							Document Code
	Universitas Negeri Surabaya **Vocational Faculty,** **D4 Mechanical Engineering Study Program**						

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Mechanical Vibration	2130202034	Compulsory Study Program Subjects	T=2	P=0	ECTS=3.18	4	February 1, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	Case Studies

Program Learning Outcomes (PLO)	**PLO study program which is charged to the course**	
	PLO-3	Develop logical, critical, systematic and creative thinking in carrying out specific work in their field of expertise and in accordance with work competency standards in the field concerned
	PLO-6	Able to communicate effectively both verbally and in writing accurately and validly to other parties who need it.
	PLO-8	Designing components, systems and/or mechanical processes to meet expected needs with an analytical approach to engineering based on the latest manufacturing science and technology and considering technical standards, performance aspects, reliability and ease of application, and/or utilizing the potential of local and national resources with insight global.
	PLO-9	Able to apply knowledge of mathematics, science and/or materials, and engineering to gain a thorough understanding of engineering principles.
	Program Objectives (PO)	
	PO - 1	Students have good morals, ethics and personality when attending lectures
	PO - 2	Students have competence in understanding the basic principles of vibration mechanics and vibration classification
	PO - 3	Students can analyze problem solving in free, harmonic, forced, translational and torsional vibrations in 1-DoF, 2-DoF and Multi-DoF
	PO - 4	Students can skillfully use Newton's Second Law and free body diagrams to obtain equations of motion from vibrations
	PLO-PO Matrix	

P.O	PLO-3	PLO-6	PLO-8	PLO-9
PO-1	✔	✔		
PO-2	✔			✔
PO-3		✔	✔	✔
PO-4	✔		✔	✔

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					✔		✔			✔		✔		✔		

Short Course Description	Students will study the classification of vibrations, undamped free vibrations with one degree of freedom, free damped vibrations, forced vibrations with one degree of freedom, transient vibrations, vibrations with two degrees of freedom and vibration control.

References	**Main :**

1. Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., U.S.
2. Hibbeler, R.C. 2016. "Engineering Mechanics: Dynamics", 14th Edition. Pearson, Inc. U.S.
3. Wulandari, Diah dkk. 2023. "Fisika Dasar I". Nawa Litera Publishing.

Supporters:

1. Schitz, Tony L., Smith, K. Scoot. 2021. "Mechanical Vibration: Modelling and Measurement", 2nd Edition. Springer.
2. Beer, Ferdinand P., Johnston Jr, E. Russell. 2019. "Vector Mechanics for Engineers, Static and Dynamics", 12th Edition in SI Units. McGraw Hill Education.

Supporting lecturer	Diah Wulandari, S.T., M.T. Ferly Isnomo Abdi, S.T., S.Pd., 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	1.Introduction and college contract 2.Students are able to understand the basic concepts of mechanical vibration	1.Able to explain vibration phenomena 2.Able to explain the classification of vibration analysis	**Criteria:** 1.Compliance with the answer key 2.Exercises **Form of Assessment** : Participatory Activities	- Introductory lecture & Brainstorming - Caramah, Discussion, Question and answer - Practice questions 2 X 50	LMS Sinau Digital (SINDIG) Unesa	**Material:** History of vibration mechanics and the importance of vibration mechanics **References:** _Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US_ **Material:** Various classifications of vibrations **Reference:** _Wulandari, Diah., et al. 2023. "Basic Physics I". Nawa Litera Publishing._	3%

