COURSE DESCRIPTION CARD - SYLLABUS

Course name
CAx systems [S1MNT1>H-SCAx]

Course

Field of study
Mathematics of Modern Technologies

Year/Semester
3/5

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
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

6,00

Coordinators

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Lecturers

Prerequisites

The student starting this course should have basic knowledge of engineering graphics, mechanics, numerical methods and mathematics (especially spatial geometry). Knowledge of the characteristics of mechanical machine tools and their tools (lathe, milling machine, drill, grinder, etc.) would be an advantage. In addition, he should also have the ability to think logically and obtain information from the indicated sources. The ne- cessary element is also the ability to use a computer and graphic programs. Basic knowledge of the English language is also an important element.

Course objective

The aim of the course is to get acquainted with the basic CAx systems (CAD, CAM, CAE). CAD system skills are based on creating technical documentation; CAM simulation of the turning and milling process (with elements of drilling, grinding, chiselling, etc.) and the characteristics of creating the necessary machining tools; CAE from the comparison of numerical methods of solving mechanical problems with analytical results.

Course-related learning outcomes

Knowledge:
• knows and understands the relationship between mathematics and other disciplines, including engineering and technical sciences, in particular the use of mathematical tools as a basis for the description of technical phenomena and problems;
• knows and understands sufficiently computer graphics tools, in particular for data visualization or technical drawing;
• knows and understands the theoretical and practical principles concerning the design, construction, operation and operation of devices, systems, etc. and the processes taking place in their life cycle;
• knows and understands the impact of social and civilization changes on the lifestyle of society;
• knows and understands the principles of ergonomics, occupational health and safety;
• knows and understands social / ethical / economic / legal / other non-technical determinants of engineering activity.

Skills:
• can apply knowledge from other disciplines, including the field of engineering and technical sciences in the field of study;
• can use devices, tools, etc. in accordance with general requirements and technical documentation / can apply the principles of occupational health and safety;
• can select the appropriate sources of knowledge and obtain the necessary information as well as make a critical analysis and evaluation of complex engineering solutions and problems;
• can select, analyze, critically evaluate existing technical solutions and research results;
• can formulate an engineering problem, conduct detailed research using analytical / simulation / experimental methods, interpret the obtained results and formulate appropriate conclusions;
• can develop documentation or prepare a presentation along with a multimedia presentation on the implementation of an engineering task, using specialized terminology;
• can work individually and in a team, can estimate the time needed to complete the commissioned task and carry out the task in accordance with the prepared schedule ensuring meeting the deadline;
• can independently plan and educate in order to improve and update their competences.

Social competences:
• is ready for further education due to the awareness of the limitations of his own knowledge;
• is ready to critically evaluate the obtained results of research and analyzes;
• is ready to raise and update its competences in the field of IT tools, in particular the programming language / programming environment / software package;
• is ready to work in a specific position with awareness of responsibility for its effects;
• is ready to fulfill his social role as a graduate of a technical university, including disseminating popular science content to the public, identifying and resolving basic problems related to the field of study and promoting mathematics as a basis for analytical reasoning and precise formulation of correct conclusions.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: the knowledge acquired during the lecture is verified by a written test during the last classes in the semester; the credit consists of several dozen questions (test and calculation), with different scores. Passing threshold: 50% of points
Laboratory classes: laboratory: the acquired skills in the laboratory are verified on the basis of several reports on the content carried out during the classes. Each report is allocated points that ultimately produce a final score according to the following rules:
• 0% -50% - 2.0
• 51% -60% - 3.0
• 61% -70% - 3.5
• 71% -80% - 4.0
• 81% -90% - 4.5
• 91% -100% - 5.0

Programme content

Update: 01.06.2023r.

