module title: **INTEGRATED CAE SYSTEMS**		
field of study: **Mechanical Engineering**	type of study: **full-time**	course code: **S6_3-12**
course: **Modelling & Simulation in Mechanics**	degree: **Master (MSc)**	year: **II** semester: **III**
type of classes: **lecture, laboratory**	hours per week: **2L, 3Lab**	No of ECTS credits: **5**

MODULE DESCRIPTION

TARGETS

- **T1.** To acquaint students with the scope of existing trends that have found relation in the modern modelling techniques of machine elements.
- **T2.** To acquaint students with the possibilities of automation of the design process through the use of advanced tools parameterization and integration of knowledge and the creation of library of standard parts for example CATIA system.
- **T3.** Acquisition by students the ability to create auto-generated models and library of standard parts for example CATIA system.
- **T4.** Acquisition by students skills for conducting the kinematic, modal and strength analysis using finite element method for the chosen system of CAE.

PREREQUISITES & ADDITIONAL REQUIREMENTS

- **R1.** Basic knowledge about the technical mechanics and strength of materials.
- **R2.** Knowledge of engineering design.
- **R3.** .Knowledge of the principles of design in the basics of construction machinery, knowledge of the standards system of machine elements.
- **R4.** Ability to build parametrical solid and structural models in CAD systems.
- **R5.** Capability of using source literature.
- **R6.** Capability of individual work and collaboration in a group.
- **R7.** Data analysis and presentation of results.

LEARNING OUTCOMES

- **LO1.** Knowledge concerning the advanced parameterization of models, knowledge templates, auto-generated models, libraries of standard parts in relation to the CAE application for example CATIA system.
- **LO2.** Ability to create auto-generated models and standard parts catalogs using CAE programs for example CATIA system.
- **LO3.** Knowledge of the rules of practical application of the numerical methods used in the modal and strength analysis of engineering structures.
- **LO4.** Knowledge of the principles and basic algorithms definition and solution engineering tasks with the use the finite element method.
- **LO5.** Can individually select the analysis method and the way of discretization as well as create a model of engineering object with real geometry of the support structure.
- **LO6.** Ability to self-interpretation of the results, identify sensitive areas designed structure and propose alternative solutions.

MODULE CONTENT

LECTURE	hours
L1-6 - Advanced control of model parameters (rules, checks, reactions, decision tables).	**6**
L7,8 - Creation of knowledge templates in CATIA.	**2**
L9-12 - Stages and methods of construction of the auto-generated model in CATIA.	**4**
L13,14 - Creation of catalogue of standard parts in CATIA.	**2**
L15,16 - The analytical methods of construction analysis: forces method, displacements method.	**2**
L17 - The terminology used in the finite element method.	**1**
L18 - The basic algorithms of engineering structures analysis based on the finite element method.	**1**
L19 - Types and characteristics of the finite elements used in the strength analysis of engineering structures.	**1**
L20 - The typical shape functions of the finite elements.	**1**
L21 - Selection of types of the finite elements to design of the numerical models of machines parts.	**1**
L22 - The material models applied in the strength analysis of structures.	**1**
L23 - The one-dimensional load condition of structural elements.	**1**
L24 - The type of beam finite elements.	**1**
L25 - The plane strain and the plane stress.	**1**
L26 - Interpretation of the results of numerical simulations.	**1**
L27 - The volume elements.	**1**
L28 - Modelling of the contact problems.	**1**
L29,30 - Selected examples of practical applications of the finite element method in the design of engineering structures.	**2**

LABORATORY	hours
Lab1,2 - Adaptation of CATIA system for correct operation with the parametric models	**2**
Lab 3,4 - Construction of parameterized solid model in CATIA	**2**
Lab 5-8 - Creation the relationship between the elements of the model: the rule, check and reactions (CATIA system)	**4**
Lab 9-14 - Construction of the auto-generated model of selected part (CATIA system)	**6**
Lab 15-18 - Creation of standard part catalogue of selected normalized element (CATIA system)	**4**
Lab 19,20 - The comparative implementation of forces method and displacements method in Mathcad system or equivalent	**2**
Lab 21 - The training of basic operation of the ADINA system	**1**
Lab 22,23 - Modelling of objects undergoing the one-dimensional load	**2**
Lab 24,25 - The conditions of plane strain and plane stress in the modelling of machine elements	**2**
Lab 26-29 - Modelling of the engineering object by volume elements (ADINA and CATIA system)	**2**
Lab 30 - Substituting the solid finite elements by the axially symmetric finite elements	**1**
Lab 31-34 - Modelling of the contact zone (ADINA and CATIA system)	**4**
Lab 35 - Determination of the notch coefficient for the selected parts of machine	**1**
Lab 36-45 - Modal and strength analysis of the complex construction that will be discretization by using of different number of nodes for finite elements (ADINA and CATIA system)	**9**

TEACHING TOOLS

1 - lecture with the use of multimedia presentations
2 - computer laboratory, software: Autodesk AutoCAD, Autodesk Inventor, ADINA, CATIA, Mathcad

SOURCE LITERATURE

1.	ADINA: Theory and Modeling Guide. Volume 1: ADINA. ADINA R&D, Inc., Watertown 2012.
2.	Akin J.E.: Finite Element. Analysis Concepts. Via SolidWorks, World Scientific, 2010.
3.	Bathe K.J.: Finite Element Procedures. Prentice-Hall, Inc. Simon & Schuster / A Viacom Company Upper Saddle River. New Jersey 1996.
4.	CATIA Version 5 Release 20, English documentation in HTML format.
5.	Johnson K.L.: Contact Mechanics. Cambridge University Press, Cambridge 2004.
6.	Woyand H.-B.: FEM mit CATIA V5, J. Schlembach Fachverlag Wilburgstetten, 2009.

TEACHERS

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