	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
SEMICONDUCTOR & MICROELECTRONIC DEVICES	2020103303	Study Program Elective Courses	T=0	P=0	ECTS=0	5	January 4, 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 can explain about MOS transistors which consist of n-channel MOS and p-channel MOS types.
	PO - 2	Students are able to apply the digital integrated circuit design stages from schematics to designs ready to be sent to the foundry.
	PO - 3	Students are able to explore CMOS inverters as the most important circuit in digital circuit design.
	PO - 4	Students are able to explore CMOS inverters as the most important circuit in digital circuit design
	PO - 5	Students are able to carry out analysis of the fabrication process.
	PO - 6	Students are able to carry out analysis on the realization of combinational circuits with static complementary CMOS and transmission gates.
	PO - 7	Students are able to carry out analysis of architectural design techniques for the radix-4 multiplier booth architecture.
	PO - 8	Students are able to explore analog component design.
	PO - 9	Students are able to plan, design and evaluate sequential circuit simulations.
	PLO-PO Matrix	

P.O
PO-1
PO-2
PO-3
PO-4
PO-5
PO-6
PO-7
PO-8
PO-9

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																
PO-8																
PO-9																

Short Course Description	This course discusses semiconductor device theory and the basic concepts of integrated circuit design as well as how to analyze them using the project based learning method.
References	**Main :**
	1. S.M. Sze.1985. Semiconductor Devices Physics and Technology . John Wiley & Sons.
	Supporters:
	1. R.L. Geiger, P.E. Allen, N.R. Strader. 1990. VLSI Design Technique for Analog and Digital Circuit . McGraw-Hill 2. Neil H. Waste, Kamran Eshragian. 1989. Principles of VLSI Design- A System Perspective . New York: Addisson. 3. Douglas A. Pucknell, Kamran Eshragian. 1989. Basic VLSI Design, System and Circuits . New Delhi: Prentice Hall.
Supporting lecturer	Prof. Dr. Bambang Suprianto, M.T. L. Endah Cahya Ningrum, S.Pd., M.Pd.

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 can explain about MOS transistors which consist of n-channel MOS and p-channel MOS types.	1.Students can explain the characteristics of MOS transistors 2.Students can explain the structure of the MOS transistor 3.Students can explain the MOS transistor layout	**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	Through lectures, questions and answers and 100 minute assignments		**Material:** MOS Transistor **Library:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	4%
2	Students can explain about MOS transistors which consist of n-channel MOS and p-channel MOS types.	1.Students can explain about effective channel length. 2.Students can explain about latch up.	**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	Through discussion activities to increase activeness, determine the depth of students' knowledge and analytical skills, 100 minutes		**Material:** MOS Transistor **Library:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%

3	Students can explain about MOS transistors which consist of n-channel MOS and p-channel MOS types.	1. Students explain about MOS parasitic capacitance 2. Students explain about NMOS pass transistors 3. Students explain about PMOS pass transistors 4. Students explain about transmission gates 5. Students explain about multiple contact	**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	Through discussion activities to increase activeness, determine the depth of knowledge and analytical abilities of students for 100 minutes		**Material:** MOS Transistor **Library:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%
4	Students are able to apply the digital integrated circuit design stages from schematic to design ready to be sent to the foundry.	1. Students are able to apply the design stages 2. Students are able to apply the CMOS process layer color system 3. Students are able to apply stick diagrams	**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	Through group activities to train the ability to coordinate the division of tasks, increase student initiative and cohesiveness 100 minutes		**Material:** Digital integrated circuit design stages **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%
5	Students are able to explore CMOS inverters as the most important circuit in digital circuit design	1. Students are able to carry out analysis of CMOS circuits 2. Students are able to carry out analysis of the static characteristics of CMOS inverters 3. Students explore CMOS inverter design 4. Students explore switching characteristics and interconnection effects on CMOS inverters 5. Students are able to carry out analysis about delays 6. Students are able to carry out analyzes of power consumption 7. Students explore CMOS layout	**Criteria:** Analysis method (the process of giving grades based on analysis according to the answers provided based on the level of truth). **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Using the discovery method with students carrying out knowledge exploration activities independently for 100 minutes		**Material:** CMOS Inverter **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%

