Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## (ONLINE)
## SEMESTER II
## SESSION 2020/2021

| | | |
|---|---|---|
| COURSE NAME | : | ADVANCED SOLID MECHANICS |
| COURSE CODE | : | MFS 10403 |
| PROGRAMME CODE | : | MFA |
| EXAMINATION DATE | : | JULY 2021 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS<br>**CLOSE BOOK EXAMINATION** |

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

**Q1** The stress components at a point with reference to x, y, z coordinate system are:

.

| | | |
|---|---|---|
| $\sigma_x = 400$ | $\sigma_x = 400$ | $\sigma_x = 400$ |
| $\tau_{xy} = 0$ | $\tau_{yz} = 1600\ x$ | $\tau_{zx} = 800\ y$ |

The stress tensor for the state of stress is:

$$\begin{bmatrix} 400 & 0 & 800y \\ 0 & 400 & 1600x \\ 800y & 1600x & 400 \end{bmatrix}$$

Find the stress components at a point (4,8,12) on a plane whose equation is given by:

$$x + y + z = 24$$

(20 marks)

**Q2** The strain components at a point in a continuum with respect to coordinates system are given as follows:

| | | |
|---|---|---|
| $\varepsilon_x = 0.08$ | $\varepsilon_y = 0.12$ | $\varepsilon_z = 0$ |
| $\gamma_{xy} = 0.\ 04$ | $\gamma_{yz} = -0.016$ | $\gamma_{zx} = 0$ |

Determine the strain components in a different coordinate system x', y', z' which was obtained through rotating xyz system about y axis by an angle of 45° as shown in **Figure Q2.**

(25 marks)

**Q3** An elastic body was subjected to body force of $B_z = 40\ Gxy$. The displacement components are found to be as:

$$u = 4Ax^2yz \qquad v = 4Bxy^2z \qquad w = 4Cxyz^2$$

Determine the constants A, B and C in order to satisfy Navier equations, for the case of Poisson's ratio being 0.3.

(20 marks)

**Q4** Find rotation, deflection, shear and moment in the beam shown in **Figure Q4** using bending theory. Plot diagram for rotation, deflection, shear and moment. Consider steel cross section 80 mm × 80 mm and E= 200 GPa

(20 marks)

**Q5** The principle stresses at a point are given as follows:

$\sigma_2 = 20000$ kPa $\sigma_3 = 40000$ kPa

The yield stress for the material is 4000 kPa.

(a) Use the Tresca yielding criterion which is based on the maximum shear stress for the followings:

(i) Determine the minimum value of $\sigma_1$ for yielding to occur (3 marks)

(ii) Show Tresca yield surface (5 marks)

(b) Use the Von Mises criterion which is based on the distortion energy for the following:

(i) Determine the minimum value of σ1 for yielding to occur (3 marks)

(ii) Show Von Mises yield surface (4 marks)

**– END OF QUESTIONS –**

**FINAL EXAMINATION**

SEMESTER/SESSION : SEM II/2020/2021 PROGRAMME : MFA
COURSE NAME : ADVANCED SOLID MECHANICS COURSE CODE : MFG 10403

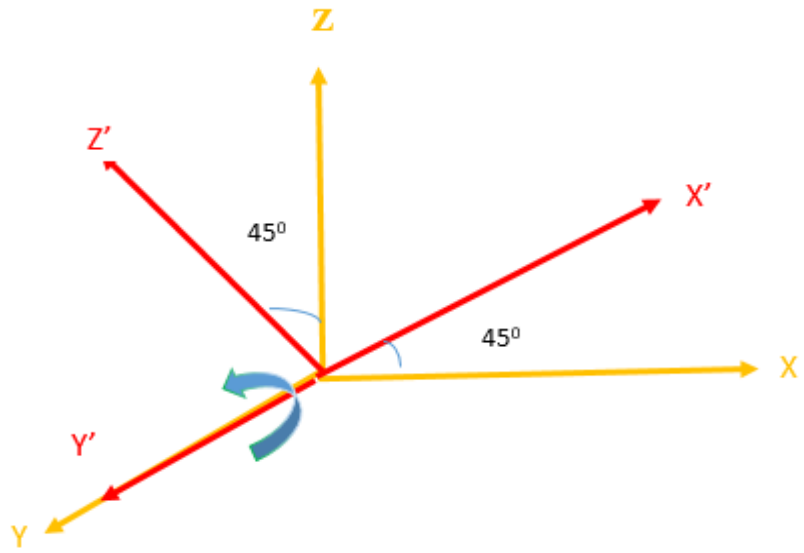


**Figure Q2:** Strain components

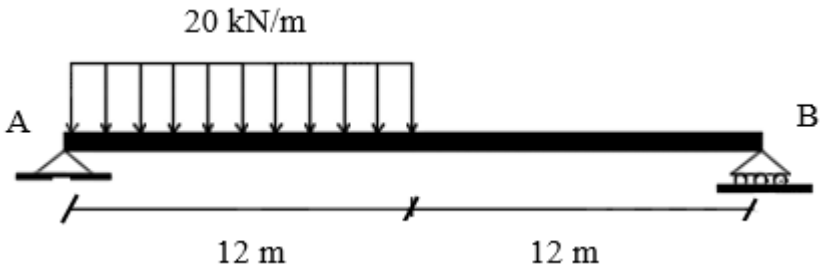


**Figure Q4:** Beam