	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
POWER ELECTRONICS	2020102298	Compulsory Study Program Subjects	T=0	P=0	ECTS=0	4	April 10, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Case Studies**	
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	PLO-8	Able to apply engineering principles, identify, formulate and analyze data/information to solve problems in the electrical field
	Program Objectives (PO)	
	PO - 1	Students are able to explain the concept of power semiconductor components, power diodes, thyristors.
	PO - 2	Students are able to explain the concept of basic theory of rectifiers, Single Phase Diode - Bridge rectifiers, Voltage Doubler (Single Phase) rectifiers, Three Phase Full Bridge rectifiers and comparisons of Single Phase and Three Phase Rectifiers.
	PO - 3	Students are able to carry out analysis of controls on controlled rectifiers and frequency inverters, analysis of Three Phase Converters, AC Inductance effects, Current effects, Discontinuity, Inverting Operations, AC Waveforms, and other Three Phase converters.
	PO - 4	Students are able to use the concept of commutation techniques.
	PO - 5	Students are able to explore Chopper circuits, switching converter models, various types of chopper circuits, and chopper circuit configurations.
	PO - 6	Students can explain the basics of AC voltage regulator circuits and DC voltage regulators.
	PO - 7	Students are able to carry out analysis on inverter circuits and the basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models.
	PO - 8	Students are able to explore the application of power supplies and motor drives.
	PLO-PO Matrix	

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

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																

Short Course Description	This course discusses the characteristics of Power Electronics components which include Diodes, Thyristons, DIAC, TRIAC, UJT, FET, Electronic switch analysis, Pulse generator circuit analysis. Rectifiers use diodes for one phase and three phases, Rectifiers use SCRs for one phase and three phases. Single phase inverter and three phase inverter. As well as the use of electronic circuits to regulate electrical machines using the case study method.
References	**Main :**

1. Singh,MD. 1998. Power Electronics, New Delhi, Tata McGraw Hill- Publishing Company Limited.
2. Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.

Supporters:

1. Sen, P. C. 1990. Power Electronics. Tata McGraw Hill- Publishing Company Limited. New Delhi.
2. R. W. Erickson. 1997. Fundamentals of Power Electronics
3. R.S. Ramshaw. 1993. Power Electronics Semiconductor Switches

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 are able to explain the concept of power semiconductor components, power diodes, thyristors	1.Students are able to explain correctly the characteristics of power diodes and thyristors 2.Students are able to explain correctly the differences between di/dt and dv/dt protection	**Criteria:** The Evaluation Rubric uses an analytical 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:** Power diodes and Thyristors **References:** *Main Reference : Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	3%
2	Students are able to explain the concept of power semiconductor components, power diodes, thyristors	1.Students are able to explain correctly the characteristics of power diodes and thyristors 2.Students are able to explain correctly the differences between di/dt and dv/dt protection	**Criteria:** The Evaluation Rubric uses an analytical 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:** Power diodes and Thyristors **References:** *Main Reference : Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	3%

