

## LAB-3 EXPERIMENT

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

[artunsel@gmail.com](mailto:artunsel@gmail.com),

[karahanmehmet13@gmail.com](mailto:karahanmehmet13@gmail.com)

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, November 11, 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

## Contents

Task-1.....	2
Task-2.....	4
Task-3.....	6
Important Rules.....	7

## The Experimental Study

### Task-1

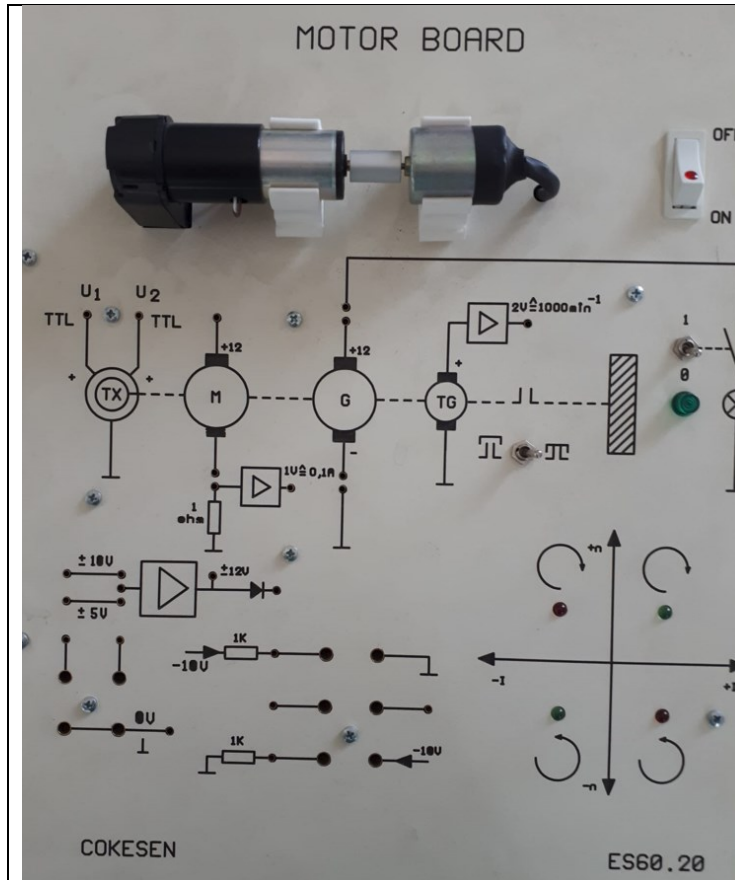


Figure 1: motor board



Figure 2: black jumper

#### Lab tools and devices

- 1) Oscilloscope
- 2) Signal-generator
- 3) Motor-board
- 4) PID-Control-Board
- 5) Black-jumpers
- 6) Jumper-wires
- 7) Oscilloscope probes
- 8) Signal-generator probes
- 9) Motor-board power cord
- 10) PID- board power cord

This is the motor board image in Figure 1.

Please do the subtasks listed below.

- 1) Plug the power cord of the board to the power outlet.
- 2) Turn-on the board.
- 3) Using the black-jumpers [depicted in Figure 2], close the circuits as shown in Figure 3.
- 4) Using the jumper-wires set the connection as given in Figure 4.
- 5) Using the signal-generator probe's positive[red] and negative[black] part, set the connections depicted in Figure 5.
- 6) Signal generator signal parameters are given in Figure 6. [amplitude= 2, offset=1,freq=0.5Hz]
- 7) Observe the motors' movement. [if motor does not operate, check the connections step-by-step]
- 8) Using oscilloscope measure the signal that is generated by the signal-generator.

