COURSE DESCRIPTION CARD - SYLLABUS

Course name

Simulation analyzes of the dynamics of rail vehicles

Course

Field of study

Mechanical and Automotive Engineering

Year/Semester

1/2

Area of study (specialization)

Rail vehicles

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

polish/english

Form of study

part-time

Requirements

elective

Number of hours

Lecture

9

Laboratory classes

0

Other (e.g. online)

0

Tutorials

0

Projects/seminars

18

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Bartosz Firlik

bartosz.firlik@put.poznan.pl

tel. (61) 665 2012

Faculty of Civil and Transport Engineering

ul. Piotrowo 3, pok. 722, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

The student has a basic knowledge of the dynamics and construction of rail vehicles, in particular their running systems. The student is able to use the acquired knowledge to analyze specific phenomena and processes occurring in the operation of rail vehicles. He has a structured basic knowledge of the main divisions of technical mechanics: statics, kinematics and dynamics of a material point and a rigid body.

Can use learned mathematical theories to create and analyze simple mathematical models of machines and their elements, and simple technical systems. Student is able to solve specific problems that arise during the construction of technical objects.

Course objective

The aim of the course is to learn how to use the MBS (multibody simulation) SIMPACK environment

aimed at simulating the dynamics of rail vehicles. The student acquires the ability to make models of rail vehicles and simple mechanical systems by the multibody system method.

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 extended knowledge of physics in the field of contemporary physical problems conditioning the progress in technical sciences: solid state physics nonlinear optics, nuclear physics and new research methods used in physics.

Has a general knowledge of the principles and methods of constructing working machines, in particular the methods of functional and strength calculations, mathematical optimization of mechanical structures and modeling of machine structures in 3D 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.

Is able to use the acquired knowledge in the field of thermodynamics and fluid mechanics to simulate thermodynamic processes in technological systems of machines, using specialized computer programs.

Social competences

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.

Is ready to fulfill professional roles responsibly, taking into account changing social needs, including:

- developing the professional achievements,

- maintaining the ethos of the profession,

- observing and developing the rules of professional ethics and acting towards the observance of these rules.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Credit with the use of a computer. The final grade includes both the final grade as well as the student's activity during the classes and preparation for them

Programme content

• using the SIMPACK interface, editing the view position, modifying the graphic representation of the designed object, using templates,

• developing and reading the topology of multibody systems based on technical documentation and photos of real vehicles,

• developing models of multibody systems based on available elements (body, joint, constraint, force element), including rail vehicle models,

• preparation of the track and simulation scenario,

• editing simulation conditions, introducing model variants,

• running a simulation,

• postprocessing of simulation results.

Teaching methods

Multimedia presentation, independent work with computers (SIMPACK software), assessment in the form of online tests. Students can also use the software on private computers, using it for other projects during their studies.

Bibliography

Basic

1. S. Iwnicki , M. Spiryagin, C. Cole, T. McSweeney, Handbook of Railway Vehicle Dynamics, Second Edition, CRC Press, 2019.

2. Simpack tutorials.

Additional

1. M. Spiryagin, C. Cole, Y. Q. Sun, M. McClanachan, V. Spiryagin, T. McSweeney, Design and Simulation of Rail Vehicles, CrC Press, T&Fr Group.

2. E. Andersson, M. Berg, S. Stichel, Rail Vehicle Dynamics, Railway Group KTH, Stockholm, 2014.

Breakdown of average student's workload

	Hours	ECTS
Total workload	45	3,0
Classes requiring direct contact with the teacher	27	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	18	1,0

[1] delete or add other activities as appropriate