Co-funded by the Erasmus+ Programme of the European Union

DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code Date (Month / Year)	PSTU Ukraine June 2021
TITLE OF THE MODULE	**Code**
Computer simulation of multi-body models	

Teacher(s)	Department
Coordinating: Assoc. Prof. Yurii Sahirov, PhD **Others:**	Department of automation and computer-integrated technologies

Study cycle (BA/MA)	Level of the module (Semester number)	Type of the module (compulsary/elective)
Masters	9th semester	Elective

Form of delivery (theory/lab/exercises)	Duration (weeks/months)	Language(s)
Lectures, Seminary	18 weeks	Ukrainian/English

Prerequisites	
Prerequisites: Knowledge: Basic knowledge of physics, chemistry, biology, linear algebra Skills: ability to search information in the Internet. Competences: none	**Co-requisites (if necessary):** Students should have skills to work in basic computer software

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
4	120	32	88

Aim of the module (course unit): competences foreseen by the study programme		
Students should be able to: - Analyze the structure of a given body joint; - Develope a multibody model of the joint; - Visualize the obtained results.		
Learning outcomes of module (course unit)	**Teaching/learning methods (theory, lab, exercises)**	**Assessment methods (written exam, oral exam, reports)**
Knowledge: Knowledge of popular approaches in biomechanical modeling. Knowledge of body joints' structure and methods of modeling their elements. Knowledge of popular numerical methods for solving algebraic and differential equations	Work with the lecture notes as well as on the available fundamental subject literature	Knowledge test
Skills: Ability to write complex programs in Python. Ability to program numerical solvers for typical models in biomechanics. Skills connected with visualizing the obtained results with a simple user interface.	Lectures, project, consultation	Active attendance on lectures, individual/group project and presentation
Competences: Study the subject literature, exchange knowledge, working in group	Lectures, project, consultation	Individual/group project and presentation

Themes	Contact work hours								Time and tasks for individual work
	Lectures	Consultations	Seminars	Practiacl work	Laboratory work	Placements	**Total contact work**	**Individual work**	**Tasks**
1. Introduction to modeling in biomechanics	1						**1**	**4**	Study popular approaches in modeling included in compulsory literature
2. Structural analysis of selected human joints and their models	2						**2**	**8**	Understand the basic components of human body joints on selected examples
3. Introduction to programming in Python	3				4		**11**	**14**	Study different features of numpy, methods for vectorizing the code and plotting with matplotlib
4. Introduction to numerical methods in one-dimensional dynamics and statics	3				2		**7**	**14**	
5. Introduction to PyGame library	3				2		**4**	**20**	Program a simple two-dimensional game with basic user input
6. Rigid body dynamics in two dimensions	2				4		**8**	**14**	Model, solve and visualize a selected body joint in dynamics
7. Rigid body statics in two dimensions	2				4		**7**	**14**	Model, solve and visualize a selected body joint in statics
Total	16				16		**32**	**88**	

Assessment strategy	Weight in %	Deadlines	Assessment criteria
Individual or group final project referred during seminars	20	3^{th} - 14^{th} week	Project
Final exam	80		Test

Author	Year of issue	Title	No of periodical or volume	Place of printing. Printing house or internet link
Compulsory literature				
J.Z. Li	2015	3D Modeling, Engineering Analysis, and Prototype Experimentation: Industrial and Research Applications		Springer. – 264 p. ISBN-10:3319059203
J. Duhovnik, I. Demsar, P. Drešar	2015	Space Modeling with SolidWorks and NX		Springer, Cham. – 490 p. ISBN 978-3-319-03861-2.
N. Vukašinović, J. Duhovnik	2018	Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering		Springer. –253 p. ISBN-10: 3030023982.
Additional literature				
E. Khoo, C.Hight, R.Torrens, B.Cowie	2017	Software Literacy: Education and Beyond		Springer, – 114 p. ISBN-10: 981107058X
M. Peksen	2018	Multiphysics Modeling: Materials, Components, and Systems		Academic Press. – 282 pages. ISBN 978-0-12-811824-5
E. Gindis, R. Kaebisch	2020	Up and Running with AutoCAD 2021, 1st Edition: 2D and 3D Drawing, Design and Modeling		Academic Press,. – 862 p. ISBN: 9780128231173.
M. Brand	2016	FEM-Praxis mit SolidWorks. Simulation durch Kontrollrechnung und Messungverifizieren		Springer. – 187 p. ISBN: 978-3-658-09386-0.
M. Schabacker	2016	SolidWorks - kurz und bündig: Grundlagen für Einsteiger (German Edition)		Springer Vieweg. - 140 p. ISBN-10: 3658161736