Fall 2021, ME1029 Mechanical Design 2

Homework 02

Name		Student ID	

Question 01 (30 points)

The outer diameter of a solid aluminum shaft is in the range of 2.003-2.006 inch. Its mating hub is made of 18-8 stainless steel and has the inner diameter in the range of 2.000-2.002 inch and 3-inch outer diameter. Elastic constants of the two materials can be found in Table A–5 in the textbook.

a. Identify the range of radial interference δ, then
b. find the maximum interference pressure P, and the
c. radial and hoop stresses on both parts at the fit surface under the given P.

Question 02 (20 points)

Following Question 01 and calculate the followings at the interference-fit interface:

a. safety factor of the hub ID per MSS failure criteria,
b. safety factor of the hub ID per DET failure criteria, and
c. the guaranteed torque capacity limit of the fit assuming 1.25 in fit length and COF of 0.2.

Also make an assessment whether the parts will fail or not.
Yield strength of the 18-8 steel is 50 ksi.

Question 03 (50 points)

Your mission is to make a force-fit design of a 150-mm-diameter steel shaft with a 300-mm-outside-diameter hub. The hub is 25 mm long. The designed system is intended to operate under 150degC environment.
Both hub and shaft are made of 1050 CD steel. Moduli of elasticity is 207 GPa and Poisson's ratio is 0.3. Coefficient of friction of steel-on-steel is 0.20.
Design the fit per ANSI B4-2-1978.

a. Specify the range of the shaft outer diameter.
b. Specify the range of the hub inner diameter.
c. Calculate max and min interference.
d. How will you mark the dimensions of shaft OD and hub ID on the drawing?
e. Safety factor of the hub ID surface per DET failure criteria.
f. Guaranteed capacity for torque transmission.