PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Mid Term Examination : Semester I **Academic Year :** 2006

Date : 4 th August 2006. **Time :** 09:00-12:00

Subject : 226-305 Machine Design I **Room :** R 201

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ทุจริตในการสอบ โทษขั้นต่ำปรับตกในรายวิชานั้น และพักการเรียน 1 ภาคการศึกษา

INSTRUCTION :

1. There are 5 questions, 150 points.
2. Attempt to do all questions in test paper. If it isn't enough, you can use other blank pages.
3. Books, sheets of paper note, a dictionary and a calculator are allowed.
4. Don't write with red pen.
5. Please check all questions before start working.

No.	Full Score	Score
1	40	
2	40	
3	20	
4	20	
5	30	
Total	**150**	

Asst. Prof. Pichet Trakarnchaisiri

1. Figure 1 shows a hand crank is made of stainless steel type 314 bar annealed with static vertical load 1000 N applied to the handle. (40 points)
   1.1. Calculate the bending stress at the selected point A,B and D on hand crank surface. (neglect stress concentration) (6 points)
   1.2. Calculate the combined torsional and transverse shear stress location at the selected point A, B and D on hand crank surface. (neglect stress concentration) (10 points)
   1.3. Determine the principle stress at the selected point A, B and D on hand crank surface. (neglect stress concentration) (12 points)
   1.4. Compute safety factors of ultimate strength, for stress element at point A, B and D. Based upon the maximum shear-stress theory and the distortion energy theory. (12 points)

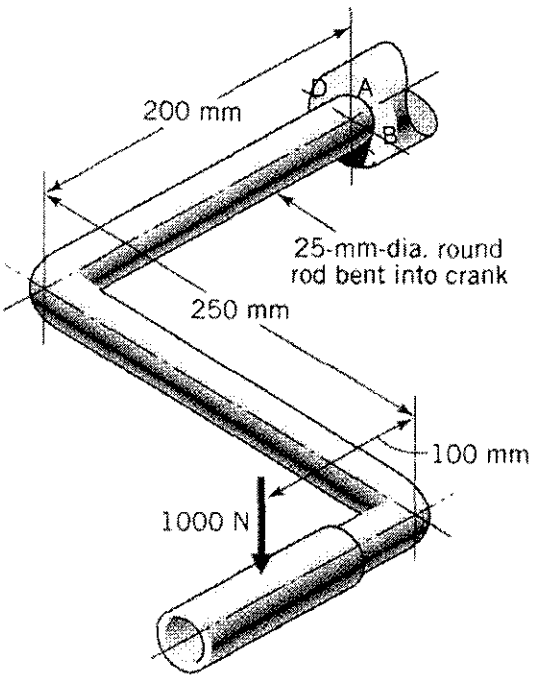

Figure 1

2. A 20-mm-diameter shaft with a 6-mm-diameter transverse hole is made of cold-drawn steel having S_u = 550 MPa and S_y = 462 MPa. Surface in the vicinity of the hole and the shaft have a machine finish. Use the notch sensitivity, q of this shaft is to 0.86 and select the theoretical stress concentration factor (K_t) , normal stress and shear normal stress from diagram as in figure 2. Estimate the safety factor with respect to infinite fatigue life with 90% reliability. (40 points)

   2.1 Determine the fully corrected endurance limit of shaft. (20 points)

   2.2 Determine the maximum stress of mean stress and alternating stress in case :

   Torque fluctuation between 0 and 100 N-m.(16 points)

   2.3 Determine the factor of safety of crack failure of shaft in case :

   Torque fluctuation between 0 and 100 N-m.(4 points)

