**COURSE DESCRIPTION CARD - SYLLABUS**

Course name
Vehicle chassis systems and components
**Course**

Field of study
Mechanical Engineering (Erasmus Plus)
Area of study (specialization)
-
Level of study

Form of study

Year/Semester
2/3
Profile of study

Course offered in
english
Requirements

 **Number of hours**

Lecture
15
Tutorials
0
Laboratory classes
0
Projects/seminars
0
Other (e.g. online)
0

**Number of credit points**6

**Lecturers**

Responsible for the course/lecturer:
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 61-138 Poznan, Poland

Ph: + 48 61-665 22 22Responsible for the course/lecturer:

 **Prerequisites**
Knowledge: Basic knowledge of machine science, the basics of machine design and the laws of physics; mechanics - in particular the knowledge of the basic principles of formulating dynamics.

Skills: The student Is able use the languages: native and international at a level sufficient to enable understanding of technical texts. Is able to obtain information from the literature, internet, databases and other sources. Can integrate the information to interpret and learn from them, create and justify opinions. The student is able to use learned mathematical and physical theories to build and analyze of simple mathematical models of vehicle dynamics. Helpfull will be spreadsheet usage practice.

Social competences: The student is creative and consistent in the implementation of tasks, shows independence in solving problems, acquiring and improving the acquired knowledge and skills. Understands the need and knows the possibilities of lifelong learning.

**Course objective**
The aim of the course is to present knowledge on the basic relations between the design parameters of vehicles, road conditions and the requirements of motion dynamics, while maintaining safety and driving comfort. Provide students with basic information on the design and operation of car chassis and body systems as well as general requirements for motor vehicles.

**Course-related learning outcomes**Knowledge
1. The student knows the tasks, structure and properties of various types of basic vehicle systems.
2. Knows the basic dynamics relationships describing the motion of a car allowing to determine of the vehicle's behavior on the road.
3. Has knowledge of how to solve problems in the field of longitudinal, lateral and vertical dynamics of the vehicle.

Skills
1. The student can describe the tasks, principles of operation, design and functional variations, properties and the scope of applications of various solutions of mechanisms and assemblies of the main vehicle systems.
2. The student is able to define the phenomena occurring during the car motion in the form of mathematical relations.
3. The student is able to determine the relationship between the design and traction parameters of the vehicle and its motion properties.
3. The student can solve the problems of car dynamics with use of spreadsheet.

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. Is aware of the importance and understanding of non-technical aspects and effects of engineering activities, including its impact on the safety of people and environment and the related responsibility for decisions

**Methods for verifying learning outcomes and assessment criteria**Learning outcomes presented above are verified as follows:
Lecture: Written exam on the lecture material.

Rating scale: below 50% - 2.0, from 50% - 3.0, from 60% - 3.5, from 70% - 4.0, from 80% - 4.5, from 90% - 5.0.

**Programme content**

LECTURES

LECTURE 1. Vehicle structure and subystems definition. Connection of vehicle subsystems with basic areas of vehicle dynamics - longitudinal, lateral and vertical.

LECTURE 2. Vehicle powertrain systems and vehicle longitudinal dynamics - car propulsion process - performance (acceleration ability, maximum speed, hill climbing ability, towing ability), car traction and dynamic characteristics. Energy aspects of a car motion - propulsion and nonpropulsion energy demand, power of motion resistances, driving cycles.

LECTURE 3. Typical powertrain systems of passenger and commercial vehicles. Characteristics and functioning of internal combustion engines, electric motors and hybrid powertrain systems (purposefulness of use from the perspective of energy demand, methods of accumulating kinetic energy of the car). Clutches, transmissions, drive shafts and final gears with differentials.

LECTURE 4. Tires, braking systems and the process of car braking - time histories and energy aspects - braking power and energy, emergency braking versus service braking, regenerative braking.
Friction brakes in cars - disc and drum brakes. Brake actuation systems - mechanical, hydraulic and air systems. Mechatronic control of braking process - ABS systems.

LECTURE 5. Tires, steering systems and lateral car dynamics - the theory of car turning for low speeds, the possibility of automating the parking process. Forces affecting the car while driving in a curve at higher speeds, lateral dynamics in transient states (sudden lane change), vehicle motion stability, importance of the moment of inertia around the vertical axis - the value and distribution of mass, car tilting stability.

LECTURE 6. Steering systems design, steering linkages, Ackerman geometry, steering boxes, rack-and-pinion steering, power steering systems.

LECTURE 7. Vertical dynamics of the car - criteria and indexes of the suspension assessment - comfort and safety and suspension design limitations, dynamics of the two degre of freedom system - characteristics of the body vibration amplification, tire loads, suspension deflections, resonances, the influence of the choice of stiffness and damping, influence of the variability of the sprung mass .

LECTURE 8. Suspension functions - functions of transferring vertical forces as well as longitudinal and transverse - leading elements of suspensions, types of kinematic systems of suspensions (McPherson, transverse, longitudinal and oblique wishbones, torsion beam), elastic elements (springs, springs, air bellows, hydropneumatic suspensions) and damping (types and construction of shock absorbers).

**Teaching methods**

Lecture with multimedia presentation, some examples wit use of spreadsheet calculations also for some homework for students

**Bibliography**

Basic
1. Duffy J.E. Modern automotive technology, Goodheart-Willcox Publ, 2016

2. Bosch Automotive Handbook 8th edition, Bentley Publishers, 2010

3. Jazar, Reza N. : Vehicle Dynamics Theory and Application, Springer 2017

Additional
1. Rill G.: Rod Vehicle Dynamics - Fundamentals and Modeling, CRC Press, 2011

2. Abe M.: Vehicle Handling Dynamics - Theory and Application, Butterworth-Heinemann, 2015

3. Rajamani R.: Vehicle Dynamics and Control, Springer 2012

4. Ślaski G.: Studium projektowania zawieszeń samochodowych o zmiennym tłumieniu,
 Wydawnictwo Politechniki Poznańskiej, Rozprawy. Nr 481. ISSN 0551-6528, Poznań 2012

**Breakdown of average student's workload**

|  | Hours | ECTS |
| --- | --- | --- |
| Total workload | 60 | 6,0 |
| Classes requiring direct contact with the teacher | 30 | 3,0 |
| Student's own work (literature studies, preparation for workshops, project preparation) [[1]](#footnote-1) | 30 | 3,0 |

1. delete or add other activities as appropriate [↑](#footnote-ref-1)