



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Architectural Design of Residential Buildings 2 [S1Arch1E>PAObM2]

Course

Field of study
Architecture

Year/Semester
3/5

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
45

Number of credit points

9,00

Coordinators

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Lecturers

Prerequisites

- structured and theoretically based general knowledge covering the key issues in architectural design; - basic knowledge of development trends in architectural design; basic knowledge necessary to understand social, economic, legal and non-technical conditions of architectural design; - acquiring information from literature, databases and other properly selected sources, also in English, integrating information, aggregating and interpreting, drawing conclusions and formulating and justifying opinions, - critical functional analysis, evaluation of existing solutions, systems and processes; - identify and formulate specifications of practical tasks in architectural design; - design of facilities at the scale of a single dwelling and a single-family house; - understanding the need for lifelong learning, ability to inspire and organize the process of learning process of others; - awareness and understanding of non-technical aspects and effects of engineering activities, including their The ability to co-operate and work in a group, assuming various roles in the group; - ability to cooperate and work in a group, taking various roles in it; - correct identification and solving of dilemmas in various spatial situations on an architectural scale architectural scale. - well-ordered, theoretically grounded general knowledge covering key issues in the field of general construction, material science and principles of preparing a design for of single-family building construction project.

Course objective

LECTURE The subject of the course: The process of designing multi-family residential buildings, trends and trends in contemporary architecture, functional models and typology of designed multi-family buildings of various intensities. Aim of lectures: The aim of the course is to present students with various types of multi-family housing (frontage building, block building, quarter building, etc.) and forms of residential buildings (hall building, corridor building, gallery building, etc.) used in various spatial, cultural and social contexts). In addition, boundary conditions and provisions of the Polish construction law regarding multi-family residential development will be discussed. In connection with them, design requirements and functional diagrams of individual types of buildings will be presented. It will be supplemented with a presentation of contemporary trends in the design of medium and high-intensity buildings. An additional goal is to get acquainted with students' opinions on the discussed issues and problems of contemporary architecture. **DESIGN CLASSES** - acquaintance with issues, contemporary tendencies and trends in architectural design of residential buildings; - perfecting skills of recognizing formal and legal localization conditions, interpretation of higher order project (so called "extract and extraction" or decision on land development conditions); - training skills of recognizing the localization potential: analysis of various connections, existing values and surrounding conditions such as cultural context, existing functional problems and socio-economic aspects; - perfecting skills of applying tools and techniques of qualitative and quantitative analysis in design practice; acquiring skills of obtaining functional-metric parameters for designing an architectural object in a specific location; - acquiring and training skills to construct the utility program of an object with a complex function, training skills of functional integration of the object and its environment; - cognition of issues connected with shaping of human residential environment of medium and high intensity, - getting to know types of multi-family housing, - getting to know functional diagrams of different types of housing, - develop skills of site analysis on urban and architectural scale, - mastering the application of the known functional diagrams in various configurations, - developing skills of graphical presentation of architectural concepts (projections, sections, elevations), - deepening knowledge and skills of making conceptual drawings (projections, sections, elevations) based on construction knowledge; - practical application of the theoretical knowledge learned in the lectures "ARCHITECTURAL DESIGN OF RESIDENTIAL OBJECTS 2" in own conceptual design. **LABORATORY CLASSES** - getting to know forms and scopes of particular phases of design process in the context of the Act Building Law; - knowing the principles of preparing a technical documentation for a multi-family residential building; - apply learned principles about multi-family residential buildings design to the work performed; - perfecting the ability to prepare lists of individual building elements in multi-family building with special attention to those prepared by the Architect; - learning about traditional building technologies in design practice, - develop existing students knowledge of building materials.