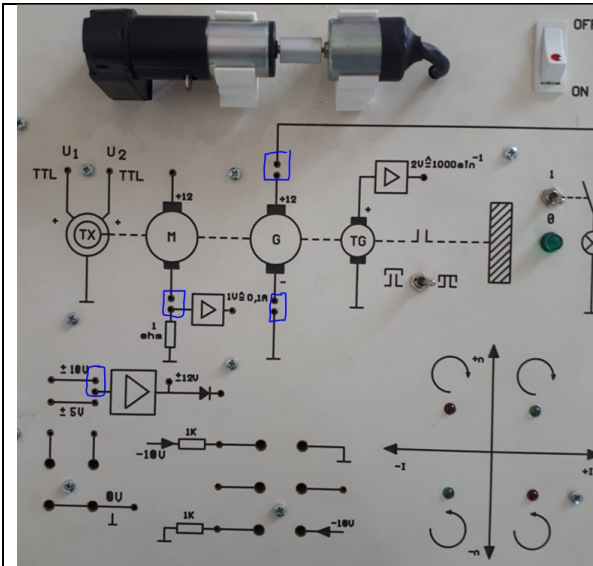


Figure 3: black-jumper connection points  
There are 4 black-jumper connections to be made.

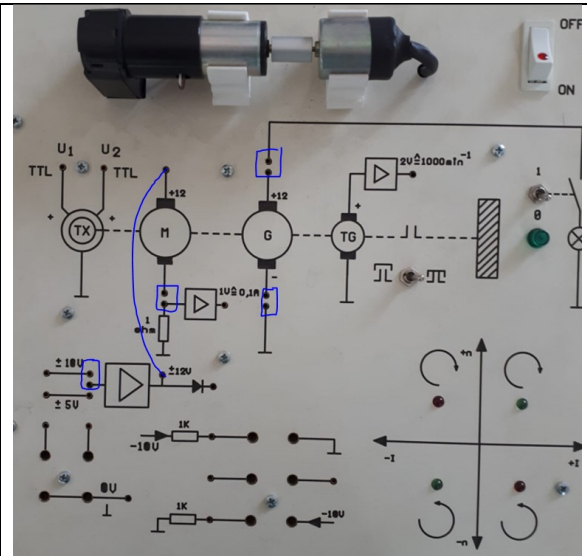


Figure 4: jumper-cable connection  
There is only one connection to be made.

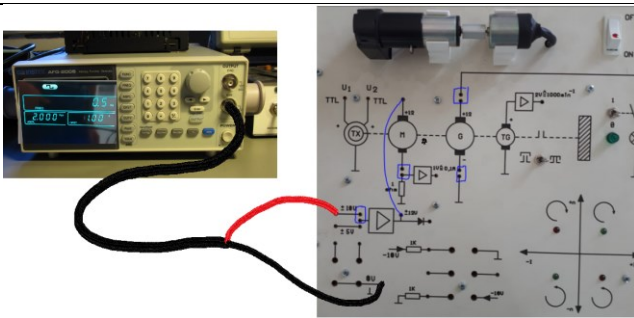


Figure 5: signal generator connection  
There is only the signal generator's positive and negative cable connections to be made.



