STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Modeling of Exploitation Systems**		Code **1010612221010610504**

Field of study **Transport**	Profile of study (general academic, practical) **(brak)**	Year /Semester **1 / 2**

Elective path/specialty **Road Transport**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**

Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**

No. of hours Lecture: **2** Classes: **2** Laboratory: **-** Project/seminars: **-**	No. of credits **4**

Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**

Education areas and fields of science and art **technical sciences** **Technical sciences**	ECTS distribution (number and %**)** **4 100%** **4 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Construction, maintenance and repair techniques, diagnosis of motor vehicles (technical objects).
2	**Skills**	Statistical analysis of the data. Parameters evaluation properties and applications of the normal distribution, exponential and Weibull.
3	**Social competencies**	Teamwork.

Assumptions and objectives of the course:

An introduction to RCM (Reliability Centered Maintenance), i.e. a systematic approach to the selection of effective and technically feasible task handling.

Ability to develop and improve the operating instructions.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The operational definition of exploitation system components and the relationships between them according to the point 1 of course description. - [K2A-W14, K2A-W15]

2. Concepts and procedures for a systematic approach to the selection of tasks and use techniques and strategies aimed at reliability according to point 2 of course description. - [K2A-W14, K2A-W15]

3. Problems selected systems operate a motor vehicle in accordance with point 4 of course description. - [K2A-W14, K2A-W15]

Skills:

1. Formulation of the problems the task selection and strategy use according to point 2 of course description. - [K2A-U15]

2. Troubleshooting the selection of tasks and use strategies using the methods listed in section 3 of course description. - [K2A-U15]

3. Application and verification of knowledge and skills with examples of vehicle selected systems.   - [K2A-U15]

Social competencies:

1. Developing or improving the operating instructions. - [K2A-K02]

2. Taking action to reduce the incidence of injury and the ensuing consequences (risks). - [K2A-K02]

3. Taking action to reduce operating costs. - [K2A-K02]

4. Increasing safety and operating the equipment and reduce environmental risks. - [K2A-K02]

Assessment methods of study outcomes
Final exam and control tests

Course description

1.The exploitation

The device - design, technical functions. The manufacturing process, exploitation unit. The standard description of the structure and function. Use measuring device lifetime. Condition, changes in use. Destructive processes - deterioration of the structural properties. Degradation - the deterioration of the properties of the functional unit. Standards of performance: safety, environmental performance, quality of product or service, availability, efficiency. Quantitative and alternative assessment of technical condition.

Serviceability, unserviceability, damage. The useful life to damage and between the damages. Due to the damage, the consequences of failure. Damage to observable and unobservable. Maintenance: prophylactic, preventive, corrective. Control of the state, provide the means to maintenance and use. Maintenance strategies: correction initiated by damage, regardless of the state of prevention, preventive measures based on state assessments. Maintenance schedules. Maintenance consistent, inconsistent, minimal, perfect. Models of maintenance strategy.

2 Maintenance focus on reliability (RCM)

Concepts methodical systematic approach to job selection techniques and strategies. Determination of the device, the phases of its operation and use. The definition of objectives and tasks handling. The operational definition of functions and their compliance with standards (functional fitness). Term unserviceability of functional devices. Causes analysis of each functional unserviceability. The deductive approach - using fault tree analysis (FTA). Inductive approach - the method of identifying the types and effects of unserviceability (FMEA). Term effects (effects) of each cause. Analysis of the consequences (risks) resulting from any effect (effect). The logical structure issues job selection techniques and strategies. Maintenance instructions and schedules.

3 Methods for analyzing the causes of unserviceability and the choice of strategy

The operational definition of the functions and standards of their fulfillment in relationships: the parameter value - tolerance, load - carrying capacity, quality property - a pattern of properties, the ability of potential equipment and process - the tolerances for the product or service. Determination of tolerances based on assessments of the potential capacity of the machine and the process. Basic structure and analyze the reasons for unserviceability. Reliability structures. Reliability analysis using flowcharts trees serviceability and unserviceability. Quantitative assessment of reliability and maintainability based on fault tree.

Evaluation of the frequency of damage and mean time to correction facilities based on data from service. Reliability, maintainability evaluation system based on the evaluation of failure frequency and mean time to objects. Statistical basis for selection of strategies. The characteristics of the failure on the assumption durability of the Weibull distribution. Evaluation of the effects of actions to improve: quality, reliability and durability of objects. Gamma and Gamma facilities system resurs. Gamma resurs residual objects used. Rationale of the strategies based on the characteristics of the failure and gamma residual resurs. Hazard analysis and risk arising from equipment damage and human errors - using the event tree. Maintenance on the basis of assessments of the state, the logical structure of the problem to recognize the causes of unserviceability.

4 The use of methods and procedures for handling RCM selected systems of a motor vehicle

Transmission system. Brake systems, hydraulic and pneumatic. Steering sytem. The suspension system.

Basic bibliography:

1. PN?JEC 300-3-1, PN-EN 60300-2, PN-JEC 60300-3-9: - Zarządzanie niezawodnością.

2. PN-JEC 706-1 (do 5): - Przewodnik dotyczący obsługiwalności urządzeń.

3. PN-JEC 812: Procedura analizy rodzajów i skutków uszkodzeń (FMEA, FMECA).

4. PN-JEC 1025: - Analiza drzew niezdatności.

5. PN-JEC 1078: - Metoda schematów blokowych niezawodności.

Additional bibliography:

1. Ben-Daya M., Duffuaa S., Raouf A.: Maintenance Modeling and optimization, Kluwer Academic Publishers 2000.

2. Moubray J. : Reliability-Centered Maintenance. Industrial Press INC NewYork 1997.

Result of average student's workload	
Activity	**Time (working hours)**
1. Preparing for classes	20
2. Participation in the lectures and classes	60
3. Learning of the courses content	10
4. Consultations	2
5. Exam and test preparation	10
6. Participation in the exam	2

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Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	104	4
Contact hours	64	2
Practical activities	30	1