Course-related learning outcomes

Knowledge:

Student knows and understands:

- A.W1. architectural design for the implementation of simple tasks, in particular: simple facilities taking into account the basic needs of users, single- and multi-family housing, service facilities in residential complexes, public facilities in an open landscape or in an urban environment;
- A.W3. records of local spatial development plans to the extent necessary for architectural design;
- A.W4. principles of universal design, including the idea of designing spaces and buildings accessible to all users, in particular for people with disabilities, in architecture, urban planning and spatial planning, and ergonomic principles, including ergonomic parameters necessary to ensure full functionality of the designed space and facilities for all users, especially for people with disabilities

Skills:

Student can:

- A.U1. design an architectural object by creating and transforming space so as to give it new value - in accordance with a given program that takes into account the requirements and needs of all users;
- A.U4. make a critical analysis of the conditions, including the valorization of the land development and building conditions;
- A.U5. think and act creatively, using the workshop skills necessary to maintain and expand the ability to implement artistic concepts in architectural and urban design;
- A.U6. integrate information obtained from various sources, formulate their interpretation and critical analysis;
- A.U7. communicate using various techniques and tools in a professional environment appropriate for architectural and urban design;
- A.U8. prepare architectural and construction documentation in appropriate scales in relation to the

conceptual architectural design;

A.U9. implement the principles and guidelines of universal design in architecture, urban planning and spatial planning.

Social competences:

Student is capable of:

A.S1. independent thinking to solve simple design problems;

A.S2. taking responsibility for shaping the natural environment and cultural landscape, including the preservation of the heritage of the region, country and Europe.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

LECTURE

Written final exam on the knowledge provided during the lectures and contained in the given literature (Moodle.put.poznan.pl), with particular emphasis on the function, form and structure of a multi-family building, the variety of types and forms of medium-intensity residential development and selected issues of construction law, and construction. Knowledge of modern trends in the design of multi-family housing will also be required. The test consists of 10 questions, each worth 1 point.

Grading scale:

0-5 points - 2.0

6 points - 3.0

7 points - 3.5

8 points - 4.0

9 points - 4.5

10 points - 5.0

DESIGN CLASSES

Important evaluation criteria are:

- Knowledge of the functional assumptions necessary to develop a multi-family residential building concept;
- ability to critically perceive and analyze the surroundings of the designed object and to draw conclusions being the basis and one of the guidelines in shaping the architectural form,
- method of shaping the architectural composition based on the principles derived from theoretical studies;
- quality of functional-spatial solutions;
- connection of the functional-spatial system with the built and natural environment,
- quality of shaping the architectural composition,
- quality of technical representation of the spatial composition in the form of flat layouts (plans, sections, views, etc.), axonometric sketches and perspectives,
- way of using basic tools and materials helpful in presentation of achieved solutions of architectural composition,
- functionality, efficiency and profitability of applied technologies, sanitary installations and building materials,
- technical correctness and energy efficiency of the adopted design solutions,
- quality of technical reproduction of the spatial composition in the form of mock-ups,
- quality of the presentation of the design solutions in the form of composed/ designed boards,
- aesthetics and legibility of the design solutions presentation.

Assessments include:

- completeness and coherence of the work in the analytical, design and descriptive parts, graphic quality of the project,
- adopted design and functional-spatial solutions,
- relationship of the designed building with the built and/or natural environment,
- relations between public, semi-private and private space,
- the way of satisfying the psycho-physical and social needs of the resident (house user),
- innovation of formal and functional solutions,
- proper solution of technical issues in the building,
- aesthetics and legibility of the graphic and descriptive part and the model.

Formative Assessment:

- The advancement of design work and technical knowledge are evaluated on an ongoing basis during subsequent exercises in the form specified by the instructor,
- Partial reviews, including individual project tasks, checking the progress of the student's work, presented on the group and in front of other lecturers, joint discussion, brainstorming,

- Required elements of the design: drawing and photographic inventory, analytical part, land development design, floor plans of all floors, cross-sections (min. 2, one through the staircase), elevations with consideration given to the materials and colors used, perspectives: external and internal, descriptive part: surface and volume indicators, summary of areas, urban layout model (including the surroundings) and architectural model in scales adequate for the presentation of the design;
- assessment of knowledge and skills affects the semester grade,
- the adopted grading scale: 2,0; 3,0; 3,5; 4,0; 4,5; 5,0.

Summative Assessment:

- Final review, including the final project task, which is a summary of the knowledge and skills acquired in the course of previous projects (tasks), a presentation in the group or at a collective review in the presence of other instructors;
- a condition for passing the course is obtaining positive grades from all reviews,
- The adopted grading scale: 2,0; 3,0; 3,5; 4,0; 4,5; 5,0.

