

## Surat Tugas/ Letter of Appointment

Nomor/  
Number ST/THS2/MIT-1122/ExO/XI/2019 - YuY

Tanggal/  
Date 22 November 2019/ 22 November 2019

### Penugasan Sebagai Pembimbing Utama/Pendamping Skripsi Mahasiswa S2 Semester Ganjil 2019/2020 *Appointment of Thesis Advisor/Co-Advisor for Master's Degree Student(s) in Odd Semester 2019/2020*

Dekan Fakultas Teknik dan Teknologi Informasi, Universitas Swiss German/  
*The Dean of Engineering and Information Technology Faculty of Swiss German University,*

Menimbang/*Considering:*

1. Perkuliahan S2 semester 3 yg telah berakhir/*The lectures for semester 3 have finished.*
2. Persyaratan untuk mencapai gelar kesarjanaaan/*Requirements for Master's Degree graduation.*

Memperhatikan/*Referring to:*

Hasil penunjukan Dekan Fakultas Teknik dan Teknologi Informasi/*The appointment by the Dean of Engineering and Information Technology Faculty.*

Memutuskan/*Has Reached the Decision:*

1. Dengan ini menugaskan kepada dosen yang tercantum pada lampiran, sebagai Pembimbing Utama/Pendamping skripsi program Strata Dua (S2) mahasiswa yang tercantum pada lampiran dengan masa penugasan 23 September 2019 sampai dengan 13 Januari 2020/*Herewith gives the task to the lecturers as listed on the attachment to become Thesis Advisor/Co-Advisor for the Master's student(s) listed on the attachment with period of task starting from 23 September 2019 until 13 January 2020.*
2. Dosen yang bersangkutan harus melaksanakan tugas dan tanggung jawab sebaik-baiknya, sesuai dengan petunjuk pembimbingan skripsi dari SGU/*The appointed lecturer shall accomplish the task in responsible ways in line with the thesis guidelines and other regulations given by SGU.*

Terima kasih atas perhatian dan kerjasama Saudara/*Thank you for your attention and cooperation.*

Dekan/*Dean,*



Dr. Maulahikmah Galium, S.Kom, M.Sc.  
Dekan Fakultas Teknik dan Teknologi Informasi/  
*Dean of Engineering and Information Technology Faculty*

Lampiran/*Attachment:*

Daftar Nama Pembimbing Utama, Pendamping dan Mahasiswa pada Semester Ganjil 2019/2020  
*List of the Thesis Advisor, Co-Advisor and the Student in the Odd Semester 2019/2020.*

1. Lampiran 1/*Attachment 1:* Program Studi Magister Teknik Informatika/*Study Program of Master of Information Technology*

Attachment 1 to the Appointment Letter of Thesis Advisor/Co-Advisor Number: ST/THS2/MME-1122/ExO/XI/2019 - YuY  
Lampiran 1 Surat Tugas Pembimbing Utama/Pendamping Skripsi Nomor: ST/THS2/MME-1122/ExO/XI/2019 - YuY

*List of The Thesis Advisor/Co-Advisor Master's Degree Program, Study Program of Master of Mechanical Engineering, Faculty of Engineering and Information Technology, in Odd Semester 2019/2020*

Daftar Nama Pembimbing Utama/Pendamping Skripsi Pada Program Pasca Sarjana, Program Studi Magister Teknik Mekatronika, Fakultas Teknik dan Teknologi Informasi, pada Semester Ganjil 2019/2020

**List of Advisor**

Nr.	The Advisor Name/ Nama Pembimbing	Status Dosen/ Lecturer's Status	Student's Name/ Nama Mahasiswa	Student's ID/ NIM	Thesis Title/ Judul Skripsi
1.	Dr. Widi Setiawan	Part Time Lecturer/ Dosen Tidak Tetap	Herlin Soraya	21652002	ANALYSIS OF PH CONTROLLER FOR IMPLEMENTING IN TISSUE PRODUCTION MACHINE
			Tri Randi Utama	21852007	DEVELOP DYNAMIC ENERGY HARVESTER BY USING PIEZOELECTRIC FOR TOLL ROAD
2.	Dr. Hanny J. Berchman	Home Base Lecturer/ Dosen Tetap	Jeremia Hakim	21652003	DESIGN AND DEVELOPMENT OF LOW COST DATA ACQUISITION SYSTEM FOR STANDALONE SOLAR PV POWER PLANT MONITORING

