STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Vehicle dynamics simulation		**1010612111010611453**
Field of study	Profile of study (general academic, practical)	Year /Semester
Mechanical Engineering	**(brak)**	**1 / 1**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Motor Vehicles and Tractors	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
Second-cycle studies	**full-time**	

No. of hours				No. of credits
Lecture: **1**	Classes: **-**	Laboratory: **1**	Project/seminars: **-**	**2**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**1 50%**
Technical sciences	**1 50%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	The student has knowledge of applied mechanics and vehicle dynamics fundamentals. The student knows fundamentals of numerical computation methods.
2	**Skills**	The student is able to use computer, in particular operating system, office suite (software). Is able to use basic functions of English language software, if desired with use of a dictionary.
3	**Social competencies**	The student understand the meaning of computer computational methods for modern engineer work in terms of their capabilities and limitations

Assumptions and objectives of the course:

Understanding the modeling and simulations techniques of vehicle dynamics for determining values of design parameters of a car and for optimizing them. Getting students familiar with typical tools for road vehicle dynamics simulation.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Has knowledge of developing physical models of vehicle dynamics - [K2A_W01]
2. Has knowledge of solving differential equations of motion - [K2A_W02]
3. Has knowledge of vehicle dynamics models - [K2A_W05]
4. Is familiar with computer software for simulation tests of vehicle dynamics and principles of its functioning - [-]

Skills:

1. Is able to use simple computer numerical computation software to conduct simulation tests of vehicle motion on the base of theoretical vehicle dynamics description - [K2A_U02]
2. Is able to plan and perform simple simulation tests of vehicle dynamics with use of Matlab/Simulink software - [-]
3. Is able to prepare data and present results of simulation in a graphical form with use of computer tools - [-]

Social competencies:

1. Is aware of capabilities and limitations of computer methods of vehicle motion simulation and is able to properly evaluate their importance on the effects of taken decisions on the base of obtained results. - [K2A_K02]
2. Is aware of the importance of understanding simulation methods for accelerating new devices design process and for improving economic competitiveness - [K2A_K04]

Assessment methods of study outcomes

Written test, which is based on answers related to the selection of given answers and open questions. Credits will be given after achieving at least 50% of points. Answers are scores from 0 to 1 point.

Course description

Modeling physical systems and methodology of simulation tests (fundamentals of developing physical models, types of technical approximations and their influence on design decision making, developing of mathematical models - selection of physical variables and physical laws, methods of derivation of equation of motion, force equilibrium (d?Alamert method), energy balance (Lagrange method).

Numerical computational methods of solving differential equations of motion (numerical integration, algorithms, parameters, procedures available in selected software).

Longitudinal vehicle dynamics models (acceleration process, driveline models).

Lateral vehicle dynamics models (2 DOF ?bicycle?model, tests of a quasi-static motion negotiating a curve, coordinate transformation from local to global coordinates).

Vertical vehicle dynamics model (2DOF suspension model).

MSC ADAMS MBS software, software structure, capabilities and limitations, pre- i postprocessor.

ADAMS/Car module, models of vehicle subsystems and full vehicle model.

Basic bibliography:

1. Celmerowski A.: Modelowanie i symulacja układów fizycznych Matlab/Simulink, Białystok 2008
2. Cegieła R., Zalewski A.: Matlab - obliczenia numeryczne i ich zastosowania. Wydawnictwo NAKOM.. Poznań 1996

Additional bibliography:

1. Rill G.: Road vehicle dynamics - fundamentals and modeling, CRC Press, 2012
2. Prochowski L. .: Pojazdy samochodowe mechanika ruchu. Wydawnictwa Komunikacji i Łączności, Warszawa 2008.
3. Andrzejewski R.: Stabilność ruchu pojazdów samochodowych. WNT, Warszawa 1997.
4. Arczyński S.: Mechanika ruchu samochodu, WNT, Warszawa, 1994.
5. Gillespie T.D.: Fundamentals of Vehicle Dynamics. SAE Warrendale 1992
6. Siłka W.: Teoria ruchu samochodu, WNT, Warszawa 2002.

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Literature studies	14
3. Consultation	1
4. Preparation for written credits (based on lectures)	8
5. Participation in written test solving.	2

Student's workload

Source of workload	hours	ECTS
Total workload	55	2
Contact hours	33	1
Practical activities	29	1