COURSE DESCRIPTION CARD - SYLLABUS

Course name
Frames and load-bearing structures part 2 [S1MiBP1>RiKN2]

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
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Theoretical and practical information in the field of construction of supporting structures of working machines, construction of currently used mechanical connections, basic methods of computer aided design of frame systems. Knowledge of the principles of structural mechanics (statics, stability and dynamics). Skills: The ability to design frame structures and load-bearing structures in traditional engineering terms. Basic practice in handling computational systems based on the finite element method, allowing for the development and numerical solution of spatial computational models of supporting structures, taking into account the actual connections and contacts. Social competences: The ability to independently formulate problems of mechanical analysis of a structure and to resolve related dilemmas. The ability to correctly plan and timely perform activities in the implementation of computational projects.

Course objective

Provide students with knowledge on: theoretical foundations and the implementation of numerical computational methods intended for modeling load-bearing systems of working machines and their static, stability, dynamic analysis in the linear and non-linear range, as well as the principles of inference regarding the strength and durability of structures.

Course-related learning outcomes

Knowledge:
Has basic, ordered knowledge of metal materials used in mechanical engineering, such as alloys of iron, aluminum, copper, etc. used in machine building, and in particular about their structure, properties, methods of production, heat and thermo-chemical treatment and the impact of plastic working on them strength.
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.
Has basic knowledge of manufacturing techniques used in the engineering industry, such as casting, forming, reducing and incremental machining, welding and other joining techniques, cutting, coating and surface treatments.

Skills:
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.
Can perform basic functional and strength calculations of machine elements such as traction, gear, friction, bearings, rolling and sliding gears, clutches, brakes.
Can perform strength calculations of simple frames and load-bearing structures of machines using elementary strength theories.

Social competences:
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.
Is willing to think and act in an entrepreneurial manner.
Is ready to fulfill professional roles responsibly, including:
- observing the rules of professional ethics and requiring this from others,
- caring for the achievements and traditions of the profession.

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 on the lecture material and credit exercises based on computational analyzes of subassemblies or structural elements found in typical working machines.

Programme content

The importance of using calculation methods in the design of frames and load-bearing structures. Continuous and discrete issues. The transformation of a continuous problem into a discrete problem through discretization and approximation. Calculation methods: finite difference method (MRS), finite element method (FEM), boundary element method (MEB) and finite volume method (MOS).
Static calculations using FEM. Review of finite elements: volumetric, surface and linear. The course of static analysis. Methods for solving systems of linear equations: direct and iterative.
Stability calculations using FEM. The idea of bifurcation. Initial stability. Generalized eigenstability problem. The course of bifurcation analysis.
Dynamic calculations using FEM. Equation of dynamics at the discrete level.

Course topics

none

Teaching methods

Performing a model of the load-bearing structure and carrying out strength calculations using the available FEM system.

Bibliography

Basic
1. Kleiber M., Wprowadzenie do metody elementów skończonych, Poznań, WPP 1984

2. Kleiber M., Numeryczna analiza statycznych i dynamicznych zagadnień stateczności konstrukcji, Poznań, WPP 1987
3. Łodygowski T., Kąkol W., Metoda elementów skończonych w wybranych zagadnieniach mechaniki konstrukcji inżynierskich, Poznań, WPP 1994
4. Praca zbiorowa pod red. Zabrodzkiego J.: Grafika komputerowa. Metody i narzędzia. WN-T, Warszawa, 1994.
5. Kruszewski J., Sawiak S., WittbrodtL.: Wspomaganie komputerowe CAD/CAM. Metoda sztywnych elementów skończonych w dynamice konstrukcji. WN-T, Warszawa, 1999.
6. Perkowski P.: Technika symulacji cyfrowej. WN-T, Warszawa, 1980.
Additional
1. Zienkiewicz O.C.: Metoda elementówskończonych. Arkady, Warszawa, 1972.
2. Weiss S., Giżejowski M.: Stateczność konstrukcji metalowych. Układy prętów. Arkady, Warszawa 1991.
3. Biegus A.: Nośność graniczna stalowych konstrukcji prętowych. Wydawnictwo Naukowe PWN. Warszawa-Wrocław 1997.

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