# ADVANCED STRUCTURAL SYSTEMS

| **General information** | |
|---|---|
| *Subject* | Advanced Structural Systems |
| *Faculty* | Faculty of Civil Engineering, Architecture and Environmental Engineering |
| *Course of study* | Architecture |
| *Profile* | General academic |
| *Type of study* | II level with the degree of M.Sc. Eng. Arch. |
| *Starting semester* | Summer semester |

| **Information about the subject** | |
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| *Semester* | 1 |
| *Number of ECTS points* | 4 |
| *Subject type* | obligatory |
| *Language of instruction* | English |
| *Syllabus prepared by* | Prof. dr hab. inż. Jakub Marcinowski |

**Type of class**

| *Course type* | *Number of classes per semester (full time studies)* | *Number of classes per week (full time studies)* | *Number of classes per semester (part time studies)* | *Number of classes per week (part time studies)* | *Credit type* |
|---|---|---|---|---|---|
| Lecture | 15 | 1 | - | - | Credit with a grade |
| Project | 30 | 2 | - | - | Credit with a grade |

**Subject objective**

Providing students with knowledge in the field of design and construction steel-concrete composite floors made of Angelina beams and steel trapezoidal sheets. Acquainting students with surface girders in the form of plates and shells of any shape and with spatial truss systems covering huge space. Presentation of contemporary trends in the design of high-rise buildings. Modern cable, tensile systems with particular emphasis on tensegrity and membrane constructions.

**Initial requirements**

Formal: Structural mechanics, Civil engineering - general rules, Structures I, II, III.

**Subject scope**

Lecture: Steel-concrete composite floors. Plates. Axi symmetrical, shells of revolution - membrane state, bending state. Shells of other shapes. Spatial, truss girders. Main structural ideas. Principles of designing. Ferro-concrete and metal high buildings. Load carrying systems. Bracing systems. Tensile structures. Plane, tensile girders. Tensile nets. Membrane structures. Modern tensegrity structures. Organic shapes. Glass facades.

Project 1 – Steel-concrete composite floor made of Angelina profiles and trapezoidal metal sheets. Design done by means of Angelina program offered by Arcelor-Mittal.

Project 2 – Steel, roof, truss girder made of members of tubular cross section. Project accomplished by means of COSMOS/M system.

Project 3 – Project of ferro-concrete dome with central skylight. Project accomplished by means of COSMOS/M system.

| **Educational methods** |
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| Explanation methods: Lecture - the conventional lecture illustrated by presentations prepared in PowerPoint program.<br>Research methods: Project - the individual work in the computer laboratory on projects accomplished on the basis of clarifications of the lecturer. |

| **Education results and verification methods** | | | |
|---|---|---|---|
| *Description* | *Symbol* | *Verification method* | *Type of class* |
| The student acquires knowledge in the field of shaping and constructing steel-concrete composite floors and shell and truss structures covering large space. | K_W03 | – test with points | lecture |
| Student is able to generate the geometry of shell covering of any shape and the structural, spatial covering as well. Student is able to accomplish the static numerical analysis required in the conceptual state of the project of the large space covering. | K_U09 | – preparation of three projects | project |
| The student is able to work in a team. He is aware of the responsibility of the designer of building objects. | K_K02 | – observation and evaluation of participation in the classes<br>– observation and evaluation of the student's practical skills | lecture<br>project |

| **Requirements to obtain a credit** |
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| The student acquires knowledge in the field of shaping and constructing steel-concrete composite floors and shell and truss structures covering large space.<br>Student is able to generate the geometry of shell covering of any shape and the structural, spatial covering as well. Student is able to accomplish the static numerical analysis required in the conceptual state of the project of the large space covering.<br>The student is able to work in a team. He is aware of the responsibility of the designer of building objects.<br>A grade for the achievement of the educational effect in the category: knowledge, skills and competences is based on a test with points:<br>50% - 60% correct answers satisfactory<br>61% - 70% satisfactory plus<br>71% - 80% good<br>81% - 90% good plus<br>91% - 100% very good<br>The final grade in the subject is a grade weighted from the marks from the $O_l$ lecture test and the evaluation from the $O_p$ projects: $O_f$ final = $0.5[O_l + O_p]$ |

| **Student's work** | |
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| *Student's work* | *Full time study (h)* |
| Interaction with the teacher (classes; consultations; exam, etc.) | 50 |
| Student's individual work (preparation for the classes, test exam; literature research preparation of: written paper, project, presentation, report, speech; etc.) | 50 |
| *Total* | 100 |

| *ECTS points* | *Full time study* |
|---|---|
| Work with a teacher | 2 |
| Work without a teacher | 2 |
| *Total* | 4 |

**Basic literature**


1. Łubiński M., Żółtowski W.: *Konstrukcje metalowe. Część II. Obiekty budowlane*, Wydawnictwo Arkady, 2004.
2. Menyhard I.: Konstrukcje powłokowe, Arkady, Warszawa 1971.
3. Bródka J., Kozłowski A.: Stalowe budynki szkieletowe, Ofic. Wyd. Politechniki Rzeszowskiej, Rzeszów 2003.
4. Przewłocki S.: Kształtowanie geometryczne konstrukcji powłokowych, Arkady, Warszawa 1969.
5. Hajduk J., Osiecki J.: Ustroje cięgnowe. Teoria i obliczanie. Wydaw.. Naukowo-techniczne, Warszawa 1970.
6. Cosmos/M – Instrukcja obsługi, 1999.
7. Program Angelina - Instrukcja obsługi, Arcelor-Mittal, 2015.


**Complementary literature**


1. Borusiewicz W., Konstrukcje budowlane dla architektów, Arkady, Warszawa 1978.
2. Ziółko J., Włodarczyk W., Mendera Z., Włodarczyk S.: Stalowe konstrukcje specjalne, Arkady, Warszawa 1995.
3. Biegus A.: Stalowe budynki halowe, Arkady, Warszawa, 2004.
4. Bródka J.: Stalowe konstrukcje hal i budynków wysokich, t.1 i 2, Wyd. Politechniki Łódzkiej, Łódź 1994.
5. Pałkowski Sz.: Konstrukcje stalowe. Wybrane zagadnienia obliczania i projektowania. PWN, Warszawa, 2009.


**Notes**