B.E. (Mechanical Engineering) Fourth Semester (C.B.S.)

Mechanics of Materials

P. Pages : 3 **NRJ/KW/17/4427**

Time : Three Hours * 0 2 1 5 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Use of non programmable calculator & Design Data book is permitted.

1. a) Explain in brief the stress strain curve for a ductile material with labelled diagram. **5**

b) Find the change in length of the bar ABCD subjected to tensile force of kN as shown in fig1 (b). Take E = 200GPa. **9**

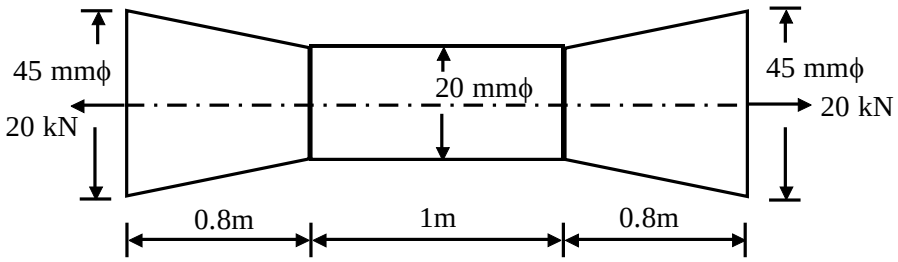


Fig. 1 (b)

2. a) A steel cube block of SAE1030 material [carbon steel] of 60mm side is subjected to force of 10kN [tension]; 6kN [tension]; and 7kN [tension] along x; y; & z-directions respectively. Determine the change in volume of the block. **7**

b) Three rods each of length 900mm and cross sectional area $180\,mm^2$ are connected to rigid plates at the ends as shown in fig 2 (b). If the temperature of the assembly is raised by 40ºC, Determine the stress in each rod. **7**

$E_{st} = 200GPa$

$E_{Al} = 70\,GPa$

$\alpha_{st} = 12\times10^{-6}/^{o}C$

$\alpha_{Al} = 25\times10^{-6}/^{o}C$

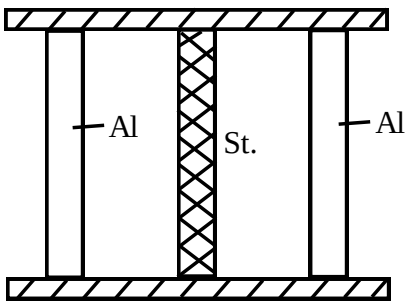


Fig. 2 (b)

3. A simply supported beam having equal overhangs on both sides and carrying loads is shown in fig (3) Draw Shear Force and Bending Moment diagrams and find point of contraflexure if any. **13**

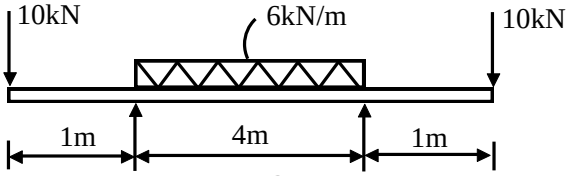


Fig. 3

4. a) A simply supported beam has an effective span of 8 meter. It carries a uniformly distributed load of 25kN/m over it's entire span. An I section symmetrical about the axis of bending is to be used. If the maximum bending stress is not to exceed 160MPa, determine the minimum value of modulus of section required. **7**

b) Prove that maximum shear stress in a rectangular section of a beam is $(3/2)$ times the average shear stress. The rectangular section is having width 'b' and depth 'h'. **6**

5. A beam of flexural rigidity EI is loaded as shown in Fig (5). Determine the slope at support A and B and the deflection at end point C ; E and midpoint D of beam. **13**

