

TOPICS for the STATE EXAM from the course titled „Durability and Fatigue in Vehicle Engineering”

13th December 2021

- **Physical background**
 - What were the observations of August Wöhler?
 - Show the phases of fatigue phenomena in a diagram and illustrate it on the cross-sectional area of a rod subjected to (pulsating) bending!
 - Explain how the microcrack initiation takes place!
 - Describe the direction of the macrocrack propagation!
- **S-N curve**
 - Draw a general S-N curve and name the 4 categories of loadings based on the number of repetitions! Explain the x and y axes and show the transition lifetime on the diagram!
 - Name the characteristic points of the S-N curve and give its equation!
 - Explain the 10% and 90% failure probability S-N curves! Draw them also into the diagram!
 - What changes the standard deviation of the S-N curve?
 - How can the endurance region be described by the S-N curve?
- **Cyclic loadings**
 - What is the stress ratio and why is it important for durability?
 - Show the difference between the static and stabilized cyclic σ - ϵ diagram! Explain its mathematical model!
 - Categorize the materials based on their cyclic behavior!
 - How can the endurance limit of a material be estimated? What is the usual range of the cycle limit?
 - Explain the Haigh diagram and its importance!
- **Load measurements and load collectives - Cycle counting methods**
 - What quantities are measured and how?
 - Explain the concept of turning a load time history into a load collective!
 - What are the kept and lost parameters during cycle counting?
 - One parameter cycle counting methods
 - Two parameters cycle counting methods
- **Durability tests and evaluation methods**
 - pros/cons of the following test benches: pneumatic test bench, hydraulic test bench, resonance test bench, shaker
 - Explain the goal, process and pros/cons of the following test procedures:
 - staircase method by Hück
 - Probit procedure
 - Horizons procedure
 - Pearl line procedure
- **Durability assessment**
 - Fatigue strength assessment
 - Definition of partial damage
 - Theory of the linear damage accumulation method (Palmgren-Miner rule)
 - Inaccuracies of the Palmgren-Miner rule
 - Correction possibilities for Palmgren-Miner rule

- Endurance limit assessment
 - Definition
 - Statistical aspects of loading/endurance limit
 - Definition of safety factor
 - Failure probability
- **Design for Durability**
 - What are the different design approaches/philosophies?
 - Name the influence factors of durability!
 - What are the methods to increase the durability of a part/structure?
 - When do you use test and when simulation/calculation?