University of Technology
Building and Construction Engineering Department
Final exam 2013-2014

Subject: Material Technology
Division: All divisions
Examiner:-

Year:First
Time:3Hrs
Date:5 /6 /2014

Note: Answer only four questions

Q1/A Derive the generalized Hook's law equation for the body shown in Fig.1 (10%)

Q1.B. Differentiate between the following:

1. Bonding of H_2O and bonding of NaCl
2. Elasticity and Plasticity
3. Hard steel and mild steel in uses (15%)

Q2/A A steel shaft shown in Fig. 2 has diameter 6mm and length equal to 60mm subjected to axial tensile force 10kN and to increase in temperature (ΔT) 110°C. Determine the change in length and diameter due to combined effect of load and temperature. Solve assuming that the modulus of elasticity of steel is $150*10^3 N/mm^2$, Poisson ratio equal to 0.25, and $\alpha = 24*10^{-6}/°C$. (15%)

Q2/B Write a brief about behavior of material during fracture under creep and fatigue; enhance your answer with drawings (10 %)

Q3/A For the bar shown in Fig. 3, determine the ratio between change in length L_0 to change in diameter D_0 due to a tensile force F, assuming that the modulus of elasticity is E , Poisson ratio is μ and $L_0 = 10 D_0$ (16%)

Q3/B Show by sketch only:

a. Steps of failure during tensile test for ductile material
b. Model of failure during torsion test
c. Stress – strain diagram for all types of steel during tensile test (9 %)

Q4/A During a stress – strain test, the unit deformation at a stress 35 N/mm^2 was observed to be $167 * 10^{-6}$ and at a stress 140 N/mm^2 it was $667 * 10^{-6}$ mm/mm. If the proportional limit was 200 N/mm^2, what is the modulus of elasticity? What is the strain corresponding to a stress of 80 N/mm^2? Would these results be valid if the proportional limit were 150 N/mm^2 (10%)

Q4/B Compare between drying and burning stage during manufacture of clay brick. (15%)

Q5 **Fig.4 shows the stress – strain curve for copper in tension. If the original diameter of the bar is 22mm, the gauge length is 200 mm. Determine:**

1. **Load at Failure**
2. **Percentage of reduction in cross sectional area if the diameter of the specimen at failure was 9.5mm**
3. **Stress at yield point**
4. **Maximum load that the material can be carried without failure.**
5. **Modulus of toughness** **(25%)**

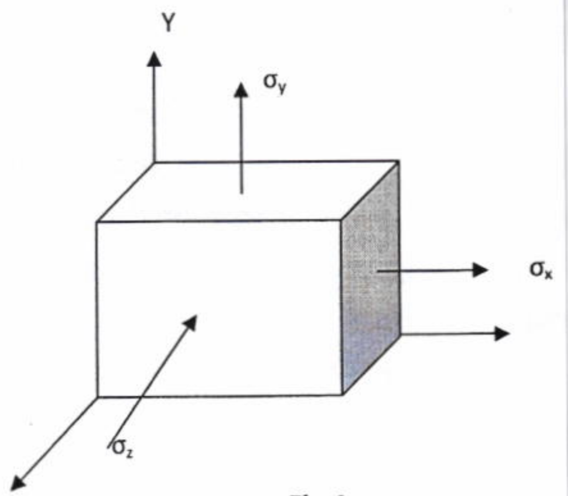

Fig.1

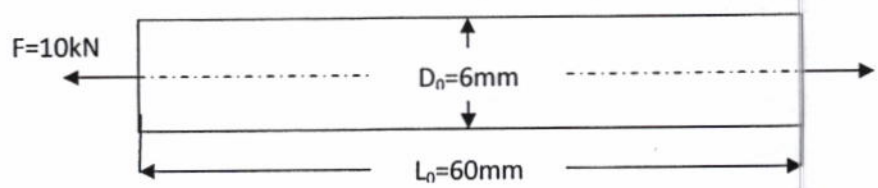

Fig. 2

(2-3)