Figure 6: signal generator parameters

## Task-2

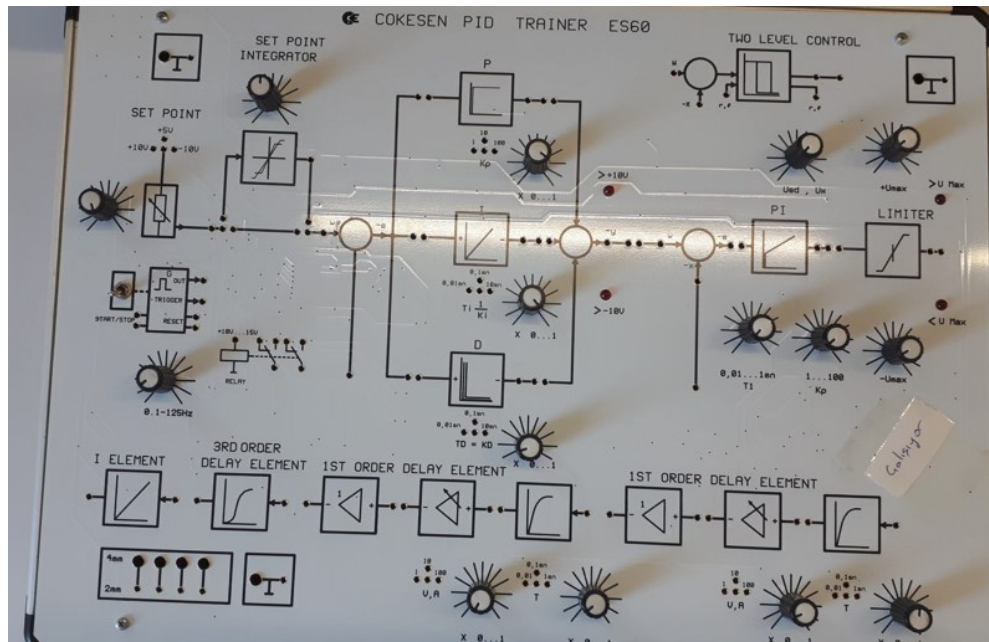


Figure 7: PID-control-board

This is the PID-control-board image in Figure 7:.

Please do the subtasks listed below.

- 1) Plug the power cord of the board to the power outlet.
- 2) Turn-on the board.
- 3) Using the black-jumpers, close the circuits as shown in Figure 8.
- 4) Using a jumper-wire, connect the 2 ground points together as depicted in Figure 9:.
- 5) Using the jumper-wires do the connections between the control board and the motor-board that are depicted in Figure 10.
- 6) Using the signal-generator-probe set the connections between the signal generator and the control board as depicted in Figure 11.
- 7) Observe the motors operation. If the motor does not operate, check the connections one-by-one.
- 8) Using an oscilloscope, measure the reference signal to the control system [that is the signal generated by the signal-generator] and the motor's speed signal [that is the signal generated by the tacho-generator (tacho-generator is a device to measure the speed of the motor)] and display these two signals on the same display.

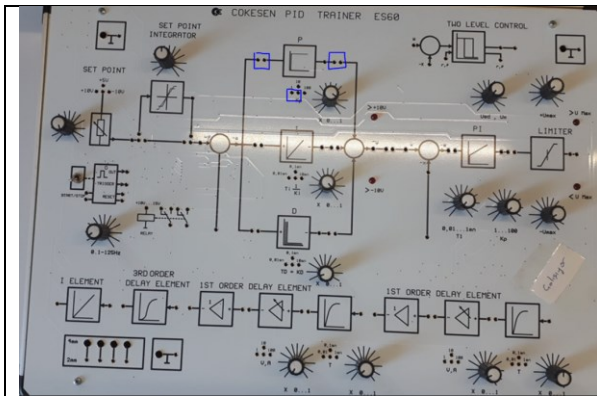


Figure 8: black-jumper connections  
There are 3 black-jumper connections to be made. [indicated by blue lines]

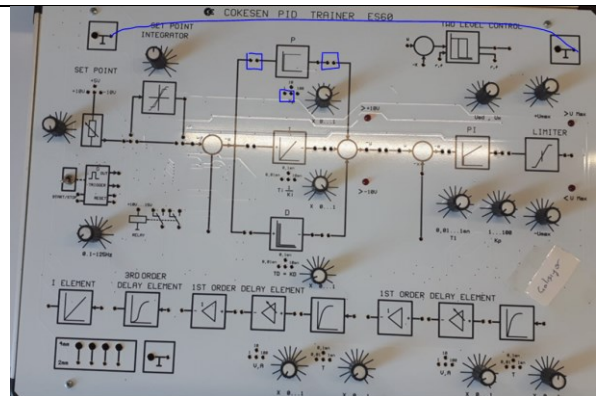


Figure 9: jumper-cable connection for ground points  
There is only one connection to be made.

