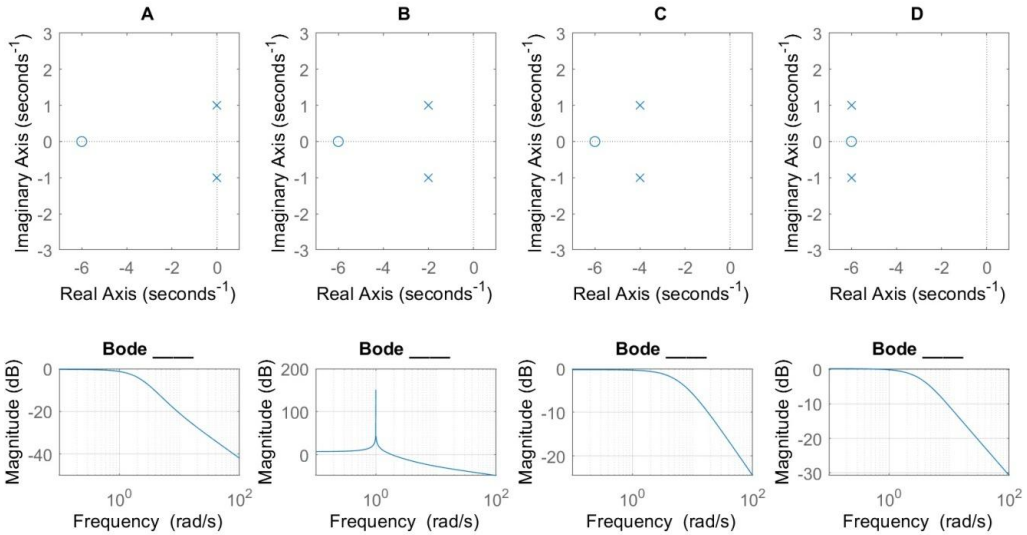
Above you can see the PN diagrams of four systems A, B, C and D, including the step responses.
Match by entering the correct letters below.

4



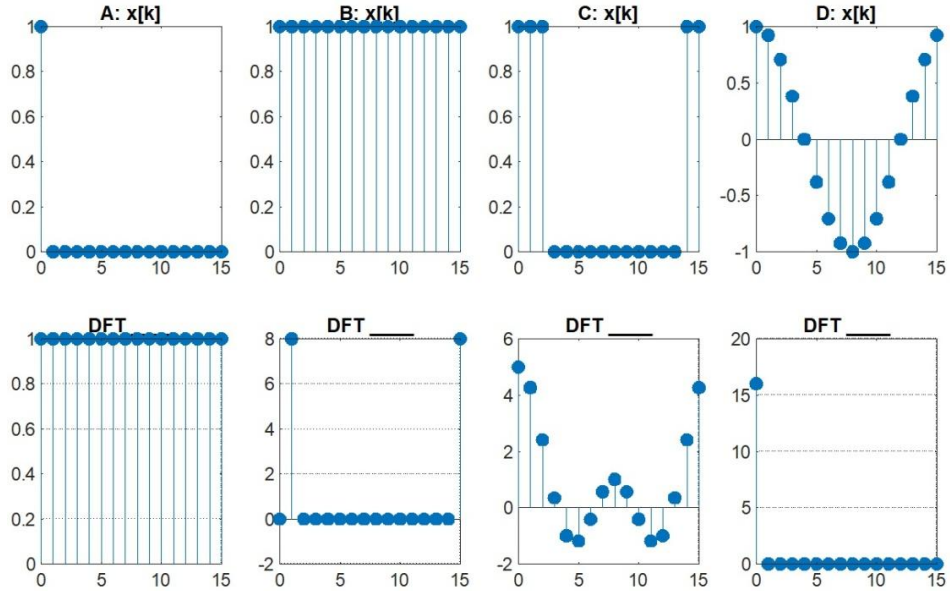
Above you see the PN diagrams of four systems A, B, C and D, including Bode diagrams (you only see the amplitude responses). Match by entering the correct letters below.

4

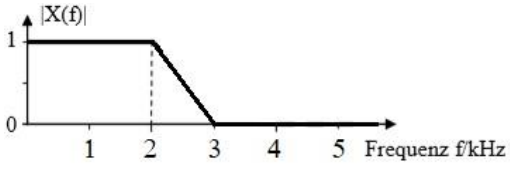


As is well known, DFT provides support points for periodic spectra. Above you see discrete-time real signals A, B, C and D of length N = 16, if continued periodically these are all straight signals! Below you can see DFTs.
Match by entering the correct letters below.

