

**PRINCE OF SONGKLA UNIVERSITY**  
**FACULTY OF ENGINEERING**

Final Examination: Semester 2  
Date: February 25, 2007  
Subject: 226-305 Machine Design

Academic Year: 2006  
Time: 13:30-16:30  
Room: A401

**Instructions**

- Books, sheets of paper note are allowed.
- A Dictionary and a calculator are allowed.
- There are 7 problems in 15 pages.
- Answer all problems in these sheets.
- Total score is 175.
- Your answers could be in English or Thai.
- Please check all questions before start working.

Name: .....	Student ID.....
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Problem	Full Score	Assigned Score
1	25	
2	25	
3	25	
4	25	
5	25	
6	25	
7	25	
<b>Total</b>	<b>175</b>	

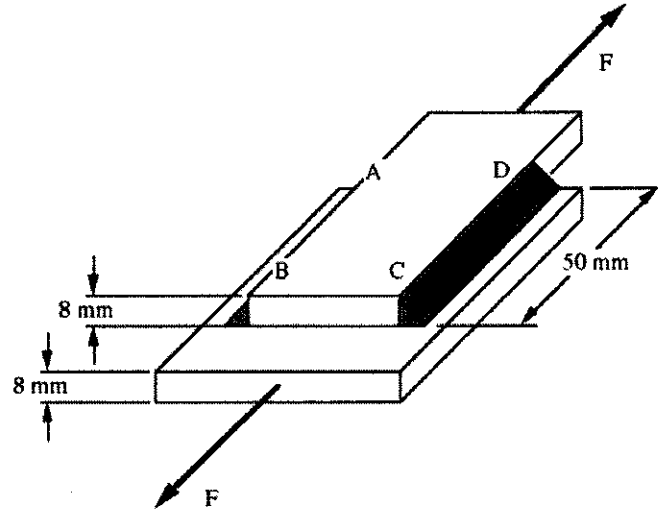
Mr.Srisit Chianrabutra

**ทุจริตในการสอบโทษขั้นต่ำ คือ พักการเรียน 1 ภาคการศึกษา และปรับตกในรายวิชานั้น**

*Dr*

**Problem 1:** Two steel plates are welded with a convex fillet weld. Estimate the static load,  $F$ , which can be carried by the joint. (25 points; Welds)

Note: Leg length = 5 mm.,  $S_{sy} = 200$  MPa, SF = 4 , Weld Efficiency is 90%



*Dr*

Problem 2: An SAE grade 2, 1/4 UNF bolt with rolled threads is initially tightened to 60% of its proof strength; the joint stiffness is equal to the bolt stiffness. A force, 40 kip, pulls on the joint. Find the safety factor against joint separation. (25 points; Bolts)

Note: Minimum Proof Strength = 55 kpsi.

Minimum Tensile Strength = 74 kpsi.

Minimum Yield Strength = 57 kpsi.

Tensile Stress Area =  $0.0364 \text{ in}^2$

Bolt Stiffness = 3.5 Mlb/in

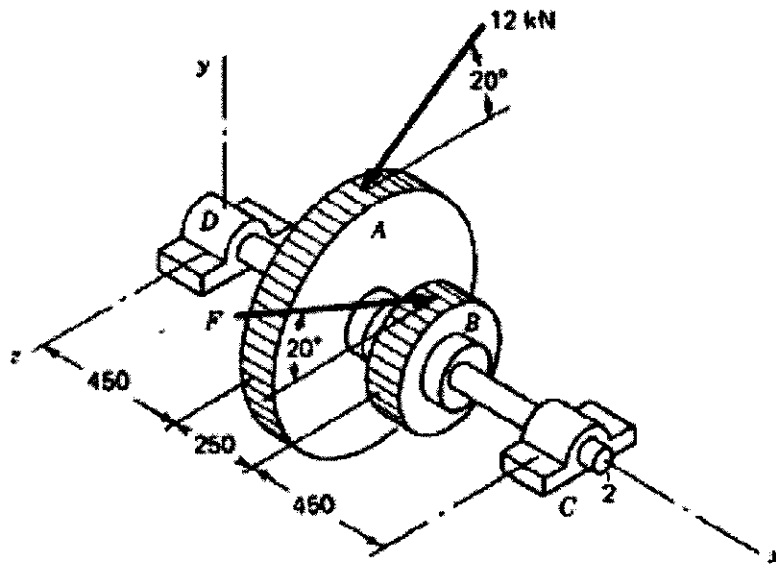
Problem 3: A 1-inch shaft transmits 5 hp at 2500 rpm. The shaft is made from cold-drawn 1020 steel, hub is made from hot-rolled 1213 steel and a cold-drawn 1040 steel key is to be used. If direction is regularly reversed, determine length of square key required for a SF= 1.5 (25 points; Keys)

