	Universitas Negeri Surabaya Faculty of Engineering Civil Engineering Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Matrix Method Structural Analysis	2220102002	Study Program Elective Courses	T=2	P=0	ECTS=3.18	5	April 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 which is charged to the course

Program Objectives (PO)

PO - 1	Students are able to analyze internal forces in the form of: M (moment), N (normal force), D (shear force) and statically indeterminate structural shape modes
PO - 2	Students are able to analyze statically indeterminate structural shape modes (SSTT).

PLO-PO Matrix

P.O
PO-1
PO-2

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																

Short Course Description	1. Understanding Indefinite Static Structure (SSTT), Matrix Method Structural Analysis (ASMM), The Role of Matrix Algebra and Computation in Structural Analysis. 2. ASMM Displacement Method: Method Description, Bar Stiffness Matrix, Global Stiffness Matrix, Global Equation. 3. ASMM Flexibility Method: Method Description, Flexibility Matrix, Static Matrix, Support Reaction of Continuous Beam Structures, Certain Static Plane Truss Structures. 4. SSTT shape mode analysis. 5. Learning is carried out using the Case Study Method and ends with discussion activities in class.

References

Main :

1. Wang, Chu-Kia. 1985. Pengantar Analisis Struktur dengan Cara Matriks. Jakarta: Erlangga.
2. Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.
3. Muto, Kiyoshi. 1990. Aseismic Design Analysis of Building. Penterjemah Wira: Analisis Perancangan Gedung Tahan Gempa. Jakarta: Penerbit Erlangga
4. Susastrawan. 1991. Analisis Struktur dengan cara Matriks + Program Komputer. Yogyakarta: Andi Offset
5. Ghali, A. & Neville, A. M. 1986. Structural Analysis. Penterjemah Wira: Analisa Struktur Gabungan Metode klasik dan Matrik. Jakarta: Penerbit Erlangga.

Supporters:

1. Szilard, Rudolph. 1989. Teori dan Analisis Pelat Metode Klasik dan Numerik. Jakarta: Erlangga.
2. Sunggono. 1984. Buku Teknik Sipil. Jakarta: Penerbit Nova.
3. Kho Hong Geh. 1989. Singkat Tepat Jelas MathCad Menyelesaikan Problem Numerik dan Matematika. Jakarta: PT. Elex Media Komputindo.

Supporting lecturer	Dr. Ir. Bambang Sabariman, S.T., M.T. Muhammad Imaduddin, 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	Able to use matrices in the analysis of statically indeterminate structures Displacement Method	1. Explain the use of matrices in statically indeterminate (STT) structural analysis. 2. Explains software-based matrix analysis	**Criteria:** If you can explain the various matrices used in the analysis of statically indeterminate structures with a score of 40, if you can explain the meaning/function of the matrix resulting from operations on a score 40 matrix, if you can use applicative software to create and perform operations on a score 20 matrix. **Form of Assessment** : Participatory Activities	Lecture, discussion, question and answer exercise (case study) statically indeterminate structures (SSTT) 2 X 50 minutes	Lectures, discussions, question and answer exercises (case study) of statically indeterminate structures (SSTT). 2 X 50 minutes	**Material:** Theory and case study of statically indeterminate structures (SSTT). **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	6%
2	Able to form simple beam matrices and continuous beams SSTT Displacement Method	Explains matrix formation and analysis of simple beams and STT continuous beams	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions, question and answer exercises (case study) on simple beams & SSTT continuous beams. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case study) on simple beams & SSTT continuous beams. 2 X 50 minutes	**Material:** Theory of analysis and case studies of simple beams and SSTT continuous beams. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	6%
3	Able to form simple beam matrices and continuous beams SSTT Displacement Method	Explains matrix formation and analysis of simple beams and STT continuous beams	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Forms of Assessment** : Participatory Activities, Practice/Performance, Tests	Lectures, discussions, question and answer exercises (case study) on simple beams & SSTT continuous beams. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case study) on simple beams & SSTT continuous beams. 2 X 50 minutes	**Material:** Theory of analysis and case studies of simple beams and SSTT continuous beams. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	6%
4	Able to form a fixed portal matrix Displacement Method.	Explains matrix formation and fixed portal analysis	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities, Practice/Performance	Lectures, discussions, question and answer exercises (case studies) portal remain 2 x 50 minutes	Lectures, discussions, question and answer exercises (case studies) portal remain 2 x 50 minutes	**Material:** Analysis theory and case study of the SSTT fixed portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	6%