3	Students are able to explain the concept of the basic theory of rectifiers, Single Phase Diode - Bridge rectifiers, Voltage Doubler (Single Phase) rectifiers, Three Phase Full Bridge rectifiers and comparisons of Single Phase and Three Phase Rectifiers	1. Students can explain the basic concepts of rectifiers 2. Students can explain the application of freewheeling diodes 3. Students can compare single-phase and three-phase rectifiers	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activeness, determine the depth of students' knowledge and analytical skills 100 minutes		**Material:** Basics of rectifiers, Single Phase Diode - Bridge rectifiers, Voltage Doubler (Single Phase) rectifiers, Three Phase Full Bridge rectifiers **References:** *Singh, MD. 1998. Power Electronics, New Delhi, Tata McGraw Hill-Publishing Company Limited.*	3%
4	Students are able to explain the concept of the basic theory of rectifiers, Single Phase Diode - Bridge rectifiers, Voltage Doubler (Single Phase) rectifiers, Three Phase Full Bridge rectifiers and comparisons of Single Phase and Three Phase Rectifiers	1. Students can explain the basic concepts of rectifiers 2. Students can explain the application of freewheeling diodes 3. Students can compare single-phase and three-phase rectifiers	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activeness, determine the depth of students' knowledge and analytical skills 100 minutes		**Material:** Basics of rectifiers, Single Phase Diode - Bridge rectifiers, Voltage Doubler (Single Phase) rectifiers, Three Phase Full Bridge rectifiers **References:** *Singh, MD. 1998. Power Electronics, New Delhi, Tata McGraw Hill-Publishing Company Limited.*	3%
5	Students are able to carry out analysis of controllers on controlled rectifiers and frequency inverters, analysis of Three Phase Converters, AC Inductance effects, Current effects, Discontinuity, Inverting Operations, AC Waveforms, and other Three Phase converters	1. Students are able to explain about controlled rectifiers 2. Students are able to carry out analysis on converter circuits 3. Students are able to carry out waveform analysis	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activeness, determine the depth of students' knowledge and analytical skills 100 minutes		**Material:** Controls on controlled frequency rectifiers and inverters, analysis of Three Phase Converters, AC Inductance effects, Current effects, Discontinuity, Inverting Operations, AC Waveforms, and other Three Phase converters **References:** *Main Library: Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	3%

6	Students are able to use the concept of commutation techniques	1. Students are able to explain commutation techniques 2. Students are able to apply the thyristor extinction process	**Criteria:** The Evaluation Rubric uses an analytical 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	Through group discussion activities to increase activeness, determine the depth of students' knowledge and analytical skills 100 minutes		**Material:** Commutation techniques **References:** *Sen, PC 1990. Power Electronics. Tata McGraw Hill-Publishing Company Limited. New Delhi.*	5%
7	Students are able to explore Chopper circuits, switching converter models, various types of chopper circuits, and chopper circuit configurations.	1. Students are able to explain the switching converter model 2. Students are able to apply various converters 3. Students are able to make a converter circuit 4. Students can develop models with Simulink 5. Students are able to carry out simulations on converter circuits	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activity, determine the depth of students' knowledge and analytical abilities. As well as developing a Converter model with Simulink Matlab. 100 minutes		**Material:** Chopper circuit, switching converter model, various types of chopper circuits, and chopper circuit configurations **Library:** *RW Erickson. 1997. Fundamentals of Power Electronics*	5%
8	UTS	Students are able to analyze information about power diodes, thyristors, rectifiers, three-phase converters, commutation techniques and switching converters through free description tests	**Criteria:** Students are able to interpret information about power diodes, thyristors, rectifiers, three-phase converters, commutation techniques and switching converters through free explanation tests **Form of Assessment** : Participatory Activities, Tests	By giving questions about power diodes, thyristors, rectifiers, three-phase converters, commutation techniques and switching converters 100 minutes		**Material:** Power diodes, thyristors, rectifiers, three-phase converters, commutation techniques and switching converters **References:** *Main Library : Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	20%
9	Students can explain the basics of AC voltage regulator circuits and DC voltage regulators	1. Students can explain AC/DC voltage settings 2. Students can explain the basics of voltage regulator circuits 3. Students are able to simulate AC/DC voltage regulators	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activeness, determine the depth of students' knowledge and analytical skills 100 minutes		**Material:** AC voltage regulator and DC voltage regulator circuits **Reference:** *Singh, MD. 1998. Power Electronics, New Delhi, Tata McGraw Hill-Publishing Company Limited.*	3%