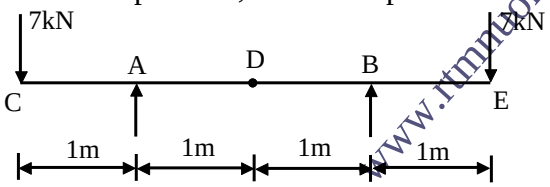
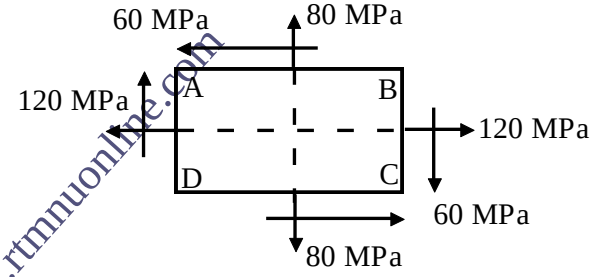


Fig. 5

6. a) Determine the principal stresses and location of principal planes for an element loaded as shown in fig 6. (a). **8**



Check the answer by using Mohr's circle.

b) Prove that, Under uniaxial loading the maximum shear stress is half the magnitude of the applied stress. **5**

7. a) Explain in brief with neat sketch the crushing and buckling failure of column. **5**

b) A 2.4 meter long column has a circular cross section of 70mm diameter. One of the ends of the column is fixed in direction and position and other end is free. Taking factor of safety as calculate the safe load using. **8**

i) Rankine's formula, take $\sigma_c = 600\text{MPa}$ & $a = 1/1600$

ii) Euler's formula; Young's modulus for CI $= 1.2\times10^5\ \text{N}/\text{mm}^2$.

8. a) Derive the torsion equation for circular shaft. **7**

$$\frac{T}{J} = \frac{\tau}{R} = \frac{G.\theta}{L}$$

$T \Rightarrow$ Torque transmitted; $J \rightarrow$ Polar MI; $\tau \Rightarrow$ Max. shear stress $R \Rightarrow$ Radius of shaft; $G \rightarrow$ mod. of rigidity; $\theta \Rightarrow$ Angle of twist $L \rightarrow$ length of shaft.

b) A shaft transmit 100kW of power at 750 rpm. Determine. **6**

i) The diameter of a solid shaft to transmit the required power

ii) The inner and outer diameter of hollow shaft if the ratio of inner to the outer diameter is $2/3$.

iii) The percentage saving in material on using hollow shaft instead of solid shaft.

Take τ=80MPa & density of material = $78\,kN/m^3$.

9. a) Prove that the stress induced in a body when the load is applied with impact is given by **6**

$$\sigma = \frac{P}{A} + \sqrt{(P/A)^2 + \frac{2PhE}{A\ell}}$$

Where

$P \rightarrow$ load applied with impact

$A \rightarrow$ cross-sectional area of the body

$h \rightarrow$ height through which load falls

$\ell \rightarrow$ length of the body

$E \rightarrow$ Mod. of Elasticity

b) A weight of 15kN falls by 35mm on a collar rigidly attached to a vertical bar of length 4500mm and $1200\,mm^2$ cross-sectional area. Find the maximum instantaneous stress and the elongation produced in the bar. Take E = 200 GPa. **7**

10. a) A cantilever of span 'L' carries a point load 'P' at free end. Find the total strain energy stored in bending and the corresponding maximum deflection under the point load in the beam. **7**

b) Explain in brief the various phases of creep phenomenon. **6**

11. a) A bolt having Metric fine thread made up of SAE 1120 cold drawn steel is subjected to axial thrust of 7.5kN together with a transverse shear force of 3.7kN. Calculate the diameter of bolt and suggest the suitable pitch according to. **8**

i) Maximum principal stress theory ii) Maximum shear stress theory

Take factor of safety as 3.

b) Define the endurance strength with neat sketch. Also Enlist the various factors which affects or considered while deriving the value of endurance strength. **6**

12. A steel shaft made of SAE 6150 [Oil Quenched at 425ºC] is subjected to a completely reversed bending moment of 100kN. Meter. The shaft transmits 500kW at 100 rpm. The torque varies over a range of $\pm 40\%$ of Average torque Determine the diameter of shaft. Take factor of safety '2.5'; size factor of 0.85; and surface finish factor of 0.62. The expected reliability is 95% And temperature factor is 1. **14**

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