Note: CD 1040  $S_y = 70$  ksi.,  $S_u = 85$  ksi

HR 1213  $S_y = 60$  ksi.,  $S_u = 75$  ksi

CD 1020  $S_y = 50$  ksi.,  $S_u = 60$  ksi

**Problem 4:** The shaft in the figure has two spur gears mounted on it with the keys which have a fatigue stress concentration factor of 1.7. The pitch diameters of gear A and B are 250 mm. and 150 mm. respectively. A uniform diameter, cold drawn steel shaft having  $S_y=390$  MPa and  $S_{ut}=400$  MPa is to be used for the shaft. Find a safe diameter using factor of safety of 1.5 with Sodeberg approach. (The endurance limit modifying factors are 65 MPa) (25 points; Shafts)

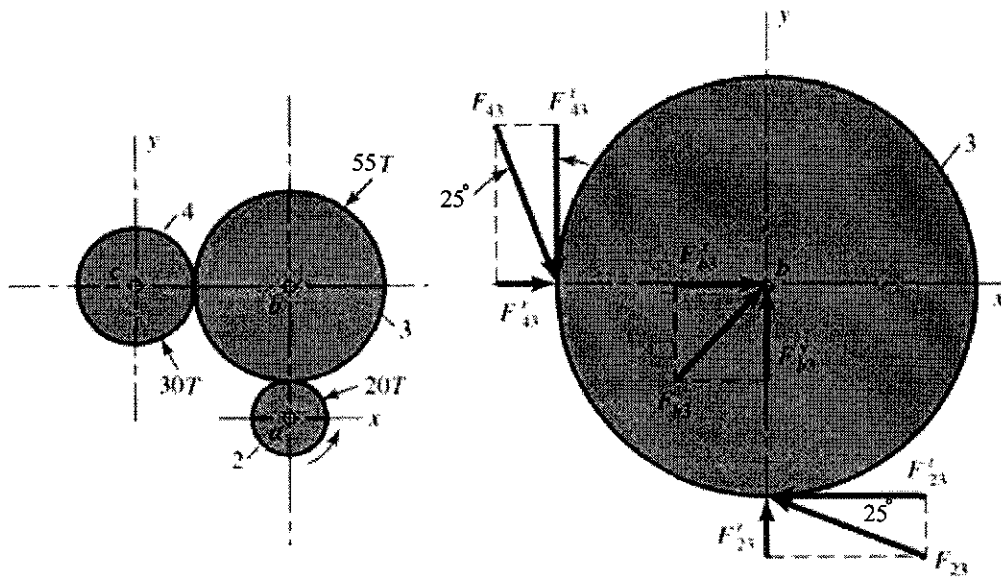


(Dimensions in millimeters)

Problem 5: The basic dynamic load rating for bearing number 6207 is 4,450 pounds. What would the expected life be for this bearing if it were subjected to an equivalent bearing load of 2,000 pounds? If the shaft turns at 1,500 rpm, how many hours would this bearing last based on the  $L_{10}$  design life? (25 points; Bearings)



**Problem 6:** Pinion (2) is turning at 2,500 rpm and transmits 5 hp to idler. The pressure angle is 25 degrees. Diametral pitch (P) is 6. Calculate all forces acting on gear 3. (25 points; Gears)



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**Problem 7:** A pulley of given power input, rotational speed, radius, and angle of wrap drives a V-belt with known friction, weight, and maximum tension. Determine the maximum power transmitted by the pulley. Determine the number of belts required. (25 points; Belts)