**List of Co-Advisor**

Nr.	The Advisor Name/ Nama Pembimbing	Status Dosen/ Lecturer's Status	Student's Name/ Nama Mahasiswa	Student's ID/ NIM	Thesis Title/ Judul Skripsi
1.	Dena Hendriana, BSc., S.M., Sc.D	Full Time Lecturer/ Dosen Tetap	Herlin Soraya	21652002	ANALYSIS OF PH CONTROLLER FOR IMPLEMENTING IN TISSUE PRODUCTION MACHINE
2.	Aulia Arif Iskandar, ST, MT	Full Time Lecturer/ Dosen Tetap	Jeremia Hakim	21652003	DESIGN AND DEVELOPMENT OF LOW COST DATA ACQUISITION SYSTEM FOR STANDALONE SOLAR PV POWER PLANT MONITORING
3.	Dr. Hanny J. Berchman	Home Base Lecturer/ Dosen Tetap	Tri Randi Utama	21852007	DEVELOP DYNAMIC ENERGY HARVESTER BY USING PIEZOELECTRIC FOR TOLL ROAD

The Thesis Advisor of Study Program of Master of Mechanical Engineering in Odd Semester 2019/2020 in total are 2 persons/  
Jumlah Pembimbing Utama Skripsi Studi Program Magister Teknik Mekatronika pada Semester Ganjil 2019/2020 adalah 2 orang

The Thesis Co-Advisor of Study Program of Master of Mechanical Engineering in Odd Semester 2019/2020 in total are 3 persons/  
Jumlah Pembimbing Pendamping Skripsi Studi Program Magister Teknik Mekatronika pada Semester Ganjil 2019/2020 adalah 3 orang

Dean,  
Dekan,



Dr. Maulahikmah Galinium, S.Kom, M.Sc.

## STATEMENT BY THE AUTHOR

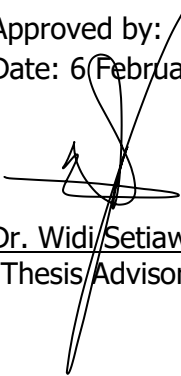
Name of Student : Herlin Soraya  
Student ID : 21652002  
Faculty : Engineering & Information Technology  
Study Program : Master of Mechanical Engineering  
Date of Defense : 23 January 2020  
Thesis Title : IMPLEMENTATION OF PH CONTROLLER IN TISSUE MACHINE PRODUCTION

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.



Herlin Soraya  
(Name of Student)

Approved by:  
Date: 6 February 2020



Dr. Widi Setiawan  
(Thesis Advisor)



Dena Hendriana, B.Sc., S.M., Sc.D.  
(Thesis Co-Advisor)

Acknowledged by:  
Date: 6 February 2020



Dr. Maulahikmah Galinium, S.Kom, M.Sc.  
(Dean of Faculty of Engineering & Information Technology)

**IMPLEMENTATION OF PH CONTROLLER IN TISSUE MACHINE  
PRODUCTION**

By

HERLIN SORAYA  
2-1652-002

MASTER'S DEGREE  
in

MECHANICAL ENGINEERING – MECHATRONICS CONCENTRATION  
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY  
The Prominence Tower  
Jalan Jalur Sutera Barat No. 15, Alam Sutera  
Tangerang, Banten 15143 - Indonesia

January 2020

**ABSTRACT****IMPLEMENTATION OF PH CONTROLLER IN TISSUE MACHINE  
PRODUCTION**

By

Herlin Soraya

Dr. Widi Setiawan, Advisor

Dena Hendriana, B.Sc., S.M., Sc.D. Co-Advisor

**SWISS GERMAN UNIVERSITY**

Advance control technique in industrial application for the process industries are more demanding due to process itself and it is required to it, most of advance control its impact to effectiveness of machine production and increasing significant on product quality. One of the most important parts in process of tissue machine is a water neutralization, which is two different paper material mixing in the tank between tropical hard wood paper and softwood paper into one process medium then later adding chemical solution  $H_2SO_4$  for breaking and homogenous purposes, those two papers are most popular it's called as Fiber. It's creating of pH water value then increasing pH itself, due to this condition controlling pH number is significantly needed. In this process water neutralization also, there is an uncertain condition, which is contains chemical coating and chemical bond caused pH is significantly increased. The objective of the thesis work is to implement of pH water controlled by replacing the manual system mode to automatic system by using PID controller.

In this case dosing chemical pump is used to supply the chemical solution for decreasing the pH indication, afterward we analysed result to conclude which better for precisely controlling the pH neutralization water. Outcomes from MATLAB Simulink of PID controller logic toolbox for simulation of our schematic has been provided in this

---

thesis work. From its simulation result of PID controller of pH measurements it can be obtained the percentage overshoot, rising time of the output signal and minimize the error.

*Keywords: pH Neutralization, PID controller, pH measurement, Distributed control system, transmitter, Arduino, Simulink, Transfer function, Calibration.*

© Copyright 2020  
by Herlin Soraya  
All rights reserved

## **DEDICATION**

I dedicate this works for my beloved mother Yeti Ngatirah and lovely wife Nurpani

## ACKNOWLEDGEMENTS

I wish to thank the members of my committee for their support and patience. Their gentle but firm direction has been most appreciated. Dr. Widi Setiawan as Thesis Advisor and Dena Hendriana B.sc., S.M., Sc.D. as Thesis Co-Advisor was particularly helpful in guiding me toward a qualitative methodology.

