	Universitas Negeri Surabaya Faculty of Engineering, Electrical Engineering Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Microprocessor and Microcontroller	2020103090	Compulsory Study Program Subjects	T=3	P=0	ECTS=4.77	4	January 19, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Parama Diptya Widayaka, S.ST., M.T., Sayyidul Aulia Alamsyah, S.T., M.T., L. Endah Cahya Ningrum, S.Pd., M.Pd.	Dr. Bambang Suprianto, M.T.	Dr. Lusia Rakhmawati, S.T., M.T.

Learning model	**Project Based Learning**	
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	PLO-6	Able to design system components and/or processes to be applied in the field of electrical engineering
	PLO-7	Able to design and carry out experiments in the laboratory/field as well as analyze and interpret data to strengthen technical assessments
	PLO-11	Able to plan, complete and evaluate tasks within the constraints that exist in the field of electrical engineering
	Program Objectives (PO)	
	PO - 1	Students are able to explain the use of microcontrollers and the role of microcontrollers in electronic systems, automation systems and robotic systems
	PO - 2	Students are able to apply knowledge in using ADC peripherals to solve certain problems
	PO - 3	Students are able to apply knowledge in using Timer/Counter peripherals to solve certain problems
	PO - 4	Students are able to apply knowledge in using Serial communication peripherals to solve certain problems
	PO - 5	Students are able to apply knowledge in using I2C peripherals to solve certain problems
	PO - 6	Students are able to design and realize a microcontroller-based automation system in solving problems
	PO - 7	Students are able to design and realize a microcontroller-based automation system in solving problems
	PLO-PO Matrix	

P.O	PLO-6	PLO-7	PLO-11
PO-1			
PO-2			
PO-3			
PO-4			
PO-5			
PO-6			
PO-7			

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																
PO-3																
PO-4																
PO-5																
PO-6																
PO-7																

Short Course Description	The Microprocessors and Microcontrollers course is aimed at understanding how microprocessors and microcontrollers work and being able to design microcontroller-based electronic devices to solve automation or robotics problems. The Microprocessor and Microcontroller course explains how to determine, plan and realize a microcontroller-based electronic system, microcontroller programming, and the use of functions or facilities contained in a microcontroller such as General Purpose Input Output (GPIO), Analog-Digital Converter (ADC), Communication Serial, Timer and Counter, Interrupt, etc.
References	**Main :**
	1. Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Micrcocontroller and Embedded Systems using Assembly and C. Prentice Hall. 2. Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publisher. 3. Crisp, John. 2004. Introduction to Microprocessors and Microcontrollers. Elsevier.
	Supporters:
	1. Datasheet Mikrokontroler Atmel AVR Family
Supporting lecturer	Prof. Dr. Bambang Suprianto, M.T. Prof. Dr. I Gusti Putu Asto Buditjahjanto, S.T., M.T. L. Endah Cahya Ningrum, S.Pd., M.Pd. Parama Diptya Widayaka, S.ST., M.T. Sayyidul Aulia Alamsyah, S.T., M.T.

Week-	**Final abilities of each learning stage (Sub-PO)**	**Evaluation**		**Help Learning, Learning methods, Student Assignments, [Estimated time]**		**Learning materials [References]**	**Assessment Weight (%)**
		Indicator	**Criteria & Form**	**Offline (*offline*)**	**Online (*online*)**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**

1	Students are able to explain the definition and workings of a microcontroller, microcontroller architecture, memory and registers contained in a microcontroller	1. Able to explain the definition, differences, and working principles of microcontrollers 2. Be able to explain the types of memory in microcontrollers 3. Able to explain the definition of register	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	Learning Model: 3 X 50 Lectures	Learning Model: 3 x 50 Lectures	**Material:** Definition, differences between microprocessors and microcontrollers, working principles of microcontrollers, memory and registers in microcontrollers **Reference:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** Definition, differences between microprocessors and microcontrollers, working principles of microcontrollers, memory and registers in microcontrollers **References:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%
2	Students are able to explain the meaning of a minimum system circuit, and how the clock works on a microcontroller	1. Students are able to name and explain the components used in the minimum system 2. Students are able to analyze how the clock works on a microcontroller	**Criteria:** Analysis method (the process of giving grades based on analysis according to the answers provided based on the level of truth) **Form of Assessment** : Participatory Activities, Tests	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 x 50 Discussion	**Material:** Minimum system and clock **Reference:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** Minimum system and clock **Reference:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%

3	Students are able to explain the definition of GPIO, how GPIO works and configure GPIO registers in accessing Input Output	1. Students are able to explain the definition of GPIO 2. Students are able to analyze how GPIO works 3. Students are able to analyze the GPIO register configuration	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 X 50 Discussion	**Material:** General Purpose Input Output **Bibliography:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** General Purpose Input Output **References:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.* **Material:** GPIO Register **Library:** *Atmel AVR Family Microcontroller Datasheet*	5%
4	Students are able to explain the definition of GPIO, how GPIO works and configure GPIO registers in accessing Input Output	1. Students are able to design simulation circuits using GPIO 2. Students are able to create programs using GPIO 3. Students are able to analyze programs and simulation circuits in using GPIO	**Criteria:** Assessment rubric **Forms of Assessment** : Participatory Activities, Practice/Performance, Tests	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 X 50 Discussion	**Material:** General Purpose Input Output **Bibliography:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** General Purpose Input Output **References:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.* **Material:** GPIO Register **Library:** *Atmel AVR Family Microcontroller Datasheet*	5%

