COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fundamentals of Computer Aided Vehicle Design [S1MiBP1>PKWPP]

Course

Field of study
Mechanical and Automotive Engineering

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
45

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of applied mechanics and material strength. Approximation and interpolation. Discretization of continuous issues. Knowledge of the basic computational methods of algebra. Basic practice in computer skills, and running computer programs in the scope of numerical methods. Understanding the need to use numerical methods and evaluate their properties (accuracy, stability). The ability to correctly select numerical methods, to estimate the effects of their application, to quantify and qualify the results, and to relate these results to real conditions.

Course objective

A simple and demonstrative introduction to the basic issues related to computer calculations in the field of mechanics and strength of structures, with particular reference to motor vehicles. Explanation of the similarities and differences in the analysis of continuous and discrete systems, together with a description of the methods and effects of appropriate transformations.

Course-related learning outcomes

Knowledge:
M1_W04 Has ordered basic knowledge of the main divisions of technical mechanics: statics, kinematics

and dynamics of a material point and a rigid body.
M1_W11 Has basic knowledge of the strength of materials, including the basics of the theory of elasticity and plasticity, stress hypotheses, calculation methods for beams, membranes, shafts, joints and other simple structural elements, as well as methods of testing the strength of materials and the state of deformation and stress in mechanical structures.
M1_W12 Has elementary knowledge of the basics of computer science, i.e. computer architecture, binary, decimal and hexadecimal counting system, representation of numbers and graphic characters in computer memory, variable types, general knowledge of low, medium and high level languages used in computer programming, operating systems , databases, RAD development environments, and typical engineering applications.

Skills:
M1_U05 Can use integrated with the packages for spatial modeling, programs for the calculation of mechanical structures by the finite element method and correctly interpret their results.
M1_U16 Can create a system diagram, select elements and perform basic calculations using ready-made computational packages of mechanical, hydrostatic, electric or hybrid machine drive system.
M1_U17 Can perform strength calculations of simple frames and load-bearing structures of machines using elementary strength theories.

Social competences:
M1_K02 Is ready to recognize the importance of knowledge in solving cognitive and practical problems and to consult experts in case of difficulties in solving the problem on its own.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Written credit for lectures (colloquium), and credit for laboratory classes based on the results of project tasks.

Programme content

Mathematical equations in the description of real physical phenomena and processes. Classification of first and second order differential equations in the descriptions of mechanics. Stationary and evolutionary (dynamic) problems. The importance of using computational methods.
Modelling and simulation in mechanics. Meaning and understanding of boundary and initial conditions. Descriptions of mechanics on a continuous and discrete level. Approximative methods for solving systems of differential equations. Transformation of continuous descriptions into discrete forms - types of discretization and approximation of mechanics. Discretization methods - global, local and super-local methods. Discussion of selected methods: finite difference method (FDM), finite element method (FEM), boundary element method (BEM) and finite volume method (FVM).
Creation of local matrices of coefficients and aggregation of these matrices. Discussion of the operation diagrams of individual methods on example implementations: statics of truss systems (FEM), one-dimensional heat flow (MRS), air flow (aerodynamics) and macroscopic description of road traffic (MOS). Methods for solving the resulting systems of algebraic equations. Interpretation of the results along with the generalization of their discrete forms to a continuous level. Application of particular computational methods in vehicle design.

Teaching methods

1. Lecture: multimedia presentation. 2. Laboratory classes: conducting computer simulations of simplified vehicle models in the field of structural mechanics.

Bibliography

Basic
1. Łodygowski T., Kąkol W., Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich, WPP 1994, Poznań
2. Kleiber M., Wprowadzenie do metody elementów skończonych, WPP 1984, Poznań
3. Kleiber M., Numeryczna analiza statycznych i dynamicznych zagadnień stateczności konstrukcji, WPP 1987, Poznań

4. Zienkiewicz O.C., Metoda elementów skończonych, Arkady 1972, Warszawa
Additional
1. Saouma, V.E., Matrix structural analysis, with an introduction to finite elements, University of Colorado, 1999

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	2,00