Finally, I would like to thank Dena Hendriana, B.Sc., S.M., Sc.D. as Dean. From the beginning, he had confidence in my abilities to not only complete a degree but to complete it with excellence.

I have found my coursework throughout the Curriculum and Instruction program to be Stimulating and thoughtful, providing me with the tools with which to explore both past and present ideas and issues.



---

## TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR.....	2
ABSTRACT.....	3
DEDICATION.....	5
ACKNOWLEDGEMENTS.....	6
TABLE OF CONTENTS.....	7
LIST OF FIGURES.....	9
LIST OF TABLES.....	9
CHAPTER 1 - INTRODUCTION.....	12
1.1 Background.....	13
1.2 Research problem.....	12
1.3 Objectives.....	14
1.4 Significance of Study.....	14
1.5 Research Questions.....	15
1.6 Hypothesis.....	15
CHAPTER 2 – LITERATURE REVIEW.....	16
2.1 pH measurement processes.....	16
2.2 Arduino.....	21
2.2.1 Arduino IDE.....	22
2.2.2 Arduino Board.....	22
2.3 Transmitter.....	23
2.4 PID controller.....	24
2.5 Action of P,I and PID.....	24
2.6 Method Ziegler-Nichol design.....	24
2.7 Control loop system structure.....	27
2.8 Distributed control system.....	29
CHAPTER 3 – RESEARCH METHODS.....	31
3.1 Evaluation researched.....	31
3.2 Suggestion of experiment research.....	33
3.3 Process of level control tank.....	33

---

3.4	Level Control using MATLAB.....	34
3.5	Application of PID control using MATLAB.....	40
3.6	System transfer function.....	43
3.7	Step input response using MATLAB.....	45
CHAPTER 4 – RESULTS AND DISCUSSIONS.....		48
4.1	Initial evaluation.....	48
4.2	Direct application in the pH measurements.....	49
4.3	Calibration.....	52
4.4	Direct application.....	54
CHAPTER 5 – CONCLUSION AND RECCOMENDATIONS.....		58
5.1	Conclusion.....	58
5.2	Recommendations.....	59
REFERENCES.....		60
CURRICULUM VITAE.....		62

---

**LIST OF FIGURES**

<i>Figures</i>	<i>Page</i>
1. Figure 1. Installation of pH indication in the water.....	13
2. Figure 2. Topical hardwood and softwood .....	16
3. Figure 3. Stock preparation.....	17
4. Figure 4. Stock approach .....	17
5. Figure 5. Tissue machine .....	18
6. Figure 6. Sensor electrode.....	21
7. Figure 7. Glass electrode.....	21
8. Figure 8. Sensor pH .....	21
9. Figure 9. Arduino .....	22
10. Figure 10. Transmitter.....	23
11. figure 11 PID control system structure .....	23
12. Figure 12. Ziegler Nichols design method .....	25
13. Figure 13. Close loop design system .....	27
14. Figure 14. An open loop system .....	27
15. Figure 15. Close loop design system .....	28
16. Figure 16. DCS Architecture .....	30
17. Figure 17. DCS human machine interface .....	30
18. Figure 18. Project flow.....	31

---

<i>Figures</i>	<i>Page</i>
12. Figure 19. Process flow diagram .....	32
20. Figure 20. Neutralization tank .....	33
21. Figure 21. Steps response .....	34
22. Figure 22. Bode diagram .....	34
23. Figure 23. Bode diagram .....	35
24. Figure 24. Bode diagram control PID interactive .....	35
25. Figure 25. Bode diagram PID .....	37
26. Figure 26. Bode diagram Tank .....	38
27. Figure 27. Bode diagram between PID and Tank.....	39
28. Figure 28. Close loop .....	40
29. Figure 29. Frequency respond .....	41
30. Figure 30. Steps respond.....	42
31. Figure 31. pH neutralization .....	44
32. Figure 32. Block diagram.....	44
33. Figure 33. pH neutralization .....	45
34. Figure 34. Simulink model with PID.....	46
35. Figure 35. Simulink model with PID.....	47
36. Figure 36. Simulink model with PID.....	47

---

37. Figure 37. Combining Simulink .....	48
38. Figure 38. pH neutralization control system.....	49
39. Figure 39. pH sensor electrical connection.....	50
40. Figure 40. pH calibration .....	51
41. Figure 41. Silo tank.....	53
42. Figure 42. Dosing chemical NaOh.....	54
43. Figure 43. pH certificate .....	54
44. Figure 44. Automatic response .....	56
45. Figure 45. Ramp input .....	57
46. Figure 46. Ramp input response Simulink.....	57
47. Figure 47. Transfer function .....	58
48. Figure 48. Step response combining PID .....	58

**LIST OF TABLES**

<b>Table</b>	<b>Page</b>
1. Table 1. Calibration of pH sensor .....	53
2. Table 2. Output differential pH measurements .....	56