5	Able to form a fixed portal matrix Displacement Method.	Explains matrix formation and fixed portal analysis	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities	Lectures, discussions, question and answer exercises (case studies) portal remain 2 x 50 minutes	Lectures, discussions, question and answer exercises (case studies) portal remain 2 x 50 minutes	**Material:** Analysis theory and case study of the SSTT fixed portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	6%
6	Able to form a swaying portal matrix Displacement Method	Explains matrix formation and sway portal analysis	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Lecture, discussion, question and answer practice (case study) swaying portal 2 x 50 minutes	Lecture, discussion, question and answer practice (case study) swaying portal 2 x 50 minutes	**Material:** Analysis theory and case study of the SSTT swaying portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	6%
7	Able to form a swaying portal matrix Displacement Method	Explains matrix formation and sway portal analysis	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Tests	Lecture, discussion, question and answer practice (case study) swaying portal 2 x 50 minutes	Lecture, discussion, question and answer practice (case study) swaying portal 2 x 50 minutes	**Material:** Analysis theory and case study of the SSTT swaying portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	6%
8	UTS ASMM Transfer Method	Able to complete MN and D analysis of SSTT swaying portals using ASMM method.	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities	Written exam and collecting assignments 1. 2 X 50 minutes	Written exam and collecting assignments 1. 2 X 50 minutes	**Material:** Completion of MN and D analysis of SSTT swaying portals using ASMM method. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	0%

9	Able to form simple beam matrices and continuous beams SSTT Flexibility Method.	Explains matrix formation and analysis of simple beams and SSTT continuous beams.	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions, question and answer exercises (case study) on simple beams & SSTT continuous beams. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case study) on simple beams & SSTT continuous beams. 2 X 50 minutes	**Material:** Theory of analysis and case studies of simple beams and SSTT continuous beams. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	8%
10	Able to form a fixed portal matrix SSTT Flexibility Method.	Explains matrix formation and analysis of simple beams and SSTT continuous beams.	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions, question and answer exercises (case studies) on the SSTT portal. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case studies) on the SSTT portal. 2 X 50 minutes	**Material:** Analysis theory and case study of the SSTT fixed portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	8%
11	Able to form a fixed portal matrix SSTT Flexibility Method.	Explains matrix formation and analysis of simple beams and SSTT continuous beams.	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions, question and answer exercises (case studies) on the SSTT portal. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case studies) on the SSTT portal. 2 X 50 minutes	**Material:** Analysis theory and case study of the SSTT fixed portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	8%
12	Capable of forming a swaying portal matrix SSTT Flexibility Method.	Explains matrix formation and analysis of SSTT sway portals.	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions, question and answer exercises (case studies) on the SSTT rocking portal. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case studies) on the SSTT rocking portal. 2 X 50 minutes	**Material:** Analysis theory and case study of the SSTT swaying portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	8%
13	Capable of forming a swaying portal matrix SSTT Flexibility Method.	Explains matrix formation and analysis of SSTT sway portals.	**Criteria:** If the moment analysis using the ASMM method is correct, the score is 70, if the free body diagram analysis includes positioning reactions, latitude forces, normal forces and M elements, the score is correct, the score is 15, if the depiction of the M, N, and D planes is correct, the score is 15. **Form of Assessment** : Participatory Activities	Lectures, discussions, question and answer exercises (case studies) on the SSTT rocking portal. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case studies) on the SSTT rocking portal. 2 X 50 minutes	**Material:** Analysis theory and case study of the SSTT swaying portal. **Bibliography:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	8%

14	Able to analyze various sways (shape modes) of level 2 indefinite static structures.	Explains structural shape mode analysis using Mathcad 15 or Matrix Calculator Pro based on Android.	**Criteria:** If the lateral stiffness (K), flexibility matrix (f), dynamic matrix (D), angular natural frequency (□omega), shape mode (Ø) are correct, the score is 70, if the nth Ø cycle has converged, the score is 15, if the display image correct shape mode score 15. **Form of Assessment** : Participatory Activities	Lectures, discussions, question and answer exercises (case studies) rocking portal. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case studies) rocking portal. 2 X 50 minutes	**Material:** Mode shape **Library:** *Muto, Kiyoshi. 1990. Aseismic Design Analysis of Buildings. Wira Translator: Analysis of Earthquake Resistant Building Design. Jakarta: Erlangga Publishers*	8%
15	Able to analyze various types of sway (shape modes) of indefinite static structures at level 3 and level n.	Explains structural analysis using Android-based Mathcad 15 or Matrix Calculator Pro	**Criteria:** If the lateral stiffness (K), flexibility matrix (f), dynamic matrix (D), angular natural frequency (□omega), shape mode (Ø) are correct, the score is 70, if the nth Ø cycle has converged, the score is 15, if the display image correct shape mode score 15. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions, question and answer exercises (case studies) rocking portal. 2 X 50 minutes	Lectures, discussions, question and answer exercises (case studies) rocking portal. 2 X 50 minutes	**Material:** Mode shape **Library:** *Muto, Kiyoshi. 1990. Aseismic Design Analysis of Buildings. Wira Translator: Analysis of Earthquake Resistant Building Design. Jakarta: Erlangga Publishers*	10%
16	Final Semester Examination (UAS) shape mode	Able to complete SSTT sway portal shape mode analysis.	**Form of Assessment** : Participatory Activities	Solving statically indeterminate structure cases 2x50 minutes	Solving statically indeterminate structure cases 2x50 minutes	**Material:** Shape mode **Reader:** *Sabariman, Bambang. 2011. Mektek IV. Surabaya: JTS FT Unesa.*	0%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	61%
2.	Project Results Assessment / Product Assessment	2%
3.	Portfolio Assessment	2%
4.	Practice / Performance	5%
5.	Test	30%
		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.