NOTRE DAME UNIVERSITY
Faculty of Engineering

Instructor : Joseph NASSAR

Course Code : CEN 102 Section: A

EXAM No. 1 Closed Book, Closed Notes Time: 1½ Hours

Name: _____

Last , First

ID No.:

Problem	Points
1	
2	
3	

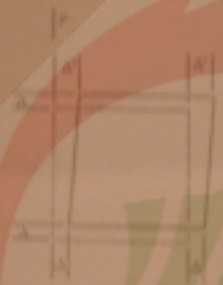
Total:

Part I: Short Answer (6 points each)

1. What is the physical meaning of the modulus of Toughness u_R?

3. A uniaxially-loaded cylindrical rod has an elastic modulus, E, and a Poisson's ratio, ν. If the rod's unloaded radius is r_0, what is its radius when it is subjected to an axial stress, σ?

2. An $a \times a$ square plate of material is deformed as shown below. Assuming the displacements are small, determine the corresponding strain components in terms of a, Δ_1, and Δ_2.



$\epsilon_x =$

$\epsilon_y =$

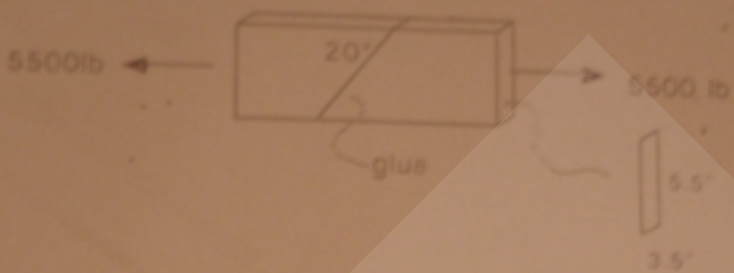
$\gamma_{xy} =$

4. Stress-strain curves for three materials are shown below, along with a device which is to be made of the three materials, one different material being used for each of the three ribs. The device will then be tested to failure.

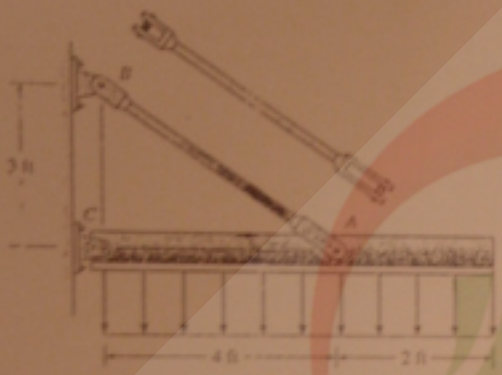
(a) When axially loaded as shown, will the device fail in a brittle or ductile manner (i.e., will it exhibit substantial yielding prior to fracture)?

(b) Which material in the device will fracture first?

5. The wooden members are glued at the joint shown above. Given the allowable shearing stress for the glue is 73 psi, can it support the 5500 lb force shown above?



Pb. 2 (30 pts) Determine the intensity W of the maximum distributed load that can be supported by the hanger assembly so that an allowable shear stress of $\tau_{allow} = 13.5$ksi is not exceeded in the 0.40 in diameter bolts at A and B, and an allowable tensile stress of $\sigma_{allow} = 22$ksi is not exceeded in the 0.5 in-diameter rod AB.



Problem 2.40 mm2

A tension test was performed on a steel specimen whose original diameter was 0.50 in. and whose gauge length was 2.0 in. Corresponding values of load and deformation are given in the following tabulation.

Load (lb)	Deformation (in.)	Load (lb)	Deformation (in.)
0	0	12,300	0.0170
1,500	0.0004	12,200	0.0200
3,100	0.0010	12,000	0.0275
4,700	0.0016	13,000	0.0330
6,200	0.0022	15,000	0.0400
8,000	0.0026	16,000	0.0500
9,500	0.0032	17,500	0.0680
11,000	0.0035	19,000	0.1080
12,000	0.0041	19,600	0.1510
12,300	0.0051	20,100	0.2010
12,500	0.0071	20,100	0.2600
12,700	0.0100	18,700	0.3300
12,700	0.0131	17,200	0.4100
12,500	0.0150	16,400	0.4500 (fracture)

Construct the engineering stress-strain curve for this material and determine:

a) The ultimate stress and the fracture stress
b) The modulus of elasticity
c) The upper yield point and the lower yield point
d) The proportional limit
e) The true fracture stress if the final diameter of the specimen at the location of the fracture was 0.355 in.
f) The percent reduction of area and the percent elongation
g) The modulus of resilience and the modulus of toughness
h) If the specimen is loaded until it is stressed to 80 ksi , Determine the approximate amount of elastic recovery and the permanent increase in the gage length after it is unloaded