	Universitas Negeri Surabaya Faculty of Economics and Business Digital Business Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Internet of Things	6120903025	Compulsory Study Program Subjects	T=0	P=2	ECTS=3.18	4	February 8, 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 that is charged to the course

Program Objectives (PO)

PO - 1	Students are able to understand and explain the concept of the Internet of Things
PO - 2	Students are able to explain and provide examples of Internet of Things applications
PO - 3	Students are able to implement the Internet of Things in a case study of local problems

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	This course discusses History, IT Architecture, Resource Management, IoT Data Management and Analytics Communication Protocols, Internet of Things Application, Security, Identity Management and Authentication, Privacy, Standardization and Regulatory Limitations. The course covers topics on the History, IT Architecture, Resource Management, IoT Data Management and Analytics, Communication Protocols, Internet of Things Applications, Security, Identity Management and Authentication, Privacy, Standardization, and Regulatory Limitations.

References

Main :

1. 1. B. Rajkumar, D.A.Vahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann
2. 2. G.C. Hillar. (2017). MQTT Essentials - A Lightweight IoT Protocol. Pack Publishing
3. 3. S. Ciraini, G. Ferrari, M. Picone, L. Veltri (2019). Internet of Things: Architectures, Protocols and Standards. Wiley

Supporters:

1. Modul Praktikum IoT Bisnis Digital

Supporting lecturer	Dr. Nanang Hoesen Hidroes Abbrori, S.T., M.T.I. Riska Dhenabayu, S.Kom., M.M.

Week-	Final abilities of each learning	Evaluation	Help Learning, Learning methods, Student Assignments, [Estimated time]	Learning materials [References]	Assessment Weight (%)

	stage (Sub-PO)	Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Students can understand the concept of the IoT ecosystem	1.1 Able to understand the concept of an IoT ecosystem	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practice questions [TM: 2x(3x50')] Assignment: presentation • each meeting requires 1 group (3 people) for presentation • duration 15 minutes • content: application of lecture material (which is being discussed) in the field Science and Technology/ ICT. [BT BM: (1 1)x2x(2X60')] 3x50	Lectures: • Online lectures • Online discussions • Independent practice questions [TM: 2x(3x50')] Assignments: online presentations • each meeting requires 1 group (3 people) to present • duration 15 minutes • content: application of lecture material (current discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** 1. Definition of Internet of Things 2. IoT Architecture 3. Resource Management 4. Data Management 5. Communication Protocols **Literature:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann* **Material:** 5. Communication Protocol **Reference:** *2. GC Hillar. (2017). MQTT Essentials - A Lightweight LoT Protocol. Pack Publishing* **Materials:** 2. IoT Architecture 5. Communication Protocols **References:** *3. S. Ciraini, G. Ferrari, M. Picone, L. Veltri (2019). Internet of Things: Architectures, Protocols and Standards. Wiley*	2%
2	Students can understand the concept of IoT architecture	2.1 Able to understand the concept of an IoT architecture	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practice questions [TM: 2x(3x50')] Assignment: presentation • each meeting requires 1 group (3 people) for presentation • duration 15 minutes • content: application of lecture material (which is being discussed) in the field Science and Technology/ ICT. [BT BM: (1 1)x2x(2X60')] 3x50	Lecture: • Online lecture • Online discussion • Independent practice questions [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for online presentation • duration 15 minutes • content: application of lecture material (which being discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** Concepts about IoT architecture **References:** *3. S. Ciraini, G. Ferrari, M. Picone, L. Veltri (2019). Internet of Things: Architectures, Protocols and Standards. Wiley*	3%

3	Students can understand programming frameworks for the Internet of Things	1.3.1. Able to understand basic programming for Arduino on the Internet of Things 2.3.2. Get to know add ons and basic operations for Arduino in IoT	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities, Practical Assessment	Lecture: • Lecture • Discussion • Practice questions [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for the presentation • duration 15 minutes • content: application of lecture material (which is being discussed) in field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	Lecture: • Online lecture • Online discussion • Independent practice questions [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for online presentation • duration 15 minutes • content: application of lecture material (which being discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** 1. Basic programming for Arduino on the Internet of Things 2. Add on Arduino for the Internet of Things 3. Basic Arduino operations on the Internet of Things **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	8%
4	Students know sensor data	1.4. Know about sensor data in IoT 2.5. Basic operation of sensors on Arduino in IoT	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practicum [TM: 2x(3x50')] Assignment: presentation • each meeting requires 1 group (3 people) for an online presentation • duration 15 minutes • content: application of lecture material (which is being discussed) in the field Science and Technology/ ICT. [BT BM: (1 1)x2x(2X60')] 3x50	Lectures: • Online lectures • Online discussions • Independent practicum [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for online presentation • duration 15 minutes • content: application of lecture material (current discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** 1. Definition of sensor data in IoT 2. Basic practices of Arduino sensors in IoT **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	3%
5	Students know sensor data	1.4. Know about sensor data in IoT 2.5. Basic operation of sensors on Arduino in IoT	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities, Practical Assessment	Lecture: • Lecture • Discussion • Practicum [TM: 2x(3x50')] Assignment: presentation • each meeting requires 1 group (3 people) for an online presentation • duration 15 minutes • content: application of lecture material (which is being discussed) in the field Science and Technology/ ICT. [BT BM: (1 1)x2x(2X60')] 3x50	Lectures: • Online lectures • Online discussions • Independent practicum [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for online presentation • duration 15 minutes • content: application of lecture material (current discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** 1. Definition of sensor data in IoT 2. Basic practices of Arduino sensors in IoT **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	8%

