# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | | Code |
|---|---|---|
| **Computational Mechanics** | | **1010102111010113703** |

| Field of study | Profile of study (general academic, practical) | Year /Semester |
|---|---|---|
| **Structural Engineering Second-cycle Studies** | **general academic** | **1 / 1** |
| Elective path/specialty | Subject offered in: | Course (compulsory, elective) |
| **-** | **Polish** | **obligatory** |

| Cycle of study: | Form of study (full-time,part-time) |
|---|---|
| **Second-cycle studies** | **full-time** |

| No. of hours | | | | | No. of credits |
|---|---|---|---|---|---|
| Lecture: **30** | Classes: **-** | Laboratory: **30** | Project/seminars: **-** | | **5** |

| Status of the course in the study program (Basic, major, other) | (university-wide, from another field) |
|---|---|
| **major** | **from field** |

| Education areas and fields of science and art | ECTS distribution (number and %) |
|---|---|
| **technical sciences** | **5 100%** |
| **Technical sciences** | **5 100%** |

**Responsible for subject / lecturer:**

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## Prerequisites in terms of knowledge, skills and social competencies:

| | | |
|---|---|---|
| 1 | **Knowledge** | Mathematics: foundations of differenctial, integral and matrices calculuses; Structural Mechanics, Strength of Materials and Theory of Elsticity on the level of 6 according to KRK system; Numerical Methods and Information Technology on the level of 6 according to KRK system; |
| 2 | **Skills** | The Student is able to follow through the static analysis of beam structures; Uses the displacement method for solving beam systems; The Student uses the selected software tools of computer analysis and design of structures; |
| 3 | **Social competencies** | Understand the role of continuous education in teh direction of the study but also other technical sciences; |

## Assumptions and objectives of the course:

To be familiar with the basics and applications of numerical methods and computational analysis of structures for linear and nonlinear cases; also to be responsible for proper modeling and the results of computations;

## Study outcomes and reference to the educational results for a field of study

### Knowledge:

1. Advanced knowledge on the behavior and modeling of materials - [K_W01, K_W04]
2. Knows the foundations of numerical analysis for statics, dynamics and stability of structures - [K_W03]
3. Knows the tools and their constrains of numerical analysis of structures which support the computer aided design - [K_W08]
4. Has the basic knowledge on optimisation of structures - [K_W09]

### Skills:

1. Is able to take the decissions on design of elements in civil engineering - [K_U03]
2. Can build the numerical models for 1-D, 2-D and 3-D cases and perform the static, dynami and stability analyses - [K_U04]
3. Can define the computer model for complex engineering problems for linear cases and some nonlinear - [K_U06]

### Social competencies:

1. Works independently and in the team - [K_K01]
2. Is responsible for the quality of results - [K_K02]
3. Understands the LLL necessity - [K_K03]
4. Works and lives according to the good ethic practices - [K_K11]

## Assessment methods of study outcomes

The lectures are finished with final egzam which consists of two parts - written test (1,5 hour) and if necessary oral one. In the written part the Students answer to 4-6 questions (problems). After reviewing the oral part is only for those who are the best in the group.

During the labs the progres in the work of Students is evaluated. The marks are offered for every problem that has to be solved.

## Course description

The course is focused on the following topics:

- Modeling in structural analysis (the real structure and its numerical model), matrix formulation of continuum mechanics;
- Finite Element Method (FEM), approximation of displacement field; shape functions; stifness matrices for selected elements in local coordinate systems;
- Transformation and the basic steps of FEM computations for linear cases;
- The field of applications of FEM in civil and mechanical engineering;
- Natural coordinate system, Isoparametric elements, numerical integration, selected FE for 2-D and 3-D problems, plates and shell elements;
- selected problems in dynamics and stability;
- Elements of optimal design of structures

## Basic bibliography:

1. T.Łodygowski, W.Kąkol, Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich (in Polish), on teh web page of The CAD Chair
2. G.Rakowski, Z. Kacprzyk, Metoda elementów skończonych w mechanice konstrukcji (in Polish), Oficyna Wydawnicza Politechniki Warszawskiej
3. M.Kleiber i in., Zastosowanie metod komputerowych w mechanice kontinuum (in Polish), PWN Warszawa, 1996
4. O.C.Zienkiewicz, (R.Taylor), The finite element method, Ed. 1 - 6, 1972 - 2007
5. T.J.R.Hughes, The finite element method. Linear static and dynamics, Prentice-Hall Eds., 1987
6. Web page: www.cad.put.poznan.pl

## Additional bibliography:

## Result of average student's workload

| Activity | Time (working hours) |
|---|---|
| 1. Participation in lectures | 30 |
| 2. Participation and the work during the labs | 30 |
| 3. Preparing of the excersises - partialy at home | 30 |
| 4. Preparing for the exam | 30 |
| 5. Consulting hours | 10 |

## Student's workload

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 125 | 5 |
| Contact hours | 65 | 3 |
| Practical activities | 65 | 2 |