



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Designing autonomous vehicle subsystems [N1MiBP1>PPPA]

### Course

Field of study

Mechanical and Automotive Engineering

Year/Semester

3/6

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

part-time

Requirements

elective

### Number of hours

Lecture

9

Laboratory classes

18

Other

0

Tutorials

0

Projects/seminars

0

### Number of credit points

3,00

### Coordinators

dr inż. Marek Maciejewski

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### Lecturers

### Prerequisites

Basic knowledge of technical drawing, machine construction, car construction and car mechanics. Knowledge of the basic principles of carrying out strength and fatigue analyzes. Understanding the basic principles of design. Ability to adapt the calculation process to the task performed, the selection and use of dependencies in the field of traction calculations, geometric structures, strength and fatigue. Spreadsheet support. Determining the hierarchy and schedule of tasks when designing typical mechanical structures. The ability to identify problems and solve computational and construction dilemmas. Independence.

### Course objective

Provide students with basic information on the design of vehicle systems and components, in particular the methods of designing mechanical car drive systems and their components.

### Course-related learning outcomes

Knowledge:

M1\_W05 Has basic knowledge of the basics of machine design and the theory of machines and mechanisms, including mechanical vibrations.

M1\_W18 Is aware of the latest trends in machine construction, i.e. automation and mechatronization,

automation of machine design and construction processes, increased safety and comfort of operation, the use of modern construction materials.

Skills:

M1\_U02 Can search in catalogs and on manufacturers' websites ready-made machine components to be used in his own projects.

M1\_U16 Can create a system diagram, select elements and perform basic calculations using ready-made computational packages of mechanical, hydrostatic, electric or hybrid machine drive system.

Social competences:

M1\_K02 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.

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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

The specificity of drive systems of autonomous vehicles (passenger cars, delivery vans and trucks).

Classification of design solutions for drive systems in passenger cars.

Design of disc couplings - calculation algorithms for: geometry of the clutch disc, durability of the friction clutch and clutch pressure (diaphragm and multi-coil) springs.

Types of mechanical gearboxes. Selection of basic geometrical parameters of gears and teeth. Materials and their heat treatment. Tooth checking for fatigue strength. Ways of taking into account variable loads. Synchronizers: synchronizing torque, synchronization time and heat loads.

Calculations of (helical and hypoid) bevel gear final drives. Selection of basic parameters for differential and axle bevel gears in differentials.

Planetary gears in automatic drive systems - selection of geometrical parameters.

Calculations of hydrodynamic clutches and torque converters. Characteristics of clutches and converters and their selection for vehicles with automatic transmission.

Selection of rolling bearings in the vehicle transmission system: in the gearbox, in the final drive, and in the road wheels. Determination of the fatigue life of rolling bearings taking into account equivalent dynamic bearing loads.

Design of drive shafts and joints. Kinematics and dynamics of asynchronous universal joints and synchronous joints. Cardan shafts: vibrations and load on supports.

Geometric and strength calculations of steering systems, including power steering systems.

Classification of braking systems, disc and drum brakes. Calculations of components and brake control system.

### Course topics

none

### Teaching methods

1. Lecture: multimedia presentation. 2. Laboratory classes: preliminary design development of vehicle subsystems, strength and durability calculations and modification of previously adopted subsystems.

### Bibliography

Basic

1. Jaśkiewicz Zb., Projektowanie układów napędowych pojazdów samochodowych, WKiŁ, Warszawa, 1982

2. Jaśkiewicz Zb., Wąsiewski A., Układy napędowe pojazdów samochodowych: obliczenia projektowe, OWPW, Warszawa, 2002

3. Poradnik inżyniera samochodowego (red. Jaśkiewicz Zb.), WKiŁ, 1990

Additional

1. Stańczyk T.L., Lomako D., Komputerowe obliczenia zespołów samochodów i ciągników, WPŚ, Kielce, 2004
2. Zając M., Układy przeniesienia napędu samochodów ciężarowych i autobusów, WKiŁ 2008
3. Micknass W., Popiol R., Sprenger A., Sprzęgła, skrzynki biegów, wały i pólósie napędowe, WKiŁ 2012

#### Breakdown of average student's workload

|   | Hours | ECTS |
|---|-------|------|
| Total workload  | 75    | 3,00 |
| Classes requiring direct contact with the teacher   | 27    | 1,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 48    | 2,00 |