UNIVERSITY of ARKANSAS 1871

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MEEG 4103 Name: _____
(Underline your **last name**.)

Midterm Exam ID#: _____

1. (25%) A steel countershaft ($E = 30\times10^6$ psi) with roller bearings at O and B is in equilibrium as shown, where $T_1 = 8T_2$. Taking the bearings as simple supports, determine *(a)* the deflection y_C at C, *(b)* the minimum shaft diameter $d_{\min}$ needed, using ⅛-in. increments, if the slope at either bearing should not exceed $0.05°$, *(c)* the value of y_C when the shaft diameter is $d_{\min}$.

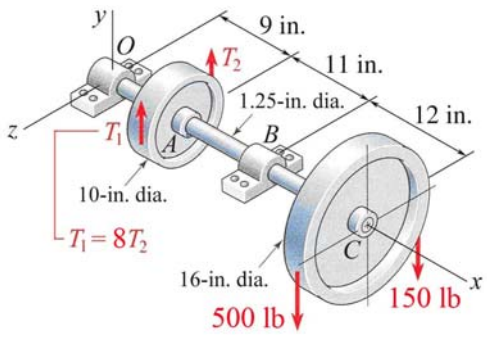

Fig. P1

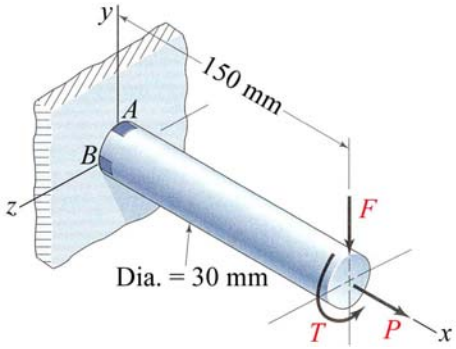

Fig. P2

2. (25%) A bar is made of AISI 1006 hot-rolled steel with S_y =170 MPa and is loaded as shown, where F = 1.5 kN, P = 18 kN, and T = 150 N·m. Compute the factor of safety n for stress elements at A and B using the *distortion-energy theory*.

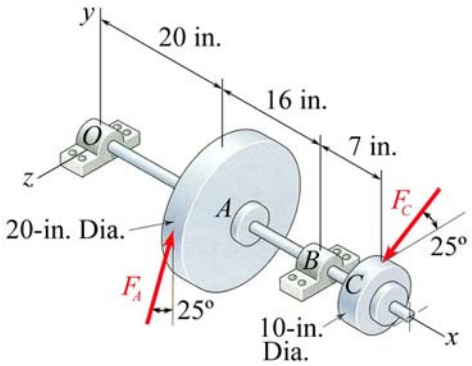

Fig. P3

3. (20%) The gear forces shown are parallel to the *yz* plane, where F_A = 500 lb, the bearings at O and B may be taken as simple supports, and the shaft has S_y = 50 kpsi. For static analysis and a factor of safety of 3.5, use *distortion-energy theory* to find the minimum safe diameter $d_{\min}$ of the shaft.

4. (30%) *(a)* Derive the octahedral normal stress σ_{oct} and octahedral shear stress τ_{oct} in terms of the principal stresses σ_1, σ_2, σ_3. *(b)* Describe the *octahedral-shear-stress theory*.