LABORATORY CLASSES

An important evaluation criterion is to check:

- knowledge of technical drawing principles necessary to prepare architectural-technical documentation for a multi-family house, including principles of representation of architectural form, description and dimensioning of documentation elements, use of graphic designations, principles of technical writing;
- knowledge of multi-family building elements, their nomenclature, principles of shaping and design;
- knowledge of modern building technologies and materials, their properties and scope of application in multi-family housing construction;
- knowledge of the form and scope of the technical documentation;
- ability to represent the spatial form of a multi-family building in flat drawings (plans, sections, elevations, etc.), axonometry;
- the ability to use drafting tools and materials and the ability to apply freehand drawing techniques;
- the ability to choose the correct size of the worksheet and the correct placement of content;
- the ability to describe and dimension technical drawings using technical writing;
- the ability to assemble technical drawings;
- technical correctness and energy efficiency of the adopted design solutions;
- ability to prepare technical documentation legibly and aesthetically.
- the ability to work in team

Formative assessment:

- The progress of design works and technical knowledge are assessed on an ongoing basis during subsequent classes in the form specified by teacher.
- Evaluation of drawing tasks.

Summative Evaluation:

- The assessment of knowledge and skills affects the semestral grade.
- The evaluation of the completed project and team work.
- A prerequisite for passing the course is obtaining positive grades from all reviews and correct completion of the project within the specified time.

The adopted grading scale: 2,0; 3,0; 3,5; 4,0; 4,5; 5,0.

Successful completion of the module depends on the student's achievement of all learning outcomes specified in the syllabus.

Programme content

LECTURE

- Lecture 1 History of multi-family housing part. 1; from the Roman insulae to the Pruitt-Igoe estate
- Lecture 2 History of multi-family housing part. 2; from the Byker Wall to contemporary buildings and apartment complexes
- Lecture 3 Typology and intensity of multi-family housing - selected concepts, terms and issues
- Lecture 4 Plot development project part. 1
- Lecture 5 Plot development project part. 2
- Lecture 6 Architecture of contemporary housing complexes - dr Tomasz Jastrząb
- Lecture 7 Structural elements and systems in multi-family residential buildings
- Lecture 8 Densifying multi-family buildings - use of residual space
- Lecture 9 Hybrid residential development - the importance of complementary functions
- Lecture 10 Tall buildings - the specificity of design and use
- Lecture 11 Housing for seniors
- Lecture 12 Housing for young people - a case study of the Neu Leopoldau estate

Lecture 13 - Original realizations of residential buildings - prof. Ewa Pruszeicz-Sipinska

Lecture 14 - Shaping the contemporary living environment - an attempt to synthesize current issues.

DESIGN CLASSES

The semester design task includes the performance of a conceptual design of a multi-family residential building on the basis of guidelines and information received from the teacher, e.g. location of the study area.

Design task is performed in two stages:

Analytical stage including:

- analysis of situation and altimetric maps and other cartographic data,
- qualitative analyses: view studies, analyses of compositional connections, studies of the architectural environment and genius loci, documentation of landscape values,
- quantitative analyses: studies of land absorption, identification of location potential, functional connections with the surroundings, pedestrian and vehicular communication, identification of service infrastructure,
- analysis of local law provisions, summary analysis of land development conditions,
- SWOT analysis,
- determination of program of the designed object,
- determination of social structure of target users.

The student presents the materials during a discussion with the teacher in paper or computer form. The analytical part ends with a partial review. The scope of the review is presented by the class instructor at the beginning of the semester.

Design stage including:

- creation of a functional and spatial program for the study area and the designed object,
- development of the form of the building along with its surroundings,
- technical description of the architectural design (in the form of projections, sections, elevations, details, etc.) and land development design,
- development of a coherent presentation of the architectural design with the use of selected graphic methods (board format, a model of the designed building on the plot together with the surroundings).

The materials are presented in class during a discussion with the instructor in paper or computer form. The design part ends with a final review. The scope of the review is presented by the class instructor at the beginning of the semester.

Final review end credit as a review in the student group and/or with other instructors.

LABORATORY CLASSES

Laboratory classes concern the developing technical documentation for a multi-family building with an underground garage hall and services on the ground floor, according to a concept provided by the teacher, prepared by students individually according to consultations and instructions of the teacher, handdrawn in 2H pencil on paper to be redrawn in ink on tracing paper or in CAD software.

