POLITEHNICA University of Bucharest (**UPB**)
Faculty of Industrial Engineering and Robotics (**FIIR**)
Study Programme: Industrial Engineering (**IE**)
Form of study: Licence (**Bachelor**)

COURSE SPECIFICATION

Course title:	COMPUTER AIDED ENGINEERING	***Semester:***	5
Course code:	UPB.06.C.05.O.001	***Credits (ECTS):***	6

Course structure	Lecture	Seminar	Laboratory	Project	Total hours
Number of hours per week	3		1	2	6
Number of hours per semester	42		14	28	84

Lecturer	Lecture	Seminar / Laboratory / Project
Name, academic degree	Cristina Pupăză Professor PhD. Eng.	Tudor George Alexandru Lecturer PhD. Eng.
Contact (email, location)	cristinapupaza@yahoo.co.uk CE 004	alexandru_tudor_imst@yahoo.com CE 008

Course description:

The course deals with structural analysis procedures applied to industrial components and assemblies. This includes simulation, validation, and optimization of products, processes, and manufacturing tools. Information regarding native and neutral graphical formats is included to perform geometry imports. The course comprises information regarding different solvers and procedures and presents mesh generation techniques, as well as mesh quality criteria. Because engineering problems require the simulation of multiple phenomena in order to represent the underlying physics, fundamentals are provided to address multi-physics solutions, as well. Uni or multi criteria optimization techniques using structural analysis are presented for shape and parameter improvement. The main objectives of the course are to get familiar with static, dynamic (modal and harmonic response simulation), thermal analysis (steady-state and transient) procedures using the Finite Element Method applied to industrial components and assemblies. Different material models are employed. All types of structural non-linearities are explained and exemplified: geometrical, material and contact non-linearities. The appropriate mathematical formulation is discussed and different solving options are analyzed for implicit and explicit methods. Fundamentals of kinematics and multibody dynamics tools are illustrated. An introduction to the Computational Fluid Dynamics, as well as the fluid-structure interaction are also included. For each simulation type different case studies are presented and methods for the verification of the results are provided.

Seminar / Laboratory / Project description:

The laboratory aims to develop the necessary skills in order to easily use the Computer Aided Engineering interface and to perform all simulation types for industrial components, assemblies, or manufacturing processes involving linear and non-linear Finite Element procedures. Topology optimization and shape finder algorithms are used to improve the structural behavior of the industrial components. Computational Fluid Dynamics and fluid-structure interaction are applied for basic calculations. Explicit and implicit solvers are employed.

The project is a complete Computer Aided Engineering approach for an industrial assembly or process, involving: geometry generation and parameterization, definition of the physical properties and material models, mesh generation and improvement of the computational model in order to assure the accuracy of the simulation results, definition of the applied loads and constraints, solving the simulation using the appropriate mathematical formulation, results processing and an optimization attempt. The project ends with the review of the results comprising the verification and conclusion.
Intended learning outcomes:
The course combines general engineering knowledge to support mechanical design simulation, as well as industrial processes. The engineer can take decisions based on their impact on the performance. The student can evaluate designs and processes, refine the solutions using computer simulations, avoiding prototype testing, saving money and time. The course provides engineering insights regarding industrial assemblies and processes, helping the student to run „what-if" scenarios and to optimize the desired parameters.

Assessment method:	% of the final grade	Minimal requirements for award of credits
Written exam	20%	
Report / project	30%	
Homework	-	
Laboratory	20%	
Other	30%	

References:	
Mandatory: [1] Pupăză, C - Updated Lecture notes and e-handouts on Moodle Platform [2] Pupăză, C., Parpală, R.C. - Modelare şi analiză structurală cu ANSYS Workbench, PolitehnicaPress, ISBN 978-606-515-189-5, 2011 – English extended summary in e-format available on the Moodle Platform [3] ANSYS Workbench Tutorials Pdf : https://www.ansys.com/academic/learning-resources [4] CAE User's Manuals: ANSYS Workbench, ANSYS Mechanichal, ANSYS CFD, ANSYS Design Explorer – available on web	
Prerequisites:	***Co-requisites*** ***(courses to be taken in parallel as a condition for enrolment):***
Technical Mechanics, Mathematics 1, Mechanics of Materials 1, Mathematical analysis, Physics, Materials Science, Mechanics of Materials 2, Computer Aided Design 1 & 2, Mechanical Systems Design, Instrumentation and Measurement	Modelling and simulation or Finite Element Analysis of Solids
Additional relevant information:	
The course is useful and provides simulation tools to support both process and design engineers, as well as researchers in broad areas.	

Date: August, the 22nd, 2022

Professional degree, Surname, Name:

Professor Habil. PhD. Eng. Cristina PUPĂZĂ