COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mechanical Engineering Design [S2MwT1>PKM]

Course

Field of study
Mathematics in Technology

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Student should have basic knowledge of mathematics, strength of materials, engineering drawing. Moreover, should have skills of solving basic problems in the field of mechanics of solid body, solving elementary tasks in geometry and calculus as well as skills to extract information from literature, data bases and catalogues.

Course objective

To present the basic rules of design and typical parts of machines. To show in a comprehensible way the selected problems of mechanical engineering design. To indicate constraints typical for engineering design owing to safety, reliability, regulations and norms. The review of basic models of joints used in the design of machine parts and theirs assemblies. To point out the economic and ecological aspects of engineering. To take note of the attainable set of solutions and optimal solution of the task. To enlighten the complexity of the design process and the necessity of systemic approach.

Course-related learning outcomes

Knowledge:
1. Has knowledge of mathematical modelling in engineering science.

2. Has knowledge related with design, structure, principle of operation and exploitation of appliances and machines; knows and understand the processes occurring during theirs live cycle.
3. Has knowledge in engineering calculations covering the strength of materials giving the possibility to determine the geometrical properties of machine elements.
4. Has knowledge of ecological aspects of engineering design including rational material usage and the recycling process.

Skills:
1. Is able to construct and analyse simple mathematical models of the basic structural elements.
2. Is able to conduct simple structural calculations of individual machine elements.
3. Is able to select normalised machine elements from catalogs based on previously conducted structural calculations.

Social competences:
1. Understands the importance of normalization and unification in mechanical engineering design.
2. Understands the impact of the designer"s work on the functioning and shaping of society.
3. Understands the complexity of the design process and the necessity of the team work to realize the process.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture – one colloquium at the end of the semester covering the knowledge presented in lectures; the condition to get a positive grade is to obtain at least 50 % points.
Tutorials – two colloquiums verifying the understanding of mathematical models of joints and machine elements and verifying the ability to use these models in engineering tasks.

Programme content

Introduction: explaining the importance of the machine engineering design in a modern technical knowledge; classification of machines; limitations and constraints in the design process; fatigue failure; tolerances;
Engineering materials: characteristic and mechanical properties of metals, polymers and ceramics; modern materials – light alloys, nanomaterials, metal foams, composites; experimental techniques in materials.
Shaping of structural elements: strength, stiffness and stability constraints.
Joints: general characteristic of permanent and non-permanent joints (welded, riveted, bonded, screwed etc.); mathematical models of selected joints and design procedures.
Springs and energy absorbers: types of springs; examples of usage of different types of springs; spring rate; design of helical springs; analysis of a simple energy absorber.
Shafts and axes: general description and design approaches to shaft design; strength and stiffness of shafts; analytical method of determining the diameter of the shaft.
Bearings: description of friction phenomenon; design of friction bearing; classification and selection procedure of rolling bearing – load, life and reliability.
Gears: types of gears and teeth wheels; nomenclature of spur-gear teeth; involute and its properties; gear forces; stress in gear teeth; Hertz contact stress; friction gears; chain and belt transmission; types of belts; stress in a flat belt.
Power transmission system: elements of power transmission system; clutches – basic functions, principle of operation, types and structure of clutches; brakes – basic function, classification and structure.
Summary: problem of vibration and noise; occupational diseases; ecological aspects of engineering.

Teaching methods

Lectures:
- lecture with multimedia presentation containing figures and pictures supported with examples presented on the blackboard
- the theory is presented in close relation with practice
- different aspects of presented problems are included e.g. economic, ecological, legal, social, etc.

- during the lecture the discussion with students is initiated
Tutorials:
- solving exemplary problems on the blackboard
- tutorials are complemented with multimedia presentations containing figures and pictures
- the discussion is initiated on the obtained solutions of presented problems

Bibliography

Basic
1. Magnucki K., Jasion P.: Podstawy konstrukcji maszyn. Wydawnictwo Politechniki Poznańskiej, 2016
2. Dietrich M. (red.): Podstawy konstrukcji maszyn. Warszawa, WNT, 2015
3. Osiński Z. (red.): Podstawy konstrukcji maszyn. Warszawa, Wyd. Naukowe PWN, 2012
Additional
1. Rutkowski A.: Części maszyn. Warszawa, WSiP, 2003
2. Mazanek E. (red.): Przykłady obliczeń z podstaw konstrukcji maszyn. Warszawa, WNT, 2012
3. Skoć A., Spałek J.: Podstawy konstrukcji maszyn. Warszawa, WNT, 2006
4. Shigley J.E., Mischke C.R., Budynas R.G.: Mechanical engineering design. McGraw-Hill, 2004

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,00
Classes requiring direct contact with the teacher	34	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	26	1,00