10	Students can explain the basics of AC voltage regulator circuits and DC voltage regulators	1. Students can explain AC/DC voltage settings 2. Students can explain the basics of voltage regulator circuits 3. Students are able to simulate AC/DC voltage regulators	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activeness, determine the depth of students' knowledge and analytical skills 100 minutes		**Material:** AC voltage regulator and DC voltage regulator circuits **Reference:** *Singh, MD. 1998. Power Electronics, New Delhi, Tata McGraw Hill-Publishing Company Limited.*	2%
11	Students are able to carry out analysis on inverter circuits and basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models	1. Students can explain the basic concept of switches 2. Students can use the inverter formula 3. Students can explore the model with Simulink 4. Students can carry out analysis on inverter circuit simulations	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activity, determine the depth of students' knowledge and analytical abilities. As well as developing a Converter model with Simulink Matlab 100 minutes		**Material:** Inverter circuits and basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models **Reader:** *Singh, MD. 1998. Power Electronics, New Delhi, Tata McGraw Hill-Publishing Company Limited.*	3%
12	Students are able to carry out analysis on inverter circuits and basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models	1. Students can explain the basic concept of switches 2. Students can use the inverter formula 3. Students can explore the model with Simulink 4. Students can carry out analysis on inverter circuit simulations	**Criteria:** The Evaluation Rubric uses an analytical 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 discussion activities to increase activity, determine the depth of students' knowledge and analytical abilities. As well as developing a Converter model with Simulink Matlab 100 minutes		**Material:** Inverter circuits and basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models **Reader:** *Singh, MD. 1998. Power Electronics, New Delhi, Tata McGraw Hill-Publishing Company Limited.*	2%

13	Students are able to explore the application of power supplies and motor drives	1. Students can carry out analyzes on power supply, motor drive, residential and industrial applications 2. Students can carry out analysis on applied industrial application simulations	**Criteria:** Rubric for evaluating student presentation activities **Form of Assessment** : Participatory Activities, Portfolio Assessment	Through group discussion activities to increase activity, determine the depth of students' knowledge and analytical abilities. As well as developing application models for power supplies and motor drives with Simulink Matlab 100 minutes		**Material:** Applications of power supplies and motor drives **References:** *Main Reference: Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	5%
14	Students are able to explore the application of power supplies and motor drives	1. Students can carry out analyzes on power supply, motor drive, residential and industrial applications 2. Students can carry out analysis on applied industrial application simulations	**Criteria:** Rubric for evaluating student presentation activities **Form of Assessment** : Participatory Activities, Portfolio Assessment	Through group discussion activities to increase activity, determine the depth of students' knowledge and analytical abilities. As well as developing application models for power supplies and motor drives with Simulink Matlab 100 minutes		**Material:** Applications of power supplies and motor drives **References:** *Main Reference: Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	5%
15	Students are able to explore the application of power supplies and motor drives	1. Students can carry out analyzes on power supply, motor drive, residential and industrial applications 2. Students can carry out analysis on applied industrial application simulations	**Criteria:** Rubric for evaluating student presentation activities **Form of Assessment** : Participatory Activities, Portfolio Assessment	Through group discussion activities to increase activity, determine the depth of students' knowledge and analytical abilities. As well as developing application models for power supplies and motor drives with Simulink Matlab 100 minutes		**Material:** Applications of power supplies and motor drives **References:** *Main Reference: Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	5%

16	UAS	Students are able to interpret information about AC voltage regulator circuits and DC voltage regulators; inverter circuits and basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models; and applications of power supplies and motor drives through free explanation questions	**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, Tests	By giving questions about AC voltage regulator circuits and DC voltage regulators; inverter circuits and basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models; and 100 minute power supply and motor drive applications		**Material:** AC voltage regulator and DC voltage regulator circuits; inverter circuits and basic concepts of Inverting Model Switches, Single Phase Inverters, Three Phase Inverters, other inverting Switch Schemes and rectifier operating models; and applications of power supplies and motor drives **References:** *Main Reference : Rashid, Muhammad H. 2004. Power Electronics: Circuits, Devices, and Applications, 3 ND. ED. Prentice Hall Inc. New Jersey.*	30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	52.5%
2.	Portfolio Assessment	7.5%
3.	Test	40%
		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.