



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Technical drawing and CAD [S1Mech2>RTiCAD1]

### Course

Field of study  
Mechatronics

Year/Semester  
1/1

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  
15

Laboratory classes  
0

Other  
0

Tutorials  
15

Projects/seminars  
15

### Number of credit points

4,00

### Coordinators

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### Lecturers

### Prerequisites

A student enrolling in the course should have basic knowledge of elementary geometry, including familiarity with planar and spatial figures. The ability to think analytically and solve problems related to the representation of elements in the correct scale and proportions is also essential. Knowledge of basic drafting tools, such as a ruler, set square, compass, and technical pencil, as well as the ability to create freehand technical sketches, is required. Additionally, the student should have fundamental knowledge of mathematics, including algebraic operations, coordinate systems, and an understanding of geometric relationships. A basic understanding of physics, particularly the principles of mechanics and material strength, will be an advantage in comprehending technical issues. It is also necessary to have the ability to retrieve information from designated sources, including textbooks, technical documentation, and digital resources, allowing for independent development of competencies in technical drawing. Another important aspect is the willingness to collaborate within a team, enabling effective participation in project tasks and collective problem-solving in engineering contexts. Meticulousness, precision, and logical thinking skills will be crucial for correctly interpreting and creating technical documentation. Meeting these requirements will allow the student to participate effectively in the course and develop skills in technical drawing and engineering graphics.

## Course objective

The aim of the course is to master the fundamental principles of constructing representations of spatial objects on a plane, which forms the foundation of engineering work. The classes are designed to develop spatial imagination and enhance the ability to analyze and interpret technical drawings. Students will learn methods and principles of construction documentation, enabling them to effectively create technical drawings and accurately "read" engineering documentation. Through these classes, students will acquire practical skills in preparing technical documentation in both two and three dimensions (2D and 3D), including both detailed and assembly drawings. The course prepares students to seamlessly integrate traditional construction documentation methods with modern computer-aided techniques, facilitating efficient use of CAD tools and other design-supporting systems.

## Course-related learning outcomes

Knowledge:

Upon completion of the course, the student:

Understands the fundamental principles of projection and representation of spatial objects on a plane.  
Comprehends methods of construction documentation and the standards applied in technical drawing.  
Possesses knowledge of the principles of creating technical documentation, including detailed and assembly drawings.

Understands the role of technical drawing in the design and manufacturing process of technical components.

Skills:

Upon completion of the course, the student is able to:

Create technical drawings in accordance with standards and projection principles.

Interpret technical documentation, including detailed and assembly drawings.

Use basic drafting tools effectively.

Develop technical documentation in 2D and 3D formats, ensuring correct annotations and dimensioning.

Analyze and correct errors in technical drawings and optimize construction representation methods.

Social competences:

Upon completion of the course, the student:

Is able to collaborate effectively within a team in the creation of technical documentation.

Demonstrates meticulousness, precision, and responsibility in preparing technical drawings.

Is aware of the importance of accuracy and compliance of technical documentation with applicable standards.

Understands the need for continuous improvement of skills in technical drawing and the use of digital tools in design.

Can independently search for and utilize technical information necessary for creating accurate technical documentation.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - The final grade is based on a written exam consisting of two parts:

Theoretical part - includes 3-5 questions regarding the principles of technical drawing, standards, projection methods, and interpretation of technical documentation.

Practical part - requires the execution of 2-3 technical drawings according to specified requirements, including projections, sections, or dimensioning.

Projects - The grade is awarded based on the accuracy and completeness of completed project assignments. The evaluation criteria include:

Compliance of the drawing with technical standards,

Accuracy of projection, dimensioning, and annotations,

Aesthetics and clarity of drawings.

Exercises - The grade is based on the systematic completion of practical exercises and verification of the accuracy of technical drawings. The evaluation criteria include:

Compliance of drawings with technical standards and projection principles,

Accuracy and precision of freehand drawings,

Correctness of dimensioning and application of annotations,

Aesthetics and clarity of drawings,

Technical accuracy of executed sketches,  
Timeliness and engagement in completing exercises.

