Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year	2025-26
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
Course Author Email	clhlee@ntu.edu.sg
Course Title	Structural Analysis III
Course Code	CV4101
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	CV2012 Structural Analysis II
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	This course requires students with good foundation and keen interest in Structural Mechanics, such as Mechanics of Materials, Structures I and Structures II.

Course Aims

This course aims to equip students with plastic theory and stability analysis of members and frames.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Construct stiffness matrix and force vectors for trusses, beams and frames.
ILO 2	Apply unit displacement method to solve trusses, beams and frames.
ILO 3	Analyse stability of simple struts (ideal struts and real struts) using differential equation approach and relate structural stability with EC3.
ILO 4	Analyse stability of beam-columns and frames using matrix approach.
ILO 5	Understand elastic-plastic stress-strain relationship and plastic bending without axial force.
ILO 6	Quantify effect of axial load and shear force on plastic moment
ILO 7	Understand collapse loads, collapse mechanisms and combination of mechanisms and apply them for analysis
ILO 8	Apply fundamental theorems of plastic collapse for plastic analysis of RC frames and steel frames

Course Content

No	Topic	Lecture (Hour)	Tutorial (Hour)
1	Review of stiffness matrix method. Unit displacement method	4	2
2	Structural stability with EC3. Elastic stability analysis of simple ideal and real struts	6	3
3	Elastic stability analysis of frames	5	2
4	Elastic-plastic stress-strain relationship and plastic bending without axial force. Effect of axial load and shear force on plastic moment	4	2
5	Collapse loads, collapse mechanisms and combination of mechanisms	4	2
6	Fundamental theorems of plastic collapse and their applications in frames.	3	2
	Total	**26**	**13**

Reading and References (if applicable)

Textbooks

1. McGuire, W., Gallagher, R.H. and Ziemian, R.D., “Matrix Structural Analysis”. 2nd edition, Wiley, 2015

2. Sukhvarsh Jerath, “Structural Stability Theory and Practice: Buckling of Columns, Beams, Plates, and Shells”, Wiley, 2020.

3. M.R. Horne, Plastic Theory of Structures, 2nd edition, Pergamon Textbook

References

1. Kassimali, A. “Matrix Analysis of Structures”. Cengage Learning, 2022

2. Chen, W.F. and Lui, E.M. “Structural Stability: Theory Implementation”. Elsevier, 1987.

3. Wong, M.B. “Plastic Analysis and Design of Steel Structures”, Elsevier, 2009

Teaching faculty will provide updated reading materials when it is available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction to the course. Review of stiffness matrix method for structural analysis. Unit displacement method.	1,2	Lecture materials	In-person	Lectures & Tutorial
2	Unit displacement method	1,2	Lecture materials	In-person	Lectures & Tutorial
3	Introduction of elastic stability; Euler bucking load. Simple struts and effective buckling length.	3	Lecture materials	In-person	Lectures & Lab
4	Differential equation method for beam-columns (ideal and real). Relate real struts to Perry-Robertson equation in EC3.	3	Lecture materials	In-person	Lectures & Tutorial
5	Stability effects on beam-columns, Stability functions (s, c functions) Discussion of s,c, functions, Stiffness matrix incorporating s,c, functions.	3,4	Lecture materials	In-person	Lectures & Tutorial

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
6	Computing critical load using matrix approach, Elastic stability of plane frames.	1,2,4	Lecture materials	In-person	Lectures & Tutorial
7	Computing critical load using matrix approach, Elastic stability of plane frames. Elastic-plastic stress-strain relationship	1,2,4,5	Lecture materials	In-person	Tutorial & Lab
8	Plastic bending without axial force	5	Lecture materials	In-person	Lectures & Tutorial
9	Effect of axial load and shear force on plastic moment resistance. Collapse loads, collapse mechanisms and combination of mechanisms for continuous beams.	5,6	Lecture materials	In-person	Lectures & Tutorial
10	Collapse loads, collapse mechanisms and combination of mechanisms for rigid-jointed frames.	7,8	Lecture materials	In-person	Lectures & Tutorial

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
11	Collapse loads, collapse mechanisms and combination of mechanisms for rigid-jointed frames.	7,8	Lecture materials	In-person	Lectures & Tutorial
12	Fundamental theorems of plastic collapse.	5,6,7,8	Lecture materials	In-person	Lectures & Tutorial
13	Application of plastic collapse in RC frames and steel frames. Comparison of frames using different methods.	1-8	Lecture materials	In-person	Lectures & Tutorial

