## STUDY MODULE DESCRIPTION FORM

| Name of the module/subject **Numerical Analysis** | | Code **1010115131010111980** | |
|---|---|---|---|
| Field of study **Civil Engineering Extramural Second-cycle** | Profile of study (general academic, practical) **(brak)** | Year /Semester **2 / 3** | |
| Elective path/specialty **Structural Engineering** | Subject offered in: **Polish** | Course (compulsory, elective) **obligatory** | |

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

| No. of hours Lecture: **16** Classes: **10** Laboratory: **10** Project/seminars: **-** | No. of credits **3** |
|---|---|

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

| Education areas and fields of science and art **technical sciences** **Technical sciences** | ECTS distribution (number and %**)** **3  100%** **3    100%** |
|---|---|

### Responsible for subject / lecturer:

dr inż. Tomasz Jankowiak
email: tomasz.jankowiak@put.poznan.pl
tel. +48616652814
Faculty of Civil and Environmental Engineering
ul. Piotrowo 5 60-965 Poznań

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

| 1 | **Knowledge** | Basics of partial differential equations,  basics of nonlinear structural mechanics, finite element method ? Plain stress, plane strain, 3d, shells, geometrical nonlinearity, buckling, linear dynamic,  nonlinear :explicit and implicit solution of the equations of motion |
|---|---|---|
| 2 | **Skills** | Solving static and dynamic linear and nonlinear problems by the finite element method |
| 3 | **Social competencies** | Social competencies |

### Assumptions and objectives of the course:

A goal is to learn and practice using the finite element method in solving complex nonlinear structural problems in civil engineering

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

#### Knowledge:

1. The finite difference method applied to solving nonlinear partial differential equations - [K_W01, K_W03]

2. The finite element method, its implicit and explicit approaches, applied to solving nonlinear structural problems - [K_W03, K_W01]

3. Advanced numerical methods applied to nonlinear static and dynamic problems, contact problems, buckling and post-buckling stability analysis, basics of computational fluid dynamics. - [K_W04]

#### Skills:

1. Solving advanced practical problems by numerical methods  - [K_U04, K_U06]

2. Modeling by the finite element method advanced boundary and initial-boundary problems   - [K_U06, K_U04]

3. Usage of a commercial finite element program to practical complex engineering problems  - [K_U18]

#### Social competencies:

1. Student understands needs of cooperation in solving theoretical and practical engineering problems - [K_K03]

2. Student is aware of needs for affordable share their expertise in the field of computationa mechanics - [K_K05]

3. Student sees needs for a systematic deepening and broadening its competence - [K_K01]

### Assessment  methods of study outcomes

| Course grading: Lectures - end-term exam, Laboratory - evaluation of the exercises and the final test |
| --- |
| **Course description** |
| Physical nonlinearity. Constitutive modelling in civil engineering (for concrete, steel, gum, ceramic, glass, wood). The coupling of the experiments and computer simulations in description of the dynamic behaviour of the material and structure in high strain rates condition. Using of the computer simulation to describe the behaviour of the structure for unique loadings as impacts, explosions and floods. The coupling problems (thermo-mechanical) ? the behaviour of the structure at elevated temperatures (fire).  The contact conditions. The basics of the fluid mechanics ? interaction of the fluid and structure. |
| **Basic bibliography:** |
| |
| **Additional bibliography:** |
| |

| **Result of average student's workload** | |
| --- | --- |
| **Activity** | **Time (working hours)** |
| 1. Lectures | 16 |
| 2. Labs | 10 |
| 3. Final exam | 24 |

| **Student's workload** | | |
| --- | --- | --- |
| **Source of workload** | **hours** | **ECTS** |
| Total workload | 50 | 3 |
| Contact hours | 26 | 2 |
| Practical activities | 24 | 1 |