4

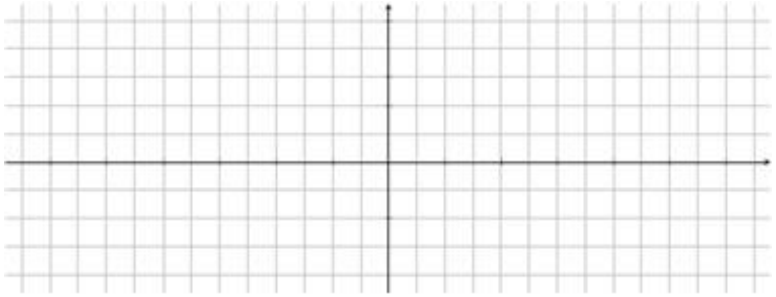


Task 5 **Points: 13**

A continuous-time system has the following transfer function: – Convert this system into a time-discrete system G(z) for the sampling time using the jump-invariant transformation**T = 2s**around.	4
A dead-time discrete-time system with —— are stimulated by a jump, ie Calculate the resulting output signal .	4
The balance y[k] in an account earns interest at 4% every year (the counting index of the years is k). Specify a recursion equation (difference equation) that calculates the new account balance depending on the account balance from the previous year.	3
An analog speech signal x(t) has the magnitude spectrum shown opposite. The signal is to be sampled and the numerical values taken are to be continuously transmitted digitally via a telephone line.  a) In what range must the sampling frequency be in order to comply with the sampling theorem? b) In a specific case, each sample taken is quantized with 8 bit precision before transmission. A data stream of 64 kBit/s is created. So at what frequency is the sampling taking place here?	2

Task 6 **Points: 15**

Sketch the following time signal:
including correct axis labeling!



3

A digital filter with output y[k] and input u[k] is described by the following difference equation:

What are the transfer functions? —— of the filter?

Is it an FIR filter (with justification)?

5

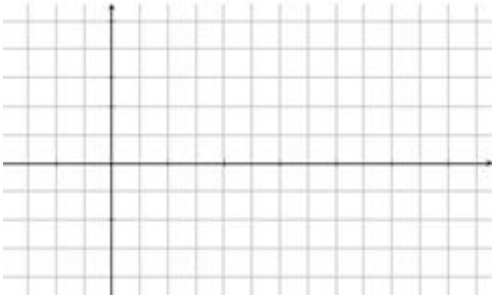
A digital filter has the following frequency response: Which ——— frequency is not allowed through by this filter?

1

Find the spectrum X(j-) of the causal signal:

2

From a PT_2-System are only and the parameters K = 2,
D = 0.5 and $-_0$= 2 known.
Specify the transfer function and sketch the step response h(t) of the system (with correct axis labeling!) Where are the poles of the system and at what frequency - does the step response oscillate?



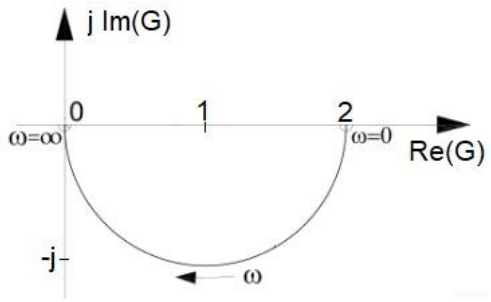
4

Task 7

Points: 9

An analog system has the following frequency response: On the right, the frequency response can be seen as a locus curve.

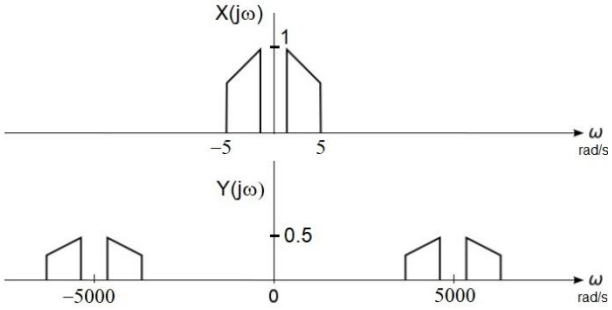
What value does a have?



3

For a low-frequency signal x(t), only the spectrum X(j-) is known. In a modulator let x(t) be one high-frequency carrier and a constant a multiplied , i.e. the following rule applies:

Transform this equation into the frequency domain:



You can also see the resulting spectrum Y(j-). Which numerical values do you have? ?

6