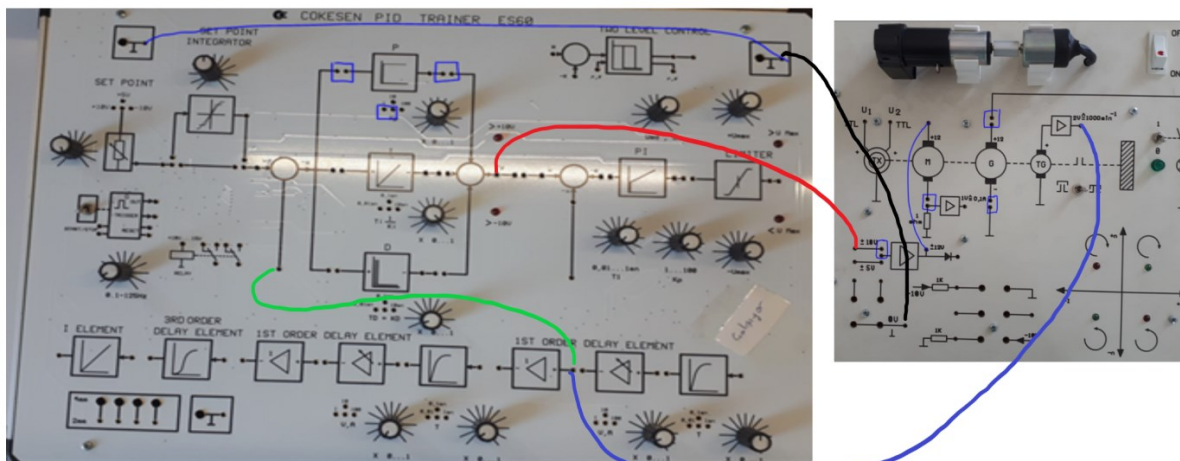


Figure 10: the connections between the control-board and the motor-board  
There are 4 jumper-wire connections to be made. And these are indicated by thick black, blue, green, red lines.

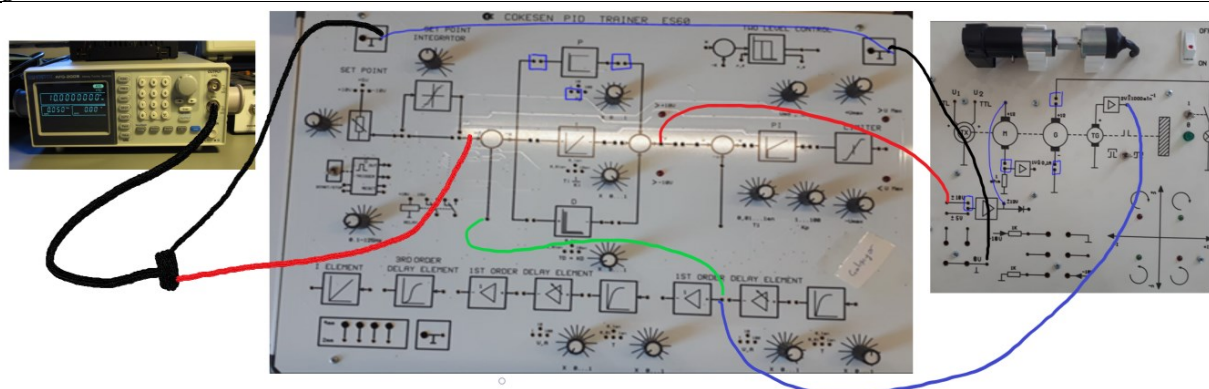


Figure 11: the connection between signal generator and control-board.  
There is only 1 pair of connections to be made. 1 for the positive[red] part of the signal-generator-probe and 1 for the negative[black] part of the signal-generator-probe.

### Task-3

Please do the listed subtasks listed below.

- 1) After Task-2, change the controller from Proportional-controller to Proportional-Integral-Controller. To add the integral block to the system, set the connections [in addition to the all of the connections indicated in Task-2] as depicted in Fig-12.
- 2) Using an oscilloscope, measure the reference signal to the control system [that is the signal generated by the signal-generator] and the motor's speed signal [that is the signal generated by the tacho-generator (tacho-generator is a device to measure the speed of the motor)] and display these two signals on the same display.

