

KATIHAR ENGINEERING COLLEGE

Code: 011513

B.Tech 5th semester Mid Term Exam

Mechanics of Solid-II

Time: 2 hours

Full Marks: 20

Instructor: Prof. Rashid Mustafa

Instructions: Answer any five question in which question number 1 is compulsory

The marks are indicated in the right- hand margin

1. Choose and write the correct option

1x4= 04

(i) Two long column C_1 and C_2 are made of the same material. Column C_1 has both the ends hinged while column C_2 has one end hinged and other end fixed. What is the ratio of the critical load for C_1 to that of C_2 according to the Euler's formula?

- (a) 2 (b) 1/2 (c) 4 (d) 1/4

(ii) Set of principal stress acting at any point in a stressed body are given below

1. $\{\sigma, 0\}$ 2. $\{\sigma, \sigma\}$ 3. $\{\sigma, -\sigma\}$ 4. $\{\sigma, \sigma/2\}$

The correct sequence of the ascending order of intensity of the maximum shear stress induced by the above set will be

- (a) 1,4,3,2 (b) 2,1,4,3 (c) 1,3,4,2 (d) 2,4,1,3

(iii) Match **List-I** (Theories of failure) with **List-II** (Failure envelopes) and select the correct answer using the codes given below the lists:

List-I

- A. Maximum Principal stress theory
- B. Maximum Principal strain theory
- C. Maximum shear stress theory
- D. Maximum strain energy theory

List-II

- 1. Ellipse
- 2. Square
- 3. Rhombus
- 4. Hexagon

Codes:

	A	B	C	D
(a)	2	3	4	1
(b)	1	4	3	2
(c)	3	2	4	1
(d)	2	3	1	4

(iv) The first invariant of stress (I_1) is defined as

- (a) $\sigma_{xx} + \sigma_{yy} + \sigma_{zz}$ (b) $0.33 (\sigma_{xx} + \sigma_{yy} + \sigma_{zz})$ (c) $\sigma_{xx} + \tau_{xy} + \tau_{xz}$ (d) None of these

2. The state of stress (in MPa) at a point for a given reference xyz is given below:

$$\begin{array}{lll} C_{11} = 15 & C_{12} = 8 & C_{13} = -6 \\ C_{21} = 8 & C_{22} = -12 & C_{23} = 5 \\ C_{31} = -6 & C_{32} = 5 & C_{33} = 8 \end{array}$$

Determine the principal stresses.

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3. A plane element of a body is subjected to stresses (N/mm^2) are given below:

$$\sigma_x = 100, \quad \sigma_y = 80, \quad \tau_{xy} = 50$$

Find factor of safety as per Maximum principal stress theory and maximum shear stress theory, if the yield stress is 200 N/mm^2 and Poisson's ratio = 0.3

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4. The strain measurements from a rectangular strain rosette were $\epsilon_0 = 600 \times 10^{-6}$, $\epsilon_{45} = 500 \times 10^{-6}$ and $\epsilon_{90} = 200 \times 10^{-6}$. Find the magnitude of principal strains.

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5. The Cartesian components of stress at a point are given below:

$\sigma_{xx} = 15$, $\sigma_{yy} = \sigma_{zz} = 8$, $\tau_{xy} = 6$, $\tau_{yz} = 4$, $\tau_{xz} = 4$ MPa. Determine the normal and shear stresses on a plane whose direction cosines are $1/\sqrt{3}$, $1/\sqrt{3}$, and $1/\sqrt{3}$.

6. What is the difference between Euler's theory and Rankine theory? Also enlist the various assumptions taken by Euler.

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7. The strain components at a point are given by:

$$\epsilon_{xx} = 200, \quad \epsilon_{yy} = 100, \quad \epsilon_{zz} = 50 \mu \text{ strains, and } \phi_{xy} = \phi_{yz} = \phi_{xz} = 40 \mu \text{ radians.}$$

Calculate the normal and shearing strain on a plane having direction cosines $1/\sqrt{3}$, $1/\sqrt{3}$, and $1/\sqrt{3}$.

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Note: Solution of Mid Term Exam (Mechanics of Solid-II) will be uploaded on the college website www.keck.ac.in