University *of Ljubljana*
Faculty *of Mechanical Engineering*

Operational Strength 5 ECTS

Lecturer: **M. Nagode, J. Klemenc, D. Šeruga**

Lectures: 30h | Tutorials: 6h | Labs: 24h | Project: 0h | Lang. :

Objectives

1. Gain knowledge of damage of crystal lattice due to cyclic and monotonous loading.
2. Gain knowledge of the damage growth process and the influences to this process.
3. Gain knowledge and understand high cycle and low cycle fatigue, fatigue crack growth and learn to use associated methods and computer software on practical examples.
4. Upgrade fundamental knowledge of mechanical engineering and use it on practical examples.

Programme

Introduction into operational strength. Defects in crystalline solid. Crack growth propagation. High cycle fatigue - Region of validity determination. High cycle fatigue - SN curve and hypothesis on damage accumulation and damage evolution. High cycle fatigue - Equivalent stress amplitude. High cycle fatigue - Damage calculation for random load history: conventional and alternative procedure. Low cycle fatigue - Region of validity determination and influence of macro yielding. Low cycle fatigue - Stress - strain response: conventional and alternative procedure. Low cycle fatigue - EN curve and damage parameters. Low cycle fatigue - Damage calculation for random load history: conventional and alternative procedure. Cyclic creep and relaxation.

Prerequisites

In order to successfully achieve this course, the students must have:

- Meeting the enrolment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.

Learning outcomes

Knowledge:

In-depth theoretical, methodological and analytical knowledge with elements of research, which is fundamental for very demanding professional tasks:

- Understanding and mastering mechanisms that lead to damage due to cyclic and monotonous loading.
- Mastering methods to predict durability due to high cycle and load-cycle fatigue and creep.
- Understanding and mastering methods to predict fatigue crack growth.

Skills:

Mastering very demanding and complex work processes and methodological tools in specialised fields:

- high cycle and low cycle fatigue and creep and fatigue crack growth.

Ability of original breakthroughs/creations and critical reflection in the field of operational strength.

Assessment

- Theoretical knowledge (lectures): 50%,
- Individual work at exercises: 20%,
- Work at laboratory exercises (including reports): 20%,
- Seminar: 10%.

Literature

1. Dowling N.E., Kampe S.L., et al. Mechanical Behavior of Materials - Fifth Edition. NE. Pearson Education Limited, 2018.
2. Lemaitre J., Desmorat R. Engineering Damage Mechanics: Ductile, Creep, Fatigue and Brittle Failures. Springer Vieweg, 2005.
3. Wu X. Deformation and Evolution of Life in Crystalline Materials: An Integrated Creep-Fatigue Theory. CRC Press, 2019.
4. Naumenko K., Altenbach H. Modeling High Temperature Materials Behavior for Structural Analysis: Part II. Solution Procedures and Structural Analysis Examples (Advanced Structured Materials Book 112). Springer, 2019.