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Cadeira: **MECÂNICA DOS MEIOS CONTÍNUOS**

Época: **Normal**

Ano lectivo: 2018/2019 (1º Semestre) **TESTE 2** (2018/11/28)

Duração: 1,5 horas

Nome: _____ Número: _____ Curso: **EC**

Questions 1 to 5 should be answered in this sheet. Please do not write derivations or calculations in these questions; they will not be rated anyway. It is not worth presenting several variants of the answer (if they are contradictory, the answer will be considered incorrect). The remaining questions should be answered on the examination sheets with appropriate derivations and calculations.

1. [4] The state of stress at a point of a continuum is described by the stress tensor

$$\left[\hat{T} \right] = \begin{bmatrix} 300 & 0 & 0 \\ 0 & -200 & 0 \\ 0 & 0 & 400 \end{bmatrix} \text{ Pa.}$$

- (a) Determine the stress vector on a plane passing through the considered point and normal to the direction $2\mathbf{e}_1 + 2\mathbf{e}_2 + \mathbf{e}_3$.

Answer _____

- (b) Determine the normal stress on this plane.

Answer _____

- (c) Determine the shearing stress on this plane.

Answer _____

- (d) Determine the maximum shearing stress at the point considered.

Answer _____

2. [2] Write the definition of ideal fluid.

3. [2] Consider a cylindrical rod of length 1.5 m and diameter 2 cm. Under the effect of a tensile force, the length of the bar increases by 0.2 mm and the diameter decreases by $0.5 \mu\text{m}$. Determine the Poisson's ratio of the substance from which the bar is made.

Answer _____

4. [2] Express the principal stresses in a linear isotropic elastic solid in terms of the principal strains and the Lamé constants.

Answer _____

5. [2]

- (a) What are the SI units of the Lamé constants?

Answer: _____, _____

- (b) What are the SI units of the constants λ and μ that appear in Newton's viscosity law?

Answer: _____, _____

6. [4] The state of stress in point P is given in MPa as

$$\left[\widehat{T} \right] = \begin{bmatrix} 57 & 0 & 24 \\ 0 & 50 & 0 \\ 24 & 0 & 43 \end{bmatrix}.$$

Find the principal stresses and the principal stress directions in P .

7. [4] Consider the following velocity field in m s^{-1} for an incompressible newtonian fluid with the viscosity equal to 0.96×10^{-3} in SI units:

$$v_1 = x_1^2 - x_2^2; \quad v_2 = -2x_1x_2; \quad v_3 = 0.$$

Consider stress at the point $(1, 2, 1)$ m over the plane for which the normal is directed along \mathbf{e}_1 . Find:

- (a) the normal compressive viscous stress;
- (b) the shearing stress.