

MEEG 4103

Name: _____

(Underline your **last name**.)

Final Exam

ID#: _____

- (20%)** A shaft made of a 1095 HR steel with *machined surfaces* rotates at a speed of 1500 rev/min and supports a bending force of $P = 8$ kips, as shown in Fig. P1, where the notch radius is $r = d/5$, and R_1 and R_2 are the bearing forces. **Letting $d = 2$ in. in the first trial**, specify a diameter d using a design factor $n_d = 1.6$ for a life of 3 min.

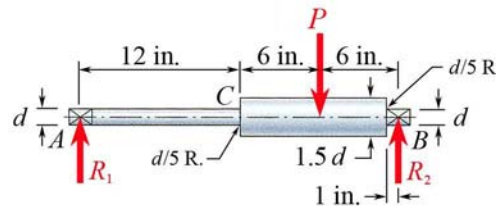


Fig. P1

- (20%)** A *nonrotating* round bar made of a 1095 HR steel undergoes cyclic loading such that $\sigma_{\max} = 70$ kpsi, $\sigma_{\min} = -20$ kpsi at the critical point C, as shown in Fig. P1, where the notch radius is $r = d/5$. If $d = 2.5$ in., estimate the number of cycles to a fatigue failure for this round bar using: (a) modified Goodman criterion, (b) Gerber criterion.
- (20%)** A shaft has the properties $S_e = 300$ MPa, $S_y = 490$ MPa, and $S_{ut} = 600$ MPa. The shaft is subjected to an alternating bending stress of 110 MPa, an alternating torsional stress of 80 MPa, and a steady torsional stress of 90 MPa. Find the factor of safety n_y guarding against a static failure.
- (20%)** For the shaft in Problem 3, find the factor of safety n_f guarding against a fatigue failure using (a) modified Goodman criterion, (b) ASME-elliptic criterion, (c) Gerber criterion, (d) Soderberg criterion.
- (20%)** In computing the size factor k_b for a nonrotating round bar in bending with diameter d , show that the effective dimension d_e is given by $d_e = 0.370d$.