

## Theory of Damage

Code: MK3KAREG04G117-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3<sup>rd</sup> year, 1<sup>st</sup> semester

Its prerequisite(s): Manufacturing Processes II

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+1

### Topics:

The aim of the course is to describe the damage to the materials based on the exact mathematical mechanical and physical background. A description of the changes in the errors in the materials and, based on this, an estimation of the lifetime of a given fault. From now on, demonstration of destruction-free tests and procedures to detect errors in the structure.

Students will get acquainted with the compilation of tribological science and the most common tribotechnical problems. Understanding the Tribological Processes of Interconnected, Interdependent Technical Surfaces. Designing aspects of the tribological environment that are favorable for the operation of machines and machine elements. Deeper knowledge of friction, wear and lubrication processes.

### Literature:

#### Compulsory:

- Tóth L.: A törésmechanika alapelvei. <http://mek.oszk.hu/01100/01190/>
- G. Pluinage: Linerás törésmechanika. <http://mek.oszk.hu/01100/01182/>
- Zolnay,G., Tóth,L.(szerk.): Fémek és szerkezetek törése, Alkalmazott törésmechanika, Gépipari Tudományos Egyesület. Budapest, 1986.
- Broek, D.: The Practical Use of Fracture Mechanics, Kluwer Academic Publishers, London, 1988.
- Blumenauer,H. - Pusch,G.: Műszaki törésmechanika, Műszaki Könyvkiadó, Budapest, 1987.
- Panasjuk, V.V.: Mekhanika razrusheniya i prochnost' materialov, Tom 1-4. Naukogo Dumka, Kiev, 1988-90
- Singh, R. (eds): Weld Cracking in Ferrous Alloys, Woodhead Publishing, Cambridge, 2009.
- NDT Handbook, American Society for Nondestructive Testing, Vol. 1-7, Third edition,
- Non-destructive testing: A Guidebook for Industrial Management and Quality Control Personnel, IAEA, Vienna, 1999.
- Mix, P. E.: Introduction to Nondestructive Testing: A Training Guide, John Wiley & Sons, 2005.
- Valasek, I. (szerk.): Tribológia, 1-7 kötet. Tribotechnik Kft, Budapest, 2002.
- Neale, M. J.: The Tribology. Handbook, Butterworth, Oxford, 1996. ISBN 0750611987, 9780750611985, p640.
- Bharat Bhushan Modern Tribology Handbook, CRC Press, 2010, ISBN 0849377870, 9780849377877, p 1760
- Valasek István, Törös Mihályné: Tribológia, Műszaki Kiadó, Budapest, 2007

### Schedule

#### 1<sup>st</sup> week Registration week

#### 2<sup>nd</sup> week:

**Lecture:** The development and development of breakthrough mechanics The importance of fracture mechanics in estimating the reliability of structures.

**Practice:** Issue a semiannual assignment. Presentation of the solution steps of the problem.

#### 3<sup>rd</sup> week:

**Lecture:** Types and Methods of Fracture Mechanical Examinations. Comparison of the fracture toughness of different materials. The basic correlations of linearly flexible breakdown mechanics, the voltage intensity factor, and the concept of fracture toughness.

**Practice:** Material Testing - Perform Charpy's Impact Test for semester task

**4<sup>th</sup> week:**

**Lecture:** Principles of fracture mechanics control. The plastic deformation of the crack peak environment and its role in the description of breakdown processes. The basic methods of nonlinear flexible resilient mechanics. Concept and measurement of COD.

**Practice:** Completion of non-destructive material tests for semester task

**6<sup>th</sup> week:**

**Lecture:** The basic methods of nonlinear flexible resilient mechanics. Concept and measurement of COD. The role of residual tensions in the spread of cracks. The principles of breakthrough mechanical controls (R9, EPRI, COD, leak-before-break, etc.) and its software

**Practice:** Calculation practice

**8<sup>th</sup> week: 1<sup>st</sup> drawing week****9<sup>th</sup> week:**

**Lecture:** Radiological and isotope examinations, their physical bases, reliability, constraints, Ultrasound tests, their physical bases, reliability, constraints.

**Practice:** Task finalization

**11<sup>th</sup> week:**

**Lecture:** Elements of the Tribological System; Factors influencing friction, wear and lubrication processes.

**Practice:** Issue a semester task. Discussing the tasks related to the lecture

**13<sup>th</sup> week:**

**Lecture:** Lubrication of lubrication and lubrication of machine parts. Dry, Bound, Mixed and Fluid Detection. Lubricating greases, lubricating oils.

**Practice:** Determination of oily wear rates by dielectric constant change using OILCHECK.

**15<sup>th</sup> week: 2<sup>nd</sup> drawing week****5<sup>th</sup> week:**

**Lecture:** The plastic deformation of the crack peak environment and its role in the description of breakdown processes. The basic methods of nonlinear flexible resilient mechanics. Concept and measurement of COD. The plastic deformation of the crack peak environment and its role in the description of breakdown processes.

**Practice:** Calculation practice

**7<sup>th</sup> week:**

**Lecture:** Possible principles of error detection methods. Chronological overview of their development and industrial introduction. Grouping of tests, physical constraints, detection and probability of error probability. Methods for detecting surface defects, their physical bases, reliability, constraints.

**Practice:** Calculation practice

**10<sup>th</sup> week:**

**Lecture:** Structural fracture sensitivity in quasi-static and repetitive loads. Summary overview is the location of the break mechanism and its role in assessing the safety of structures. Numerical examples for evaluating the hazards of errors. Report on the issues that are issued

**Practice:** Re-take Task finalization

**12<sup>th</sup> week:**

**Lecture:** Wearing processes. Categorization and characterization of wear processes. Wearing of machine elements

**Practice:** Presentation of the solution steps of the problem.

**14<sup>th</sup> week:**

**Lecture:** Tribology of sliding and rolling bearings. Tribological aspects of the design of sliding and rolling bearings. Tribological failure of bearings. Tribology of toothed wheels and seals.

**Practice:** Re-take Task finalization

**Requirements****A, for a signature:**

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of

further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test is on the 8th week and the end-term test is on the 15th week. Students must sit for the tests.

**B, for grade:**

The course ends in a mid-semester grade based on the average grade of the two tests.

The minimum requirement of the mid-term and the end-term test is 60% separately. The grade for each test is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, the student once can take a retake test of the whole semester material.