**Nazwa przedmiotu:**

Computer Methods for Structural Design

**Koordynator przedmiotu:**

Tomasz Sokół, Ph.D., Eng.

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia II stopnia

**Program:**

Civil Engineering

**Grupa przedmiotów:**

Obligatory

**Kod przedmiotu:**

1080-BUKBD-MSA-0403

**Semestr nominalny:**

2 / rok ak. 2021/2022

**Liczba punktów ECTS:**

4

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

Total 100 h = 4 ECTS: 30 h laboratory exercises in a computer lab., 15 h lecture, 30 h own work in the preparation of three homeworks - computing projects, 10 h to prepare and to be present for the test completion of lectures.

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

Total 60 h = 2,5 ECTS: 30 h laboratory exercises in a computer lab., 15 h lecture, consultations and test 15 h.

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

Total 60 h = 2,5 ECTS: 30 h exercises in the computer lab, 30 h self-work to prepare 3 homeworks - computational projects.

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład: | 15h |
| Ćwiczenia: | 0h |
| Laboratorium: | 0h |
| Projekt: | 0h |
| Lekcje komputerowe: | 30h |

**Wymagania wstępne:**

Basic knowledge of algebra and mathematical analysis, knowledge of matrix and differential, completed a course strength of materials and structural mechanics of statics, dynamics and stability of the structure, basics of the theory of elasticity and plasticity. Basics of linear FEM static.

**Limit liczby studentów:**

none

**Cel przedmiotu:**

The ability to model complex flat and spatial structures using finite element method, understanding and application of FEM algorithms to solve the advanced structural mechanics problems, an understanding of the theoretical basis of approximate methods for solving nonlinear boundary value problems and eigenprobles, the ability to interpret and verify the results obtained on computer. Gaining knowledge of design optimization and nonlinear programming methods.

**Treści kształcenia:**

Modeling of complex engineering structures using finite element method. Creating a geometric model of structure and mesh generation in Ansys FEA system. Practical application of adaptive techniques to automatically correct the accuracy of the solution. Alternative methods for FEM: finite difference method, Ritz and Galerkin methods, the concept of meshless methods. Analysis of the initial stability and vibration problems by solving a generalized eigenproblems. The dynamics of discrete systems and overview of the method of integration of motion equations. FEM algorithm in nonlinear mechanics. Selected problems of design optimization: size, shape and topology optimization. Optimal design of structures subjected to multi-load cases.

**Metody oceny:**

Credit with a course consists in collecting min. 50% of points of theoretical knowledge and and practical skills. The first one is verified in one final test. Practical skills in FEM-modelling and FEM-software is evaluated in three computational projects.

**Egzamin:**

nie

**Literatura:**

[1] A. Ralston, P. Rabinowitz, A First Course in Numerical Analysis: Second Edition, McGraw-Hill, 1978;
[2] O.C. Zienkiewicz, The Finite Element Method in Engineering Science, McGraw-Hill, 1971;
[3] O.C. Zienkiewicz, R.L. Taylor, The Finite Element Method, Fifth Edition, Volume 1: The Basis, Butterworth-Heinemann, 2000;
[4] S.S. Rao, Engineering Optimization, Theory and Practice, Third Edition, John Wiley & Sons, Inc., New York, 1996;
Other links are included in the web-page.

**Witryna www przedmiotu:**

wektor.il.pw.edu.pl/~mkb

**Uwagi:**

## Charakterystyki przedmiotowe

### Profil ogólnoakademicki - wiedza

**Charakterystyka W1:**

The graduates have knowledge of the theoretical foundations of computer methods for: linear and nonlinear statics, dynamics and stability of the structure, as well as extended knowledge of structural optimization (optimization of shape and topology). They understand the nature of the approximate solutions obtained by discrete methods.

Weryfikacja:

Test of theoretical knowledge from the lecture.

**Powiązane charakterystyki kierunkowe:** K2\_W04, K2\_W05

**Powiązane charakterystyki obszarowe:** I.P7S\_WG.o, P7U\_W, III.P7S\_WG

### Profil ogólnoakademicki - umiejętności

**Charakterystyka U1:**

The graduates can define computational models used for computer analysis of the design and choose suitable for this purpose software/method. They can verify the results obtained by computer.

Weryfikacja:

Realization and defense of the three computational projects.

**Powiązane charakterystyki kierunkowe:** K2\_U03

**Powiązane charakterystyki obszarowe:** P7U\_U, I.P7S\_UW.o, III.P7S\_UW.o

### Profil ogólnoakademicki - kompetencje społeczne

**Charakterystyka K1:**

The graduates can work independently and in a team to solve the specific problem. They draws conclusions and describes the results of their own work.

Weryfikacja:

Reports on project work done partly independently and partly as a team with a comparison of the results obtained with various programs. Observation of students' work in the computer room.

**Powiązane charakterystyki kierunkowe:** K2\_K02

**Powiązane charakterystyki obszarowe:** P7U\_K, I.P7S\_KK