

# MATERIAL SCIENCE FOR MECHANICAL ENGINEERS



SPRING 2020-2021

## Midterm Exam

Time: 40 Minutes

Date: April 18<sup>th</sup>, 2021

### Instructions:

- This is an open book, open notes test. Solve ALL problems.
- Try to TYPE your answers when possible, otherwise use your clear and neat handwriting.
- Solve each problem on a *separate sheet*.
- Upload your answers as a PDF file, use the cover page and the correct file name: IDnumber\_Midterm.pdf (incorrect file names will NOT be graded)
- Maximum grade 25/25.
- Test starts at **3.00 pm** and end sharp at **3.40 pm**. 2 minutes are given for submission through MS Teams. Any delay beyond 3.42 means that your grade will be ZERO.
- Submit using the assignment section on MS Teams and make sure to turn in your work. Submissions sent by e-mail or the chat will be ignored.
- No late submission will be accepted.

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### Problem 1 (10 Points)

What is the difference between FCC, BCC and HCP? (a detailed comparison that includes **ALL** aspects must be presented in a TABULAR format).

### Problem 2 (8 Points)

*Design* a case-hardening process for a set of spur gears made of an austenitic stainless Steel. The gears initially have 0.20 wt% carbon. They are set to be carburized at an elevated temperature and in an atmosphere that gives a surface carbon concentration constant at 1.0 wt%. After 49.5 h the concentration of carbon is 0.35 wt% at a position 4.0 mm below the surface. Provide your answer(s) in degrees kelvin.

### Problem 3 (7 Points)

What is the ASTM grain-size number for material shown in the micrograph?

Why is it important for a metallurgist to know the grain size?

