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

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Maintenance and Repair of Electrical Machines	8320102084		**T=2**	**P=0**	**ECTS=3.18**	6	January 2, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Dr. Joko, M.Pd. MT.	.....	Dr. Nur Kholis, S.T., M.T.

Learning model	**Project Based Learning**
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**
	Program Objectives (PO)
	PLO-PO Matrix

P.O

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

Short Course Description	Students have the ability to inspect and solve problems in carrying out damage inspections, maintenance and repair of electric motors for cooling machines, electric motors for heating machines, electric motors for driving machines, generators and transformers and have the ability to inspect damage to electric motor installations, generator installations and installations. transformer and report the results

References

Main :

1. Joko, 2019. Pemeliharaan dan perbaikan motor listrik. Unesa University Press
2. Joko, Agus Budi Santoso, Parama Diptya W., Alfredo A.A.A, 2021. Buku pemeliharaan dan perbaikan motor listrik berbasis model pembelajaran berbasisi proyek
3. Ghanshyam Prasad, 2023. Guidelines for O & M of Distribution Transformer. Operation and maintenace of distribution transformer. Governmenf of India Ministry of Power Central Electricty Authority

Supporters:

1. Joko, 2016. Mesin arus searah. Unesa University Press
2. Joko, 2018. Mesin arus bolak balik. Unesa University Press
3. Supari M., Joko, Puput W. R., Teknik Pembangkit Tenaga Listrik Jilid 2. Dit. PSMK DirJen Manajemen Pendidikan Dasar dan Menengah Depdiknas
4. Reclamation, 2005. Transformers Basics, Maintenance, and Diagnostics. Hydroelectric Research and Technical Services Group Denver Colorado

Supporting lecturer	Prof. Dr. Ismet Basuki, M.Pd. Prof. Dr. Joko, M.Pd., M.T. Yulia Fransisca, 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 carry out maintenance and repair of DC motors by inspecting problems, causes, carrying out repairs, and reporting the results in writing and orally (presentation)	1. Students inspect problems, causes, carry out repairs, and report the results of DC motor maintenance and repairs 2. Participative	**Criteria:** 1. Accuracy of carrying out fault inspections, determining causes, carrying out repairs, and reporting the results of maintenance and repair of DC motors, max score. 50 2. Participative, min score 50 **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, group discussions and carry out maintenance and repair of damaged DC motors and report the results; and reflect. Maintenance and repair reports are uploaded by each student on Google Drive 2 X 50		**Material:** Maintenance and repair of DC machines **References:** *Supari M., Joko, Puput WR, Electric Power Plant Engineering Volume 2. Dit. PSMK Director General of Primary and Secondary Education Management, Ministry of National Education* **Material:** Maintenance and repair of DC motors **Reference:** *Joko, Agus Budi Santoso, Parama Diptya W., Alfredo AAA, 2021. Book for maintenance and repair of electric motors based on a project-based learning model. Unesa University Press*	4%
2	Students are able to carry out maintenance and repair of DC generators by inspecting faults, determining the cause, carrying out repairs, and reporting the results in writing and orally (presentation)	1. Students carry out fault inspections and determine causes, carry out repairs, and report the results of maintenance and repair of DC generators and report the results 2. Participative	**Criteria:** 1. Accuracy in inspecting faults, causes, carrying out repairs, and reporting the results of maintenance and repair of DC motors, max score. 50 2. Participative, min score 50 **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, group discussions and carry out maintenance and repair of damaged DC generators, and report results; and reflect. Maintenance and repair reports are uploaded by each student on Google Drive 2 X 50		**Material:** Maintenance and repair of DC machines **References:** *Joko, Agus Budi Santoso, Parama Diptya W., Alfredo AAA, 2021. Book on maintenance and repair of electric motors based on a project-based learning model* **Material:** Maintenance and repair of DC generators **Reference:** *Supari M., Joko, Puput WR, Electric Power Plant Engineering Volume 2. Dit. PSMK Director General of Primary and Secondary Education Management, Ministry of National Education*	4%