6	Students are able to explore CMOS inverters as the most important circuit in digital circuit design	1. Students are able to carry out analysis about inter-digitization 2. Students are able to carry out an analysis of the width of the transistor 3. Students are able to carry out analysis of metal interconnections 4. Students are able to carry out analysis of inverter delay 5. Students are able to explore inverter design and simulation 6. Students are able to explore chain inverters	**Criteria:** Analysis method (the process of giving grades based on analysis according to the answers provided based on the level of truth). **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Using the discovery method with students carrying out knowledge exploration activities independently for 100 minutes		**Material:** CMOS Inverter **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%
7	Students are able to carry out analysis of the fabrication process	1. Students are able to carry out analysis of rule design 2. Students are able to carry out analysis of design rules for transistors	**Criteria:** Analysis method (the process of giving grades based on analysis according to the answers provided based on the level of truth). **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Using the discovery method with students carrying out knowledge exploration activities independently for 100 minutes		**Material:** Fabrication process **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%
8	UTS	Students can plan, complete and evaluate the results of the projects they have created	**Criteria:** 1. Explain accurately and clearly 2. Explain accurately and clearly; Presented comprehensively 3. Explain accurately and clearly; Delivered comprehensively; Based on analysis 4. Explain accurately and clearly; Delivered comprehensively; Based on analysis; Explained without bias 5. Explain accurately and clearly; Delivered comprehensively; Based on analysis; Explained without bias; Information is conveyed with the support of facts **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	By providing group project questions to be presented in class for 100 minutes		**Material:** MOS Transistor, Digital integrated circuit design stage, CMOS Inverter, Fabrication Process **Library:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	20%
9	Students are able to carry out analysis on the realization of combinational circuits with static complementary CMOS and transmission gates.	1. Students are able to carry out analysis of static complementary CMOS 2. Students are able to carry out an analysis of transmission gates.	**Criteria:** Analysis method (the process of giving grades based on analysis according to the answers provided based on the level of truth). **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Using the discovery method with students carrying out knowledge exploration activities independently for 100 minutes		**Material:** Realization of combinational circuits **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%

10	Students are able to carry out analysis of architectural design techniques for the radix-4 multiplier booth architecture	1. Students are able to explore multiplier booths 2. Students conduct an analysis of the performance of the multiplier booth	**Criteria:** Analysis method (the process of giving grades based on analysis according to the answers provided based on the level of truth). **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Using the discovery method with students carrying out knowledge exploration activities independently for 100 minutes		**Material:** Architecture of the radix-4 multiplier booth. **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%
11	Students are able to explore analog component design.	1. Students are able to carry out analysis of resistor design 2. Students are able to carry out analysis of capacitor design	**Criteria:** Analysis method (the process of giving grades based on analysis according to the answers provided based on the level of truth). **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Using the discovery method with students carrying out knowledge exploration activities independently for 100 minutes		**Material:** Analog component design **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	3%
12	Students are able to plan, design and evaluate sequential circuit simulations	1. Students can plan sequential circuits 2. Students can complete sequential circuit designs 3. Students can carry out evaluations on sequential series	**Criteria:** Analysis method (the process of assigning values based on the results of the sequential circuit design). **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Using the inquiry method, students can solve problems through theoretical studies carried out in groups for 100 minutes		**Material:** Sequential Series **Bibliography:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	5%
13	Students are able to plan, design and evaluate sequential circuit simulations	1. Students can plan sequential circuits 2. Students can complete sequential circuit designs 3. Students can carry out evaluations on sequential series	**Criteria:** Analysis method (the process of assigning values based on the results of the sequential circuit design). **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Using the inquiry method, students can solve problems through theoretical studies carried out in groups for 100 minutes		**Material:** Sequential Series **Bibliography:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	5%
14	Students are able to plan, design and evaluate sequential circuit simulations	1. Students can plan sequential circuits 2. Students can complete sequential circuit designs 3. Students can carry out evaluations on sequential series	**Criteria:** Analysis method (the process of assigning values based on the results of the sequential circuit design). **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Using the inquiry method, students can solve problems through theoretical studies carried out in groups for 100 minutes		**Material:** Sequential Series **Bibliography:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	5%
15	Students are able to plan, design and evaluate sequential circuit simulations	1. Students can plan sequential circuits 2. Students can complete sequential circuit designs 3. Students can carry out evaluations on sequential series	**Criteria:** Analysis method (the process of assigning values based on the results of the sequential circuit design). **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Using the inquiry method, students can solve problems through theoretical studies carried out in groups for 100 minutes		**Material:** Sequential Series **Bibliography:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	4%

16	UAS	Students can plan, complete and evaluate the results of the projects they have created	**Criteria:** 1. Explain accurately and clearly 2. Explain accurately and clearly; Presented comprehensively 3. Explain accurately and clearly; Delivered comprehensively; Based on analysis 4. Explain accurately and clearly; Delivered comprehensively; Based on analysis; Explained without bias 5. Explain accurately and clearly; Delivered comprehensively; Based on analysis; Explained without bias; Information is conveyed with the support of facts **Form of Assessment** : Project Results Assessment / Product Assessment	By providing group project questions to be presented in class for 100 minutes		**Material:** Realization of combinational circuits, Radix-4 booth multiplier architecture, Sequential circuits **Reference:** *SM Sze.1985. Semiconductor Devices Physics and Technology. John Wiley & Sons.*	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	32%
2.	Project Results Assessment / Product Assessment	55.5%
3.	Test	12.5%
		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** 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.