COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of machine design [S1Mech2>PKM2]

Course

Field of study
Mechatronics

Year/Semester
2/4

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

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Knowledge of technical drawing, technical mechanics, introduction to mechatronics, construction materials, mathematics and physics, design of detachable and inseparable connections, identification of machine parts. Skills: Ability to sketch the concept of machine parts, simple mechanisms, determine the method of securing and loading parts, propose materials for machine parts, calculate permanent and detachable connections, apply tolerances and fits in machine construction. Social competences: Understanding the need to expand one's competences, readiness to cooperate within a team.

Course objective

The aim of the course is to familiarize the student with the basics of machine design in the field of axles and shafts, rolling and sliding bearings, mechanical transmissions, clutches and brakes.

Course-related learning outcomes

Knowledge:
Knows axles and shafts, sliding and rolling bearings, mechanical transmissions, clutches and brakes.

Skills:
Can calculate and design axes and shafts.
Can select bearings.
Is able to select mechanical transmissions and clutches.

Social competences:
Understands the need for lifelong learning; can inspire and organize the learning process of other people.
Able to cooperate and work in a group, taking on various roles.
Is able to set priorities for the implementation of tasks specified by himself or others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Written exam containing 3 theoretical questions and 2 practical tasks. Duration: 90 minutes.
Assessment criteria: 2 points for each theoretical question, 3 points for each task, points are awarded with an accuracy of 0.5 points, a total of 12 points can be obtained.
Rating scale: below 50% - 2.0, from 50% - 3.0, from 60% - 3.5, from 70% - 4.0, from 80% - 4.5, from 90% - 5.0.
Tutorials: Written assessment of exercises during the last classes, containing from 3 to 5 computational tasks. Duration: 90 minutes.
Assessment criteria: for each task there is a specific number of points to be scored (from 1 to 2 points), points are awarded with an accuracy of 0.25 points, a total of 5 points can be obtained.
Rating scale: up to 50% - 2.0, from 51% - 3.0, from 61% - 3.5, from 71% - 4.0, from 81% - 4.5, from 91% - 5.0.
Project: Design of a screw mechanism (calculations, 3D model, manufacturing drawings and assembly drawing) in accordance with the design data received by the teacher during the first class. The project is carried out individually. Ongoing verification of the progress of design work.
Assessment criteria: the project is presented to the teacher during the last class and submitted to the teacher in paper form. The final grade is the result of the grade from the project presentation (25% of the grade) and the substantive grade from the completed project (75% of the grade).

Programme content

Design of shafts and axles, selection of plain and rolling bearings, design of screw mechanisms, mechanical transmissions, selection of clutches and brakes.

Course topics

Lectures:
Lecture 1 (2) - Shafts and axles
Characteristics, calculations and design of axles and shafts.
Lecture 2 (2) - Sliding bearings
Characteristics, division, selection of sliding bearings
Lecture 3 (2) - Rolling bearings
Characteristics, division, selection of rolling bearings
Lecture 4 (2) - Mechanical gears - gears
Characteristics, division, calculations and selection of gears.
Lecture 5 (2) - Mechanical transmissions - gears
Characteristics, division, calculations and selection of gears.
Lecture 6 (2) - Mechanical transmissions - friction and cable
Characteristics, division, calculations and selection of cable and friction gears.
Lecture 7 (2) - Clutches
Characteristics, division and selection of clutches.
Lecture 8 (1) - Brakes
Characteristics and selection of brakes.
Tutorials:
Tutorial 1 (2) - The process of designing machine nodes on the example of a flange coupling
Stages of the design process, scheme for solving PKM tasks, determining the permissible stress, selecting elements/dimensions from standards and tables, designing a disc clutch - threaded connection

+ keyed connection (task 1).
Tutorial 2 (2) - Design of threaded connections and screw mechanisms
Two-socket screw connection, loose fit (task 2), calculation of the friction moment on the screw (task 3), calculation of the nut height (task 4), calculation of the screw's buckling resistance (task 5).
Tutorial 3 (2) - Design of hub-shaft connections
Calculation of a keyway connection (task 6), calculation of a spline connection (task 7), calculation of a radial pin connection (task 8).
Tutorial 4 (2) - Design of hinged connections
Calculation of a loose-fit fork pin connection (task 9), calculation of a tight-fit fork pin connection (task 10).
Tutorial 5 (2) - Design of welded joints
Calculation of the front connection with overlays (task 11), calculation of the welded angle connection (task 12), calculation of the welded bending bracket (task 13).
Tutorial 6 (2) - Design of riveted joints
Calculation of a tensile riveted connection (task 14), calculation of a bending riveted connection (task 15).
Tutorial 7 (1) - Design of welded and glued joints
Calculation of the spot weld (task 16), calculation of the butt weld of the lathe tool (task 17), calculation of the shaft-hub glued connection (task 18).
Tutorial 8 (2) - Assessment
Projects:
Project 1 (2) - Discussion and distribution of project topics
Determining the project input data, assigning the project type: (vise, lift, press, gripper, bearing extractor), discussion of individual project stages.
Project 2 (2) - Bolt and nut design
Strength calculations of the bolt (buckling, compression + torsion) and nut (contact stresses).
Project 3 (2) - Design of the body and cooperating elements
Calculations of welded joints in the body, calculations of connectors locking the nut, calculation of the connection of the driving crank with the screw.
Project 4 (2) - Creation of a 3D model - parts
Creation of 3D models of all designed parts.
Project 5 (2) - Creation of a 3D model - assembly
Assembling previously designed parts and standardized elements into the designed screw mechanism.
Project 6 (2) - Development of 2D documentation of the designed mechanism
Development of manufacturing drawings of the designed parts, development of an assembly drawing of the designed mechanism.
Project 7 (1) - Project consultations.
Project 8 (2) - Passing the project.

Teaching methods

Lecture: Lecture with multimedia presentation, using the case study method - analysis of solutions to real construction problems.
Tutorials: Blackboard exercises supported by a multimedia presentation, using the case study method - analysis of solutions to real construction problems.
Project: Workshop methods for practical construction classes. Project methods.

Bibliography

Basic:
1. Zbigniew Osiński, Podstawy Konstrukcji Maszyn, Wydawnictwo Naukowe PWN, 2017.
2. Antoni Skoć, Jakub Pałek, Podstawy Konstrukcji Maszyn, Tom 1, 2, 3, Wydawnictwo Naukowe PWN.
3. Marek Dietrich, Podstawy Konstrukcji Maszyn, Tom 1, 2, 3, Wydawnictwo Naukowe PWN, 2017.

Additional:
1. Leonid Kurmaz, Projektowanie węzłów i części maszyn, Wydaw. Politechniki Świętokrzyskiej, Kielce 2007.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	28	1,00