COURSE DESCRIPTION CARD - SYLLABUS

Course name

Simulation tests of vehicle dynamics

Course

Field of study	Year/Semester
Construction and operation of means of transport	2/3
Area of study (specialization)	Profile of study
Motor vehicles	general academic
Level of study	Course offered in
Second-cycle studies	polish
Form of study	Requirements
part-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
18	18	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

Knowledge:The student has knowledge of applied mechanics and vehicle dynamics fundamentals. The student knows fundamentals of numerical computation methods

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.

Social competencies: The student understand the meaning of computer computational methods for modern engineer work in terms of their capabilities and limitations

Course objective

TUnderstanding 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.

Course-related learning outcomes

Knowledge

1. Has knowledge of developing physical models of vehicle dynamics

2. Has knowledge of solving differential equations of motion

3. Has knowledge of vehicle dynamics models

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

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 competences

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

2. Is aware of the importance of understanding simulation methods for accelerating new devices design process and for improving economic competitiveness

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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.

Programme content

Methodology of building mathematical models and performing simulation test. Types of assumptions used in model development, relations between assumptions and simplification used in mathematical model and results interpretation and design decisions. Selecting model variables and physical laws and phenomena's to use during formulating mathematical model, determining of boundary conditions, Derivation of Equation of motion using Lagrange Principle and d' Alembert's principle.

Methods of numerical integrations of equations of motion, numerical methods and their parameters, frequently used integration procedures in popular engineering software (for example Matlab/Simulink software, MSC/Adams).

Physical and mathematical models of longitudinal vehicle dynamics (acceleration, deceleration, cruising, models of an engine, clutch, transmission, differential, tire).

Physical and mathematical models of lateral vehicle dynamics (quasistatic and transient processes modeling). Tire lateral properties models (linear, non-linear, static, combined-slip, transient tire models - Dugoff, Magic Formula, SWIFT), bicycle plane model, understeer and oversteer, transformation of model variables from local to global coordinate system.

Physical and mathematical models of vertical vehicle dynamics (quarter car model, half car model and full car model, functional model - derivation of transfer functions, models of road irregularities, shock absorber models - linear and nonlinear with hysteresis and time delay)

Multibody Dynamics Analysis software MSC ADAMS - processor, preprocessor and postprocessor.

Modul ADMS/CAR - subsystem models and templates, predefined tests - kinematic and dynamics analyses,

Teaching methods

1. Lecture with a multimedia presentation - a combination of an information and problem lecture;

2. Laboratory exercises with the use of Matlab / Simulink systems, MSC ADAMS, V-SIM

Bibliography

Basic

1. Celmerowski A.: Modelowanie i symulacja układów fizycznych Matlab/Simulink, Białystok 2008

2. Prochowski L.: Pojazdy samochodowe mechanika ruchu. Wydawnictwa Komunikacji i Łączności, Warszawa 2008

3. Cegieła R., Zalewski A.: Matlab - obliczenia numeryczne i ich zastosowania. Wydawnictwo NAKOM. Poznań 1996

Additional

1. Rill G.: Road vehicle dynamics - fundamentals and modeling, CRC Press, 2012

3. Andrzejewski R.: Stabilność ruchu pojazdów samochodowych. WNT, Warszawa 1997

4. Arczyński S.: Mechanika ruchu samochodu, WNT, Warszawa, 1994

5. Siłka W.: Teoria ruchu samochodu, WNT, Warszawa 2002

Breakdown of average student's workload

	Hours	ECTS
Total workload	96	4,0
Classes requiring direct contact with the teacher	36	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	60	2,0

[1] delete or add other activities as appropriate