Class #1: Getting the students acquainted with the subject matter of the classes, reminding them about the scope of the construction design in relation to the Regulation of the Minister of Infrastructure of September 11, 2020 on the detailed scope and form of the construction design and principles of technical drawing according to valid standards - markings, dimensioning, lines. Discussion of traditional multi-family building technologies. Learn the main guidelines and principles of preparing technical documentation for a multi-family residential building through an e-learning course available on the university's eMoodle platform.

Class #2: Selection of wall and floor technology and foundation method. Choosing of basic structural solutions for the previously developed concept of a multi-family building and adjustment of its dimensional parameters to the requirements of the adopted technologies. Redraw the concept with architectural details omitted including spans and ceiling support directions. Schematic projections at 1:50 scale in pencil on paper with structural axes marked.

Class #3: Concretization of the construction scheme for the building, corrections of the trusses and ceilings, the definition of technology for chimney ducts (gravitational ventilation only), selection of the source of thermal energy, selection of technology for window and door lintels. PlansC in scale 1:50 in pencil on paper with the marking of installation risers and location of central heating and hot water supply.

Class #4: Recalling the principles of the dimensioning door and window openings in relation to the dimensions of carpentry, discussion of the issues of sanitary installations in multi-family buildings and the principles of their routing, explanation of the principles of designing and drawing staircases and passenger lifts in multi-family buildings as well as acoustic insulation issues and basic fire protection concepts.

Class #5: Drawing of "empty" building openings in structural walls, as well as stairs and flue pipes, determination of foundation level and height parameters of floors, as well as ground level in relation to the surrounding terrain. Plans and schematic cross-section at 1:50 scale in pencil on paper indicating stairs, columns, lintels, and stringers.

Class #6: Drawing of window and door joinery on projections and sections, discussion of rules of estimating

dimensions and describing construction elements, selection of dimensions of rafter framing, floor, beams, lintels, and columns. Projections and a schematic cross-section on a scale of 1:50 in pencil on paper with labels of construction elements.

Class #7: Discussion of the principles of foundation of multi-family buildings, selection of water insulation technology, selection of foundation dimensions for structural elements, stairs, and heavy chimneys. Plans and schematic cross-section in scale 1:50 in pencil on paper with the layout of foundations.

Class #8: Drawing elements of architectural arrangement - partition walls, balustrades, room descriptions. Plan and schematic cross-section in scale 1:50 on paper with layout rooms.

Class #9: Drawing of built-in and movable elements of the architectural arrangement of rooms - sanitary ware, built-in appliances, closets, furniture, and vehicles. Discuss the principles of internal dimensioning of projections. Plans and a schematic cross-section at a scale of 1:50 in pencil on paper with room arrangements and internal dimension lines.

Class #10: Discussion of the principles of architectural façade design, types of sandwich walls and selection of technology supplier and workshop design, problems of thermal protection of buildings, and energy efficiency issues. Projections and schematic cross-section in the scale 1:50 pencil on paper with consideration of facade finishing technology.

Class #11: Drawing the land development elements on the ground plan, basement, and upper floors - exits, driveways, terrain stairs, paving, bands, terraces, balconies, and canopies. Discussion of the principles of external dimensioning of buildings, projections and schematic cross-section at a scale of 1:50 in pencil on paper with the nearest land development and external dimension lines.

Class #12: Drawing a plan of the roof, flat roof, discussing practical problems of draining rainwater and snow from the building and the principles of designing a rainwater drainage system of the building. Finished projections and schematic cross-section at 1:50 scale in pencil on paper with a projection of of developed roof.

Class #13-14: Consultation and verification of completion of drawing assignment.

Class #13: Discussion of the principles of section and elevation drawing - vertical dimensioning building, elements of descriptions and designations. Discussion of the scope and form of technical description. Finished projections, cross-sections and elevations in scale 1:50 in pencil on paper, ready to redraw in ink on tracing paper, technical description in A-4 format.

Class #14: Discussion of the scope and form of the land development project (site plan), drawing building on the map for design purposes, issues of land development and principles of dimensioning. Plan of the land development (site plan) on the map for design purposes in the scale 1:500 with the elements of the utilities and dimensioning and description of land development.

Class #15: Completion of the project work, credit of the semester.

