PME3433 EXAM #1 Nov. 09, 2015

(closed book)

1. When the material is cold worked, please explain what happens to the yield strength of a material, and explain why? (5%)
2. A steel plate is subject to static tension load. (20%)
3. If a very small hole is drilled at the center of the plate, please draw the stress distribution along the horizontal center line. (3%)
4. Similarly, if there is no hole at the center, please draw the stress distribution along the horizontal center line.(2%)
5. Can we neglect the influence of stress concentration? Why? (5%)
6. What is the difference between Theoretical Stress Concentration Factor Kt and Fatigue Stress Concentration Factor Kf ? (5%)
7. Give an example to illustrate what useful residual stress is. (5%)
8. Describe the difference in appearance of the fracture surface of ductile material under steady loading and fatigue loading, respectively? (10%)
9. What is Miner’s rule? Under what condition Miner’s rule should be used? (5%)
10. The following figure shows the redesign of aluminum alloy 7075-T73 landing-gear torque-arm assembly for the purpose of eliminating fatigue fracture at a lubrication hole. What is the difference between the original and improved design? Why is the improved design better? (10%)

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1. The following figure shows a gear-type speed reducer. Both input and output shafts rotate at constant speeds, i.e., ωi and ωo= 2000 rpm. The input torque is Ti and the output torque is To= 60 N-m. The input and output shafts are supported, respectively, by four bearings at A, B, C, and D. The reducer’s box is bolted to motor box (not shown) at locations E, F, I and H. The pitch radii of gears G1 and G2 are r1 = 20mm and r2 = 40mm, with pressure angle φ = 20o. Besides, J is the center of G1, and JA = 25 mm and JB = 38 mm; K is the center of G2, and KC = 25 mm and KD = 38 mm. Draw the free-body diagrams for the input shaft, output shaft, and reducer’s box, and compute the forces and moments, and then indicate them on the free-body diagrams. tan(20o) = 0.36 (30%)



1. The following figure shows a shaft of 200 mm long and 20 mm in diameter supported by two bearings A and B. Both forces are applied to a sheave in the center, as shown. The left end of the shaft is connected to a clutch by means of a flexible coupling. Nothing is attached to the right end.
   1. Determine and make a sketch showing the stresses acting on the top and side elements, T and S, located adjacent to the sheave. (10%)
   2. If the shaft is made of AISI 1040 Annealed steel with Sy = 353MPa, find the factor of safety using Distortion Energy Theory. (10%)

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