



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Modeling of exploitation systems [S2Trans1-TrD>MSE]

### Course

Field of study

Transport

Year/Semester

1/2

Area of study (specialization)

Road Transport

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

### Number of hours

Lecture

15

Laboratory classes

15

Other

0

Tutorials

15

Projects/seminars

0

### Number of credit points

4,00

### Coordinators

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### Lecturers

### Prerequisites

Construction, maintenance and repair techniques, diagnostics of motor vehicles (technical facilities); The student is able to analyze and synthesize information, draw conclusions, formulate and justify opinions; The student is aware of the importance of rational car operation in terms of technical, economic and ecological aspects.

### Course objective

Introduction to the issues of reliability-oriented maintenance, i.e. a systematic approach to the selection of effective and technically feasible maintenance tasks and modeling of selected operating systems.

### Course-related learning outcomes

Knowledge:

1. Has advanced and in-depth knowledge of transport engineering, theoretical foundations, tools and means used to solve simple engineering problems.
2. Has advanced and detailed knowledge of the processes taking place in the life cycle of transport systems.

#### Skills:

1. Can plan and carry out experiments, including measurements and simulations, interpret the obtained results and draw conclusions as well as formulate and verify hypotheses related to complex engineering problems and simple research problems.
2. Can use analytical, simulation and experimental methods to formulate and solve engineering tasks and simple research problems.

#### Social competences:

1. Understands that knowledge and skills very quickly become obsolete in the field of transport engineering.
2. Understands the importance of using the latest knowledge in the field of transport engineering in solving research and practical problems

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:

Assessment on the basis of a written or oral exam carried out during the examination session, completed laboratory classes (reports + tests) and a project carried out as part of the exercises.

### Programme content

The scope of the lecture includes the following topics:

- Operating system - definition, construction
- Statistical basis for selection of operating strategy (Weibul, Gumbel)
- Reliability-oriented maintenance (RCM)
- Methods for analyzing the causes of unfitness and selecting an operating strategy
- Analysis of hazards and risks resulting from equipment failure and human error -Event tree method (ETA).
- Analysis of the causes of each functional unfitness using the FTA method,
- Application of RCM methods and procedures to service selected systems of a motor vehicle.

As part of the exercises, students apply the FTA method and statistical methods for selecting maintenance strategies to examples of basic motor vehicle systems.

As part of the laboratory activities, they confront the created models with the real object.

### Course topics

#### LECTURES

Models of operation of means of transport. Classification of models of exploitation processes of technical objects. Praxeological model of the exploitation system (chain of use and operation).

Exploitation state symbols, exploitation graphs.

Technological models of organization of use of means of transport. Structural model of the use base.

Measures of the process of use (quantitative characteristics) of means of transportation.

Models of operation of means of transportation. Classification of types of servicing of means of transportation. Methods of determining the inter-service resource. Structural model of the service base of means of transportation.

Models of service processes. Measures of the process of operating means of transport.

Modeling of operating systems of means of transport. Costs of operation. Criteria of operational efficiency.

Planning of operational needs. Freight work. Matching

of the service system to the needs of the usage system. Determination of the number of vehicles anticipated for current repairs. Planning the supply of spare parts to the vehicle servicing system.

Methods for analyzing the causes of unfitness and selecting servicing strategies. Statistical basis for selection of servicing strategies (Weibul, Gumbel).

Reliability-oriented maintenance (RCM). Application of RCM methods and procedures to the servicing of selected motor vehicle systems.

Analysis of hazards and risks resulting from equipment failures and human error - event tree method (ETA). Analysis of the causes of each functional unfitness using the FTA method,

#### EXERCISES

Case study. Analysis of real transportation systems. Identification of utilization model and operating strategy. Quantitative characterization of operating efficiency of fleets of transport companies (based on real data from transport companies).

Application of the FTA method and statistical methods for selecting handling strategies on examples of basic motor vehicle systems.

#### LABORATORIES

As part of the laboratory activities, students confront the created models with the real object.

#### Teaching methods

1. Lecture with a multimedia presentation - a combination of an informative and problem lecture.
2. Classes - practical application of the FTA method - design method
3. Laboratory - confrontation of the created models with real objects - the method of the experiment

#### Bibliography

##### Basic

1. Kupiec J., Wróblewski P.: Diagnostowanie podzespołów i zespołów pojazdów samochodowych, WKiŁ, Warszawa 2015r
2. Szopa T.: Niezawodność i bezpieczeństwo, Oficyna wydawnicza Politechniki Warszawskiej, Warszawa 2009r.
3. PN-JEC 300-3-1, PN-EN 60300-2, PN-JEC 60300-3-9: - Zarządzanie niezawodnością.
4. PN-JEC 706-1 (do 5): - Przewodnik dotyczący obsługiwalności urządzeń.
5. PN-JEC 812: Procedura analizy rodzajów i skutków uszkodzeń (FMEA, FMECA).
6. PN-JEC 1025: - Analiza drzew niezdatności.
7. PN-JEC 1078: - Metoda schematów blokowych niezawodności.

##### Additional

#### Breakdown of average student's workload

|   | Hours | ECTS |
|---|-------|------|
| Total workload  | 90    | 4,00 |
| Classes requiring direct contact with the teacher   | 45    | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 45    | 2,00 |