Signals and Sytems I.

Homework for students of Electrical Engineering Course

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Deadlines:

1st part: 8th week
2nd part: 8th week
3rd part: 13th week

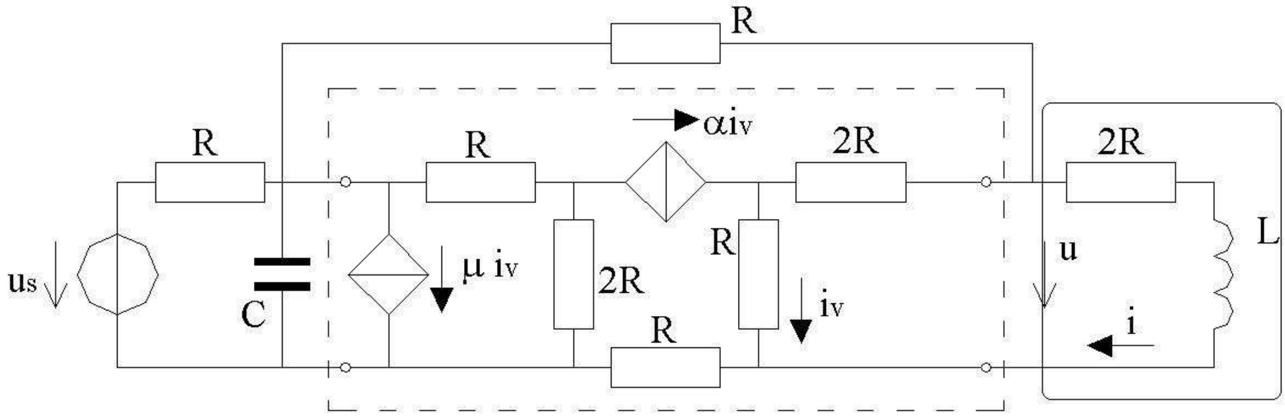
Remarks: *This Homework-sheet must be submitted with the Homework. Take care on the perspicuous form! The full solution must be written down every time,* ***the submittion of the final results is not enough****! You can use computer programs (MATLAB) to make numerical calculations, or plot figures, but* ***the main steps of the solution*** *should be introduced* ***very detailed****; You should described how the program was applied, what kind of initial conditions were taken into account, and how did you used the results of the program. The submission of the Homework is NOT obligatory, just recommended. Each part can be submitted once, until the deadline. The solution is appreciated by the lecturer with 0 to 5 points. These points are the part of middterm mark. The not submitted homework counts as a 0 point one. It is not necessary to solve the examples marked by #, but it is very useful!*

	1. subpart	2. subpart	3. subpart	4. subpart	$\sum$	Corrector
1. part	/ 2	/ 1	/2	–	/ 5	
2. part	/ 2	/ 1	/ 1	1	/ 5	
3. part	/ 1.5	/ 1.5	1	1	/ 5	
					/ 5*	

* final result of the home work is the arithmetic mean of the best 2 parts.

1. Example

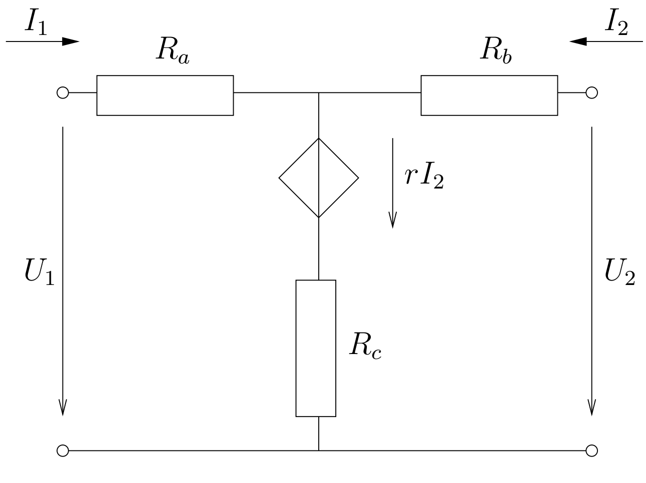
1.1 Find 3 possible two-port characteristic of the two-port indicated by the dashed line! (Prefer characteristics of **R**, **H**, **A** !) (2 points)

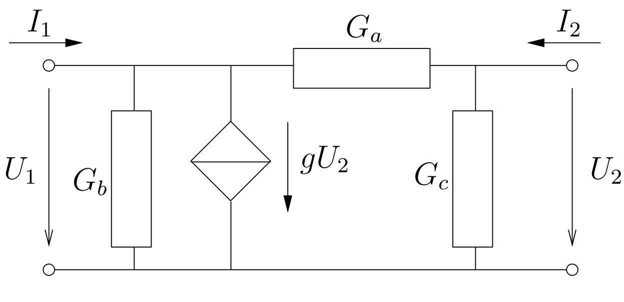


R	C	L	μ	α	ω	T	A_0
$0.2M\Omega$	$12pF$	$15mH$	0.5	2.4	$1/(2CR)$	$12CR$	20 V

1.2 Check the reciprocity, symmetry and passivity of the two-port! Proove your statement! (1 point)

1.2 Find the hybrid **T** equivalent (see the figure) of the two-port, or if it is not available then the hybrid **Π** (see the figure)! (2 points)





2. Example

2.1 Denote the state-variables, and mark their reference direction of them in the Figure! The network is linear, invariant, its excitation is the voltage of the voltage-source, while the response is the **u** voltage. Give the normal form of the state variable description of the system represented by the network! Choose a coherent unit system. Give the normal form of the state description of the system with the values in this unit system. Do the further calculations in this unit system. (2 points)

2.2 Find the eigenvalues from the SVD! Decide wheater the system is asymptotically stable or not! (1 point)

2.3 Find the impulse-response of the system represented by the network with time-domain analysis! Plot the impulse-response! Is the system BIBO stable? Proove your statement! (1 point)

2.4 Find the step-response of the system represented by the network with time-domain analysis! Plot the step-response! (1 point)

2.5 # Find the response of the system represented by the network with time-domain analysis and plot the time function of the result if the excitation of the network is:

$$A_0[\varepsilon(t) - \varepsilon(t-T)]e^{-t/1{,}5T}$$

3. Example

3.1 The network is linear, invariant, its excitation is the voltage of the voltage-source, while the response is the indicated **u** voltage. Give the expression of the transfer characteristic of the system (as a quotient of $j\omega$ polinomials)! (1.5 points)

3.2 Sketch the Bode-plot and the Nyquist-plot of the transfer characteristic of the system! (The plots can be applied if the value of the amplitude-, and phase-characteristics belonging to any angularfrequency can be read from the figure.) Show the transfer characteristic vector belonging to the angular frequency of 3.3. on the Nyquist-plot, and give the values of the amplitude-, and phase-characteristics read from both plots! (1.5 points)

3.3 Calculate the peak value and the initial phase of the response, and find the time-function of the response if the excitation is: (1 point)

$$A_0 \sin(1{,}4\omega t - 50^\circ)$$

3.4 Find the average and the reactive powers of the two-pole noted in the figure and connected to the response (marked by continouos line), and calculate the power-factor! (1 point)

3.5 # Find the **Thnin** equivalent of the network referred to the noted two-pole, or if it is not available to give it, find the other equivalent.