Course topics

none

Teaching methods

1. Lecture with a multimedia presentation with elements of conversation.
2. Design exercises have the character of individual consultations conducted in a student group. Discussion and correction of solutions applied in the project with the participation of all students, discussion of special cases of recurrent design problems.
3. Exercises based on the use of various sources of knowledge (film, photographs, archival materials, source texts, documents, statistical yearbooks, maps, Internet, etc.),
4. Project method / case study (sample study) - discussing different ways of solving project problems
5. PUT eKursy platform (a system for supporting the teaching process and distance learning).

Bibliography

Basic:

1. Alexander Ch., Język wzorców, wyd. GWP, Gdańsk, 2008
2. Bonenberg W., Przestrzeń publiczna w osiedlach mieszkaniowych. Metoda analizy społeczno-przestrzennej, WA Politechnika Poznańska, 2007
3. Fikus, M., Przestrzeń w autorskich zapisach graficznych, wyd. PP, Poznań, 1991
4. Grandjean E., Ergonomia mieszkania, Arkady, 1978
5. Jastrząb T., Urbanistyczno-architektoniczne wyznaczniki jakości współczesnych struktur mieszkalnych, wyd. PP, Poznań, 2014
6. Pallado J., Zabudowa wielorodzinna. Podstawy projektowania, wyd. PŚ, Gliwice, 2014
7. Pruszewicz-Sipińska E. Architektura usługowa i mieszkaniowa w programach nauczania, tom 1, Wyd.

PP, Poznań, 2010

8. Yi - Fu Tuan, Przestrzeń i miejsce, PIW, 1987

9. Żórawski J., O budowie formy architektonicznej, 1962 5

10. "Architectural Design of Residential Buildings 2" course on eKursy (PUT e-learning platform).

11. Markiewicz P., Budownictwo ogólne dla architektów, Archi-Plus, Arkady 2011;

12. Żeńczykowski W.. Budownictwo ogólne 2/1, Arkady , Warszawa

13. Żeńczykowski W.. Budownictwo ogólne 2/2, Arkady , Warszawa

14. Żeńczykowski W.. Budownictwo ogólne 3/1, Arkady , Warszawa

15. Żeńczykowski W.. Budownictwo ogólne 3/2, Arkady , Warszawa

Legislation:

1. ROZPORZĄDZENIE MINISTRA INFRASTRUKTURY z dn. 12 kwietnia 2002 r. w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie (z późniejszymi zmianami.)

2. Rozporządzenie Ministra Rozwoju z dnia 11 września 2020 r. w sprawie szczegółowego zakresu i formy projektu budowlanego (z późniejszymi zmianami).

3. Ustawa z dnia 7 lipca 1994 r. Prawo budowlane.

4. "Building Law" course on eKursy (PUT e-learning platform) with translation of relevant legal acts.

5. PN-B-01027:2002 Rysunek budowlany. Oznaczenia graficzne stosowane w projektach zagospodarowania działki lub terenu [Construction drawings -- Graphical designations for the landscape drawing practice]

6. PN-B-01029:2000 Rysunek budowlany. Zasady wymiarowania na rysunkach techniczno-budowlanych [Construction drawings -- Principle of dimension on architectural drawings]

7. PN-B-01030:2000 Rysunek budowlany. Oznaczenia graficzne materiałów budowlanych [Building and civil engineering drawings - Graphical symbols of building materials]

8. PN-B-01040:1994 Rysunek konstrukcyjny budowlany. Zasady ogólne. [Construction drawing for building - General principles]10. PN-ISO 129:1996 i PN-ISO 129/Ak Rysunek techniczny. Wymiarowanie. Zasady ogólne. Definicje. Metody wykonania i oznaczenia specjalne.

9. PN-ISO 9836:2015 Właściwości użytkowe w budownictwie – Określanie i obliczanie wskaźników powierzchniowych i kubaturowych.

Additional:

1. Czarnecki W., Planowanie miast i osiedli, Wydawnictwo PWN, Warszawa, 1965

2. Jodidio P., Architecture Now!, Taschen, Kolonia, 2011

3. Neufert E., Podręcznik projektowania architektonicznego, Arkady, 1995

4. The New Athens Charter. A Vision for 21st Century Cities, 2003.

5. Periodicals: architectural journals, urban planning journals, scientific journals, f.e. Zeszyty Naukowe Politechniki Poznańskiej seria Architektura i Urbanistyka, itp.