2	Students are able to understand and analyze the elements of vibration and vibration analysis procedures	1. Able to explain spring elements, damping, mass 2. Skilled in using vibration analysis procedures 3. Skilled in using equivalents (series and parallel)	**Criteria:** 1. Compliance with the answer key 2. Structured tasks **Form of Assessment** : Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Spring elements, damping, mass **Reference:** *Wulandari, Diah., et al. 2023. "Basic Physics I". Nawa Litera Publishing.* **Material:** Equivalent calculations (series and parallel) on vibration elements **Reference:** *Hibbeler, RC 2016. "Engineering Mechanics: Dynamics", 14th Edition. Pearson, Inc. US* **Material:** Procedure for solving vibrations and free body diagrams **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US*	3%
3	Students are able to understand and analyze 1-DoF undamped free vibrations	1. Able to explain 1-DoF vibrations 2. Able to analyze the differences between translational and torsional systems 3. Skilled in solving with total solutions	**Criteria:** 1. Compliance with the answer key 2. Structured Assignments **Form of Assessment** : Participatory Activities	- Presentations, lectures, face to face - Questions and Answers 2 X 50	LMS Sinau Digital (SINDIG) Unesa	**Material:** Undamped translational and torsional 1-DoF vibrations **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** Newton's Second Law Method and other methods for the press. Bibliography : *Beer, Ferdinand P., Johnston Jr, E. Russell. 2019. "Vector Mechanics for Engineers, Static and Dynamics", 12th Edition in SI Units. McGraw Hill Education.*	3%

4	Students are able to understand and analyze damped 1-DoF free vibrations with viscous damping	1. Able to explain viscous damping 2. Able to explain logarithmic decrement 3. Skilled in solving with total solutions	**Criteria:** 1. Compliance with the answer key 2. Quiz I **Form of Assessment**: Participatory Activities, Tests	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Damped translational and torsional 1-DoF vibrations **Reference:** *Hibbeler, RC 2016. "Engineering Mechanics: Dynamics", 14th Edition. Pearson, Inc. US* **Material:** Logarithmic Decrement **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US*	5%
5	Students are able to use Newton's Second Law to obtain the equation of motion for damped 1-DoF free vibrations with colomb damping	1. Able to explain colomb damping 2. Skilled in solving problems with total solutions & press. motion	**Criteria:** 1. Compliance with the answer key 2. Exercises **Form of Assessment**: Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Colomb damping system for vibrations **Reference:** *Hibbeler, RC 2016. "Engineering Mechanics: Dynamics", 14th Edition. Pearson, Inc. US* **Material:** Equations of Motion for Colomb damping systems **References:** *Beer, Ferdinand P., Johnston Jr, E. Russell. 2019. "Vector Mechanics for Engineers, Static and Dynamics", 12th Edition in SI Units. McGraw Hill Education.*	3%
6	Students are able to understand and analyze damped and undamped harmonic vibrations	1. Able to analyze damped and undamped harmonic vibrations 2. Skilled in solving problems with total solutions	**Criteria:** 1. Compliance with the answer key 2. Structured tasks **Form of Assessment**: Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Equations of motion and total solutions for harmonic systems and Beating Phenomenon **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US*	3%

7	Students are able to use Newton's Second Law to obtain the equation of motion for damped harmonic vibrations with a base	1. Able to analyze relative motion 2. Able to analyze and be skilled at solving problems with equations of motion	**Criteria:** 1. Compliance with the answer key 2. Exercises **Form of Assessment** : Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Force Transmission **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** Relative motion **References:** *Wulandari, Diah., et al. 2023. "Basic Physics I". Nawa Litera Publishing.* **Material:** Equations of motion for harmonic vibrations with base **References:** *Beer, Ferdinand P., Johnston Jr, E. Russell. 2019. "Vector Mechanics for Engineers, Static and Dynamics", 12th Edition in SI Units. McGraw Hill Education.*	3%
8	UTS material for meetings 1 to 7	Mastering the material from the 1st Meeting to the 7th Meeting	**Criteria:** Compliance with the answer key **Form of Assessment** : Participatory Activities, Tests	Written exam 2 X 50	LMS Sinau Digital (SINDIG) Unesa	**Material:** Materials from the 1st to 7th Meetings **Reference:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US*	20%
9	Students are able to understand and analyze forced vibrations with periodic forces	1. Able to explain periodic motion in forced vibrations 2. Able to analyze and be skilled at solving problems with total solutions	**Criteria:** 1. Compliance with the answer key 2. Structured tasks **Form of Assessment** : Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Periodic Forces **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** Total solutions for forced vibrations **Reference:** *Hibbeler, RC 2016. "Engineering Mechanics: Dynamics", 14th Edition. Pearson, Inc. US*	3%

