

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

**SUPERVISOR DECLARING/CONDUCTING COURSE: PhD. DSc. Grzegorz Lesiuk,
Assoc. Prof.**

DEPARTMENT: Faculty of Mechanical Engineering

SCIENTIFIC DISCIPLINE: Mechanical Engineering

COURSE CARD

Course name in Polish: Wybrane zagadnienia zmęczenia i pękania materiałów oraz konstrukcji inżynierskich

Course name in English: Selected issues of Fatigue and Fracture of Materials and Structures

Course language: English

University-wide general course type*:

The course is intended for all PhD students: YES / NO

1) BASIC COURSE

2) SPECIALIST COURSE

3) SEMINAR

4) HUMANISTIC COURSE

5) LANGUAGE

Subject code: MEQ100186W

* delete as applicable

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)				30
Grading	Exam	Exam	Oral presentation	Exam, inspection, evaluation classes

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of material strength
2. Basic knowledge of experimental mechanics

COURSE OBJECTIVES

- C1. Learning the basics of fracture and fatigue mechanics
- C2. Gaining the ability to analyze the process of fatigue crack propagation.
- C3. To acquire skills related to the methods and methodology of conducting scientific research.
- C4. To acquire the ability to prepare the presentation of scientific work results.
- C5. Acquiring skills of conducting calculation analyses and elaborating laboratory results in the field of fracture mechanics.
- C6. Acquiring skills of scientific cooperation in a team analyzing fatigue damage.
- C7. Acquisition of basic knowledge in the development of scientific expertises

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PROGRAM CONTENTS

Form of classes		Number of hours
Mf1	Determination of fracture toughness for engineering materials - linear fracture mechanics	2
Mf2	Calculations in the range of linear elastic fracture mechanics	2
Mf3	Energy methods - determination of J integral and its critical value	2
Mf4	Calculation and analysis including plasticity ahead of a crack tip	2
Mf5	Fatigue of materials - basic characteristics in a uniaxial loading condition	2
Mf6	Fatigue Crack growth rate and fatigue life prediction – experimental approach	2
Mf7	Fatigue crack growth rate and fatigue life prediction - analytical and numerical calculations	2
Mf8	Multiaxial fatigue - an overview of existing solutions for proportional and non-proportional loads	2
Mf9	Mixed-mode fatigue crack growth. Predicting of fatigue crack paths and fatigue lifetime estimation	2
Mf10	Case study - analysis of fatigue crack growth in structural components and damage analysis - example of expertise elaboration - description of fracture surface	2
Mf11	Presentation - research report on a selected topic related to fatigue analysis and fracture mechanics - case study developed by PhD students	8
Mf12	Review and colloquium	2
	Total hours	

TEACHING TOOLS USED

- N1. Lecture .
N2. Multimedia presentation
N3. Problematic discussion
N4. Own work

ACHIEVED SUBJECT LEARNING OUTCOMES

Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	P8S_WK	Presentation, participation in the discussion
Skills	P8S_UK	Presentation, participation in the discussion
Skills	P8S_UO	Report, participation in the discussion
Social competence	P8S_KK	Presentation, report, participation in the discussion
Social competence	P8S_KO	Report, participation in the discussion

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PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

1. Neimitz A., *Mechanika Pękania*, WN PWN, Warszawa 1998
2. Anderson T.L. *Fracture Mechanics. Fundamentals and Applications*, Fourth Edition. — CRC Press, 2017.
3. Kocańda S., *Zmęczeniowe pękanie metali*, WNT, Warszawa 1985.
4. GERMAN, JANUSZ. *Wprowadzenie do mechaniki pękania*. Kraków: Politechnika Krakowska, 2011.
5. Gdoutos, E. E. (2020). *Fracture mechanics: an introduction* (Vol. 263). Springer Nature.
6. Farahmand, B., Bockrath, G., & Glassco, J. (2012). *Fatigue and fracture mechanics of high risk parts: application of LEFM & FMDM theory*. Springer Science & Business Media.

SECONDARY LITERATURE:

1. Niezgodziński, T. (2007). *Elastoptyka i metoda elementów skończonych w mechanice pękania: wybrane problemy*. Wydawnictwo Politechniki Łódzkiej.
2. Saxena, A. (2019). *Advanced Fracture Mechanics and Structural Integrity*. CRC Press.
3. BROCKS, Wolfgang. *Plasticity and Fracture*. Springer International Publishing, 2018.
4. Avellar, L., & Mac Donald, K. (2019). *Mechanics of Materials and Fracture for High School Students*. In *Fracture, Fatigue, Failure and Damage Evolution*, Volume 6 (pp. 111-114). Springer, Cham.
5. Lesiuk, G., Correia, J.A.F.O., Krechkovska, H.V., Pekalski, G., Jesus, A.M.P. de, Student, O., *Degradation Theory of Long Term Operated Materials and Structures*, Springer, 2020
6. Kinloch, A. J. (Ed.). (2013). *Fracture behaviour of polymers*. Springer Science & Business Media

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

PHD. DSC. GRZEGORZ LESIUK, ASSOC. PROF., Grzegorz.Lesiuk@pwr.edu.pl