Lectures:
• the genesis of CAx systems (CAx in the economy, history and development of CAx systems)
• CAx classification (CAD, CAM, CAE, CAP, CAQ, etc.)
• data exchange in CAx systems and their comparison
• derivatives of CAx systems - discussion of other computer support systems
• description, characteristics and application of CAD - computer aided design (creating technical documentation)
• description, characteristics and application of CAM - computer-aided manufacturing (introduction to machining, discussion of basic machining tools and their parameters)
• description, characteristics and application of CAE - computer-aided engineering (static and thermal analysis, basic issues of material strength and the idea of the finite element method)
• description, characteristics and application of CAQ - computer-aided quality control (quality control procedures)
• description, characteristics and application of CAP - computer aided planning (selection of construction materials, tools, machine tools, measuring machines, etc.)
Laboratory classes:
• creating parametric sketches: sketching rules, sketch plane selection, reference selection, drawing and sketch geometry modification commands, dimensioning, constraints, sketch regeneration
• creating operations requiring the use of a sketch - adding or removing material by: 1) extruding the sketch, 2) rotating the sketch around an axis, 3) dragging the sketch along a trajectory, 4) joining sections, etc
• creating features that do not require the use of a sketch, such as: holes (straight, countersunk and threaded), edge fillets and chamfers, shells, etc
• creating auxiliary construction elements, incl. planes, axes and points
• creating technical (two-dimensional) documentation - flat working drawings of parts and assemblies based on spatial models implemented in Inventor
• basics of performing strength analyzes (static analysis based on FEM, in which tensile / compression of bars, torsion of bars and bending of beams will be carried out, etc.)
• selection of construction materials, FEM mesh generation, implementation of hinges, supports and restraints in Inventor
• simulation of machining (selection of cutting tools, implementation of turning and milling stages, cutting parameters, etc.)
Projects/seminars:
• the project consists of the student’s realization of the part manufacturing process, in which the technical documentation should be attached in the form of a technical drawing of the received object, machining process, strength analysis, planning process and quality control

Course topics

The lecture program covers the following topics:
1) classification of CAx systems
2) data exchange in CAx systems
3) derivatives of CAx systems
4) detailed characteristics of CAD, CAM and CAE
5) introduction to the finite element method
6) basic issues of mechanics (statics) and strength of materials (tension, torsion and bending)

The laboratory program covers the following topics:
1) introduction to Inventor - 3D drawing
2) creating technical documentation in Inventor
3) strength analysis in Inventor (tension, torsion and bending) and structural optimization
4) mechanical processing simulation (milling and turning)

The project program covers the following issues:
1) construction assumptions of the object to be analyzed
2) preparation of technical documentation
3) performing strength analysis
4) performing mechanical processing simulations

Teaching methods

Course studies are posted on the eKursy platform, with the possibility of downloading by the student
Lectures: multimedia presentation on the introduction to CAx systems and machining; the computational part performed on the board; interactive lecture with questions to students; performing calculations together
Laboratory classes: jointly performing examples of drawings, simulations and numerical calculations in class on the basis of instructions for classes placed on the eCursy platform before the class; brainstorming on problematic issues
Projects/seminars: consultation classes; discussion of sample projects and problem elements

Bibliography

Basic:
• Z.Brzoska - Wytrzymałość materiałów - PWN - 1983 - Warszawa
• K. Augustyn - EdgeCAM. Komputerowe wspomaganie obróbki skrawaniem - Helion - 2007
• E. Chlebus, Techniki komputerowe CAx w inżynierii produkcji - WNT - 2000
• M. Miecielica, W. Wiśniewski, Komputerowe wspomaganie projektowania procesów technologicznych -PWN/MIKOM - 2005

Additional:
• M. Niezgodziński T.Niezgodziński - Wzory wykresy i tablice wytrzymałościowe - WNT
• J. Misiak - Stateczność konstrukcji prętowych - PWN - 1990 - Warszawa
• M. Niezgodziński T.Niezgodziński - Zadania z wytrzymałości materiałów - WNT - 2006 - Warszawa
• M. Sydo, Wprowadzenie do CAD - PWN/MIKOM - 2009

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	75	3,00