

# POLITECHNIKA KRAKOWSKA IM. TADEUSZA KOŚCIUSZKI

## KARTA PRZEDMIOTU

obowiązuje studentów rozpoczynających studia w roku akademickim 2024/2025

Wydział Mechaniczny

Kierunek studiów: Mechanika i Budowa Maszyn

Profil: Ogólnoakademicki

Forma studiów: stacjonarne

Kod kierunku: M

Stopień studiów: I

Specjalności: Computational Mechanics (Mechanika obliczeniowa- w języku angielskim)

### 1 INFORMACJE O PRZEDMIOCIE

|                                         |                             |
|-----------------------------------------|-----------------------------|
| NAZWA PRZEDMIOTU                        | Fundamentals of reliability |
| NAZWA PRZEDMIOTU<br>W JĘZYKU ANGIELSKIM |                             |
| KOD PRZEDMIOTU                          | WM MIBM oIS B31 24/25       |
| KATEGORIA PRZEDMIOTU                    | Przedmioty kierunkowe       |
| LICZBA PUNKTÓW ECTS                     | 2.00                        |
| SEMESTRY                                | 5                           |

### 2 RODZAJ ZAJĘĆ, LICZBA GODZIN W PLANIE STUDIÓW

| SEMESTR | WYKŁAD | ĆWICZENIA | LABORATORIUM | LABORATORIUM<br>KOMPUTERO-<br>WE | PROJEKT | SEMINARIUM |
|---------|--------|-----------|--------------|----------------------------------|---------|------------|
| 5       | 15     | 0         | 0            | 0                                | 15      | 0          |

### 3 CELE PRZEDMIOTU

**Cel 1** Acquainting with the concepts of reliability and durability of technical objects as well as methods and principles used in the analysis of technical systems reliability.

**Cel 2** Acquiring the skills in determining basic reliability characteristics, conducting research and reliability analyzes using computer methods.

**Cel 3** Acquiring the skills to identify and build reliability structures for technical systems.

**Cel 4** Acquiring the skills to model and calculate indicators of the machines reliability, technical devices and vehicles as well as to prevent risks in operation.

**Cel 5** Acquiring the team work skills and responsibility for works and engineering projects.

## 4 WYMAGANIA WSTĘPNE W ZAKRESIE WIEDZY, UMIEJĘTNOŚCI I INNYCH KOMPETENCJI

1 Passed mathematic.

2 Basic knowledge concerning mechanics and strength of materials.

## 5 EFEKTY KSZTAŁCENIA

**EK1 Wiedza** Student defines the concepts of reliability and durability of technical machines and devices.

**EK2 Umiejętności** Student uses basic reliability characteristics of machines and technical devices.

**EK3 Umiejętności** Student identifies types of reliability structures and uses their properties in the construction and operation of technical objects.

**EK4 Kompetencje społeczne** Student calculates reliability indices of technical objects described by using of reliability structures.

**EK5 Kompetencje społeczne** Students cooperates in a team and understands the need of technological development and improvement of the operational safety of technical facilities.

## 6 TREŚCI PROGRAMOWE

| PROJEKT   |                                                                                                                                                                                             |                  |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| LP        | TEMATYKA ZAJĘĆ<br>OPIS SZCZEGÓŁOWY BLOKÓW TEMATYCZNYCH                                                                                                                                      | LICZBA<br>GODZIN |
| <b>P1</b> | Characteristics of technical facilities in terms of reliability and durability. The use of specialized computer programs to analyze the reliability and durability of technical facilities. | 4                |
| <b>P2</b> | Modeling of machine reliability by using basic probability distributions.                                                                                                                   | 3                |
| <b>P3</b> | Analysis of the reliability structures of technical objects by using computer methods.                                                                                                      | 3                |
| <b>P4</b> | Determination of basic machine reliability characteristics, reliability indicators and the relationships between them.                                                                      | 3                |
| <b>P5</b> | Study of lifecycle cost (LCC) of facility depending on RAMS indicators.                                                                                                                     | 2                |

