

Prince of Songkla University

Faculty of Engineering

Midterm Examination Semester 2

Academic Year : 2003

Date : 23 December 2003

Time : 13.30-16.30

Subject : 226-305 Machine Design I

Room :

Instruction

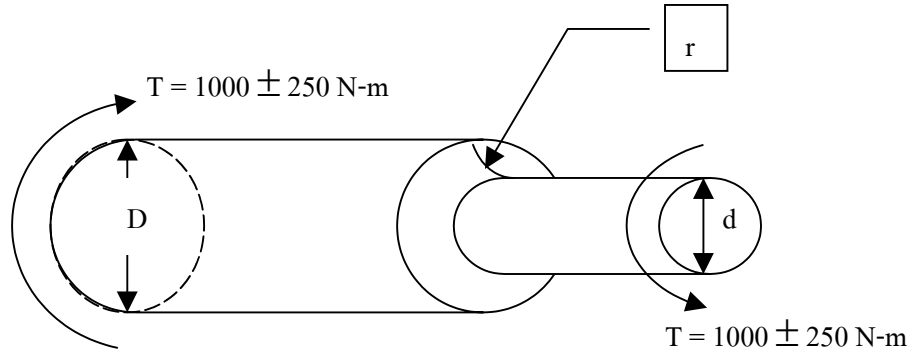
1. There are 4 questions , 130 marks.
2. Attempt to do all questions in test paper. If it isn't enough , you can use other blank pages.
3. Books, sheets of paper note ,a dictionary and a calculator are allowed.
4. Don't write in red pen.

No.	Full Score	Marks
1	36	
2	32	
3	32	
4	30	
Total	130	

Mr. Pichet Trakarnchaisiri

Lecturer

1. A shaft must transmit a torque of 1000 N-m ,with superimposed torsional vibration causing an alternating torque of 250 N-m. A safety of factor of 2.0 is to be applied to both loads. A heat-treated alloy steel is to be used, having $S_u = 1.2$ GPa , and $S_y = 1.0$ GPa (unfortunately, test data are not available for S_{us} or S_{ys}). It is required that the shaft have a shoulder , with $D/d = 1.2$ and $r/d = 0.05$ and $q = 0.95$. A Good-quality commercial ground finish is to be specified. What size of shaft (D, d , r) is required for infinite fatigue life? (36 marks)



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2. A semi-elliptic leaf spring, constant stress type, for use in a light trailer is to be made of alloys steel having $S_u = 1200$ MPa, $S_y = 1080$ MPa, and a fully corrected endurance limit of 550 MPa. The spring is 1.2 m long, and has five leaves of 5-mm thickness and 100-mm width. When the trailer is fully loaded, the static load applied to the center of the spring is 3000 N. (32 marks)

2.1 Find the maximum load as the trailer is driven over a rough road. Estimate what alternating load, when superimposed onto the fully load spring, would verge on causing eventual failure (factor of safety, $n = 1$) from fatigue. (13 marks)

2.2 What will the maximum deflection of the spring be when loaded as determine in 2.1? (4 marks)

2.3 Create the S-N Diagram of the semi-leaf spring. What value could the alternating stress be increase if only 10^4 cycles of life required? (15 marks)

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3. A double-threaded ACME screw of 2-in. major diameter is used in a jack having a plain thrust collar of 2.5-in. mean diameter. Coefficients of running friction are estimated as 0.10 for the collar and 0.11 for the screw. (32 marks)

3.1 Determine the pitch , lead , thread depth, mean pitch diameter and helix angle of the screw.

(10 marks)

3.2 Estimated the starting torque for raising and for lowering a 5000-lb load. (12 marks)

3.3 If the screw is lifting a 5000-lb load at the rate of 4 ft/min, what is the screw rpm? (3 marks)

3.4 What is the efficiency of the jack under this steady-state condition? (4 marks)

3.5 Do you think the screw is self-locking or back-driving? Give a reason. (3 marks)

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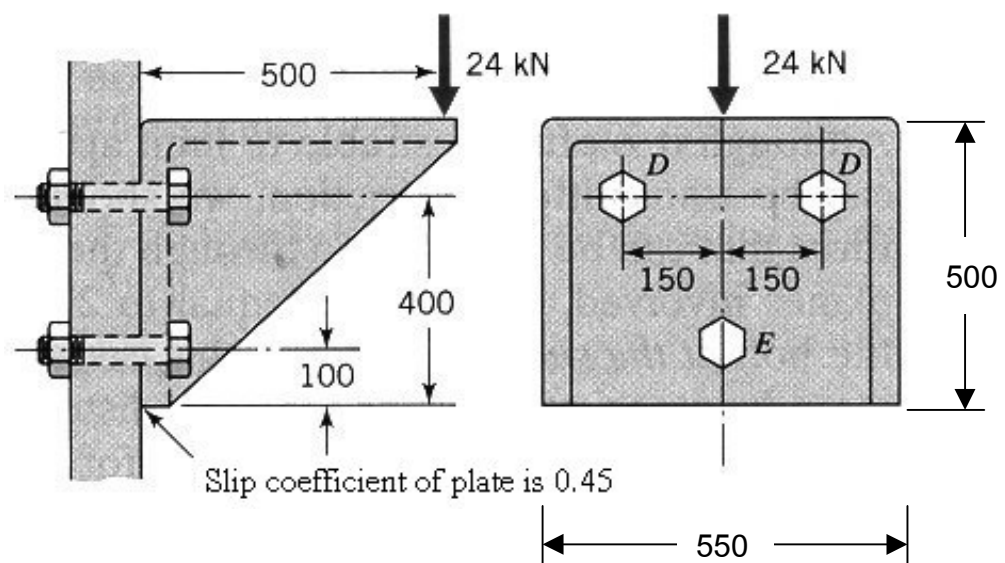
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4. A vertical loaded AISI 1040 hot rolled bracket of 550X500X500 and 25 mm.-thickness attached to a fixed member by three identical bolts. Although the 24-kN load is normally applied in the center, the bolts are to be selected on the basis that the load eccentricity shown could occur. Because of safety considerations, SAE class 9.8 steel bolts and a minimum safety factor of 6.0 (based on proof strength) are to be used. (30 marks)
- 4.1 Determine an appropriate standard bolt size. (10 marks)
- 4.2 Will this joint fail from a vertical load of 24 kN? Please show the detail of proof method. (20 marks)



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