



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Fundamentals of vehicle dynamics

		Course
Field of study		Year/Semester
Construction and Exploitation of Means of Transport		3 / 5
Area of study (specialization)		Profile of study
Motor vehicles		general academic
Level of study		Course offered in
First-cycle studies		polish
Form of study		Requirements
part-time		compulsory

		Number of hours
Lecture	Laboratory classes	Other (e.g. online)
9	18	0
Tutorials	Projects/seminars	
0	0	
<b>Number of credit points</b>		
3		

Lecturers	
Responsible for the course/lecturer:	Responsible for the course/lecturer:
Marek Maciejewski	

**Prerequisites**

Basic knowledge of mechanics, in particular the kinematics and dynamics of discrete systems. Knowledge of the basic principles of formulating dynamic problems. The ability to adapt the solution to the formulated problem. Spreadsheet support. Ability to define the computational process to achieve a problem solution. The ability to identify problems and solve dilemmas in the computational process. Independence.

### Course objective

Providing students with information on the basic relations between the construction parameters of vehicles, road conditions and the requirements of traffic dynamics, while maintaining safety and driving comfort.

### Course-related learning outcomes

- Knowledge
1. Knows the basic dynamics relationships describing the motion of a car.
  2. Has knowledge of how to solve problems in the field of longitudinal, lateral and vertical dynamics of the vehicle.
  3. Knows the algorithms of conduct leading to the correct determination of the vehicle's behavior on the road.
  4. Knows the course of determining the basic characteristics of the car.



### Skills

1. Is able to define the phenomena occurring while the car is moving in the form of mathematical relations. 2. He can solve the problems of car dynamics. 3. Knows how to determine the relationship between the design and traction parameters of the vehicle and its driving properties. 4. Is able to select kinematic and dynamic solutions to ensure adequate comfort and safety of driving.

### Social competences

1. Can independently define priorities, problems and solutions in the field of vehicle dynamics. 2. Can cooperate with people involved in the design of vehicle construction solutions. 3. Understands the requirements for driving comfort and safety.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam on the lecture material, completion of laboratory classes based on the documentation of the tasks performed.

### Programme content

Classification of dynamics for vehicle movement. Interaction between vehicle and road. Construction and kinematic and dynamic properties of the tire. The importance of the tire for the trajectory of motion and vibration of the vehicle. Force interactions and kinematic excitations on a moving vehicle.

Longitudinal dynamics of the car. Drag forces and power of resistance forces to motion - references to the driving force on wheels. The size of the gear ratios in the car drive system as a result of the equilibrium of interactions, taking into account the adhesion of the wheels. Selection of gears: the smallest and the largest. Determination of the number of gears. Methods of selecting intermediate gears. Car traction and dynamic characteristics, and the power balance.

Car braking and the balance of forces during braking. Determination of the braking forces and their limitations resulting from adhesion conditions. Distribution of braking forces on the vehicle axles drive. Braking time and distance.

Lateral dynamics of the car - movement stability. Lateral forces and balance of the car in a curve. Tire deformation and car side drift. Lateral skid problem. Longitudinal stability of the car's movement in a curve - the car understeers and oversteers. Importance of vehicle stability in rectilinear motion. Lateral stability - balance of the car in a curve.

Vehicle vertical dynamics and suspension system tasks. Discrete approach (a system of related masses) in defining vehicle models. Vehicle models: one-, two-, and three-dimensional. Basic relations between vertical dynamics, frequency and damping factors. Influence of vibrations on humans - driving comfort. Suspension models: passive, active, adjustable and semi-active. Sky-hook controlled suspensions. Research and evaluation criteria for suspensions.

### Teaching methods



1. Lecture: multimedia presentation. 2. Laboratory classes: formulation and solution of given problems in the field of car dynamics.

### Bibliography

#### Basic

1. Prochowski L. .: Pojazdy samochodowe mechanika ruchu. Wydawnictwa Komunikacji i łączności, Warszawa 2008.
2. Arczyński S.: Mechanika ruchu samochodu, WNT, Warszawa, 1994.
3. Siłka W.: Teoria ruchu samochodu, WNT, Warszawa 2002

#### Additional

1. Andrzejewski R.: Stabilność ruchu pojazdów samochodowych. WNT, Warszawa 1997.
2. Gillespie T.D.: Fundamentals of Vehicle Dynamics. SAE Warrendale 1992
3. Wong J.Y.: Theory of Ground Vehicles, J.Wiley&Sons, 2001

### Breakdown of average student's workload

	Hours	ECTS
Total workload	85	3,0
Classes requiring direct contact with the teacher	45	1,6
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	40	1,4

<sup>1</sup> delete or add other activities as appropriate