COURSE DESCRIPTION CARD - SYLLABUS

Course name

Simulation tests of vehicle dynamics

Course

Field of study	Year/Semester
Mechanical and Automotive Engineering	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
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	30	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

D.Sc.Ph.D. (Eng) . Grzegorz Ślaski

Piotrowo Street, 3

60 – 965 Poznan, Poland

Ph: + 48 61-665 22 22

E-mail: grzegorz.slaski@put.poznan.pl

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

Has extended knowledge of mathematics in the field of numerical methods used in optimization tasks, computer simulation, linear algebra, interpolation and approximation.

Has a basic knowledge of the mechanics of solids and discrete systems with many degrees of freedom, mathematical modeling of physical and mechanical systems based on d'Alembert's principle and Lagrange's equations, mathematical description of materials using constitutive equations.

Has extended knowledge in the field of computer science, concerning computer programming and engineering calculation programs in the field of computer simulation of physical systems.

Skills

Can plan and carry out experimental research of specific processes taking place in machines and routine tests of a working machine or a vehicle from a selected group of machines.

Can use a popular numerical system to program a simple system simulation task with a small number of degrees of freedom.

Can write a simple computer program with the use of modern RAD environments in a language known to him for the optimization calculations of structures using learned elementary numerical methods.

Social competences

He is ready to critically assess his knowledge and received content.

Is ready to recognize the importance of knowledge in solving cognitive and practical problems and to consult experts in case of difficulties in solving the problem on its own.

Is willing to think and act in an entrepreneurial manner.

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	100	4,0
Classes requiring direct contact with the teacher	60	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	40	2,0

[1] delete or add other activities as appropriate