VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY (VSSUT), ODISHA
Odd Mid Semester Examination for Academic Session 2024-25

SEMESTER: 3rd

COURSE NAME: B Tech

BRANCH NAME: Production Engineering
SUBJECT NAME: Mechanics of Materials (BPE-03002)

TIME: **90 Minutes**

FULL MARKS: **30**

Answer **All** Questions.
The figures in the right hand margin indicate Marks. *Symbols carry usual meaning.*

[2 × 3]

Q1. Answer all Questions.

a) Draw the engineering and the true stress-strain curves for ductile materials by labeling the salient points. — CO1

b) What is a statically indeterminate system? Explain with an example. — CO2

c) Define Poisson's ratio. Write the expressions for strains in three principal directions. — CO3

[8]

Q2. — CO1

What is complementary shear stress? What is its significance?
Determine the force P necessary for the equilibrium of a steel bar as shown in the Figure. The diameter of the first, middle, and last segments are 30 mm, 25 mm, and 30 mm, respectively. Also, find (a) the elongation of the bar (b) the length of the middle segment to have zero elongation, and (c) the diameter of the last segment to have zero elongation. E=202 GPa.

200 kN   P

100 kN ←

→ 150 KN

|← 600 mm →|← 800 - mm →|← 1000 - mm →|

OR

— CO1
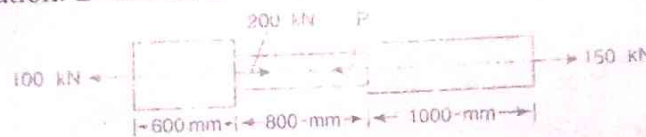
What do you mean by temperature stresses? Explain.
A rigid bar ABC is pined at A and connected by a steel bar CE and a copper bar BD as shown in the Figure. If the temperature of the whole assembly is raised by 40°C, find the stresses induced in steel and copper rods.
Given: A_S=400mm^2, A_C=600mm^2, E_S=2×10^5 N/mm^2, E_C=1×10^5 N/mm^2, α_S=12×10^{-6}/°C and α_C=18×10^{-6}/°C.

A   B   C
1 m   1 m
0.6 m
0.8 m
E
D

[8]
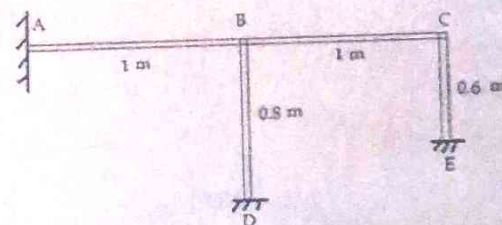
Q3. Derive the expression for the normal and shear stress on any plane for an element under biaxial and shear stress conditions.
A composite bar of aluminium and steel is rigidly attached to the end supports at 60°C as shown in the figure. Find the stresses in the two portions of the bar when the temperature of the composite system falls to 20°C if (i) the ends do not yield, (ii) the ends yield by 0.25 mm. As = 250 mm^2, Aa = 375 mm^2, Es = 200 GPa, Ea = 70 GPa, α_s = 11.7×10^{-6}/°C and α_a=23.4×10^{-6}/°C.

Al   STEEL

|← 400 mm →|← 800 mm →|

— CO2

1
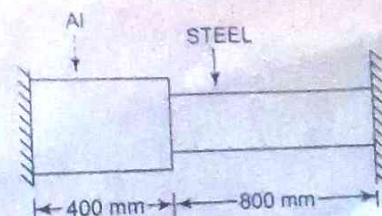
OR

The normal stresses at a point in an elastic material are 100MPa tensile and 60MPa compressive. Determine, principal stresses, the position of principal planes, maximum shear stress, and its plane both analytically and graphically.

[8]

Q4.   - CO3

Derive the relationship between the three moduli of elasticity.
An axial load of 56 kN is applied to a bar of 36 mm diameter and 1 m length. The extension of the bar is measured to be 0.265 mm whereas the reduction in diameter is 0.003 mm. Calculate the Poisson's ratio and the value of the three moduli.

OR   - CO3

Write notes on Strain Rosettes.
The strains measured on a strain rosette are $\varepsilon_0 = 450 \times 10^{-6}$, $\varepsilon_{60} = -600 \times 10^{-6}$ and $\varepsilon_{120} = 150 \times 10^{-6}$. Determine the principal stresses and their directions. E=200 GPa and Poisson's ratio = 0.3.

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