3	Students are able to carry out maintenance and repair of single-phase synchronous generators and report the results in writing and orally	1. Carry out fault inspections, causes, and carry out maintenance and repairs on single-phase synchronous generators and report the results 2. Participative	**Criteria:** 1. Accuracy in inspecting faults, causes, and carrying out maintenance and repairs on single phase synchronous generators and reporting the results, max score 50 2. Participative, min score 50% **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignment to search for sources of information, discuss and carry out maintenance and repair of damage to single-phase synchronous generators, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 2 X 50		**Material:** Maintenance of synchronous generators **Reference:** *Joko, 2019. Maintenance and repair of electric motors. Unesa University Press* **Material:** Maintenance and repair of synchronous generators **Reference:** *Supari M., Joko, Puput WR, Electric Power Plant Engineering Volume 2. Dit. PSMK Director General of Primary and Secondary Education Management, Ministry of National Education* **Material:** Single phase synchronous generator **Reference:** *Joko, 2018. Alternating current machine. Unesa University Press*	4%

4	Students are able to carry out maintenance and repair of 3-phase synchronous generators and report the results in writing and orally	1. Carry out fault inspections, causes, and carry out maintenance and repairs on 3-phase synchronous generators and report the results 2. Participative	**Criteria:** 1. Accuracy in inspecting problems, causes, and carrying out maintenance and repairs and reporting the results, max score 50 2. Participative, min score 50% **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repair of damage to 3-phase synchronous generators, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 2 X 50		**Material:** Maintenance of synchronous generators **Reference:** *Joko, 2019. Maintenance and repair of electric motors. Unesa University Press* **Material:** Maintenance and repair of synchronous generators **Reference:** *Supari M., Joko, Puput WR, Electric Power Plant Engineering Volume 2. Dit. PSMK Director General of Primary and Secondary Education Management, Ministry of National Education* **Material:** Single phase synchronous generator **Reference:** *Joko, 2018. Alternating current machine. Unesa University Press* **Material:** 3 phase synchronous generator **Reference:** *Joko, 2018. Alternating current machine. Unesa University Press*	4%

5	Students are able to carry out maintenance and repair of 1 phase synchronous motors and 3 phase synchronous motors and report the results in writing and orally	1. Carry out fault inspections, causes, and carry out maintenance and repairs on single-phase synchronous motors and 3-phase synchronous motors and report the results 2. Participative	**Criteria:** 1. Accuracy in inspecting faults, causes, and carrying out maintenance and repairs on 1-phase synchronous motors and 3-phase synchronous motors and reporting the results, max score 50 2. Participative, min score 50% **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignment to search for sources of information, discuss and carry out maintenance and repair of damage to single-phase synchronous motors and 3-phase synchronous motors, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 2 X 50		**Material:** Maintenance of synchronous motors **Reference:** *Joko, 2019. Maintenance and repair of electric motors. Unesa University Press* **Material:** Maintenance and repair of synchronous motors **Reference:** *Supari M., Joko, Puput WR, Electric Power Plant Engineering Volume 2. Dit. PSMK Director General of Primary and Secondary Education Management, Ministry of National Education* **Material:** Synchronous motors **Reference:** *Joko, 2018. Alternating current machines. Unesa University Press*	4%
6	Students are able to carry out maintenance and repair of electric motors that drive household electrical equipment and report the results in writing and orally	1. Carry out inspections of problems, causes, and carry out maintenance and repairs on electric motors driving household electrical equipment and report the results 2. Participative	**Criteria:** 1. Accuracy in inspecting faults, causes, and carrying out maintenance and repairs on electric motors driving household electrical equipment and reporting the results, max score 50 2. Participative, min score 50% **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repairs on damaged electric motors that drive household electrical equipment, and report the results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 2 X 50		**Material:** Maintenance of single-phase electric motors **Reference:** *Joko, 2019. Maintenance and repair of electric motors. Unesa University Press* **Material:** Electric motors driving household electrical equipment **Reference:** *Joko, 2018. Alternating current machines. Unesa University Press* **Material:** Single-phase induction motors and electric motors that drive household electrical equipment. **Reference:** *Joko, 2018. Alternating current machines. Unesa University Press*	4%

