	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
EMBEDDED SYSTEM PRACTICUM	2020101279	Compulsory Study Program Subjects	T=1	P=0	ECTS=1.59	5	April 10, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model: Project Based Learning

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

Program Objectives (PO)

PO - 1	Students are able to design embedded system devices according to problem solving needs
PO - 2	Students are able to apply methods applied to embedded systems in solving problems
PO - 3	Students are able to analyze data obtained from Embedded System devices through reading sensors, actuators and interface devices

PLO-PO Matrix

P.O
PO-1
PO-2
PO-3

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																

Short Course Description: The Embedded Systems Practical Course is a course that uses a project-based learning model aimed at designing and manufacturing electronic equipment or devices that can be integrated with mechanical systems to solve certain problems. The Embedded System course explains how to determine, plan and realize an Embedded System, programming an Embedded System, and using the functions or facilities contained in a microcontroller in an Embedded System.

References

Main :

1. Mastering STM32. Carmine Noviello. 2018
2. Programming with STM32: Getting Started with the Nucleo Board and C/C++. Donald Norris. 2018
3. Discovering the STM32 Microcontroller. Geoffrey Brown. 2016
4. Buku Ajar: Embedded System and Robotics. Idhar. 2017. Universitas Negeri Makassar

Supporters:

1. RM0008 Reference Manual STM32F103xx
2. STM32F103C8T6 Datasheet

Supporting lecturer: Prof. Dr. Bambang Suprianto, M.T.
Parama Diptya Widayaka, S.ST., 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 of an embedded system and the constituent devices contained in an embedded system	1. 1. Explain the definition of Embedded System 2. 2. Explain the concept of an embedded system in an electronic device 3. 3. Describe the tools that make up an Embedded System 4. 4. Identify things that must be considered when designing an Embedded System	**Criteria:** 1. Accuracy in explaining the concepts and definitions of embedded systems 2. Accuracy in explaining the constituent devices in a simple embedded system according to their function 3. Accuracy in identifying things to consider in designing embedded systems **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** 1. Definition of Embedded System 2. Embedded System Concept 3. Types of Embedded Systems 4. Examples of Embedded System applications **Library:** *Textbook: Embedded Systems and Robotics. Idhar. 2017. Makassar State University*	5%
2	Students are able to describe the architectural structure and registers contained in the STM32 microcontroller	1. Students are able to explain the architecture used in the STM32 microcontroller 2. Students are able to explain the concept of registers and the function of register bit configuration on the STM32 microcontroller	**Criteria:** 1. Accuracy in explaining the architecture used in the STM32 microcontroller 2. Accuracy in explaining the concept of registers and register bit configuration functions on the STM32 microcontroller **Form of Assessment** : Participatory Activities, Tests	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** ARM architecture, STM32 registers **Library:** *Discovering the STM32 Microcontroller. Geoffrey Brown. 2016*	5%
3	Students are able to explain the concept of clocks and clock register configuration on STM32-based microcontrollers	1. Students are able to explain the definition of clock 2. Students are able to analyze how clocks work 3. Students are able to analyze how to configure clock registers	**Criteria:** 1. Accuracy in explaining the definition of clock 2. Accuracy in analyzing how the clock works 3. Accuracy in analyzing how to configure clock registers **Form of Assessment** : Participatory Activities, Tests	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** STM32 clock system, STM32 clock registers **Library:** *Discovering the STM32 Microcontroller. Geoffrey Brown. 2016*	5%

4	Students are able to explain the concept of GPIO and register configuration in using GPIO on the STM32 microcontroller	1. Students are able to explain the definition of GPIO 2. Students are able to explain GPIO mode 3. Students are able to show how to configure GPIO registers	**Criteria:** 1. Accuracy in explaining GPIO definitions 2. Accuracy in explaining GPIO modes 3. Accuracy in showing how to configure GPIO registers **Form of Assessment** : Participatory Activities, Tests	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** GPIO **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** GPIO **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** GPIO Register **Library:** *RM0008 Reference Manual STM32F103xx*	5%
5	Students are able to apply programming languages to initialize and use GPIOs to access input and output peripherals	1. Students are able to use the STM32 configurator application in GPIO configuration 2. Students are able to configure GPIO using the STM32 configurator 3. Students are able to apply programming languages in using GPIO	**Criteria:** 1. Ability to use the STM32 configurator application in GPIO configuration 2. Accuracy in configuring GPIO using STM32 configurator 3. Ability to apply programming languages to use GPIO **Form of Assessment** : Participatory Activities	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** GPIO Configuration **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** GPIO Configuration **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** GPIO Register **Reference:** *Discovering the STM32 Microcontroller. Geoffrey Brown. 2016* **Material:** GPIO Registers **Library:** *RM0008 Reference Manual STM32F103xx*	5%

