Assignment 5

The due date for submitting this assignment has passed. Due on 2018-02-28, 23:59 IST.

Submitted assignment

Based on the data given in the question 1, answer the following up to question 13

1) A body in the form of a cube, $B = \{(x, y, z) | -1 \text{ cm} \leq x \leq 1 \text{ cm}, -1 \text{ cm} \leq y \leq 1 \text{ cm}, -1 \text{ cm} \leq z \leq 1 \text{ cm}\}$ in the reference configuration, is subjected to the following displacement field:

$$u_x = 0, \quad u_y = (y+z)10^{-4}, \quad u_z = 10^{-4}z,$$

where, $(x, y, z)$ are the Cartesian coordinates of a material point before deformation. Both the reference and current configuration is described using the same coordinate system with basis $(\mathbf{e}_x, \mathbf{e}_y, \mathbf{e}_z)$. Assuming that the cube is made of a material whose constitutive relation is given by isotropic Hooke's law: $\sigma = \lambda \epsilon + 2\mu \epsilon$, with $\lambda = 115$ GPa and $\mu = 77$ GPa. For the specified displacement field compute the following accurately up to first decimal place:

The $\epsilon_{yy}$ component of the linearized strain tensor is: $\ldots \times 10^{-4}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 1

3 points

2) The $\epsilon_{xy}$ component of the linearized strain tensor is: $\ldots \times 10^{-4}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 0.5

3 points

3) The $\epsilon_{zz}$ component of the linearized strain tensor is: $\ldots \times 10^{-4}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
4) The $\sigma_{xx}$ component of the stress tensor is: _________ MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 23.0, 23.2

5) The $\sigma_{yy}$ component of the stress tensor is: _________ MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 38.4, 38.6

6) The $\sigma_{zz}$ component of the stress tensor is: _________ MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 7.6, 7.8

7) The $\sigma_{zz}$ component of the stress tensor is: _________ MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 38.4, 38.6

8) The maximum normal stress in the cube is: _________ MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 46.0, 46.2

9) The minimum normal stress in the cube is: _________ MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 23.0, 23.2
10. The maximum shear stress in the cube is: ___________ MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 11.4, 11.6

3 points

11. Is the state of strain plane?

Yes
No

No, the answer is incorrect.
Score: 0
Accepted Answers:

3 points

12. Is the state of stress plane?

Yes
No

No, the answer is incorrect.
Score: 0
Accepted Answers:

3 points

13. If the direction along which the maximum normal strain occurs is \( n_e \) and the normal to the plane on which the maximum normal stress occurs is \( n_s \), then which of the following is correct:

- \( n_e - n_s = 0 \)
- \( n_e \cdot n_s = 0 \)
- \( n_e + n_s = 0 \)
- \( n_e \wedge n_s = 0 \)

No, the answer is incorrect.
Score: 0
Accepted Answers:

3 points

14. Based on the data given in question 14, answer the following up to question 25

A square plate of side 10 cm and thickness 1 cm is subjected to the following state of plane stress, \( \sigma = \begin{pmatrix} 20 & 30 & 0 \\ 30 & 60 & 0 \\ 0 & 0 & 0 \end{pmatrix} \) MPa with the non-zero components of the stress acting along the sides of the plate as shown in the figure. Assume that the plate is made of steel which obeys isotropic Hooke’s law with Young’s modulus, \( E = 200 \) GPa and Poisson’s ratio, \( v = 0.3 \). For this state of stress compute the following accurately up to the second decimal place
The $\epsilon_{xx}$ component of the linearized strain tensor is: $\boxed{\text{_________} \times 10^{-6}}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 10

3 points

15 The $\epsilon_{yy}$ component of the linearized strain tensor is: $\boxed{\text{_________} \times 10^{-6}}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 270

3 points

16 The $\epsilon_{xy}$ component of the linearized strain tensor is: $\boxed{\text{_________} \times 10^{-6}}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 195

3 points

17 The $\epsilon_{zz}$ component of the linearized strain tensor is: $\boxed{\text{_________} \times 10^{-6}}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) -120

3 points

18) 

No, the answer is incorrect.
Score: 0
19 The change in thickness of the plate is: \( \_ \times 10^{-3} \) mm

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 16

20 The maximum normal strain is: \( \_ \times 10^{-6} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 373,375

21 The maximum shear strain is: \( \_ \times 10^{-6} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 246,248

22 The minimum normal stress is: \( \_ \) MPa

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 0

23 Is the state of strain plane?

No, the answer is incorrect.
Score: 0
Accepted Answers:
No

24 Is the state of stress plane?

No, the answer is incorrect.
Score: 0
Accepted Answers:
Yes
25)  

- \( n_0 - n_\varepsilon = 0 \)
- \( n_\sigma \cdot n_\varepsilon = 0 \)
- \( n_\sigma + n_\varepsilon = 0 \)
- \( n_\sigma \land n_\varepsilon = 0 \)

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
- \( n_0 = n_\varepsilon = 0 \)

26)  

Three experimentalists report the following matrix components for the strain tensor at a given point in the body subjected to the same loading:  
\[
\varepsilon_1 = \begin{bmatrix} 1.1 & 0.1 & 0 \\ 0.1 & -0.9 & 0 \times 10^{-4} \\ 0 & 0 & 0 \end{bmatrix},
\]
\[
\varepsilon_2 = \begin{bmatrix} 1.105 & 0 & 0 \\ 0 & -0.905 & 0 \times 10^{-4} \\ 0 & 0 & 0 \end{bmatrix},
\]
\[
\varepsilon_3 = \begin{bmatrix} 1.11 & 0.12 & 0 \\ 0.12 & -0.85 & 0 \times 10^{-4} \\ 0 & 0 & 0 \end{bmatrix}
\]

Which of the two experimentalists have the equivalent representation of the strain?  
- \( \varepsilon_1 \) and \( \varepsilon_2 \)
- \( \varepsilon_1 \) and \( \varepsilon_3 \)
- \( \varepsilon_2 \) and \( \varepsilon_3 \)
- None of them represent the same strain

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
- \( \varepsilon_1 \) and \( \varepsilon_2 \)

27)  

A 60 degree strain rosette is used to infer the components of the strain on the surface of a plate, as shown in the figure. If the reading of the three strain gauges as indicated in the figure is, \( \varepsilon_1 = 100 \times 10^{-6} \), \( \varepsilon_2 = 200 \times 10^{-6} \), \( \varepsilon_3 = 300 \times 10^{-6} \), find the following accurately up to the first decimal place.

The \( \varepsilon_{xx} \) component of the linearized strain tensor is: \( \_ \_ \_ \_ \_ \_ \times 10^{-6} \)

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
(\( Type: \ Range \)) 99,101

28)  

The \( \varepsilon_{yy} \) component of the linearized strain tensor is: \( \_ \_ \_ \_ \_ \_ \times 10^{-6} \)
29. The $\varepsilon_{xy}$ component of the linearized strain tensor is: $\underline{\text{_______}} \times 10^6$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 299,301

Indicate if the following strains are possible in a body:

30. $\varepsilon = \begin{pmatrix} x^2 + y^2 & xy & 0 \\ xy & y^2 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

- Yes
- No

No, the answer is incorrect.
Score: 0
Accepted Answers:
Yes

31. $\varepsilon = \begin{pmatrix} x^2 - y^2 & \sin(y) & 0 \\ \sin(y) & x^2 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

- Yes
- No

No, the answer is incorrect.
Score: 0
Accepted Answers:
Yes