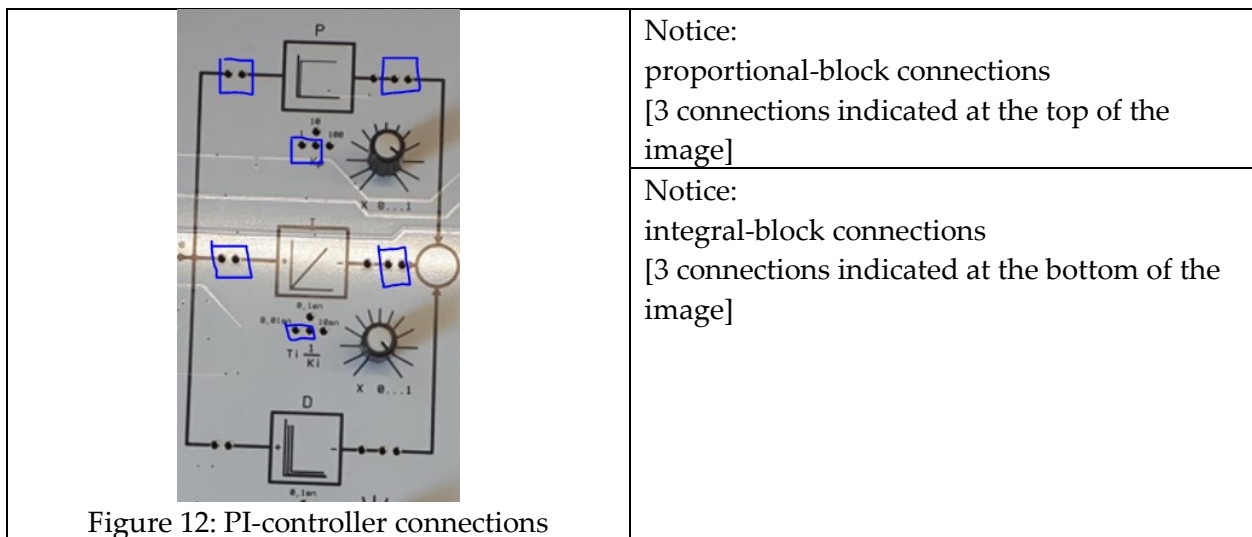


Figure 12: PI-controller connections

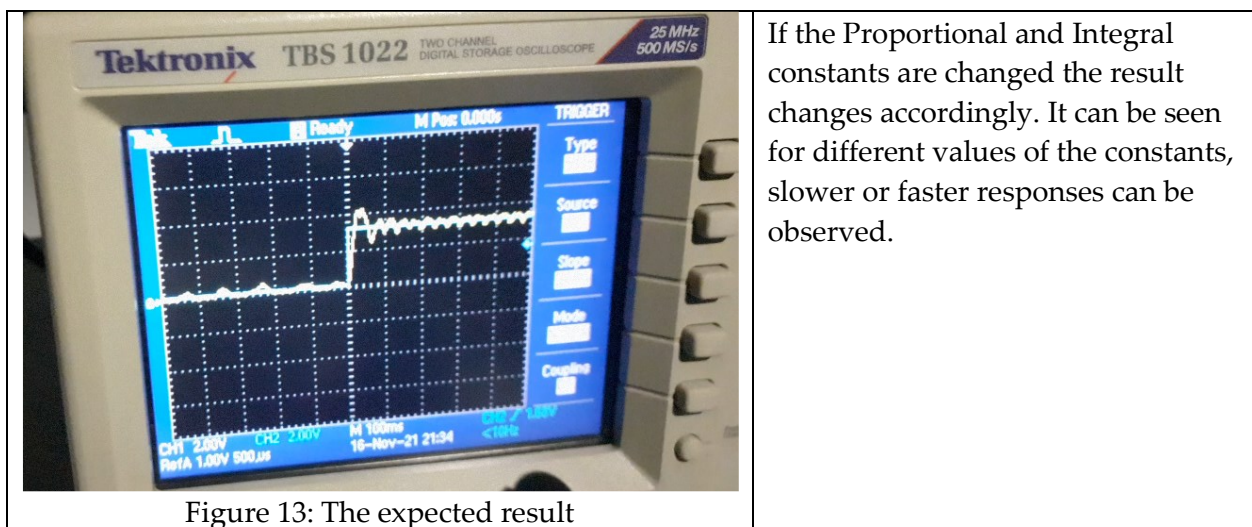


Figure 13: The expected result

## 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 the 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	References 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.
13	Interpret the findings in each task accordingly.	5 pt.