# STUDY MODULE DESCRIPTION FORM

| Name of the module/subject | | Code |
|---|---|---|
| **Structural Analysis** | | **1010102111010103701** |
| Field of study: **Structural Engineering Second-cycle Studies** | Profile of study (general academic, practical): **(brak)** | Year /Semester: **1 / 1** |
| Elective path/specialty: **-** | Subject offered in: **Polish** | Course (compulsory, elective): **obligatory** |
| Cycle of study: **Second-cycle studies** | Form of study (full-time,part-time): **full-time** | |
| No. of hours: Lecture: **30** Classes: **15** Laboratory: **-** Project/seminars: **15** | | 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 | | ECTS distribution (number and %) |

## Responsible for subject / lecturer:

dr hab. inż. Przemysław Litewka, prof. nadzw.
email: przemyslaw.litewka@gmail.com
tel. 61-6652468
Budiwnictwa i Inżynierii Środowiska
ul. Piotrowo 5, 60-965 Poznań

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

| | | |
|---|---|---|
| 1 | **Knowledge** | -Knows analytical methods of computation of internal forces and displacements in statically determinate and indeterminate bar structures.<br>-Has basic knowledge concerning buckling of compression members and stability loss of plane bar structures.<br>-Has knowledge concerning the stress and strain states in members cross sections. |
| 2 | **Skills** | -Can calculate forces and displacements in statically determinate and indeterminate bar structures.<br>-Can calculate stresses and strains in members cross sections. |
| 3 | **Social competencies** | -Can describe the calculations carried out |

## Assumptions and objectives of the course:

1. Enhancement of knowledge concerning classical methods of analysis of bar structures.
2. Getting acquainted with matrix methods of analysis of statics and stability of bar structures.
3. Getting acquainted with some methods of analysis of space girders

Generic graduate attributes

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

### Knowledge:

1. Knows analytical and numerical methods of calculation of internal forces and displacements in bar structures, also with the influence of large axial forces - [K_W03]
2. Knows methods of analysis of initial stability of bar structures - [K_W03]
3. Knows foundations concerning forming and non-linear behaviour of cable structures - [K_W03, K_W09]
4. Knows foundations of the finite strip method - [K_W03]

### Skills:

1. Can calculate by various methods internal forces and displacements in bar structures also within the second order theory - [K_U04, K_U06, K_U13]
2. Can calculate the critical load and the mode of stability loss for plane bar structures - [K_U04, K_U06]
3. Can apply the Newton-Raphson method in the analysis of geometrically non-linear cable structures - [K_U04, K_U06]
4. Can crtitcally assess the results of static and stability analysis of bar structures - [K_U07]

### Social competencies:

| |
|---|
| 1. Is responsible for the correctness of the analysis carried out - [K_K02] |
| 2. Can describe in writing the calculations and draw the appropriate conclusions - [K_K10] |

| **Assessment methods of study outcomes** |
|---|
| Lectures and example classes ? two identical marks are attributed basing on the results of two written tests checking the knowledge and problem solving skills |
| Test No.1 ? Points 1 ? 4 from the Content section ? 50% |
| Test No. 2 ? Points 5 ? 8 from the Content section ? 50% |
| Exercise classes ? one mark is attributed basing on three individual exercises with a written assessment of related knowledge and skills |
| Ex. No.1 ? Statically indeterminate curved beams ? flexibility method with numerical integration ? 33% |
| Ex. No. 2 ? Static analysis of plane frames ? matrix version of stiffness method ? 33% |
| Ex. No. 3 ? Initial stability and static analysis with large axial forces for plane frames ? matrix method ? 33% |

| **Course description** |
|---|
| 1. Calculation of internal forces and displacements in curved beams. Analytical integration for circular beams |
| and numerical integration for other geometry. |
| 2. Calculation of internal forces and displacements in space frames. |
| 3. Enhancement of the range of analytical methods for bar structures ? Hardy-Cross method, mixed method. Influence of elastic supports, temperature change and imposed support displacements. |
| 4. Matrix version of the stiffness method in plane and space frames and trusses. |
| 5. Matrix analysis of statics for plane frames with the influence of large axial forces ? the second order theory. |
| 6. Initial stability of plane frames ? the matrix approach. |
| 7. Calculation of internal forces and displacements in geometrically non-linear cable structures. |
| 8. Foundations of the finite strip method in the analysis of space girders |

**Basic bibliography:**

1. Electronic textbook ? see the links Materials at: http://www.ikb.poznan.pl/przemyslaw.litewka/strana. html
2. Selected problems of advanced structural mechanics (in Polish: Wybrane zagadnienia zaawansowanej mechaniki budowli), P. Litewka, R. Sygulski, Wydawnictwo Politechniki Poznańskiej, Poznań, 2012

**Additional bibliography:**

1. Computer Analysis of Structural Systems, J. F. Fleming, Mc Graw - Hill, 1989
2. Structural Analysis, R. C. Coates, M. G. Coutie, F. K. Kong, Van Nostrand Reinhold, 1988
3. Structural mechanics ? computer approach (in Polish: Mechanika budowli - ujęcie komputerowe), vol. 1, 2 i 3, Z. Waszczyszyn et al., Arkady, Warszawa, 1995
4. Cheung YK. Finite Strip Method in Structural Analysis. Pergamon Press (1976)

**Result of average student's workload**

| Activity | Time (working hours) |
|---|---|
| 1. Exercise No.1 | 5 |
| 2. Exercise No. 2 | 5 |
| 3. Exercise No. 3 | 10 |
| 4. Preparation to Test No.1 | 12 |
| 5. Preparation to Test No.2 | 8 |

**Student's workload**

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 75 | 3 |
| Contact hours | 60 | 2 |
| Practical activities | 45 | 2 |