7	Students are able to carry out maintenance and repair of motors driving industrial electrical equipment and report the results	1. Carry out inspections of problems, causes, and carry out maintenance and repairs on electric motors driving electrical equipment in industry and report the results 2. Participative	**Criteria:** 1. Accuracy in inspecting faults, causes, and carrying out maintenance and repairs on electric motors driving electrical equipment in industry and reporting the results, max score 50 2. Participative, min score 50% **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignment to search for sources of information, discuss and carry out maintenance and repair of damage to electric motors driving electrical equipment in industry, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 2 X 50		**Material:** Maintenance and repair of 3 phase induction motors **Reference:** *Joko, 2019. Maintenance and repair of electric motors. Unesa University Press* **Material:** 3 phase induction motor **Reference:** *Joko, 2018. Alternating current machine. Unesa University Press* **Material:** Maintenance and repair of 3-phase asynchronous motors **Reference:** *Supari M., Joko, Puput WR, Electric Power Plant Engineering Volume 2. Dit. PSMK Director General of Primary and Secondary Education Management, Ministry of National Education*	4%
8	UTS	1. Presentation materials, making presentations, revising Powerpoint, and answering questions/tests from supervisory lecturers 2. Participative	**Criteria:** 1. Accuracy of the content of presentation material and revised Powerpoint results, maximum score 10 2. Presentation: accuracy in expressing ideas, answering questions, accepting suggestions, max score 10 3. Answering questions/tests from lecturers, maximum score 30 4. Participative, min score 50 **Form of Assessment** : Test	UTS: Presenting the results of the 1st and 7th meetings, for 1 group presenting the results of 1 topic or 1 title at 1 meeting, the determination of which is drawn 2 X 50			15%

9	Students are able to carry out maintenance and repair of motors driving industrial electrical equipment and report the results	1. Carry out fault inspections, causes, and carry out maintenance and repairs on transformers and report the results 2. Participative	**Criteria:** 1. Accuracy in inspecting faults, causes, and carrying out maintenance and repairs on electric motors driving electrical equipment in industry and reporting the results, max score 50 2. Participative, min score 50% **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Practice / Performance	Short lecturer presentations, discussions and questions and answers; group assignment to search for sources of information, discuss and carry out maintenance and repair of damage to electric motors driving electrical equipment in industry, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 4 X 50		**Material:** Maintenance and repair of 3 phase induction motors **Reference:** *Joko, 2019. Maintenance and repair of electric motors. Unesa University Press* **Material:** 3 phase induction motor **Reference:** *Joko, 2018. Alternating current machine. Unesa University Press* **Material:** Maintenance and repair of 3-phase asynchronous motors **Reference:** *Supari M., Joko, Puput WR, Electric Power Plant Engineering Volume 2. Dit. PSMK Director General of Primary and Secondary Education Management, Ministry of National Education*	4%
10	Students are able to carry out maintenance and repairs on transformers and report the results	1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results 2. participative	**Criteria:** 1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results, max score. 50 2. Participative, min score 50% **Form of Assessment** : Participatory Activities, Portfolio Assessment	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repair of transformer damage, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 4 X 50		**Material:** Standardization of operational practices of utilities **Reference:** *Ghanshyam Prasad, 2023. Guidelines for O & M of Distribution Transformer. Operation and maintenance of distribution transformers. Governmenf of India Ministry of Power Central Electricity Authority* **Material:** Transformer maintenance and diagnostics **Library:** *Reclamation, 2005. Transformers Basics, Maintenance, and Diagnostics. Hydroelectric Research and Technical Services Group Denver Colorado*	4%