| WYKŁAD    |                                                                                                                                                                                                                                                           |                  |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| LP        | TEMATYKA ZAJĘĆ<br>OPIS SZCZEGÓŁOWY BLOKÓW TEMATYCZNYCH                                                                                                                                                                                                    | LICZBA<br>GODZIN |
| <b>W1</b> | Basic concepts of reliability theory, functional reliability characteristics. Relationships between reliability characteristics.                                                                                                                          | 3                |
| <b>W2</b> | : Reliability models and principles of modeling the reliability of technical objects. Indicators of reliability and methods of their determination. Empirical reliability characteristics. Mathematical models of non-renewable and renewable facilities. | 3                |
| <b>W3</b> | Functional and reliability structures. Types and methods of analysis of reliability structures of technical objects. Wear and defects of technical facilities, trees of damage.                                                                           | 3                |
| <b>W4</b> | Methods and experimental research. Laboratory studies , experimenatal and simulation tests of durability and reliability of machines and technical devices. Technique of research results analysis, statistical inference.                                | 2                |
| <b>W5</b> | Methods for predicting machine durability and reliability.                                                                                                                                                                                                | 2                |
| <b>W6</b> | The relationship between reliability (RAMS indicators) and the efficiency of technical facilities operation, the cost of the lifetime of a technical facility (LCC).                                                                                      | 2                |

## 7 NARZĘDZIA DYDAKTYCZNE

**N1** Lectures.

**N2** Laboratory exercises

**N3** Consultations.

## 8 OBCIĄŻENIE PRACĄ STUDENTA

| FORMA AKTYWNOŚCI                                                                                 | ŚREDNIA LICZBA GODZIN<br>NA ZREALIZOWANIE<br>AKTYWNOŚCI |
|--------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| <b>Godziny kontaktowe z nauczycielem akademickim, w tym:</b>                                     |                                                         |
| Godziny wynikające z planu studiów                                                               | 30                                                      |
| Konsultacje przedmiotowe                                                                         | 20                                                      |
| Egzaminy i zaliczenia w sesji                                                                    | 2                                                       |
| <b>Godziny bez udziału nauczyciela akademickiego wynikające z nakładu pracy studenta, w tym:</b> |                                                         |
| Przygotowanie się do zajęć, w tym studiowanie zalecanej literatury                               | 25                                                      |
| Opracowanie wyników                                                                              | 5                                                       |
| Przygotowanie raportu, projektu, prezentacji, dyskusji                                           | 5                                                       |
| <b>SUMARYCZNA LICZBA GODZIN DLA PRZEDMIOTU WYNIKAJĄCA Z<br/>CAŁEGO NAKŁADU PRACY STUDENTA</b>    | <b>87</b>                                               |
| SUMARYCZNA LICZBA PUNKTÓW ECTS DLA PRZEDMIOTU                                                    | 2.00                                                    |

## 9 SPOSOBY OCENY

### OCENA FORMUJĄCA

**F1** : Report of laboratory exercise

**F2** Test

### OCENA PODSUMOWUJĄCA

**P1** Weighted average of formulating evaluation.

### WARUNKI ZALICZENIA PRZEDMIOTU

**W1** The need to obtain a positive evaluation of each educational result.

### OCENA AKTYWNOŚCI BEZ UDZIAŁU NAUCZYCIELA

**B1** Test

### KRYTERIA OCENY

| EFEKT KSZTAŁCENIA 1 |                                                              |
|---------------------|--------------------------------------------------------------|
| NA OCENĘ 2.0        | The student does not meet the requirements for the grade 3.0 |

