Title of Course	Complex Metal Structures		
Semester	Autumn/Spring		
Teaching Hours per Course:	Total	- Lectures:	- Tutorials:
	90h	30h	30+30h
ECTS Credits			

The content of education	
Aims of Course	The aim of the subject is to extend the knowledge of special steel constructions and the static and dimensional calculations of uncomplicated spatial steel constructions. The computer computational techniques will be used for conducting the project exercise.
Program	W1 – Support structures for technological equipment. Pipeline flyovers. W2. Silos and trays. Silos for loose materials – loads, rules of calculation. W3. Silos for silage. Constructional solutions. Methods for installing silos. Trays. W4. Thin-walled structures. Materials and products. Examples of applications. Assumptions for calculations of different stress states. W5. Lightweight connectors. Types of connectors, issues of connection technology, principles of dimensioning. W6. Tensile structures. Division criteria. Materials, types of tendons, rope properties. Loss of compression forces. W7. Connections and anchors of tendons. Heavy loads of tendon structures. Static of a single tendon. W8. Expanding the information of the steel multi-branch bars. Bars with parallel and convergent branches. W9. Bending, twisting, buckling of multi-branch bars – parallel and convergent. W10. Arched structures. Arches with hangers and tendon. Critical forces and arch buckling. W11. Fire safety of steel structures. Fire resistance criteria. Requirements for fire resistance of buildings. Design methods of steel structures for fire conditions. Fire protection. W12 Heating rates for unprotected steel and with fire protection. Critical temperature of the steel element. Steel properties at elevated temperatures. W13 Calculated load capacity of steel elements. The use of nomograms of temperature distributions in steel elements for the selection of fireproof insulation. W14 Steel and concrete composite structures. Fasteners used for joining structural steel with concrete. Load capacity of cross-sections of beams. Computational plastic resistance to bending of a partially complex section. W15 Dislocation of composite beams. Calculation of deflections of composite girders. Composite columns and composite compression elements. Composite panels on the sheathing of steel profiled sheets.

	C1. Types of roof skylights. Material and construction solutions. The impact of using roof lights on the magnitude of climatic loads acting on the bearing structures of industrial halls. Static and strength calculations of roof skylights and their connections with structural elements of hall roofs. C2. Crane beams. Shaping of crane runways. Impacts of overhead traveling cranes on the beams of running tracks. Impact groups and dynamic coefficients. Vertical and horizontal actions of bridge cranes. Load combination factors. C3. Calculations of crane beams using the exact and simplified methods. Checking the beam limit states and fatigue of this element. C4. Wall and roof casing for industrial halls. C5. Support structure of the hall casing. Full-wall purlins and wall bolts. Cooperation of roofing elements with the housing. Static diagrams and loads. Checking supporting structure elements during assembly and operation. Assembly contact elements. C6. The main transverse system of the hall. Shaping the cross-section of the hall with a full-wall roof transom. Statics. Load combinations. C7. Interpretation of computer results of static calculations. Dimensioning of transverse system components. Buckling lengths of frame components. C8. Construction of frame assembly nodes and contacts. Design of welded and screw nodes. Checking the serviceability limit state. C9. Hall poles. Design solutions for shaft posts in industrial halls. Buckling lengths of columns in frame systems. Strength calculations and horizontal displacement check. C10. Framework nodes. Roof bolt connection with mullions. Constructing and strength calculations of nodes. C11. Design solutions for the bases of compression and bent columns. Types of anchorages. Strength calculations for column bases and anchorages. C12. Hall bracing. Types of concentrations and their formation. Impact of using bracing on dimensioning of hall elements. C13. Strength calculations for roof and wall bracing in accordance with Eurocode 3. C14. Strength calculations for roof and wall bracing according to more accurate methods presented in the technical literature. C15. Technical documentation of steel constructions. P1. Discussion of the scope of the preliminary design of an industrial hall with supported transport (alternatively with suspended transport). Technical description. Formal basics. Topic of the review. Output data. Project scope. General concept of construction. Description of structures and structural elements: roof and wall sheathing, full-wall purlin, frame of full-wall sections, crane girder made of rolled or girder I girder. P2. Loads assumed in the project: constant, variable from: wind, snow, technological. Static calculation method. Materials used to make the structure. Ground conditions. Requirements for fire and corrosion protection. General assembly rules. P3. Summary of loads and their combinations in static calculations - during assembly and operation. P4. Calculation of the overhead traveling crane track (alternatively suspended). Crane actions on the track beam. Calculation of internal forces in the beam from crane operations. P5. Adoption of the beam cross-section and calculation of its geometrical and strength characteristics. Checking beam limit states and element fatigue. Connections of the crane runway track with the hall structure.

	P6. Calculation of a continuous, solid-walled roof purlin. Static scheme. Load summary, load combinations, static calculations. Checking limit states. Calculations of assembly contacts. P7. Calculation of full-frame frame system. Load summary, load combinations. Computer static calculations of the transverse system. Interpretation of calculation results. P8. Dimensioning of frame elements and their connections. Calculation of the transom supporting node and girder assembly contact. Checking the serviceability limit state. P9. Single branch pole. Selection of cross section. Determination of buckling lengths in two planes. Strength calculations. Checking the serviceability limit state. P10. Post anchorage. Shaping the base of the pole. Strength calculations of the column base components and their connections. Calculation of column anchorages. P11. Layout of roof and wall bracing. Calculation of concentrations according to Eurocode 3. P12. Calculation of concentrations according to more accurate methods presented in the technical literature. P13. Drawing drawings of steel structures. Describing rods, profiles, plates as well as welded and bolted joints. Dimensioning methods. Schematic, assembly, assembly and workshop drawings. P14. Bill of materials and technical description of the structure
Conditions of completion	**Grading Standard:** The prerequisites for passing the subject include the positive exam, and exercises grades. Passing the exercises will take the form of a colloquium. The participation in the classes is also required. Completion of the project will be after the correct performance of calculations and drawings according to individual assumptions and a positive assessment of the written and oral defense of the work. Class attendance and consultation are also required. In addition, activity in the implementation of the project will be assessed. **Grade: 2-5**
Teacher	Dr eng. Maciej Banach