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures	Present the basic theory, problem solving process, and problem based procedure.
Tutorials	Provide examples and discussions, to illustrate detailed problem solving process.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam(Final Examination)	1-6	CEE SLOs a, b	60	It would be physical written exam conducted in exam hall	Individual	Holistic	Relational
2	Continuous Assessment (CA): Assignment(CA 1 : Assignment)	1,2,3	CEE SLOs a, b	10	This is a take home assignment that will consist of 2 questions each on plastic theory and elastic bucking respectively.	Individual	Analytic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(CA2: Quiz 1)	1, 2, 3	CEE SLOs a, b	15	This CA would be a physical written quiz session conducted in class	Individual	Analytic	Multistructural
4	Continuous Assessment (CA): Test/Quiz(CA 3 : Quiz 2)	4, 5, 6	CEE SLOs a, b	15	This CA would be a physical written quiz session conducted in class	Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

Formative Feedback

Feedback will be through the dissemination of the student's performance in quizzes as well as review of the quiz questions in class. Instructors encourage students to ask questions during the tutorials and lectures.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Digital Fluency	Intermediate
Learning Agility	Intermediate
Problem Solving	Advanced
Critical Thinking	Intermediate
Design Thinking	Advanced

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

Students are expected to attend all classes punctually and take all scheduled assignments. Students are expected to take responsibility to follow up with course notes, assignments and course-related announcements for sessions they have missed. Students are expected to participate in all discussions and activities.

Policy (Absenteeism)

CAs make up a significant portion of the course grade. Absence from quizzes without a valid reason will affect your overall grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for quizzes.

Policy (Others, if applicable)

Students are expected to work on the computing assignments themselves as all the problems will be individually customized. Students could discuss with instructors if they face obstacles. submission of assignments is compulsory.
There will be no opportunities for late submissions.

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Last Updated By: Yang, En-Hua

Rubrics of CV4101 Structural Analysis III

Assessment Criteria for CA1: Assignment

No		Needs considerable improvements (0 to 3 Marks)	Below expectations (4 to 5 Marks)	Meet Expectations (6 to 7 Marks)	Above Expectations (8 to 10 Marks)
1	**Study of Problem** **(10%)**	Poor or inadequate identification of problem. Justification based on weak arguments and/or inappropriate evidence.	Some key problems are identified and justified. Some justifications are weak and not supported by valid arguments and/or appropriate evidence.	Most key problems are identified and justified. Justifications are mostly supported by valid arguments and/or appropriate evidence.	All (or almost all) key problems are identified and justified. All (or almost all) justifications are based upon valid arguments and/or appropriate evidence.
2	**Evaluation** **(10%)**	Evaluation of problems are mostly absent and/or contains significant inaccuracies.	Evaluation of most problems are accurate but contain some inaccuracies.	Evaluation of problems are mostly accurate and are of high quality in most instances.	Evaluation of problems are accurate and are of high quality in all instances.
3	**Workings: Analytical calculations and software predictions** **(60%)**	Calculations do not solve the problem. Weak attempts in analysing most of the problems. Failure to calculate most of the problems.	Calculations are of limited relevance. Poor analysation to some of the problems. Able to analyse and calculate some of the problems.	Analysations are mostly accurate. Good calculations in solving most of the problems.	Analysations are highly accurate. Good calculations are provided to all problems. Able to analyse and calculate accurately.
4	**Limitations or assumptions in both approaches** **(10%)**	Unable to identify and provide correct assumptions. Fail to provide in both approaches	Able to identify and provide assumptions for some of the existing/ potential limitations	Able to identify and provide assumptions for most of the existing/ potential limitations,	Able to identify and provide assumptions for all (or almost all) the existing/ potential limitations.
5	**Overall comparison of analysis and numerical results** **(10%)**	Weak in analysis as compared to the numerical result, and the result are not accurate in many instances.	Part of the analysis as compared to the numerical result are correct, and the result are accurate in some instances.	Able to analyse accurately for most of the problems as compared to the numerical result, The numerical results are accurate for most of the problems.	Able to analyse accurately for all (or almost all) as compared to the numerical result. The overall results are of high accuracy.