6. Renowned architectural journals (domestic and foreign)

Legislation:

1. PN-EN ISO 3098-1:2002 Dokumentacja techniczna wyrobu - Pismo - Część 1: Wymagania ogólne [Technical product documentation - Lettering -- Part 1: General requirements]

2. PN-EN ISO 3098-2:2002 Dokumentacja techniczna wyrobu - Pismo - Część 2: Alfabet łaciński, cyfry i znaki [Technical product documentation - Lettering - Part 2: Latin alphabet, numeral and marks]

3. PN-EN ISO 3098-3:2002 Dokumentacja techniczna wyrobu Pismo - Część 3: Alfabet grecki [Technical product documentation — Lettering — Part 3: Greek alphabet]

PN-EN ISO 3098-4:2002 Dokumentacja techniczna wyrobu. Pismo. Część 4: Znaki diakrytyczne i specjalne alfabetu łacińskiego. [Technical product documentation — Lettering — Part 4: Diacritical and particular marks for the Latin alphabet]

4. PN-EN ISO 3098-5:2002 [Dokumentacja techniczna wyrobu - Pismo - Część 5: Pismo alfabetu łacińskiego, cyfry i znaki w projektowaniu wspomaganym komputerowo (CAD) [Technical product documentation - Lettering - Part 5: CAD lettering of the Latin alphabet, numerals and marks]

5. PN-EN ISO 4157-1:2001 Rysunek budowlany Systemy oznaczeń Część 1: Budynki i części budynków [Construction drawings — Designation systems — Part 1: Buildings and parts of buildings]

6. PN-EN ISO 4157-2:2001 Rysunek budowlany Systemy oznaczeń Część 2: Nazwy i numery pomieszczeń [Construction drawings — Designation systems — Part 2: Room names and numbers]

7. PN-EN ISO 5457:2002 Dokumentacja techniczna wyrobu - Wymiary i układ arkuszy rysunkowych [Technical product documentation - Sizes and layout of drawing sheets]

8. PN-EN ISO 7519:1999 [Rysunek techniczny - Rysunki budowlane - Ogólne zasady przedstawiania na rysunkach zestawieniowych [Technical drawings - Construction drawings - General principles of presentation for general arrangement and assembly drawings]

9. PN-EN ISO 128-20:2002 Rysunek techniczny - Zasady ogólne przedstawiania- Część 20: Wymagania

- podstawowe dotyczące linii [Technical drawings - General principles of presentation - Part 20: Basic conventions for lines]
10. PN-EN ISO 7200:2007 Dokumentacja techniczna wyrobu- Pola danych w tabliczkach rysunkowych i nagłówkach dokumentów [Technical product documentation - Data fields in title blocks and document headers]
11. PN-N-01603:1986 Rysunek techniczny- Składanie formatów arkuszy [Technical drawings - Folding of sheets]
12. PN-EN ISO 128-1:2020 Dokumentacja techniczna wyrobu (TPD)- Zasady ogólne przedstawiania - Część 1: Wprowadzenie i wymagania podstawowe [Technical product documentation (TPD)- General principles of representation- Part 1: Introduction and fundamental requirements]
13. PN-EN ISO 128-3:2021-01 Dokumentacja techniczna wyrobu - Zasady ogólne przedstawiania - Część 3: Widoki, przekroje i kłady [Technical product documentation - General principles of representation - Part 3: Views, sections and cuts]
14. PN-EN ISO 128-21:2006 Rysunek techniczny- Zasady ogólne przedstawiania- Część 21: Linie w systemach CAD [Technical drawings - General principles of presentation - Part 21: Preparation of lines by CAD systems]
15. PN-EN ISO 128-22:2003 Rysunek techniczny - Zasady ogólne przedstawiania - Część 22: Wymagania podstawowe i zastosowanie linii wskazujących i linii odniesienia [Technical drawings - General principles of presentation - Part 22: Basic conventions and applications for leader lines and reference lines]
16. PN-EN ISO 5455:1998 Rysunek techniczny - Podziałki [Technical drawings - Scales]

Breakdown of average student's workload

	Hours	ECTS
Total workload	225	9,00
Classes requiring direct contact with the teacher	105	4,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	120	5,00