

## LAB-1 EXPERIMENT

Please follow the instructions in the document and mail your pdf-files to the TA of your section

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Please name your pdf files as in the given example file:

Mehmet-Ali-Demir-111211102-lab-1-preliminary-G-3.pdf

Mehmet-Ali-Demir-111211102-lab-1-labreport-G-3.pdf

ALSO STATE YOUR SECTION in the E-MAIL, [there are 3 sections]

section-1 TA: Mehmet Karahan,

section-2 TA: Mehmet Karahan,

section-3 TA: Artun Sel.

PLEASE READ “Important Rules” section at the end of this document before submitting your document.

THE DEADLINE: Friday, October 28, 2022, 20:00.

WARNING: Any work submitted at any time within the first 24 hours following the published submission deadline will receive a penalty of 10% of the maximum amount of marks available. Any work submitted at any time between 24 hours and up to 48 hours late will receive a deduction of 20% of the marks available

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**Task-1**

Find the transfer function of the system given below.

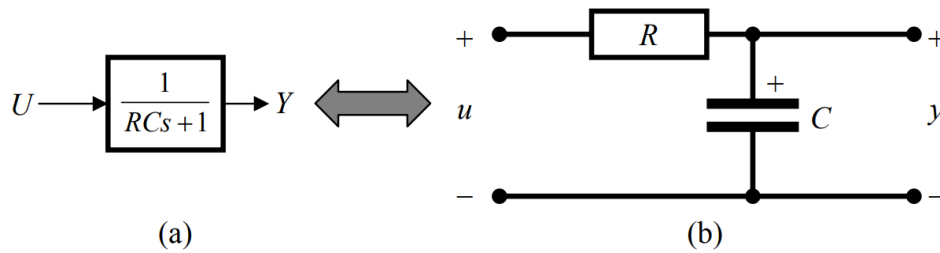


Figure 1: RC Circuit, a simple dynamical system (1<sup>st</sup> order)

Table 1: The Circuit Parameters

Parameter	Value
$R$	$1k\Omega$
$C$	$1\mu F$

**Task-2**

Set up the circuit whose diagram and the parameter values are given below.

The circuit parameters are given in the table below.

Table-2: The circuit parameters

The parameter	Value
$R_1$	$1k\Omega$
$R_2$	$10k\Omega$
$R_3$	$1k\Omega$
$C_1$	$1\mu F$
Op-amp $V^+$	$+12V$
Op-amp $V^-$	$-12V$
Op-amp	Type:741

Apply  $V_{ref} = 5V$ . Then measure “reference-voltage-signal”, “output-voltage-signal” and “input-voltage-signal”. [the input-voltage-signal is the output of op-amp]

### Task-3

Using the circuit that is stated in Figure-2, Apply

$$V_{ref} = 5 \operatorname{sgn}(\sin(2\pi[10]t)), \forall t \geq 0$$

Then measure “reference-voltage-signal”, “output-voltage-signal” and “input-voltage-signal”.  
[the input-voltage-signal is the output of op-amp]

### Task-4

Using the circuit that is stated in Figure-2, Apply

$$V_{ref} = 5 \sin(2\pi[10]t), \forall t \geq 0$$

Then measure “reference-voltage-signal”, “output-voltage-signal” and “input-voltage-signal”.  
[the input-voltage-signal is the output of op-amp]

### Task-5

Using the circuit that is stated in Figure-2, Apply

$$V_{ref} = 5 \sin(2\pi[50]t), \forall t \geq 0$$

Then measure “reference-voltage-signal”, “output-voltage-signal” and “input-voltage-signal”.  
[the input-voltage-signal is the output of op-amp]

## Task-6

Simulate the given closed-loop feedback control-system whose block diagram is given below.

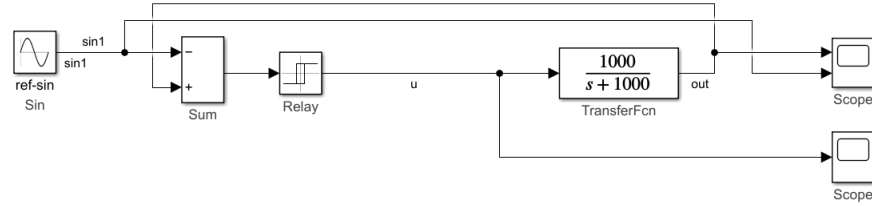


Figure 3: Block diagram

The reference-signal sine wave is defined as,

Sine Wave

Output a sine wave:

$$O(t) = \text{Amp} \cdot \sin(\text{Freq} \cdot t + \text{Phase}) + \text{Bias}$$

Sine type determines the computational technique used. The parameters in the two types are related through:

Samples per period =  $2 \cdot \pi / (\text{Frequency} \cdot \text{Sample time})$

Number of offset samples =  $\text{Phase} \cdot \text{Samples per period} / (2 \cdot \pi)$

Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.

Parameters

Sine type: Time based

Time (t): Use simulation time

Amplitude: 10

Bias: 0

Frequency (rad/sec):  $2 \cdot \pi \cdot [0.1]$

Phase (rad): 0

Figure 4: sine properties

The relay component is defined as,

Relay

Output the specified 'on' or 'off' value by comparing the input to the specified thresholds. The on/off state of the relay is not affected by input between the upper and lower limits.

Main Signal Attributes

Switch on point: 1

Switch off point: -1

Output when on: -12

Output when off: +12

Input processing: Elements as channels (sample based)

Figure 5: RELAY properties

Simulation parameters are given in the Table-3.

Table 3: The simulation parameters

Simulation parameters	Value
Simulation Duration	100 s
Max-Step Size	$1e - 5$
	[Which means $10^{-5} \text{ s}$ in MATLAB]

Then plot the reference-signal and output-signal on top of each other. Additionally, plot the control-input-signal.

### Important rules

The following is the list of the rules that must be followed. The failure of following the rules listed below will be resulted in point-deduction as stated in the table.

No.	Rule	Corresponding point-deduction for the failure of following the rule
01	The document must be mailed to TA of the section	5 pt.
02	The pdf file must be named as stated at the top of the document	5 pt.
03	The file must be in pdf format	5 pt.
04	Section-name must be stated in the mail that is to be sent to submit the <b>lab-report</b> or <b>preliminary</b> document	5 pt.
05	The deadline must be met.	10 pt. for each day after the deadline
06	The file must be prepared in digital form. MSword or Latex must be used.	5 pt.
07	All plots must be on a white background and the lines must be clearly visible. The names of the signals in the plot must be stated [either by using legend or by using appropriate Figure Naming such as "Figure 1: (red) input signal, (blue) output signal"]	3 pt.
08	All figures must be numbered.	3 pt.
09	All tables must be numbered.	3 pt.
10	All equations must be numbered.	3 pt.
11	Reference must be added. Only books are allowed. Do not use internet sources. Example references: [1] "Modern Control Engineering 5 <sup>th</sup> Ed", Ogata K., 2010, Prentice Hall [2] "Linear Systems Theory 2 <sup>nd</sup> Ed", Hespanha J., 2018, Princeton Press	3 pt.
12	Font style must be consistent. Times-New-Roman or Palatino-Linotype must be used. Font size must be 11.	3 pt.