5	Students are able to explain the definition of ADC, types of ADC, how ADC works, and ADC register configuration in accessing analog input signals	1. Students are able to explain the definition and types of ADC 2. Students are able to explain how ADC works 3. Students are able to explain the ADC register configuration	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 X 50 Discussion	**Material:** Analog to Digital Converter (ADC) **References:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** Analog to Digital Converter (ADC) **References:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%
6	Students are able to analyze ADC types, how ADCs work, and ADC register configurations in accessing analog input signals	1. Students are able to design simulation circuits using ADC 2. Students are able to create programs to access ADC 3. Students are able to display ADC data on the LCD	**Criteria:** Assessment rubric **Forms of Assessment** : Participatory Activities, Practice/Performance, Tests	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 X 50 Discussion	**Material:** Analog to Digital Converter (ADC) **References:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** Analog to Digital Converter (ADC) **References:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%
7	Students are able to integrate the use of GPIO and ADC	1. Students are able to design a program to turn on the LED based on the value produced by the potentiometer 2. Students are able to analyze programs and how GPIO and ADC simulation circuits work	**Criteria:** Analysis method (the process of giving grades based on the results of the analysis and presenting them in class) **Forms of Assessment** : Participatory Activities, Practice/Performance, Tests	Model: Case study 3 X 50	Model: Case study 3 X 50	**Material:** GPIO and ADC **References:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** GPIO and ADC **References:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%

8	MIDDLE SEMESTER EXAMINATION / MID SEMESTER EXAMINATION		**Form of Assessment** : Test	3 X 50			10%
9	Students are able to analyze the definition, workings, modes and configuration of Timer/Counter registers on microcontrollers	1. Students are able to analyze how the Timer/Counter mode works 2. Students are able to analyze the registers on the Timer/Counter	**Criteria:** Analysis method (the process of giving grades based on the results of the analysis and presenting them in class) **Form of Assessment** : Participatory Activities	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 X 50 Discussion	**Material:** Timer/Counter **Bibliography:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** Timer/Counter **Bibliography:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%
10	Students are able to apply Timer/Counter to a microcontroller to make a timer or digital clock	1. Students are able to design digital clock application programs using a Timer/Counter 2. Students are able to design a digital clock application simulation circuit using a Timer/Counter 3. Students are able to analyze programs and series of digital clock applications using Timers/Counters	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Practice/Performance	Model: Project based learning 3 X 50	Model: Project based learning	**Material:** Timer/Counter **Bibliography:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** Timer/Counter **Bibliography:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	10%
11	Students are able to apply a Timer/Counter on a microcontroller to access PWM as a motor rotation speed controller	1. Students are able to design PWM programs using Timers/Counters 2. Students are able to design a simulation circuit for controlling the speed and direction of rotation of a DC motor using a timer/counter 3. Students are able to analyze programs and circuits for controlling the speed and direction of rotation of a DC motor using a timer/counter	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Practice/Performance	Model: Project based learning 3 X 50	Model: Project based learning	**Material:** Timer/Counter **Bibliography:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** Timer/Counter **Bibliography:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	10%

12	Students are able to analyze the workings and configuration of serial communication registers (USART) on microcontrollers	1. Students are able to explain how USART serial communication works on a microcontroller 2. Students are able to analyze the USART serial communication register configuration on the microcontroller	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 X 50 Discussion	**Material:** USART serial communication **Bibliography:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** USART serial communication **Bibliography:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%
13	Students are able to apply serial communication (USART) in sending and receiving data on a microcontroller	1. Students are able to design a USART serial communication simulation circuit on a microcontroller 2. Students are able to design USART serial communication programs on microcontrollers	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	Model: Project based learning Method: 3 X 50 discussion	Model: Project based learning Method: 3 X 50 discussion	**Material:** USART serial communication **Bibliography:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** USART serial communication **Bibliography:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%
14	Students are able to analyze the workings and configuration of I2C registers on microcontrollers	1. Students are able to explain how I2C works on a microcontroller 2. Students are able to analyze the I2C register configuration on the microcontroller	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	Model: Lecture Method: 3 X 50 Discussion	Model: Lecture Method: 3 X 50 Discussion	**Material:** I2C register configuration **Reference:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** I2C register configuration **Reference:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%

15	Students are able to apply the use of I2C peripherals to microcontrollers	1. Students are able to design a simulation circuit for using I2C on a microcontroller 2. Students are able to design programs using I2C on microcontrollers	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	Model: Project based learning Method: 3 X 50 discussion	Model: Project based learning Method: 3 X 50 discussion	**Material:** I2C register configuration **Reference:** *Mazidi M. Ali, Naimi, Sarmad, Naimi, Sepehr. 2011. The AVR Microcontroller and Embedded Systems using Assembly and C. Prentice Hall.* **Material:** I2C register configuration **Reference:** *Barret, Steven F., Pack, Daniel J. 2008. Atmel AVR Microcontroller Primer: Programming and Interfacing. Morgan and Claypool Publishers.*	5%
16	FINAL SEMESTER EXAMINATION / FINAL SEMESTER EXAMINATION		**Form of Assessment** : Test	3 X 50			9%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	40.01%
2.	Practice / Performance	15.01%
3.	Test	44.01%
		99.03%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.