UNESA	**Universitas Negeri Surabaya** **Faculty of Engineering,** **Mechanical Engineering Undergraduate Study Program**	**Document Code**

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Machine Elements 1	2120102132	Machine Design	**T=2**	**P=0**	**ECTS=3.18**	3	March 28, 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-5	Work independently and in groups
	PLO-7	Problem analysis
	PLO-11	Design and development of solutions that take into account the environment and sustainability
	PLO-14	Science and engineering knowledge
	Program Objectives (PO)	
	PO - 1	Understanding the basic concepts of force, stress and strain
	PO - 2	Basic planning concepts include design thinking, design process flow diagrams, design criteria, constraint-based design, design for x
	PO - 3	Introduction to standard components
	PO - 4	Prototype concept
	PO - 5	Calculation of load strength includes basic concepts of machine elements, load analysis, stress analysis on machine elements
	PO - 6	Calculation and use of stress strain diagrams in planning
	PO - 7	Selection of appropriate safety factors for each machine element
	PO - 8	Using failure theory in calculating the design shaft diameter
	PLO-PO Matrix	

P.O	PLO-5	PLO-7	PLO-11	PLO-14
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

Able to understand the theory of the basic concepts of force, stress and strain; basic design concepts which include introduction to design thinking, design process flow diagrams, design criteria, constraint-based design, design for x, introduction to standard components, prototyping; load strength calculation which includes basic concepts and principles of machine elements, load analysis, stress analysis on machine elements, use of stress-strain diagrams in planning, safety factors, and failure theory

References

Main :

1. Richard Gordon Budynas, J. Keith Nisbett, Shigleys Mechanical Engineering Design, 10th Edition, McGraw-Hill, 2014
2. R. S. Khurmi, J. K. Gupta, Machine Design, Eurasia Publishing House, 2005
3. Robert L. Mott, Edward M. Vavrek, Jyhwen Wang, Machine Elements in Mechanical Design (6th Edition), Pearson, 2017
4. Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development, 7th Edition, Mc Graw Hill, 2020

Supporters:

Supporting lecturer

Novi Sukma Drastiawati, S.T., M.Eng.
Dany Iman Santoso, S.T., 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	Understand the one semester study contract Understand the RPS Understand the basic concept in the form of stress Understand the meaning of the basic concept in the form of force Understand the basic concept in the form of strain	1.Agree to a study contract for one semester 2.Know the material for machine element 1 for 1 semester based on RPS guidelines 3.Explain the basic concepts regarding the various forces that act on components 4.Explain the basic concept of voltage 5.Explain the basic concept of strain	**Criteria:** 1.Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2.The final value (NA) is calculated following the formula: 3.NA = (2xP)(3xT)(2xUTS)(3xUS) 4.10 **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50	Lectures, discussions and assignments 2 X 50	**Material:** Forces in machine elements **References:** *Robert L. Mott, Edward M. Vavrek, Jyhwen Wang, Machine Elements in Mechanical Design (6th Edition), Pearson, 2017*	5%

2	Understand the basic concepts of planning Understand the design thinking process Understand the design process flow diagram Understand the design criteria	1. Able to explain basic planning concepts 2. Able to create a planning process flow diagram correctly 3. Able to describe the thinkin design process 4. Able to make initial plans 5. Able to create design process flow diagrams 6. Able to explain the design process flow diagram 7. Able to explain design criteria 8. Able to classify design criteria 9. Able to set design criteria	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities	lectures, discussions and questions and answers 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Basics of planning **Bibliography:** *Robert L. Mott, Edward M. Vavrek, Jyhwen Wang, Machine Elements in Mechanical Design (6th Edition), Pearson, 2017*	5%
3	Understand the basic concepts of planning Understand the design thinking process Understand the design process flow diagram Understand the design criteria	1. Able to explain basic planning concepts 2. Able to create a planning process flow diagram correctly 3. Able to describe the thinkin design process 4. Able to make initial plans 5. Able to create design process flow diagrams 6. Able to explain the design process flow diagram 7. Able to explain design criteria 8. Able to classify design criteria 9. Able to set design criteria	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities	lectures, discussions and questions and answers 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Basics of planning **Bibliography:** *Robert L. Mott, Edward M. Vavrek, Jyhwen Wang, Machine Elements in Mechanical Design (6th Edition), Pearson, 2017* **Material:** 3 **Library:**	5%

