5E3175

Roll No. 030 Total No of Pages: 3

# 5E3175

## B. Tech. V Sem. (Old Back) Exam., Nov.-Dec.-2016

## Mechanical Engineering

## 5ME1 (O) Advanced Mechanics of Solids

**Time: 3 Hours**

**Maximum Marks: 80**
**Min. Passing Marks Main: 26**
**Min. Passing Marks Back: 24**

*Instructions to Candidates:*

*Attempt any **five questions,** selecting **one question** from **each unit.** All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

*Units of quantities used/calculated must be stated clearly.*

*Use of following supporting material is permitted during examination.*

*(Mentioned in form No. 205)*

1. NIL 2. NIL

## UNIT – I

Q.1 (a) At a point P, the rectangular stress components are (in KPa)

$\sigma_x = 1, \quad \sigma_y = -2, \quad \sigma_z = 4$

$\tau_{xy} = 2, \quad \tau_{yz} = -3, \quad \tau_{xz} = 1$

Find the principal stresses and check for invariance. [12]

(b) What do you mean by Octahedral Stresses? [4]

**OR**

Q.1 (a) Define stress at a point. And derive differential equations of equilibrium. [2+6=8]

(b) The state of stress at a point is $\sigma_x = 100MPa$, $\sigma_y = -40MPa$, $\sigma_z = 80MPa$. And all other stress components are zero. Determine the extreme value of shear stresses, their associated normal stresses, the octahedral shear stress and its associated normal stress. [2+2+2+2=8]

## UNIT – II

Q.2 The displacement field is given by –

$$u = (x^2 + y)\hat{i} + (3+z)\hat{J} + (x^2 + 2y)\hat{k}.$$

Determine the principal strains at (3, 1, –2) and the direction of the minimum principal strain. [8+8=16]

**OR**

Q.2 Explain following -

(a) Strain deviator and its invariants. [8]

(b) Plane state of strain [4]

(c) State of strain at a point [4]

## UNIT – III

Q.3 (a) A rubber cube is inserted in a cavity of the same form and size in a steel block and the top of the cube is pressed by a steel block with a pressure of p pascals. Considering the steel to be absolutely hard and assuming that there is no friction between steel and rubber, find. [10]

(i) The pressure of rubber against the box walls.

(ii) The extreme shear stresses in rubber.

(b) Explain generalized Hooke's law. [6]

**OR**

Q.3 A cubical element is subjected to the following state of stress - [16]

$\sigma_x = 100\text{MPa}, \quad \sigma_y = -20\text{MPa}, \quad \sigma_z = -40\text{MPa}.$

$\tau_{xy} = \tau_{yz} = \tau_{zx} = 0.$

Calculate (i) Principal shear strains

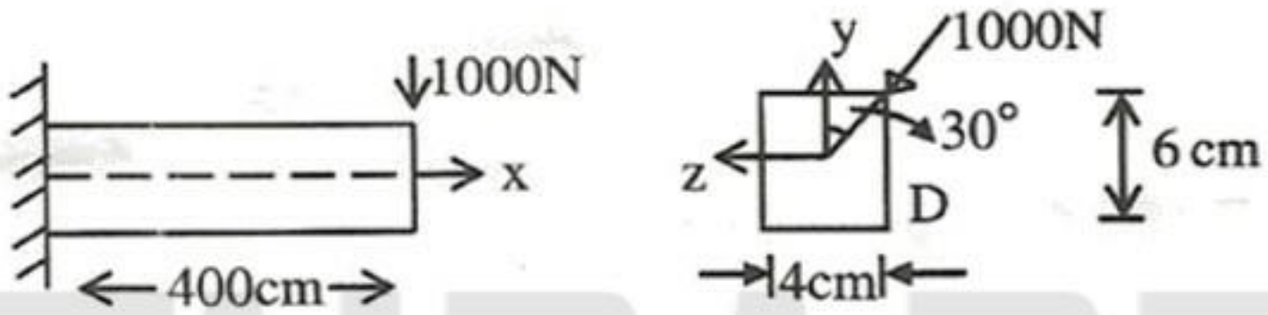
(ii) Octahedral shear strain

$E = 2 \times 10^5 \text{MPa}, \; V = 0.25.$

Material is assumed to be homogeneous and isotropic.

## UNIT – IV

Q.4 (a) What is the stress due to bending at point D near the built – in end? [12]




(b) What do you mean by unsymmetrical bending? [4]

**OR**

Q.4 (a) Explain shear centre. [6]

(b) Derive and explain Winkler – Bach formula. [10]

## UNIT – V

Q.5 Derive general expression for stresses of rotating disk having uniform thickness. Also show the stress distribution. [16]

**OR**

Q.5 Derive an expression for contact pressure between two shrink fits cylinders. Assume suitable dimensions and constants. [16]

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