

King Jahd University of Petroleum & Minerals DEPARTMENT OF CIVIL ENGINEERING Second Semester 1432-33 / 2011-12 (112) CE 203 STRUCTURAL MECHANICS I Major Exam I

Tuesday, March 13, 2012 7:00-9:15 P.M.

Student	Family					First			
Name									
ID No.									
(9 Digits)									

CIRCLE YOUR COURSESECTION NO.							
Section #	2	3 & 9	4 & 6	5	7	8	10
Instructor	Hamdan	Altayyib	Khathlan	Suwaiyan	Salah	Ali	Saeid

Summary of Scores

Problem	Full Mark	Score
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	
Remarks		

Notes:

- 1. A sheet that includes selected Basic Formulae and definitions is provided with this examination.
- 2. Write clearly and show all calculations, FBDs, and units.

Rigid member ABCD, is supported by the pin and the two cables.

- a) Calculate the stresses in the cables due to the application of the shown force.
- b) Calculate the vertical displacement of point D.
- c) In one <u>statement</u>, explain what will happen to the stresses in the cables if the temperature of the steel cable <u>only</u> is increased.

 $E_{steel} = 200 \text{ GPa}$

 $E_{aluminum} = 70 \text{ GPa}$

Cable	Length	Area (mm ²)	Material
AF	1.5 m	315	Steel
CE	1 m	600	Aluminum



The beam is supported by a pin at A and link BC. Determine:

- a) the average shear stresses in the pins at A and B,
- b) the average normal stress in link BC,
- c) the bearing stress between pin C and the link.

All pins have a diameter of 20 mm. Thickness of link BC = 20 mm



The rigid pipe is supported by a pin at *C* and a guy wire *AB*. The pin has a diameter of 20 mm while the guy wire has a diameter of 10 mm. If the allowable normal stress for the guy wire is $\sigma_{allow} = 255$ MPa and the allowable shear stress for the pin is $\tau_{allow} = 131$ MPa, determine:

- a) the maximum P_{max} that can be applied to the assembly,
- b) the stretch in length and reduction in diameter of the guy wire AB.

Use E = 68.9 GPa and *v* = 0.35.



Detail of connection at C

Rod ABC has a negligible mass and only supports two axial loads P and 21 P as shown. If *only* part BC is subjected to a temperature change ΔT = 40 °C, determine:

- *a.* the required value of **P** if the length ABC should remain unchanged,
- *b*. the displacement δ_B of point B,
- c. the relative displacement $\delta_{B/C}$,
- *d.* the final length L_{AB} .

Given E = 70 GPa and α = 24 x 10⁻⁶ / °C.



Block *A* rests on block *B* as shown. Each block is a cube with initial dimensions 200x200x200 mm. The 4 side-faces of block *A* are free to displace, while the 4 side-faces of block *B* are prevented from expanding (i.e. restrained in the *x* and *y* directions). Determine:

- a) the vertical displacement of the force F,
- b) the stress σ_x for block *A*, and for Block *B*,
- c) the value of the Shear Modulus (G) for block A.

Ignore self-weight and any friction.

E = 1 GPa, and v = 0.2

