DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Country code Date (Month / Year)	PSTU Ukraine Jan 2019
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
6	90	30	60

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**	**2**	Study popular approaches in modeling included in compulsory literature
2. Structural analysis of selected human joints and their models	2						**2**	**2**	Understand the basic components of human body joints on selected examples
3. Introduction to programming in Python	3				8		**11**	**10**	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				4		**7**		
5. Introduction to PyGame library	2				2		**4**	**14**	Program a simple two-dimensional game with basic user input
6. Rigid body dynamics in two dimensions	2				6		**8**	**14**	Model, solve and visualize a selected body joint in dynamics
7. Rigid body statics in two dimensions	1				6		**7**	**8**	Model, solve and visualize a selected body joint in statics
Total	14				26		**40**	**50**	

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**	**Title**	**No of**	**Place of printing. Printing**

	of issue		periodical or volume	house or internet link
Compulsory literature				
Adam Ciszkiewicz, Grzegorz Milewski	2019	Comparison of Methods for Computing a Target Point for Aspirations and Biopsies	831, p. 90-97	'Advances in Intelligent Systems and Computing'
Machado M., et al.	2012	Compliant contact force models in multibody dynamics: Evolution of the Hertz contact theory	53, p. 99-121	'Mechanism and Machine Theory'
Machado M., et al.	2010	Development of a planar multibody model of the human knee joint	60 (3), p. 459- 478	'Nonlinear Dynamics'
Caruntu D. I., Hefzy M. S.	2004	3-D anatomically based dynamic modeling of the human knee to include tibiofemoral and patello-femoral joints.	126(1), p. 44- 53	'Journal of Biomechanical Engineering'
Gudavalli M. R., Triano J. J.	1999	An analytical model of lumbar motion segment in flexion	22(4), p. 201- 208	'Journal of Manipulative and Physiological Therapeutics'
Additional literature				
Shabana A. A.	2010	Computational Dynamics		John Wiley & Sons
Бондарь В.К. и др. Bondar V., et al.	2017	Компьютерное моделирование эндопротезировани я тазобедренного сустава с	18 (6) -96	Травма, p-ISSN 1608-1706, e-ISSN 2307-1397

		использование трабекулярно-бионического бедернного компонента Physiohip / Computer modeling of hip arthroplasty using the trabecular-bionic femoral component Physiohip		
О.Н. Ямщиков Yamshchikov Oleg	2014	Компьютерное моделирование в травматологии и ортопедии / Computer Modeling in Traumatology and Orthopedics (literature review)	19 (6), p. 1974-1979	ISSN 1810-0198. Вестник ТГУ / Tomsk State University Journals
		The Insight Journal is an Open Access on-line publication covering the domain of medical image processing and visualization.		http://www.insight-journal.org/