4	Able to understand constraint-based design Able to understand for x design	1. Able to explain the concept of planning permission 2. Able to explain surrounding building on site (environmental conditions) 3. Able to explain the implementation time of the design concept (life 4. Able to choose the right material 5. Able to calculate force, stress, deflection, strain, and geometry in design concepts 6. Able to calculate and analyze kinematic principles in design 7. Able to explain the assembly process, manufacturing, reliability, maintainability and serviceability	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Force and tension **Bibliography:** *Richard Gordon Budynas, J. Keith Nisbett, Shigleys Mechanical Engineering Design, 10th Edition, McGraw-Hill, 2014*	5%
5	Able to understand constraint-based design Able to understand for x design	1. Able to explain the concept of planning permission 2. Able to explain surrounding building on site (environmental conditions) 3. Able to explain the implementation time of the design concept (life 4. Able to choose the right material 5. Able to calculate force, stress, deflection, strain, and geometry in design concepts 6. Able to calculate and analyze kinematic principles in design 7. Able to explain the assembly process, manufacturing, reliability, maintainability and serviceability	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Force and tension **Bibliography:** *Richard Gordon Budynas, J. Keith Nisbett, Shigleys Mechanical Engineering Design, 10th Edition, McGraw-Hill, 2014*	5%

6	Knowing about standard components in machiningKnowing machine constructionKnowing examples of components in conventional machinesKnowing examples of components in non-conventional machinesKnowing the function of components in conventional machinesKnowing the function of components in non-conventional machines	1. Students are able to explain standard components in machining 2. Students are able to explain machine construction 3. Students are able to describe machine construction by taking a simple example 4. Students are able to explain the components of non-conventional machines 5. Students are able to describe one example of a component in a non-conventional machine 6. Students are able to explain the function of components in non-conventional machines 7. Students are able to explain the function of components in conventional machines 8. Students are able to explain one example of a conventional engine component	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities	lectures, discussions and questions and answers 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Standard Machine Elements **Bibliography:** *RS Khurmi, JK Gupta, Machine Design, Eurasia Publishing House, 2005*	5%
7	Able to know about prototyping concepts	1. Students are able to explain the concept of prototyping2. Students are able to explain the principles of making prototypes	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities	lectures, discussions and questions and answers 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Prototype machine elements **References:** *RS Khurmi, JK Gupta, Machine Design, Eurasia Publishing House, 2005*	5%

8	Students are able to take the sub-summative exam (USS)	Students are able to take sub-summative exams	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Test	It says 2 X 50	It says 2 X 50	**Material:** Machine element planning **Bibliography:** *Robert L. Mott, Edward M. Vavrek, Jyhwen Wang, Machine Elements in Mechanical Design (6th Edition), Pearson, 2017*	15%
9	Able to understand load strength calculations Able to understand various types of loads based on their nature and how they work Able to understand constant loads Able to understand shock loads Able to understand impact loads Able to understand axial, radial and shear forces Able to understand torsion and bending moments	1. Able to explain the calculation of load strength 2. Able to explain the classification of loads based on their nature and working methods 3. Able to calculate constant load 4. Able to calculate shock loads 5. Able to calculate impact loads 6. Able to calculate axial, radial and shear forces 7. Able to calculate torque and twisting moments	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Loading of machine elements **References:** *Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development, 7th Edition, Mc Graw Hill, 2020*	5%
10	Able to understand the concept of voltage. Able to understand calculating voltage	1. Able to explain the concept of voltage 2. Able to classify voltage 3. Able to explain voltage calculations 4. Able to calculate tensile stress 5. Able to analyze shear stress	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 15 **Form of Assessment** : Participatory Activities	lectures and discussions 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Various loads **Bibliography:** *Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development, 7th Edition, Mc Graw Hill, 2020*	5%

