King Fahd University of Petroleum & Minerals
CIVIL ENGINEERING DEPARTMENT

CE 203 STRUCTURAL MECHANICS I

Second Semester 1433 / 2012 (**112**)

HOMEWORK NO. 3

- **Textbook Sections Covered: 2.1, 2.2; 3.1- 3.4, 3.6; 4.1- 4.3 (Introduction)**
- **Subject Material Covered:** Strain + Stress-Strain Diagram + Hooke's Law + Material Properties + Poisson's Ratio + Axially Loaded members – Statically Determinate (Introduction)
- **DUE DATE: Monday 28-3-1433 (20-2-2012)**

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1) Solve problem 2-5 (p. 75) in the textbook, but let the 10-mm displacement be 14 mm, and the 2-m dimension (AB) be 4 m. [Secs. 2.1, 2.2] (15 pts.)

2) A thin (originally) rectangular plate is uniformly deformed as shown in Fig. P2. Determine the shear strains at *P* and *Q*. [Secs. 2.1, 2.2] (10 pts.)

3) The data below are from a tensile test of a certain specimen. The diameter of the specimen is 10 mm and the length is 20 mm.

Load (N)	**Elongation** (mm)
0	0
960	0.000533
1800	0.001067
2400	0.001227
2880	0.002133
3360	0.002293
3840	0.002933
4320	0.004000
4800	0.005333

Load (N)	**Elongation** (mm)
5280	0.006400
6240	0.009600
7200	0.013333
8040	0.018133
9600	0.027733
10560	0.036267
11530	0.046933
12000*	0.053333

*rupture load

I- Plot the **stress-strain** diagram using the computer (any program/software, e.g. Excel). [Secs. 3.1 - 3.4] (15 pts.)

II- For that material, determine
   a) the modulus of elasticity,
   b) the proportional limit stress,
   c) the yield strength at 0.1% offset,
   d) the ultimate stress,
   e) the modulus of resilience,
   f) the toughness (use straight lines to approximate the curve). [Secs. 3.1 - 3.4] (15 pts.)

III) If Poisson's ratio for that material is 0.25, calculate (at failure/ rupture)
   a) the new dimensions of the specimen,
   b) the change in the volume,
   c) the dilatation (unit change in volume or volumetric strain),
   d) the percent reduction in area,
   e) the percent elongation. [Secs. 3.1- 3.4; 3.6] (15 pts.)

4) In a tensile test of a bar with rectangular cross section 200 mm × 300 mm, the axial force at the proportional limit is 1200 kN. The 900-mm gage length is observed to increase by 0.45 mm, and the 300-mm dimension decreases by 0.015 mm. Calculate

   a) the proportional limit,
   b) the modulus of elasticity,
   c) Poisson's ratio,
   d) the new value of the 200-mm dimension. [Secs. 3.1 - 3.4; 3.6] (15 pts.)

5) In Fig. P5 shown, determine the displacement of point E. [Secs. 4.1-4.3 (Introd.)] (15 pts.)

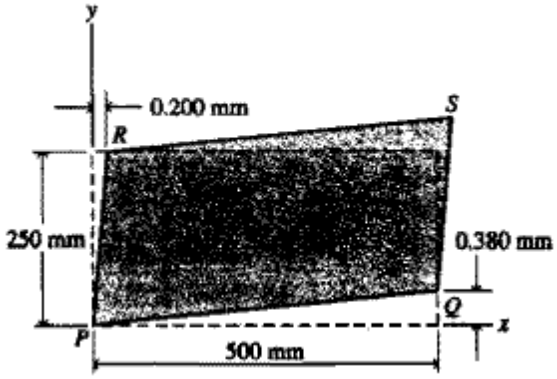
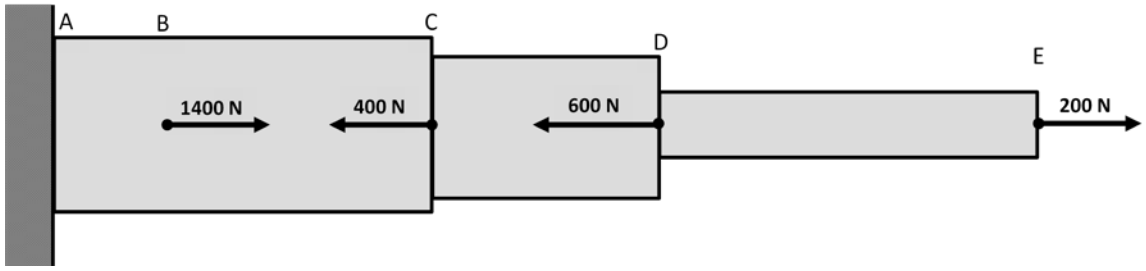


Fig. P2



Member	***Properties***		
	L (m)	***A (mm^2)***	***E (GPa)***
AB	**0.5**	**50**	**250**
BC	**1.5**	**50**	**250**
CD	**2**	**32**	**400**
DE	**3**	**10**	**600**

Fig. P5