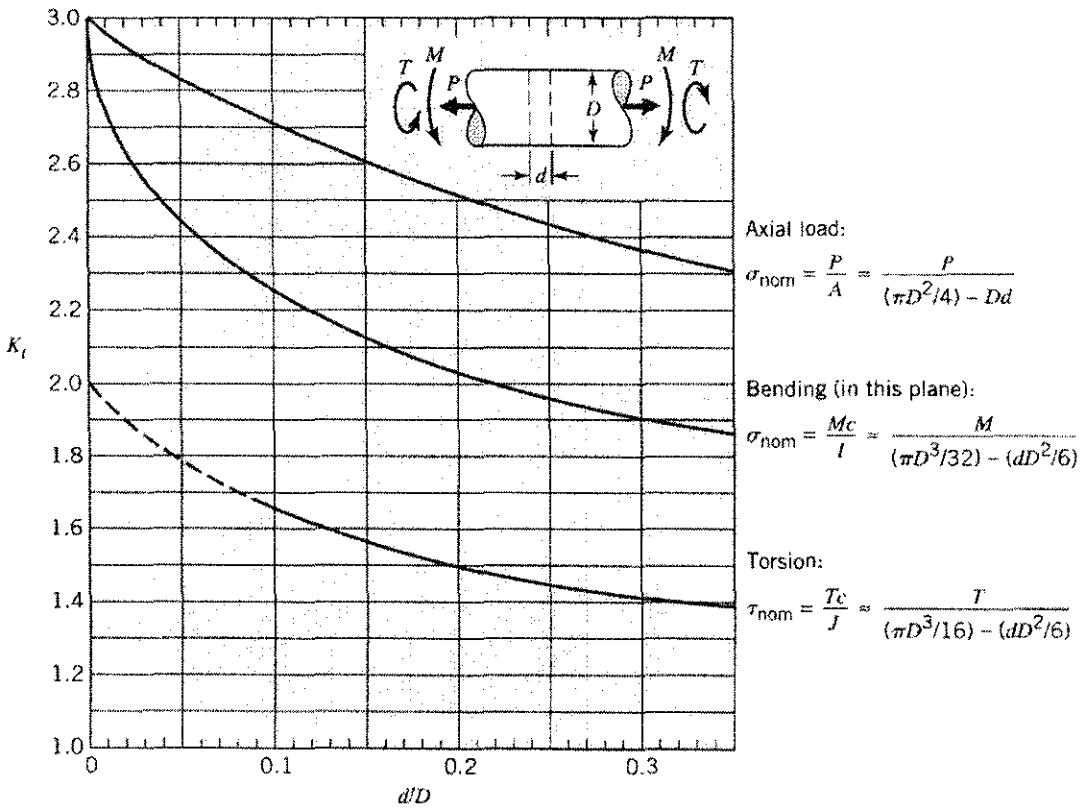

Figure 2

3. A carbon steel coil spring A227 has a mean diameter of 37.5 mm and is formed of 12.5 mm bar. It has a spring index of 3 and is subjected to a continuously alternating load between a maximum of 7000 N and a minimum of 5000 N. If the completely endurance limit of spring from the released loading is 300 MN/m^2. (20 points)

   3.1 Determine the mean and alternating shear stress and stress of spring. (15 points)

   3.2 Calculate the safety factor of operated spring compressed by fatigue loading and answer a question that the A227 spring should be used or changed. (5 points)

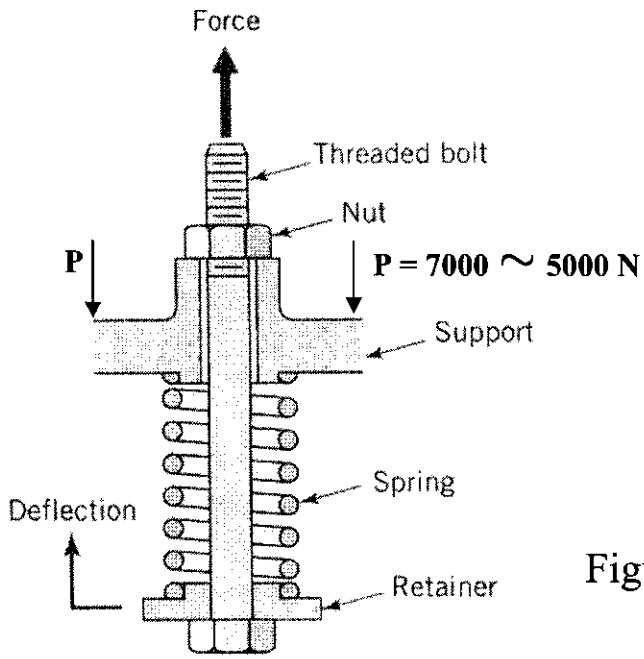

Figure 3

4. An ordinary mild steel C-Clamp shown in figure 4 uses a ½ -in. dry Acme-single thread and a brass collar of 5/8-in. mean diameter. Estimate the raising torque and the force required at the end of a 5-in. handle to develop a 200-lb clamping force. (20 points)

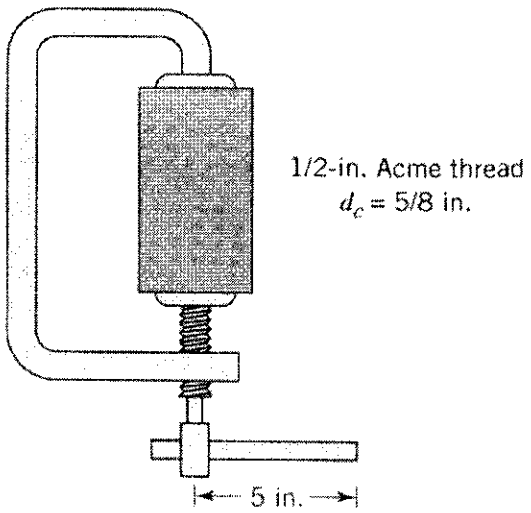

Figure 4

5. Please give a short explanation or sketch a diagram to represent the meaning.

(3 X 10 = 30 points)

5.1 The step of design process

5.2 Yielding

5.3 Ultimate stress

5.4 Modulus of rigidity

5.5 Stress concentration

5.6 Modified Mohr's Theory

5.7 Completely reversed stress cycle

5.8 Acme-double thread screw

5.9 Strength of joint

5.10 Instantaneous center

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