6	Students know about the Arduino web server	6.1. Know what is meant by an Arduino web server for IoT	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities, Practical Assessment	Lecture: • Lecture • Discussion • Practicum [TM: 1x(3x50')] Assignment: presentation • each meeting requires 1 group (3 people) for presentation • duration 15 minutes • content: application of lecture material (which is being discussed) in the field of science and technology / ICT. Task 1 • Material for meetings 3 to 5 [BT BM: (1 1)x1x(2X60')] 3x50	Lectures: • Online lectures • Online discussions • Independent practicum [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for online presentation • duration 15 minutes • content: application of lecture material (current discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** 1. Definition of the Arduino web server for IoT **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	8%
7	Students understand Security and Privacy in IoT	1. 7.1 Able to understand Security in IoT 2. 7.2 Able to understand Privacy in IoT	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practice questions [TM: 2x(3x50')] Assignment: presentation • each meeting requires 1 group (3 people) for presentation • duration 15 minutes • content: application of lecture material (which is being discussed) in the field Science and Technology/ ICT. [BT BM: (1 1)x2x(2X60')] 3x50	Lecture: • Online lecture • Online discussion • Independent practice questions [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for online presentation • duration 15 minutes • content: application of lecture material (which being discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** 1. Overview of IoT Security 2. Security Framework in IoT 3. Privacy in IoT networks 4. Container-Based Virtualization **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	3%

8	Midterm exam	Midterm exam	**Criteria:** Holistic rubric test form **Form of Assessment** : Test	Midterm Exam 90	Online Midterm Exam 90	**Material:** Midterm Exam **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann* **Material:** Midterm Exam **References:** *2. GC Hillar. (2017). MQTT Essentials - A Lightweight IoT Protocol. Pack Publishing* **Material:** Midterm Exam **References:** *3. S. Ciraini, G. Ferrari, M. Picone, L. Veltri (2019). Internet of Things: Architectures, Protocols and Standards. Wiley*	10%
9	Students can explain about Wifi and Bluetooth on Arduino and Android	1.9.1 Be able to explain Wifi and Bluetooth on Arduino 2.9.2 Be able to explain Android Wifi and Bluetooth connectivity to IoT	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practicum [TM: 1x(3x50')] Assignment: presentation • each meeting requires 1 group (3 people) to make a presentation • duration 15 minutes content: application of lecture material (which is being discussed) in the field of science and technology/ ICT. [BT BM: (1 1)x1x(2X60')] 3x50	Lectures: • Online lectures • Online discussions • Independent practicum [TM: 2x(3x50')] Assignment: online presentation • each meeting requires 1 group (3 people) for online presentation • duration 15 minutes • content: application of lecture material (current discussed) in the field of science and technology/ICT. [BT BM: (1 1)x2x(2X60')] 3x50	**Material:** 1. Explanation of Wifi and Bluetooth on Arduino 2. Explanation of Android Wifi and Bluetooth connectivity to IoT **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	4%
10	Students understand the Gas Leak Monitoring IoT Project	1.10. Able to understand and create design concepts for devices and programming in the Gas Leak Monitoring IoT Project 2.11. Students implement the Gas Leak Monitoring IoT Project	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities, Practical Assessment	Lecture: • Lecture • Discussion • Practicum [TM: 1x(3x50')] Project Assignment • Creating an IoT Gas Leak Monitoring Project [BT BM: (1 1)x1x(2X60')] 3x50	Lectures: • Online lecture • Online discussion • Online practicum [1x(3x50')] Project Assignment • Creating an IoT Gas Leak Monitoring Project [BT BM: (1 1)x1x(2X60')] 3x50	**Material:** 1. Explanation of the Gas Leak Monitoring IoT Project 2. Practicing the Gas Leak Monitoring IoT Project **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	6%