6	Students are able to explain the concept of ADC and register configuration in using ADC on the STM32 microcontroller	1. Students are able to explain how ADC works 2. Students are able to show how the ADC register works and configuration 3. Students are able to demonstrate the implementation or use of ADC	**Criteria:** 1. Provisions in explaining how the ADC works 2. Accuracy in showing how the ADC registers work and configuration 3. Accuracy in implementing or using ADC **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** ADC **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** ADC **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** ADC Register **Reference:** *Discovering the STM32 Microcontroller. Geoffrey Brown. 2016* **Material:** ADC Register **Library:** *RM0008 Reference Manual STM32F103xx*	5%
7	Students are able to apply programming languages to initialize and use the ADC on the STM32 microcontroller	1. Students are able to use the STM32 configurator application in ADC configuration 2. Students are able to configure the ADC using the STM32 configurator 3. Students are able to apply programming languages in using ADC	**Criteria:** 1. Ability to use the STM32 configurator application in ADC configuration 2. Ability to configure ADC using STM32 configurator 3. Ability to apply programming languages in using ADC **Form of Assessment** : Participatory Activities, Practice/Performance	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** ADC **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** ADC **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** ADC Register **Library:** *RM0008 Reference Manual STM32F103xx*	5%
8	MIDDLE SEMESTER EXAMINATION / MID SEMESTER EXAMINATION		**Forms of Assessment** : Participatory Activities, Practice/Performance, Tests	2 X 50		**Material:** clock, ADC, GPIO **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** clock, ADC, GPIO **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** register clock, ADC, GPIO **Library:** *RM0008 Reference Manual STM32F103xx*	5%

9	Students are able to explain the concept of timer/counter and register configuration in using the timer/counter found on the STM32 microcontroller	1. Students are able to explain how a timer/counter works 2. Students are able to explain how timer/counter registers work	**Criteria:** 1. Accuracy in explaining how the timer/counter works 2. Accuracy in describing how timer/counter registers work **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** timer/counter **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** timer/counter **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** timer/counter registers **Library:** *RM0008 Reference Manual STM32F103xx*	5%
10	Students are able to apply programming languages to initialize and use timers/counters on the STM32 microcontroller	1. Students are able to use the STM32 configurator application in timer/counter configuration 2. Students are able to configure timers/counters using the STM32 configurator 3. Students are able to apply programming languages to use timers/counters	**Criteria:** 1. Accuracy in using the STM32 configurator application in timer/counter configuration 2. Accuracy in configuring timers/counters using the STM32 configurator 3. Accuracy in applying programming languages in using timers/counters **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** timer/counter **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** timer/counter **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** timer/counter registers **Library:** *RM0008 Reference Manual STM32F103xx*	5%
11	Students are able to explain the concept of serial communication and register configuration in using serial communication on the STM32 microcontroller	1. Students are able to explain the definition of serial communication 2. Students are able to explain how serial communication works 3. Students are able to demonstrate serial communication applications	**Criteria:** 1. Accuracy in explaining the definition of serial communication 2. Accuracy in describing how serial communication works 3. Accuracy in demonstrating serial communication applications **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, Discussions & Questions and Answers 2 X 50	Lectures, Discussions & Questions and Answers 2 X 50	**Material:** Bibliography Series **:** *Mastering STM32. Carmine Noviello. 2018* **Material:** **Library** Series : *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** UART/USART Registers **Library:** *RM0008 Reference Manual STM32F103xx*	5%

12	Students are able to apply programming languages to initialize and use serial communication on microcontrollers	1. Students are able to use the STM32 configurator application in serial configuration 2. Students are able to configure serials using the STM32 configurator 3. Students are able to apply programming languages in using serials	**Criteria:** 1. Accuracy in using the STM32 configurator application in serial configuration 2. Accuracy in configuring serial using STM32 configurator 3. Accuracy in applying programming languages in using serials **Form of Assessment** : Participatory Activities, Practice/Performance	PBL 2 X 50		**Material:** Bibliography Series **:** *Mastering STM32. Carmine Noviello. 2018* **Material: Library** Series *: Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018* **Material:** Serial register **Reference:** *RM0008 Reference Manual STM32F103xx*	5%
13	Students are able to analyze simple problems around them, plan and design STM32-based embedded systems to solve problems	1. Students are able to look for problems that can be solved with embedded systems 2. Students are able to analyze problems 3. Students are able to determine the project topic and system to be created	**Criteria:** 1. Student activity 2. Accuracy in determining problems 3. Accuracy in analyzing problems **Form of Assessment** : Participatory Activities, Practice/Performance	PBL 2 X 50		**Material:** STM32 Peripherals **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** STM32 Peripheral **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018*	8%
14	Students are able to analyze simple problems around them, plan and design STM32-based embedded systems to solve problems	1. Students are able to plan a diagram of the embedded system that will be created 2. Students are able to design embedded system algorithms 3. Students are able to design electronic embedded system designs	**Criteria:** Evaluation Rubric **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	PBL 2 X 50		**Material:** STM32 Peripheral **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** STM32 Peripheral **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018*	8%
15	Students are able to create STM32-based embedded systems to solve problems	1. Student activity 2. Students are able to run embedded systems	**Criteria:** The system is running well **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	PBL 2 X 50		**Material:** STM32 Peripherals **Library:** *Mastering STM32. Carmine Noviello. 2018* **Material:** STM32 Peripheral **Library:** *Programming with STM32: Getting Started with the Nucleo Board and C/C . Donald Norris. 2018*	8%

16	FINAL SEMESTER EXAMINATION / FINAL SEMESTER EXAMINATION	Students are able to demonstrate or present the results of the system that has been created	**Criteria:** 1.Accuracy in presentation 2.System reliability 3.Reliability and achievability of the system **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	PBL 2 X 50			15%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	43.52%
2.	Project Results Assessment / Product Assessment	20.35%
3.	Practice / Performance	21.01%
4.	Test	14.18%
		99.06%

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** abilities in the process and student learning outcomes are specific and measurable statements that identify the abilities 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.