|                     |                                                                                                                                                                                             |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NA OCENĘ 3.0        | The student distinguishes the concepts of reliability and durability of technical systems and identifies them with the safety of technical system operation.                                |
| NA OCENĘ 3.5        | The student distinguishes between the concepts of reliability and durability and identifies them with the features machines, devices and technical systems                                  |
| NA OCENĘ 4.0        | The student lists the basic methods of assessment and discusses the methods of measurement reliability properties of machines and technical systems                                         |
| NA OCENĘ 4.5        | The student lists and characterizes the features of probabilistic models reliability used in the assessment of the reliability of machines and systems technical                            |
| NA OCENĘ 5.0        | The student assigns reliability models to the type of factors forcing influencing the analyzed element or technical system                                                                  |
| EFEKT KSZTAŁCENIA 2 |                                                                                                                                                                                             |
| NA OCENĘ 2.0        | The student does not meet the requirements for the grade 3.0                                                                                                                                |
| NA OCENĘ 3.0        | The student knows the selected basic characteristics of reliability.                                                                                                                        |
| NA OCENĘ 3.5        | The student distinguishes empirical characteristics and lists the basic reliability indicators of technical systems                                                                         |
| NA OCENĘ 4.0        | The student determines the empirical characteristics of reliability                                                                                                                         |
| NA OCENĘ 4.5        | The student determines models and parameters of the reliability distribution of technical object                                                                                            |
| NA OCENĘ 5.0        | The student identifies the reliability model and the parameters of the probability distribution with the structure and type of work of the object                                           |
| EFEKT KSZTAŁCENIA 3 |                                                                                                                                                                                             |
| NA OCENĘ 2.0        | The student does not meet the requirements for the grade 3.0                                                                                                                                |
| NA OCENĘ 3.0        | Student correctly identifies at least two types of structures reliability.                                                                                                                  |
| NA OCENĘ 3.5        | The student recognizes the reliability structures and assigns the properties of machines and technical systems                                                                              |
| NA OCENĘ 4.0        | The student correctly identifies, graphically determines and records analytically structures for objects built from basic reliability structures                                            |
| NA OCENĘ 4.5        | The student presents graphically and analytically the reliability structure of the selected technical object                                                                                |
| NA OCENĘ 5.0        | The student correctly identifies the reliability structures occurring in reliability and presents them in a graphical and analytical form for objects with different reliability structures |
| EFEKT KSZTAŁCENIA 4 |                                                                                                                                                                                             |
| NA OCENĘ 2.0        | The student does not meet the requirements for the grade 3.0                                                                                                                                |

|                     |                                                                                                                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NA OCENĘ 3.0        | Student determines the reliability of simple technical systems described by means of serial and parallel reliability structures.                                                                                        |
| NA OCENĘ 3.5        | The student calculates the values of reliability coefficients for technical objects built of basic structures                                                                                                           |
| NA OCENĘ 4.0        | The student determines block diagrams and performs an analytical record and conducts effective calculations of the reliability of basic technical objects and mixed reliability structures                              |
| NA OCENĘ 4.5        | The student calculates the values of the reliability indexes of technical objects built of complex structures                                                                                                           |
| NA OCENĘ 5.0        | The student correctly identifies the reliability structures present in the reliability and presents them in an analytical and effective form carries out calculations for objects with different reliability structures |
| EFEKT KSZTAŁCENIA 5 |                                                                                                                                                                                                                         |
| NA OCENĘ 2.0        | The student does not meet the requirements for the grade 3.0                                                                                                                                                            |
| NA OCENĘ 3.0        | The student performs a fragment of the assigned task within the group, does not consult and does not verify his position with the group.                                                                                |
| NA OCENĘ 3.5        | The student independently draws conclusions from the assigned task and presents it to the team members                                                                                                                  |
| NA OCENĘ 4.0        | The student uses the reliability indicators to estimate the risk in the operation of machines and technical devices                                                                                                     |
| NA OCENĘ 4.5        | The student consciously uses methods of improving reliability to ensure the physical, economic and ecological safety of people, animals and technical facilities                                                        |
| NA OCENĘ 5.0        | The student assesses the values of reliability indicators and forecasts their changes and the impact on the maintenance of the safe operation of technical systems                                                      |