11	Students understand the Gas Leak Monitoring IoT Project	1.10. Able to understand and create design concepts for devices and programming in the Gas Leak Monitoring IoT Project 2.11. Students implement the Gas Leak Monitoring IoT Project	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practicum [TM: 1x(3x50')] Project Assignment • Creating an IoT Gas Leak Monitoring Project [BT BM: (1 1)x1x(2X60')] 3x50	Lectures: • Online lecture • Online discussion • Online practicum [1x(3x50')] Project Assignment • Creating an IoT Gas Leak Monitoring Project [BT BM: (1 1)x1x(2X60')] 3x50	**Material:** 1. Explanation of the Gas Leak Monitoring IoT Project 2. Practicing the Gas Leak Monitoring IoT Project **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	6%
12	Students understand the LoT-based Simple Robot IoT Project	1.12. Students are able to understand and create design concepts for devices and programming to create a Simple LoT-based IoT Robot Project 2.13. Students implement a simple LoT-based IoT Robot Project	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practicum [TM: 1x(3x50')] Project Assignment • Creating a Simple LoT-based IoT Robot Project [BT BM: (1 1)x1x(2X60')] 3x50	Lectures: • Online lectures • Online discussions • Online practicum [1x(3x50')] Project Assignments • Creating a Simple LoT-based IoT Robot Project [BT BM: (1 1)x1x(2X60')] 3x50	**Material:** 1. Explanation of the LoT-based Simple Robot IoT Project 2. Creating a LoT-based Simple Robot IoT Project **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	6%
13	Students understand the LoT-based Simple Robot IoT Project	1.12. Students are able to understand and create design concepts for devices and programming to create a Simple LoT-based IoT Robot Project 2.13. Students implement a simple LoT-based IoT Robot Project	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Lecture: • Lecture • Discussion • Practicum [TM: 1x(3x50')] Project Assignment • Creating a Simple LoT-based IoT Robot Project [BT BM: (1 1)x1x(2X60')] 3x50	Lectures: • Online lectures • Online discussions • Online practicum [1x(3x50')] Project Assignments • Creating a Simple LoT-based IoT Robot Project [BT BM: (1 1)x1x(2X60')] 3x50	**Material:** 1. Explanation of the LoT-based Simple Robot IoT Project 2. Creating a LoT-based Simple Robot IoT Project **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	6%
14	Students create an IoT Project to solve a problem	1.14. Create an IoT Project design and proposal to overcome a problem 2.15. Implement an IoT Project to solve a problem	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities, Practical Assessment	Final Project: 1. Create an IoT Project proposal to overcome a problem 2. Create an IoT Project design to overcome a problem 3. Implement an IoT project to overcome a problem 3x50	Final Project: 1. Create an IoT Project proposal to overcome a problem 2. Create an IoT Project design to overcome a problem 3. Implement an IoT project to overcome a problem 3x50	**Material:** 1. IoT project to solve a problem 2. Creating an IoT project to solve problems in the field **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	6%

15	Students create an IoT Project to solve a problem	1.14. Create an IoT Project design and proposal to overcome a problem 2.15. Implement an IoT Project to solve a problem	**Criteria:** Non-test form of holistic rubric **Form of Assessment** : Participatory Activities	Final Project: 1. Create an IoT Project proposal to overcome a problem 2. Create an IoT Project design to overcome a problem 3. Implement an IoT project to overcome a problem 3x50	Final Project: 1. Create an IoT Project proposal to overcome a problem 2. Create an IoT Project design to overcome a problem 3. Implement an IoT project to overcome a problem 3x50	**Material:** 1. IoT project to solve a problem 2. Creating an IoT project to solve problems in the field **References:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann*	6%
16	Final exams	Final exams	**Criteria:** Final exams **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	90th Semester Final Exam	Online Final Semester Exam 90	**Material:** Final Semester Exam **Literature:** *1. B. Rajkumar, DAVahid (2016). Internet of Things - Principles and Paradigms. Cambridge: Morgan Kaufmann* **Material:** Final Semester Exam **Reader:** *2. GC Hillar. (2017). MQTT Essentials - A Lightweight LoT Protocol. Pack Publishing* **Material:** Final Semester Exam **Literature:** *3. S. Ciraini, G. Ferrari, M. Picone, L. Veltri (2019). Internet of Things: Architectures, Protocols and Standards. Wiley*	15%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	64.5%
2.	Project Results Assessment / Product Assessment	7.5%
3.	Practical Assessment	18%
4.	Test	10%
		100%

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.