ME 8253 Spring 2023
Homework #2
Due Date: Monday February 27ᵗʰ, 2023

Please submit your homework through CANVAS as a PDF file. For all problems with calculation, present all calculation details.

Problem 1 (*20 points*)
Fatigue testing can take an appreciable amount of time. Calculate the number of hours, days, or weeks it would take to apply 10^6, 10^7, and 10^8 cycles for test frequencies of
  (a) 1 Hz (approximate speed of Wöhler's original work). One of Wohler's tests ran for
      1.3×10^8 cycles. How long did the test run?
  (b) 30 Hz (speed of many common test machines).
  (c) 150 Hz (speed of some rotating beam test machines).
  (d) 20 kHz, but calculate the time for 10^8, 10^9, and 10^{10} cycles.

Problem 2 (*40 points*)
An as-forged 2 in. diameter 1040 steel rod has an ultimate tensile strength S_u of 100 ksi and a yield strength S_y of 75 ksi and is subjected to constant amplitude cyclic bending. Determine the following using appropriate approximation models:
  (a) the fully reversed fatigue strength at 10^6 cycles,
  (b) S_a and S_m for 10^6 cycles if $R = -0.2$, and
  (c) S_a and S_m for 10^4 cycles if $R = +0.2$
  (d) Plot the Constant Life Diagram for (a) and (b). Use the yield strength S_y value for S_y'.
      Plot the constant stress ratio lines on the diagram.

Problem 3 (*40 points*)
  (a) Repeat Problem (a)-(d) but with the small as-forged surface thickness machined off.
  (b) Comment on the effect of removing the as-forged surface thickness on fatigue
      resistance.