11	Students are able to carry out maintenance and repairs on transformers and report the results	1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results 2. participative	**Criteria:** 1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results, max score. 50 2. Participative, min score 50% **Form of Assessment** : Participatory Activities, Portfolio Assessment	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repair of transformer damage, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 4 X 50		**Material:** Standardization of operational practices of utilities **Reference:** *Ghanshyam Prasad, 2023. Guidelines for O & M of Distribution Transformer. Operation and maintenance of distribution transformers. Governmenf of India Ministry of Power Central Electricity Authority* **Material:** Transformer maintenance and diagnostics **Library:** *Reclamation, 2005. Transformers Basics, Maintenance, and Diagnostics. Hydroelectric Research and Technical Services Group Denver Colorado*	4%
12	Students are able to carry out maintenance and repairs on transformers and report the results	1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results 2. participative	**Criteria:** 1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results, max score. 50 2. Participative, min score 50% **Form of Assessment** : Participatory Activities, Portfolio Assessment	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repair of transformer damage, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 4 X 50		**Material:** Standardization of operational practices of utilities **Reference:** *Ghanshyam Prasad, 2023. Guidelines for O & M of Distribution Transformer. Operation and maintenance of distribution transformers. Governmenf of India Ministry of Power Central Electricity Authority* **Material:** Transformer maintenance and diagnostics **Library:** *Reclamation, 2005. Transformers Basics, Maintenance, and Diagnostics. Hydroelectric Research and Technical Services Group Denver Colorado*	4%

13	Students are able to carry out maintenance and repairs on transformers and report the results	1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results 2. participative	**Criteria:** 1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results, max score. 50 2. Participative, min score 50% **Form of Assessment** : Participatory Activities, Portfolio Assessment	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repair of transformer damage, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 4 X 50		**Material:** Standardization of operational practices of utilities **Reference:** *Ghanshyam Prasad, 2023. Guidelines for O & M of Distribution Transformer. Operation and maintenance of distribution transformers. Governmenf of India Ministry of Power Central Electricity Authority* **Material:** Transformer maintenance and diagnostics **Library:** *Reclamation, 2005. Transformers Basics, Maintenance, and Diagnostics. Hydroelectric Research and Technical Services Group Denver Colorado*	4%
14	Students are able to carry out maintenance and repairs on transformers and report the results	1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results 2. participative	**Criteria:** 1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results, max score. 50 2. Participative, min score 50% **Form of Assessment** : Participatory Activities, Portfolio Assessment	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repair of transformer damage, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 4 X 50		**Material:** Standardization of operational practices of utilities **Reference:** *Ghanshyam Prasad, 2023. Guidelines for O & M of Distribution Transformer. Operation and maintenance of distribution transformers. Governmenf of India Ministry of Power Central Electricity Authority* **Material:** Transformer maintenance and diagnostics **Library:** *Reclamation, 2005. Transformers Basics, Maintenance, and Diagnostics. Hydroelectric Research and Technical Services Group Denver Colorado*	4%

15	Students are able to carry out maintenance and repairs on transformers and report the results	1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results 2. participative	**Criteria:** 1. Carrying out preparatory work, carrying out maintenance and repairs, testing work results, and reporting work results, max score. 50 2. Participative, min score 50% **Form of Assessment** : Participatory Activities, Portfolio Assessment	Short lecturer presentations, discussions and questions and answers; group assignments to search for sources of information, discuss and carry out maintenance and repair of transformer damage, and report results; and reflect. Maintenance and repair results reports are uploaded by each student on Google Drive 4 X 50		**Material:** Standardization of operational practices of utilities **Reference:** *Ghanshyam Prasad, 2023. Guidelines for O & M of Distribution Transformer. Operation and maintenance of distribution transformers. Governmenf of India Ministry of Power Central Electricity Authority* **Material:** Transformer maintenance and diagnostics **Library:** *Reclamation, 2005. Transformers Basics, Maintenance, and Diagnostics. Hydroelectric Research and Technical Services Group Denver Colorado*	4%
16	UTS 9th-10th meeting material	1. preparing presentation materials, conducting presentations, and making improvements to presentation materials 2. Participative	**Criteria:** 1. Accuracy in preparing presentation materials, making presentations, and making improvements to presentation materials, max score 50% 2. Participative, min score 50% **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Practical / Performance, Tests	UTS method, each group presents the results of their project work and answers questions from the course supervisor 4 X 50			30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	29.48%
2.	Project Results Assessment / Product Assessment	2%
3.	Portfolio Assessment	29.48%
4.	Practice / Performance	17.48%
5.	Test	22.5%
		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.