## 10 MACIERZ REALIZACJI PRZEDMIOTU

| EFEKT KSZTAŁCENIA | ODNIESIENIE DANEGO EFEKTU DO SZCZEGÓŁOWYCH EFEKTÓW ZDEFINIOWANYCH DLA PROGRAMU | CELE PRZEDMIOTU            | TREŚCI PROGRAMOWE          | NARZĘDZIA DYDAKTYCZNE | SPOSOBY OCENY |
|-------------------|--------------------------------------------------------------------------------|----------------------------|----------------------------|-----------------------|---------------|
| EK1               |                                                                                | Cel 1 Cel 2<br>Cel 3 Cel 4 | P1 P2 P3 P4 P5<br>W1 W2 W6 | N1 N2 N3              | F1 F2 P1      |

| EFEKT KSZTAŁCENIA | ODNIESIENIE DANEGO EFEKTU DO SZCZEGÓŁOWYCH EFEKTÓW ZDEFINIOWANYCH DLA PROGRAMU | CELE PRZEDMIOTU                     | TREŚCI PROGRAMOWE                      | NARZĘDZIA DYDAKTYCZNE | SPOSOBY OCENY |
|-------------------|--------------------------------------------------------------------------------|-------------------------------------|----------------------------------------|-----------------------|---------------|
| EK2               |                                                                                | Cel 1 Cel 2<br>Cel 3 Cel 4          | P1 P2 P3 P4 P5<br>W1 W2 W3 W4<br>W6    | N1 N2 N3              | F1 F2 P1      |
| EK3               |                                                                                | Cel 1 Cel 2<br>Cel 3 Cel 4          | P1 P2 P3 P4 P5<br>W1 W2 W3 W4<br>W5 W6 | N1 N2 N3              | F1 F2 P1      |
| EK4               |                                                                                | Cel 1 Cel 2<br>Cel 3 Cel 4<br>Cel 5 | P1 P2 P3 P4 P5<br>W1 W2 W3             | N1                    | F1 F2 P1      |
| EK5               |                                                                                | Cel 1 Cel 2<br>Cel 3 Cel 4<br>Cel 5 | P1 P2 P3 P4 P5<br>W1 W2 W3 W4<br>W5 W6 | N1 N2 N3              | F1 F2 P1      |

## 11 WYKAZ LITERATURY

### LITERATURA PODSTAWOWA

- [1] | Migdalski J. — *Inżynieria niezawodności. Poradnik*, Warszawa, 1992, Wydawnictwo ZETOM
- [2] | Wallace R. B., Prabhakar Murthy D. N. — *Reliability: Modeling, Prediction and Optimization*, Canada, 2000, Wiley
- [3] | Manzini R, Regattieri A, Pham H, Ferrari E. — *Maintenance for Industrial Systems*, , 2010, Springer-Verlag Gmbh

### LITERATURA UZUPEŁNIAJĄCA

- [1] | Słowski B. — *Podstawy badań i oceny niezawodności obiektów technicznych*, Koszalin, 1996, Wydawnictwo Uczelniane Politechniki Koszalińskiej

## 12 INFORMACJE O NAUCZYCIELACH AKADEMICKICH

### OSOBA ODPOWIEDZIALNA ZA KARTĘ

dr inż. Stanisław, Jan Młynarski (kontakt: mlynarski\_st@poczta.onet.pl)

### OSOBY PROWADZĄCE PRZEDMIOT

- 1 dr hab. inż. Stanisław Młynarski (kontakt: stanislaw.mlynarski@pk.edu.pl)
- 2 dr inż. Magdalena Machno (kontakt: machno.magda@gmail.com)
- 3 dr inż. Grzegorz Kaczor (kontakt: gkaczor@pk.edu.pl)

4 dr inż. Maciej Michnej (kontakt: [maciej.michnej@mech.pk.edu.pl](mailto:maciej.michnej@mech.pk.edu.pl))

5 dr hab. inż. Grzegorz Zając (kontakt: [grzegorz.zajac@mech.pk.edu.pl](mailto:grzegorz.zajac@mech.pk.edu.pl))

## 13 ZATWIERDZENIE KARTY PRZEDMIOTU DO REALIZACJI

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(miejscowość, data)

(odpowiedzialny za przedmiot)

(dziekan)

**PRZYJMUJĘ DO REALIZACJI** (data i podpisy osób prowadzących przedmiot)

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