## Programme content

- Introduction to Technical Drawing - Importance of drawing in engineering.
- Fundamentals of Technical Drawing - Types of technical drawings, sheet formats, drawing lines, technical lettering.
- Basic Geometric Constructions - Principles and methods.
- Axonometric Projection - Types and application.
- Orthographic Projection - Principles of orthographic projection, classification of views, sections, and cross-sections.
- Dimensioning of Technical Drawings - General dimensioning principles, methods of notation, dimensioning of typical elements.
- Tolerances and Fits - Dimensional tolerances, fit types, and applications.
- Surface Roughness - Roughness parameters, notation on drawings.
- Representation of Objects in Orthographic Views - Simple and complex object projections.
- Assembly Drawing - Functions and features of assembly drawings, notation of components, bill of materials.
- Thread Representation and Dimensioning - Basics, principles of drawing and dimensioning threads, detailed drawings of threaded parts.
- Shaft-Type Components - Basics, centering holes, machining reliefs, splined elements, grooves, and other shaft details, technical drawings of shafts.
- Machine Bearings - Introduction, principles of drawing rolling bearings.
- Welds and Welded Joints - Basics, drawing and dimensioning welds, technical drawings of welded components.
- Other Mechanical Joints - Soldered, adhesive, welded, riveted, dowel, key, spline, ring, spring, and threaded connections.
- Springs - General rules for drawing springs, technical drawings of springs.
- Wheel-Type Components - Construction elements of machine wheels, technical drawings of gears, introduction to spur gears, gear geometry, principles of gear representation, technical drawing of spur gears.
- Mechanical Transmissions - Introduction, principles of drawing gear transmissions, chain drives, and ratchet mechanisms.

## Course topics

Lecture:

### 1. Standardized Elements of Technical Drawing and Projection Methods:

- o Types and formats of drawings,
- o Types of drawing lines,
- o Technical lettering,
- o Drawing scales,
- o Elements of a technical drawing,
- o Projection methods,
- o Kinematic diagrams.

### 2. Drawing Objects - Views:

- o Breaking and shortening objects,
- o Offset view,
- o Full and partial view,
- o Symmetrical elements,
- o Axonometry and isometry.

### 3. Drawing Objects - Sections and Detail Views:

- o Section vs. detail view,
- o Simple sections,
- o Sections with parallel planes,
- o Partial section (break-out),
- o Half-view, half-section,
- o Hatching rules,
- o Local and offset sections.

4. Dimensioning:

- o Dimensioning principles,
- o Drawing dimensions,
- o Baseline dimensioning,
- o Chain dimensioning,
- o Dimensioning holes,
- o Dimensioning simplifications,
- o Dimensioning symmetrical objects.

5. Drawing Common Machine Elements:

- o Drawing threaded connections,
- o Drawing welded joints,
- o Drawing key and spline joints,
- o Drawing gears,
- o Drawing bearings.

6. Drawing Schematics and Diagrams:

- o Electrical technical drawing,
- o Pneumatic and hydraulic schematics,
- o Graphs and diagrams.

7. Reading Technical Documentation:

- o Analysis of sample manufacturing and assembly documentation.

8. Final Assessment.

Tutorials:

1. Orthographic Projection:

- o Instructor-led solution of example problems on the board with discussion, followed by individual student exercises with instructor consultation:

Draw six orthographic views of a given solid (Task 1),

Draw the necessary number of views for a given solid (Task 2).

2. Orthographic Projection:

- o Instructor-led solution of example problems on the board with discussion, followed by individual student exercises with instructor consultation:

Draw the necessary number of views based on an axonometric drawing (Task 3),

Complete the missing view (Task 4),

Draw the solid in axonometry based on the given orthographic projection (Task 5).

3. Sections and Detail Views:

- o Instructor-led solution of example problems on the board with discussion, followed by individual student exercises with instructor consultation:

Draw a given solid using the necessary number of views and simple sections (Task 6),

Draw the missing section B-B (Task 7).