10	Students are able to use the Integral Convolution method for forced vibrations	1. Able to explain impulses in vibrations 2. Skilled in solving problems with equations of motion	**Criteria:** 1. Compliance with the answer key 2. Exercises **Form of Assessment**: Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Impulse and Momentum **References:** *Wulandari, Diah., et al. 2023. "Basic Physics I". Nawa Litera Publishing.* **Material:** Integral Convolution Method for forced vibrations and equations of motion **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US*	3%
11	Students are able to understand and analyze translational and torsional 2-DoF vibrations	1. Capable of analyzing translational 2-DoF vibrations 2. Capable of analyzing 2-DoF torsional vibrations	**Criteria:** 1. Compliance with the answer key 2. Structured tasks **Form of Assessment**: Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Translational and torsional 2-DoF vibrations **Reference:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** 2-DoF vibration model **References:** *Schitz, Tony L., Smith, K. Scoot. 2021. "Mechanical Vibration: Modeling and Measurement", 2nd Edition. Springer.*	3%
12	Students are able to use Newton's Second Law to obtain the equation of motion for 2-DoF vibrations	Able to skillfully use Newton's Second Law and free body diagrams	**Criteria:** 1. Compliance with the answer key 2. Quiz II **Form of Assessment**: Participatory Activities, Tests	- Caramah, Discussion, Questions and Answers - Quiz II 2 X 50	LMS Sinau Digital (SINDIG) Unesa	**Material:** Newton's Second Law Method for Equations of Motion in 2-DoF **Reference:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** Free body diagram method **References:** *Schitz, Tony L., Smith, K. Scoot. 2021. "Mechanical Vibration: Modeling and Measurement", 2nd Edition. Springer.*	5%

13	Students are able to understand and analyze Multi-DoF vibrations	Able to explain Multi-DoF systems in vibration mechanics	**Criteria:** 1.Compliance with the answer key 2.Structured tasks **Form of Assessment**: Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Multi-DoF Vibration References **:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** Multi-DoF system modeling for damped vibrations **References:** *Schitz, Tony L., Smith, K. Scoot. 2021. "Mechanical Vibration: Modeling and Measurement", 2nd Edition. Springer.*	3%
14	Students are able to use Newton's Second Law method to obtain equations of motion in Multi-DoF	Able to analyze and be skilled at solving problems using Newton's Second Law	**Criteria:** 1.Compliance with the answer key 2.Exercises **Form of Assessment**: Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Multi-DoF Motion Equations **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** Multi-DoF Free Body Diagrams **References:** *Schitz, Tony L., Smith, K. Scoot. 2021. "Mechanical Vibration: Modeling and Measurement", 2nd Edition. Springer.*	5%
15	Students are able to understand the concept of vibration control	Able to explain the basic concepts of vibration control	**Criteria:** 1.Compliance with the answer key 2.Structured tasks **Form of Assessment**: Participatory Activities	- Caramah, discussion, questions and answers - Case studies - Giving 2 X 50 assignments	LMS Sinau Digital (SINDIG) Unesa	**Material:** Balancing, Isolation, and vibration absorption **References:** *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* **Material:** Vibration reduction **References:** *Wulandari, Diah., et al. 2023. "Basic Physics I". Nawa Litera Publishing.*	5%

| 16 | Material for Weeks 9 to 15 | Mastering the material from the 9th Meeting to the 15th Meeting | **Criteria:** Compliance with the answer key

Form of Assessment: Test | Written exam | LMS Sinau Digital (SINDIG) Unesa | **Material:** Materials from the 9th to 15th Meetings
References: *Rao, Singiresu S. 2017. "Mechanical Vibration", 6th Edition. Pearson Education, Inc., US* | 30% |

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	55%
2.	Test	45%
		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.