

# Exam Biocompatible Materials 08.4.2024

Name: [REDACTED]

Matrikelnummer: [REDACTED]

- (1) Place your name and Matrikelnummer on all sheets of paper you use
- (2) Always put a number of the relevant question on top of your answers.
- (3) You have 90min of time to answer all questions

## Questions:

- (1) How is the stress intensity factor  $K$  influenced by the acting stress  $\sigma$ , defect size  $a$  and form factor  $f$ ? By rearranging this formula, how is the critical defect size  $a_c$  depending on the fracture toughness  $K_c$  of a specific material, assuming that a constant stress  $\sigma$  is acting? How much larger is the critical defect size for a part made of steel ( $K_c=50\text{MPa m}^{1/2}$ ) in comparison to the same part made of alumina ( $K_c=5\text{MPa m}^{1/2}$ ), assuming that the form factor as well as stress are the same in both cases?
- (2) Draw a typical stress-strain curve for ferritic steel and highlight the essential parameters that can be obtained from it.
- (3) Define the terms **Stiffness**, **Strength**, **Hardness**, and **Fracture Toughness**. What mechanisms can increase the dissipated energy during crack growth, leading to a higher toughness of a material?
- (4) What are the differences between chain growth and step growth polymerization? Provide the molecular weight-conversion diagram for both types to explain how they differ in reaching their final molecular weights.
- (5) What are the benefits and drawbacks of using titanium as a biomaterial? What are the reasons that CP-titanium is used for many biomedical applications instead of the engineering alloy Ti-6AL-4V?
- (6) How can high strength in ceramic materials be achieved? What are the relevant parameters that influence the translucency of such ceramics?
- (7) What is the definition of biodegradation? Name the 4 mechanisms of degradation and provide a brief explanation of each.
- (8) Which classification of biomedical devices is used in the EU? Write down 1-2 examples for each class and mention the parameters deciding which class a specific device belongs to.
- (9) What are the 4 phases of a normal wound healing process? How can wound dressings help in healing a skin wound?
- (10) What is the definition of a hydrogel and what is its important feature? Name important parameters describing a hydrogel's properties as well as some medical applications of them.