# Homework 04

Question 01 (30 points)

A solid square rod is cantilevered at one end. The rod is 0.6 m long and supports a completely reversing transverse load at the other end of ±2 kN. The material is AISI 1080 hot-rolled steel. If the rod must support this load for 10,000 cycles with a design factor of ~1.5, what dimension should the square cross section have? Since the size is not yet known, assume a typical value of k_b = 0.85 and verify its correctness later. Neglect any stress concentrations at the support end.

Question 02 (35 points)

The shaft shown in the figure is machined from AISI 1040 CD steel. The shaft rotates at 1600 rpm and is supported in rolling bearings at A and B. The applied forces are F1 = 2500 lbf and F2 = 1000 lbf. Radius of all fillets is 1/16 in R.
Determine the minimum fatigue factor of safety based on achieving infinite life. If infinite life is not predicted, estimate the number of cycles to failure. Also check for yielding.
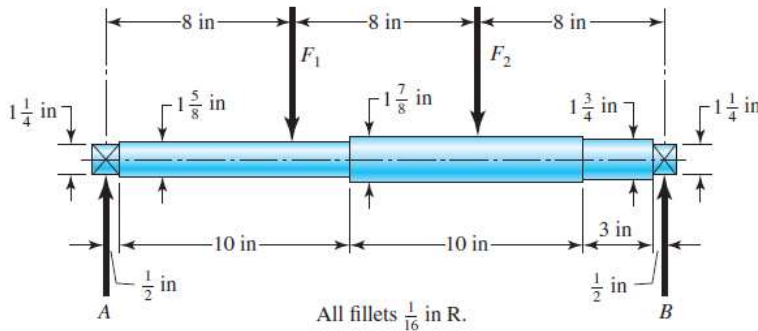
Question 03 (35 points)

Shaft A, made of AISI 1020 hot-rolled steel, is welded to a fixed support and is subjected to loading by equal and opposite forces **F** via shaft B. A theoretical stress concentration factor K_{ts} of 1.6 is induced in the shaft by the 1/8-in weld fillet. The length of shaft A from the fixed support to the connection at shaft B is 2 ft. The load F cycles from 150 to 500 lbf.

a. For shaft A, find the factor of safety for infinite life using the modified Goodman fatigue failure criterion.
b. Repeat part (a) using the Gerber fatigue failure criterion.