CLASS DESCRIPTION FORM

CL510 Advanced Structural Analysis and Design

Class Registrar: Dr. Olga Bylya	**Taught To (Course): SAE,CE, CEE, MSc in Civil Eng.**	
Other Lecturers Involved:	**Credit Weighting:10**	**Semester:1**
Assumed Prerequisites: Structural mechanics classes	**Compulsory/Optional**	**Academic Level:5**

Class Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Project	Assignments	Private Study	**Total**
20	6	4		20	50	100

Educational Aim

The main purpose of the first part of the course is to introduce the students to the Matrix stiffness method (MSM) - a modern powerful method of analysis which is the basis of the FE modelling of any sophisticated 2D and 3D engineering structures and provides the ability to take into account different features of a structures and loading. This part of the course will be complemented with the practical coursework aimed to develop the basic skills of analytical and FE structural modelling. Besides that, two special topics of advanced structural analysis will be covered – Plastic behaviour of the structures and elastic stability. The purpose this part of the course is to bring students closer to the real-life problems, which they may face in their professional carrier.

Learning Outcomes

On completion of the class the student is expected to be able to

LO1 Be able to understand basic concepts and approaches of the Matrix Stiffness Method and use it for the analysis of the structures

LO2 Be able to analyse plastic behaviour of the structures.

LO3 Be able to analyse elastic instability of the basic engineering structures.

LO4 Be able to use Matlab and Abaqus FE software for computational analysis of the structures

(UK SPEC suggests no more than 4 learning outcomes per class. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the course specifications.)

Syllabus

The class will teach the following:

Matrix Stiffness Method (MSM)
- Basic Idea and Concepts
- Ancillary Diagrams
- Initial Matrices
- Resolving Equations
- Set of Formulas and Procedure for Analysis

Plastic Behaviour of Structures
- Plastic behaviour of different materials
- Idealized Stress–Strain Diagrams
- Direct Method of Plastic Analysis
- Fundamental Methods of Plastic Analysis
- Limit Plastic Analysis of Continuous Beams

Stability of Elastic Systems

Fundamental Concepts
Stability of Structures with Finite Number Degrees of Freedom
Stability of Columns with Rigid and Elastic Supports
Stability of Continuous Beams and Frames Stability of Arches

Finite Element (FE) Analysis of the Structures
Basic Concepts of FE analysis
Direct programming of the MSM in Matlab
FE analysis in the research FE software - Abaqus

Assessment of Learning Outcomes

Criteria

For each of the Class Learning Outcomes the following criteria will be used to make judgements on student learning:

[Note: Criteria break the LO down into 'teachable' elements but do not become syllabus orientated i.e. no mention of CAD package names, components etc.]

LO1 Be able to understand basic concepts and approaches of the Matrix Stiffness Method and use it for the analysis of the structures
C1 Be able to draw joint-load(J-L),displacement-load(Z-P),andinternalforces-deformation(S-e) diagrams
C2 Be able to construct the stiffness matrix for the compound beam, truss and frame analytically
C3 Be able to formulate and solve simplest structural problems in matrix form.

LO2 Be able to analyse plastic behaviour of the structures.
C1 Be able to explain principle difference between elastic and non-elastic behaviour of basic structural materials and structural.
C2 Be able to formulate main assumptions and simplifications used in plastic analysis.
C3 Be able to solve analytically the problem of elasto-plastic beam bending and analyse the main difference of obtained results from ones from elastic solution.

LO3 Be able to analyse elastic instability of the basic engineering structures.
C1 Be able to explain the nature of the stability loss and to derive Euler force for the straight beam with different fixtures.
C2 Be able to understand and calculate degree of freedom (DOF) and explain the role of the DOF in the instability of the structures.
C3 Be able to analyse stability loss in the basic structures (beams, frames and arches) with different types of supports

LO4 Be able to use Matlab and Abaqus FE software for computational analysis of the structures
C1 Program in Matlab assembling of the stiffness matrix and solving truss problems
C2 Use Abaqus for setting the models of determinate and indeterminate structures
C3 Perform FE analysis of the loaded structures

The standards set for each criterion per Class Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

12 Principles of Assessment and Feedback
(on Learning & Teaching web pages: www.strath.ac.uk/learnteach/teaching/staff/assessfeedback/12principles/)

Please state briefly how these are incorporated in this class.

1. Marking criteria are outlined clearly in the assignment hand-out and multiple opportunities for questions are available, either in class or through electronic correspondence. Each marking sheet is taken directly from this handout.
2. Project work encourages interaction between peer groups and with the instructor.
3. Tutorial questions are provided to support student self-assessment and reflection.
4. Departmental policy is to carry out mid-term class assessments and provide feedback to students.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams

	Examinations			Courseworks		Projects	
	Number	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***
	1	120 min	60%	C/work 1 C/work 2	20% 20%		
L/Outcomes	LO1 LO2 LO3			LO2, LO4			

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines: May 2017 TBC
Resit Assessment Procedures: exam

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the class. Students who fail the class at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam / viva.

Recommended Reading

Advanced Methods of Structural Analysis Igor A. Karnovsky, Olga Lebed, Springer New York Dordrecht Heidelberg London, ISBN 978-1-4419-1046-2 e-ISBN 978-1-4419-1047-9 DOI 10.1007/978-1-4419-1047-9

Structural analysis, R. C. Hibbeler, 8th ed.. Boston : Prentice Hall 2012

Getting started with Matlab (Mathcad)

STRUCTURAL ANALYSIS Van Nostrand Reinhold 3rd edition 1988 COATES, R.C., COUTIE, M.G. & KONG, F.K.

STABILITY OF STRUCTURES Oxford University Press 1991 , BAZANT, Z.P. & CEDOLIN, L.

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

Date	Time	Room No
Week 5	TBC	Classroom

Session: mid-term oral feedback.

Approved:

Course Director Signature:
Date of Last Modifications: Aug/18

(Updated November 2010)

CLASS TIMETABLE

Class Code:	CL510	**Class Title:**	**Advanced Structural Analysis and Design**

Brief Description of Assessment:

Assessment Timing:-

Indicate on the table below the Start/Submission dates for each Assignment/Project and the timing of each Exam/Class Test(s).

Semester One	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	Exam Period

Semester Two	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	WK12	Exam Period