

COURSE SYLLABUS SEMESTER SPRING 2020/2021

Name of Course	STRUCTURAL OPTIMIZATION
Course Code	MSM407ANEP
Allotment of Hours per Week	0/0/3
Number of Credits	3
Program	Structural Engineer (MSc)
Evaluation	
Semester	2
Prerequisites	Numerical methods; Structures-1
Department	Department of Civil Engineering
Instructor	Prof. Dr. Anikó Csébfalvi

OBJECTIVES

The subject of structural optimization provides a way for structural engineers to extend and generalize their basic knowledge to a computer supported structural analysis and design. The purpose of the subject is to introduce a new concept in structural design, construct more efficient structures, e.g. by making structures as light as possible yet able to carry the loads subjected to them. However, in the last two decades computational tools based on optimization theory have been developed that make it possible to find optimal structures more or less automatically.

Two textbooks are provided to help students to follow the teaching materials and understand the presented computational examples (see: at the end of the syllabus). These textbooks give an introduction to all three classes of geometry optimization problems of engineering structures: sizing, shape and topology optimization

CONTENTS

Short description:

This course contains 14 units (listed below) of selected topics of structural optimization. In order to complete this course, you will need to work through each selected unit and all of its assigned materials in the book AN INTRODUCTION TO STRUCTURAL OPTIMIZATION (Authors: Peter W. Christensen and Anders Klarbring) and Structural Optimization, Fundamentals and Applications (Author: Kirsch, Uri) given in the Readings and Reference Materials.

Please give time to these; they are the best way to test your knowledge and learn.

Methodology:

The solution methods are applied and demonstrated with help of Wolfram Mathematica (© 2015 Wolfram. All rights reserved). Legal licensed version available in room A 117. Student version: <http://www.wolfram.com/solutions/education/students/>.

Textbooks are provided to help students to follow the teaching materials and understand the presented computational examples (see: at the end of the syllabus).

Schedule:

1. Modelling of Structural Optimization Problems. Classification of Structural Optimization Problems (**February 2, 2021**)
2. Structural Constraints. Structural modelling (**February 2, 2021**)
3. Minimal Weight Design Subject to Stress Constraints (**February 16, 2021**)
4. Minimal Weight Design Subject to Stress and Displacement Constraints (**February 16, 2021**)
5. Minimal Weight Design Subject to Buckling Constraints (**March 2, 2021**)
6. Minimal Weight Design of Three-Bar Truss Subject to Stress Constraints (**March 2, 2021**)
7. Minimal Weight Design of Three-Bar Truss Subject to Stress and Displacement Constraints (**March 16, 2021**)
8. 1st **Midterm Test Examples** (**March 30, 2021**)
9. Optimization of Elasto-Plastic Structures. Limit States (**April 13, 2021**)
10. Plastic Analysis of Continuous Beam (**April 13, 2021**)
11. Plastic Analysis of Three-Bar Truss (**April 13, 2021**)
12. Linear programming. Simplex Method (**April 27, 2021**)
13. Linear Programming of 2D Problem (**April 27, 2021**)
14. Theory of Primal-Dual Linear Problems. The Dual Problem (**April 27, 2021**)
15. 2nd **Midterm Test Examples** (**May 11, 2021**)

ATTENDANCE AND GRADING

Attendance:

Attending is required all classes, and will impact the grade (max. 10%). Unexcused absences will adversely affect the grade, and in case of absence from more than 30% of the total number of lesson will be grounds for failing the class. To be in class at the beginning time and stay until the scheduled end of the lesson is required, tardiness of more than 20 minutes will be counted as an absence. In the case of an illness or family emergency, the student must present a valid excuse, such as a doctor's note.

Grading:

Grading will follow the course structure with the following weight: **1st Midterm Test Example - 45%**, and **2nd Midterm Test Example - 45%**. The remaining 10% will be assessed according to participation, progress, effort and attitude. Please note that attendance will adversely affect one's grade, both in direct grade reduction and in missing work in the development of a project.

Offered exam grade:

Evaluation in percent	Numeric grade
89%-100%	5
76%-88%	4
63%-75%	3
55%-62%	2
0-49%	1

READINGS AND REFERENCE MATERIALS

1. **Kirsch**, Uri: Structural Optimization, Fundamentals and Applications, ISBN: 978-3-540-55919-1 (Print) 978-3-642-84845-2 (Online)
2. **Christensen**, Peter W. and **Klarbring**, Anders: An Introduction to Structural Optimization, Springer Science & Business Media, Oct 20, 2008 - [Technology & Engineering](#) - 214 pages