COURSE DESCRIPTION CARD - SYLLABUS

Course name
Theory of mechanisms and elements of numerical analysis [S1MiBM2>TMEAN]

Course

Field of study
Mechanical Engineering

Year/Semester
2/3

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
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of physics and knowledge of mechanics including statics, kinematics of a material point, rotary motion, planar motion, complex motion, dynamics of rotary motion and planar motion. In-depth knowledge in advanced mathematics including algebra, trigonometry, vector calculus, differential calculus, integral calculus, necessary to describe the physical phenomena accompanying machine operation.

Course objective

To obtain knowledge of the theory of machines and mechanisms needed to solve technical problems related to the design, construction and operation of machines.

Course-related learning outcomes

Knowledge:
1. The student is able to explain the importance of structural analysis of mechanisms, apply physical laws to describe and analyze the motion of mechanisms, formulate the principles of motion transfer and forces in machines, analyze the motion of machines under the action of forces.
2. The student is able to explain the limitations of the simplified mathematical models used to describe the operation of machines and indicate their potential effects, make a critical analysis of theoretical

calculations.
3. The student is able to use computer programs that support kinematic and dynamic analysis of mechanical systems.
4. The student is able to indicate the current directions of development of the theory of machines and mechanisms and the current directions of development of computer programs supporting kinematic and dynamic analysis of complex mechanical systems.
5. The student is able to apply the scientific method in solving technical problems related to the design and operation of machinery, adapt the knowledge and methodology of mechanism theory, as well as applied theoretical methods to related scientific disciplines.

Skills:
1. The student is able to find the necessary information in the literature, both from databases and other sources; is able to reproduce the reasoning described in the literature, taking into account the assumptions and approximations made.
2. The student uses appropriate analytical and simulation methods to formulate and solve engineering tasks.
3. The student communicates effectively with both specialists and non-specialists on a given subject matter.
4. The student identifies directions for further improvement of knowledge and skills (including self-education) in the field of theory of machines and mechanisms.

Social competences:
1. The student understands the need for lifelong learning; inspiring and organizing the learning process of others.
2. The student is aware of the benefits of engineering knowledge for society.
3. The student understands of the need to formulate and communicate information and opinions to society regarding engineering achievements.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Credit on the basis of a colloquium (5 points), project (4 points) and presence on the lecutres (1 point) .
Depending on the number of points received, a grade is obtained: <5 - ndst, 6 - dst, 7 - dst+, 8 - db, 9 - db+, 10 - bdb. The colloquium is conducted at the end
of the semester.
Laboratory:
written test; 4 problems to be solved individually . Grade scale: <50% - 2.0; 50%-60% - 3.0; 60% - 70% - 3.5; 70% - 80% - 4.0; 80% - 90% - 4.5; 90% - 100% - 5.0

Programme content

Mechanism Theory: Basic methods of testing the structure of mechanisms. Kinematic analysis of lever mechanisms - determination of positions, velocities and accelerations of links and points of mechanisms. Selected issues of machine dynamics: total compensating torque, flywheel and balancing. Selected methods of synthesis of planar and cam mechanisms.
Elements of numerical analysis: Application of computational methods to solving engineering problems.

Course topics

Lecture
1.Basic definitions. Structure of mechanisms. Classification of kinematic pairs.Classifications of mechanisms. The mobility of mechanisms.
2.Kinematics of lever mechanisms: articulated quadrilateral, crank-crank mechanism, yoke mechanism.
3.Determination of the balancing torque and power of the drive motor. Selection of the flywheel.
4.Balancing of lever mechanisms.
5.Planetary gears, wave gears.
6.Introduction to the synthesis of cam and lever mechanisms.
Laboratory:
Introduction - numbers and calculations using computers

Least square approximations
Numerical methods for solving nonlinear equations
Namerical intergation
Interpolations
Deterministic chaos - introduction
Solving of initial-value problems

Teaching methods

1. Lecture: presentation illustrated by examples given on the blackboard, solving tasks, presentation of solutions to problems in programs for numerical and symbolic calculations.
2. Laboratory: Multimedia presentation; conducting research involving the modeling and computer simulation of engineering problems; presentation of results and students' practical activities; discussion

Bibliography

Basic:
1. Teoria Maszyn i Mechanizmów, Parszewski Z., WNT, Warszawa, 1983. [in Polish]
2. Teoria mechanizmów i manipulatorów. Podstawy i przykłady zastosowań w praktyce, Morecki A.; Knapczyk J., Kędzior J., WNT, Warszawa, 2001. [in Polish
3. Stoer: Metody numeryczne [In Polish]
4. M. M. Jankowscy: Przegląd metod numerycznych [In Polish]
5. A. Uscilowska: Przegląd metod numerycznych [In Polish]
6. Burden R. L., Faires J. D., Numerical Analysis

Additional:
1. Mechanism Design: Analysis & Synthesis. A.G. Erdman, G.N. Sandor, & S. Kota 4th Ed. (Web Enhanced), Volume I, Prentice-Hall, 2001 [in Polish]
2. Kinematics and Mechanism Design, Suh C. H. Radcliffe C. W., Wiley, New York, 1978 [in Polish]

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00