

## MEE342 Midterm Exam 1 (Feb. 28, 2018)

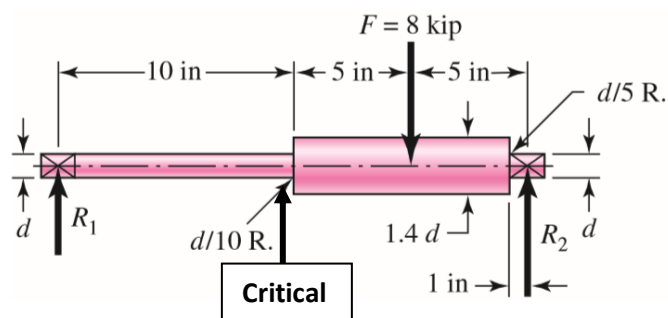
### Problem 1 (15 Points)

Evaluate the life of the steel rotating-beam test specimen with completely reversed stress of 800 MPa. The ultimate tensile strength of the specimen is 1200 MPa ( $\approx 174$  kpsi). **Note:** You need to approximate  $f$

### Problem 2 (30 Points)

A 1095 HR steel shaft ( $S_y = 66$  kpsi) is to transmit 15 hp while rotating at 1000 rpm. By using the Maximum shear stress theory and the Distortion Energy theory, calculate the minimum diameter for the shaft with respect to yielding. Consider a factor of safety of  $n_y = 2$ . **Note:** Torque =  $63025 \cdot (\text{hp}) / (\text{rpm})$

### Problem 3 (35 Points)

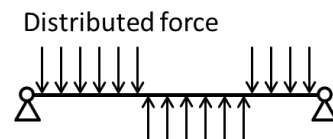


As shown on the left, reaction forces of bearing  $R_1$  and  $R_2$  are exerting on the shaft, which **rotates** at 1300 rev/min (1 rev = 1 cycle) and supports an 8-kip bending force. Use a 1020 CD steel ( $S_{ut} = 68$  kpsi  $S_y = 57$  kpsi). Calculate the diameter  $d$  using a design factor of  $n_f = 1.6$  for a life of 10 hr. **The critical stress location is marked in the figure.** Consider all surfaces **machined**.

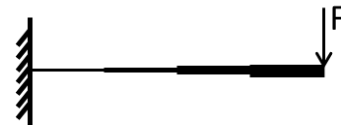
**Note:** set notch sensitivity as 0.85 and size modification factor as 0.85.

### Problem 4 (5 Points \*4)

4.1 Sketch the bending moment along the beam on the right.

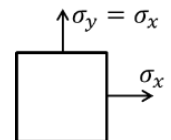


4.2 Sketch the deflection of the beam on the right. Please take into account the decrease in cross-section area along the beam.



4.3 True or false: Depending on the choice of material, a machine part under static load could fail due to either yielding or fracture.

4.4 True or false: For the plane-stress element on the right, the maximum shear stress is 0.



### Bonus Problem (5 Points)

Use this paper to create a structure that holds your solution papers vertically. Sketch on the back.