11	Able to understand the concept of voltage. Able to understand calculating voltage	1. Able to explain the concept of voltage 2. Able to classify voltage 3. Able to explain voltage calculations 4. Able to calculate tensile stress 5. Able to analyze shear stress	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 15 **Form of Assessment** : Participatory Activities, Tests	lectures and discussions 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Various loads **Bibliography:** *Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development, 7th Edition, Mc Graw Hill, 2020*	5%
12	Understanding the concept of strainUnderstanding the concept of stress-strain diagramsUnderstanding how to draw stress-strain diagramsUnderstanding the use of stress-strain diagrams	1. Able to explain the concept of strain 2. Able to calculate strain 3. Able to explain the concept of stress strain diagrams 4. Able to draw stress strain diagrams 5. Able to analyze the use of stress strain diagrams 6. Be able to explain the areas on the stress strain diagram 7. Able to calculate the modulus of elasticity 8. Able to calculate shear modulus 9. Able to calculate possession ratio	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 10 **Form of Assessment** : Participatory Activities, Portfolio Assessment	lectures and discussions 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Various loads **Bibliography:** *Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development, 7th Edition, Mc Graw Hill, 2020*	5%

13	Understanding the concept of strainUnderstanding the concept of stress-strain diagramsUnderstanding how to draw stress-strain diagramsUnderstanding the use of stress-strain diagrams	1. Able to explain the concept of strain 2. Able to calculate strain 3. Able to explain the concept of stress strain diagrams 4. Able to draw stress strain diagrams 5. Able to analyze the use of stress strain diagrams 6. Be able to explain the areas on the stress strain diagram 7. Able to calculate the modulus of elasticity 8. Able to calculate shear modulus 9. Able to calculate possession ratio	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 15 **Form of Assessment** : Participatory Activities	lectures and discussions 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Various loads **Bibliography:** *Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development, 7th Edition, Mc Graw Hill, 2020*	5%
14	Able to understand the concept of safety factors	1. Students are able to explain the concept of safety factors 2. Students are able to calculate safety factors using various comparisons 3. Students are able to analyze security factors with various comparisons	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 15 **Form of Assessment** : Participatory Activities, Portfolio Assessment	lectures and discussions 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Safety factors **References:** *Robert L. Mott, Edward M. Vavrek, Jyhwen Wang, Machine Elements in Mechanical Design (6th Edition), Pearson, 2017*	5%
15	Able to understand the principles of failure theory	1. Able to explain failure theory 2. Students are able to calculate failure theory from various methods 3. Students are able to draw a failure theory calculation model 4. Students are able to analyze various calculations regarding failure theory	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 20 **Form of Assessment** : Participatory Activities, Portfolio Assessment	lectures and discussions 2 X 50	lectures, discussions and assignments 2 X 50	**Material:** Failure theory **Bibliography:** *Robert L. Mott, Edward M. Vavrek, Jyhwen Wang, Machine Elements in Mechanical Design (6th Edition), Pearson, 2017*	5%

16	summative exam	summative exam	**Criteria:** 1. Students are considered competent and graduate if they get at least a minimum score of 55 consisting of UTS, US, structured activities (assignments/T) and participation activities (P). 2. The final value (NA) is calculated following the formula: 3. NA = (2xP)(3xT)(2xUTS)(3xUS) 4. 20 **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment, Tests	written test 2 X 50	written test 2 X 50	**Material:** Calculation of machine elements **References:** *Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development, 7th Edition, Mc Graw Hill, 2020*	15%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	63.75%
2.	Project Results Assessment / Product Assessment	3.75%
3.	Portfolio Assessment	11.25%
4.	Test	21.25%
		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.