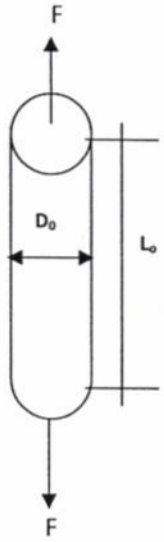
F
D₀
L₀
F

Fig. 3

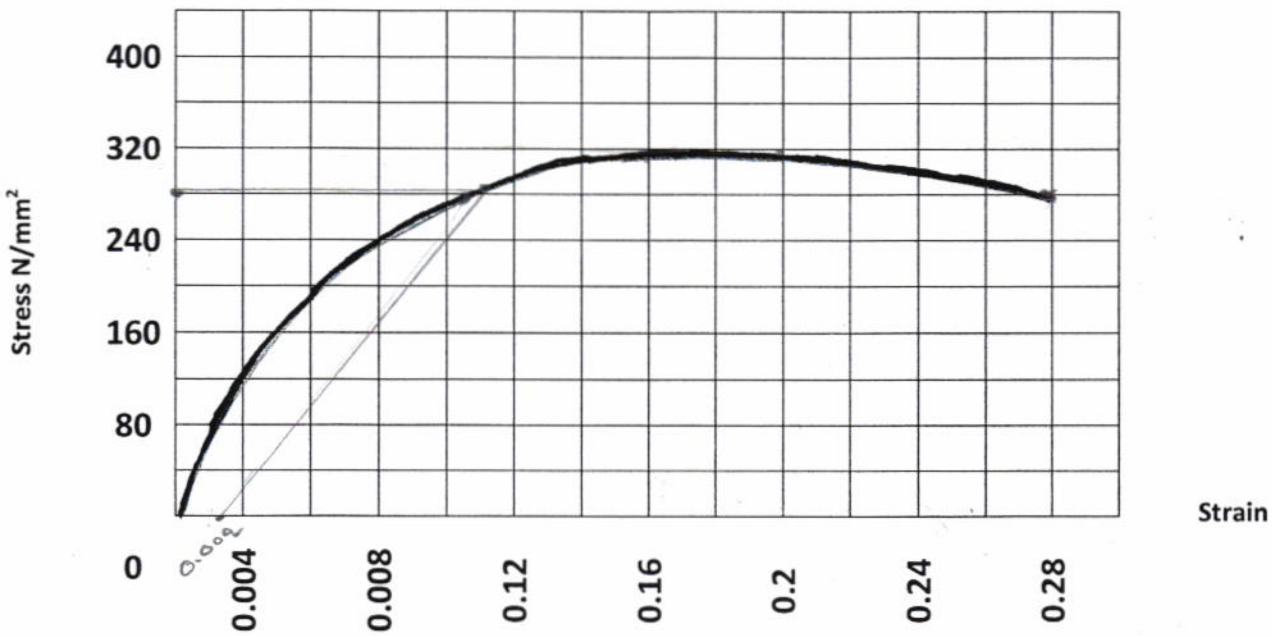
400
320
240
160
80
0
Stress N/mm²
Strain
0.002
0.004
0.008
0.12
0.16
0.2
0.24
0.28

Fig.4

(3-3)

Ans. of Q2/A

D_o=6 mm , L_o=60 mm , Load=10 kN , ΔT= +110 °C
$E = 150 * 10^3\ N/mm^2$, $\alpha = 24 * 10^{-6}$

Find the change in length and diameter?

Area (A) $= \pi . D^2/4 = \pi * 6^2/4 = 28.26\ mm^2$

Change in length ΔL

a. change in length due to force (ΔL_m)

$\Delta L_m = F.L_o/A.E = 10 * 10^3 * 60/28.26 * 150 * 10^3 = +0.141$ mm

b. change in length due to change in temp. ΔT (ΔL_{th})

$\Delta L_{th} = \alpha . \Delta T . L_o = 24 * 10^{-6} * 110 * 60 = +0.158$ mm

$\Delta L_{total} = \Delta L_m + \Delta L_{th}$

$\Delta L_{total} = +0.141 + 0.158 = 0.299$ mm

Change in diameter ΔD

a. change in diameter due to force (ΔD_m)

$\mu = \Delta D_m / D_o \Big/ \Delta L_m / L_o$

$\Delta D_m = -3.525 * 10^{-3}$ (Shorten)

b. change in diameter due to change in temp. ΔT (ΔD_{th})

$\Delta D_{th} = \alpha . \Delta T . D_o = 24 * 10^{-6} * 110 * 6 = +0.0158$ mm

$\Delta D_{total} = -3.525 * 10^{-3} + 0.0158 = 0.0125$ mm

The negative charged ion is now attracted to a positive ion, thus, forming the basic for ionic bonding.

2. **Elasticity and Plasticity**

Elasticity

Is the property by which a body, when deformed by the application of forces, recovering the original shape, when the force is removed.

Plasticity

Is the property by which a body, when deformed by the application of forces, remains in the deformed shape without recovering the original shape, when the force is removed.

3. **Hard steel and mild steel in uses**

The chief uses of hard steel are:

1. It is used for parts of structures and machinery where hard, tough, elastic, shock- proof and durable material is required.
2. It is used in pre stressed concrete.
3. It is used for making knifes, needles, bolts and surgical instruments.

The chief uses of mild steel are:

1. It is used for making rolled structural steel sections like girders, angle sections, channel and T- sections... etc.
2. It is extensively used for making bars and rods which are used as a reinforcing material in reinforced concrete.
3. It is used for making refrigerators and air conditioners.
4. It is used for making plain and corrugated sheets.
5. Structural mild steel is most commonly used for general construction purposes of buildings, bridges, towers and industrial buildings.
6. It also used for making tubes.