# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Computer-aided design [S1IZarz1E>KPK]

## Course

Field of study
Engineering Management

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

## Number of credit points

4,00

## Coordinators

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## Lecturers

## Prerequisites

Knowledge of physics (mechanics in the field of: statics, kinematics and dynamics), mathematics, after passing as part of the study program. Ability to solve problems with the basics of machine design based on knowledge and the ability to obtain information from specified sources. Awareness of the need to expand their competences, readiness to cooperate within a team.

## Course objective

1. Providing students with knowledge of the basics of machine design, to the extent specified by the curriculum content appropriate to the field of study. 2. Developing students' skills: - calculating and designing machine components and assemblies, - documenting and reading technical documentation based on acquired knowledge in the field of machine engineering graphics, - practical use of knowledge gained in the subjects of mechanics, strength of materials, machine science, material science. 3. Developing teamwork skills in students

## Course-related learning outcomes

Knowledge:
The student describes the basic principles of the design process and elements of the construction mechanism. [P6S_WG_16]
The student defines types of loads and formulates appropriate strength conditions. [P6S_WG_16]
The student names different types of connections, such as soldered, welded, brazed, glued, riveted, keyed, pinned, and threaded, and explains their applications and structural calculations. [P6S_WG_16]
The student characterizes compliant elements, such as springs and rubber compliant elements, and explains their role in constructions. [P6S_WG_16]
The student recognizes the structure of a machine's drive system, functions of transmissions, couplings, and basic drive parameters. [P6S_WG_14]
The student names various types of gearings, such as spur gears, bevel gears, worm gears, planetary gears, and others, and explains their operating principles, parameters, and applications. [P6S_WG_14]

Skills:
The student plans and conducts experiments, including measurements and computer simulations, interpreting the results and drawing conclusions in the context of structural design. [P6S_UW_09]
The student uses analytical, simulation, and experimental methods to formulate and solve engineering tasks related to constructions. [P6S_UW_10]

Social competences:
The student seeks and selects educational and training centers to supplement and improve knowledge and skills in the field of structural design. [P6S_KK_01]
The student is aware that creating products that satisfy user needs requires a systemic approach considering technical, economic, marketing, legal, organizational, and financial issues. [P6S_KO_02]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam from lecture, test from classes.

## Programme content

Lecture:
Basic principles of the construction process, mechanism elements, characteristics of load types, defining loads and formulating appropriate strength conditions.
Connections and their calculation
Vulnerable elements
The structure of the machine's drive system
Exercises:
Basics of material strength
An example process of designing a machine node. Preparation of technical documentation. Connection design

## Course topics

Connections and their
calculation: soldered, welded, pressure welded, glued, riveted connections, shaped connections: key, spline, pin, spigot and threaded connections. Screw mechanisms: examples and applications, structural calculations. Flexible components: springs, flexible rubber components.
The structure of the machine's propulsion system, gears and clutches functions, basic parameters of the drive, types of drives, kinematic diagrams. Clutch breakdown, design and application overview. System start with clutch. Clutches: permanent, controlled, flexible, overload. Calculation of couplings and selection rules from catalogs. General distribution of gears, kinematic diagrams, structure review, basic parameters. Gear selection rules, calculation of gear ratios and moments Toothed gears: classification, meshing principle, tooth outline. Helical gears: meshing geometry, kinematics, geom parameters. wheels, inter-tooth force, base of structure. Bevel gears, systems, teeth variations, wheel geometrical parameters, inter-tooth force. Stress condition in gear teeth of gears. Design calculations of front gears. Worm gears, geometry, kinematics. Planetary gears, construction examples. General characteristics of belt transmissions, forces and stresses in belt tendons, transmitted power and transmission efficiency. Calculation and selection of design features of belt transmissions. Chain gears. Friction gears, selection

of materials for wheels, slips, efficiency. Helical-ball gears, types, load capacity, efficiency, examples of structures, selection of structural features.
Tutorials:
Basics of the strength of materials, determining the allowable stress. Example of design process of the machine assembly. Elaboration of technical documentation. Designing of welded joints. Designing of riveted joints. Designing of pin and spigot connections. Designing of key and splined connections. Designing of threaded joints and screw mechanisms. Designing of the drive shafts along with its bearing and selection of the clutch.

## Teaching methods

Informative lecture, problem lecture.
Exercise method (subject exercises, exercises) - in the form of auditorium exercises.

## Bibliography

Basic:
1. Praca zbiorowa pod red. Z. Osińskiego, Podstawy konstrukcji maszyn, PWN, W-wa, 1999.
2. Praca zbiorowa pod red. M. Dietricha: Podstawy konstrukcji maszyn. Tom 3, WNT, Wa-wa, 1999.
3. Osiński Zbigniew, Sprzęgła, PWN, Warszawa 1998.
4. Dziama A., Michniewicz M., Niedźwiedzki A.: Przekładnie zębate. PWN, Wa-wa, 1989.
5. Ochęduszko K.: Koła zębate, WNT 1985.
6. Dudziak M.: Przekładnie cięgnowe. PWN, Warszawa, 1997.
7. J. Żółtowski, Podstawy Konstrukcji Maszyn, Oficyna Wydawnicza Politechniki Warszawskiej, 2002.
8. R. Knosala, A. Gwiazda, A. Baier, P. Gendarz, Podstawy Konstrukcji Maszyn, WNT, Warszawa 2000.
9. A. Dziurski, L. Kania, A. Kasprzycki, E. Mazanek, Przykłady obliczeń z Podstawy Konstrukcji Maszyn, Tom 1 i 2, WNT, Warszawa 2005.

Additional:
1. Niemann G., Maschinenelemente t. I, II, III, Springer Verlag Berlin, 1965.
2. Müller L., Przekładnie obiegowe, PWN, Warszawa, 1983.
3. Bahl G., Beitz W., Nauka konstruowania, WNT, Warszawa 1984.
4. Dietrich M., Podstawy konstrukcji maszyn, Wydawnictwo Naukowo Techniczne 1995.
5. Niezgodziński M. E., Niezgodziński T., Wzory, wykresy i tablice wytrzymałościowe, Wydawnictwo Naukowo Techniczne, 1996.
6. Sempruch J., Piątkowski T., Podstawy konstrukcji maszyn z CAD, Piła, Państwowa Wyższa Szkoła zawodowa w Pile, 2006.
7. Bhandari V. B.: Design of Machine Elements, 3rd Edition 2010, published by TATA McGraw-Hill Publishing Company Limited.
8. Bhandari V. B.: Introduction to Machine Design, 2nd Edition 2013, published by TATA McGraw-Hill Publishing Company Limited.
9. Budynas R. G., Keith J Nisbett K. J.: Shigley's Mechanical Engineering Design, McGraw-Hill Higher Education; 9 edition, 2011.
10. Collins J. A., Busby H. R., Staab G. H.: Mechanical Design of Machine Elements and Machines, John Wiley & Sons; 2nd Edition, 2009.

## 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 |