4. Sections and Detail Views:

- o Instructor-led solution of example problems on the board with discussion, followed by individual student exercises with instructor consultation:

Draw a stepped section (Task 8),

Draw a bushing in half-view, half-section (Task 9),

Draw a lever using detail views and local sections (Task 10).

5. Dimensioning:

- o Instructor-led solution of example problems on the board with discussion, followed by individual student exercises with instructor consultation:

Dimension a plate with holes (Task 11),

Dimension a plate with chamfers (Task 12),

Dimension a shaft (Task 13).

6. Dimensioning:

- o Instructor-led solution of example problems on the board with discussion, followed by individual student exercises with instructor consultation:

Dimension the bushing from Task 9 (Task 14),

Dimension the lever from Task 10 (Task 15),

Dimension the solid with a simple section from Task 6 (Task 16).

7. Consultation Sessions.

8. Final Assessment.

Projects:

1. Detailed Drawing of a Shaft:

- o Create a detailed drawing of a shaft based on project table data,
- o Create an assembly drawing of a key and spline joint.
- 2. Detailed Drawing of a Gear and Pulley:
  - o Create a detailed drawing of a gear based on project table data,
  - o Create a detailed drawing of a pulley according to project table data.
- 3. Detailed Drawings of Threaded Elements and Their Joints:
  - o Create a detailed drawing of an external thread element (bolt),
  - o Create a detailed drawing of an internal thread element (nut),
  - o Create an assembly drawing of a bolt-nut connection.
- 4. Assembly Drawing of a Threaded Connection:
  - o Create an assembly drawing of a sheet metal threaded connection based on a simplified schematic.
- 5. Detailed Drawing of a Welded Structure:
  - o Create a manufacturing and assembly drawing of a gearbox housing.
- 6. Assembly Drawing of a Bearing-Supported Shaft:
  - o Select standardized components (bearings, retaining rings, bearing nuts, sealing rings),
  - o Create an assembly drawing of the shaft (from Exercise 1), gear and pulley (from Exercise 2), and selected components.
- 7. Consultation Sessions.
- 8. Final Assessment (Submission of Projects).

## Teaching methods

1. Lecture:
  - o Multimedia presentation supplemented with examples explained on the board.
  - o Discussion of technical standards and projection principles using illustrations and diagrams.
  - o Analysis of technical drawing examples applied in engineering practice.
  - o Problem-based discussion on the interpretation of technical documentation.
2. Exercises:
  - o Creating technical sketches based on given guidelines.
  - o Practical exercises in orthographic projection, sections, dimensioning, and annotations.
  - o Correction and analysis of completed drawings with a discussion of common mistakes.
  - o Individual and group work on technical drawings under the supervision of the instructor.
3. Project:
  - o Development of complete technical documentation for a selected mechanical component or assembly.
  - o Creation of detailed and assembly drawings in compliance with applicable standards.
  - o Presentation of completed projects, discussion of assumptions, and verification of accuracy.

## Bibliography

### Basic:

1. Lewandowski T., Rysunek techniczny dla mechaników, WSiP, W-wa 2014r.
2. Dobrzański T., Rysunek techniczny maszynowy, WNT, W-wa 2019r.
3. Bajkowski J., Podstawy zapisu konstrukcji, Oficyna Wyd. Polit. Warszawskiej, 2014
4. Macko M., Rysunek techniczny maszynowy dla automatyków i mechatroników. Warszawa: Wydawnictwo Naukowe PWN. ISBN: 978-83-01-22298-0. 2021r.
5. Kiciak P., Podstawy modelowania krzywych i powierzchni: zastosowania w grafice komputerowej, Warszawa, WNT 2000.

### Additional:

1. Bober A, Dudziak M., Zapis konstrukcji, PWN, W-wa 1999.
2. Dudziak Marian, Krawiec Piotr, Wspomaganie projektowania i zapisu konstrukcji, Wydawnictwo PWSZ w Kaliszu, 2012.

## Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00