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

Aircraft Structures - I Paper - IV

P. Pages : 4 **TKN/KS/16/7404**

Time : Three Hours * 0 7 9 0 * 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. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and Chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. a) A solid circular shaft transmits 75 kw power at 200 rpm. Calculate the shaft diameter if the twist in the shaft is not to exceed 1º in 2 m length of shaft and shear stress is limited to 50 MN/m^2. Take on modulus of rigidity be 100 GN/m^2. **7**

b) A compound tube consists of a steel tube 150mm internal dia and 10mm thickness and an outer brass tube 170mm internal diameter and 10mm thickness. The two tubes are of same length. The compound tube carries an axial load of 100kN, Find the stresses and the toad carried by each tube and the amount it shortens. Length of each tube is 150mm. Take $E_S = 2\times10^5\ N/mm^2$ and $E_b = 1\times10^5\ N/mm^2$. **7**

OR

2. a) A member ABC is formed by connecting a steel bar of 20mm dia to an aluminum bar of 30mm dia and is subjected to forces as shown in fig (1) **7**

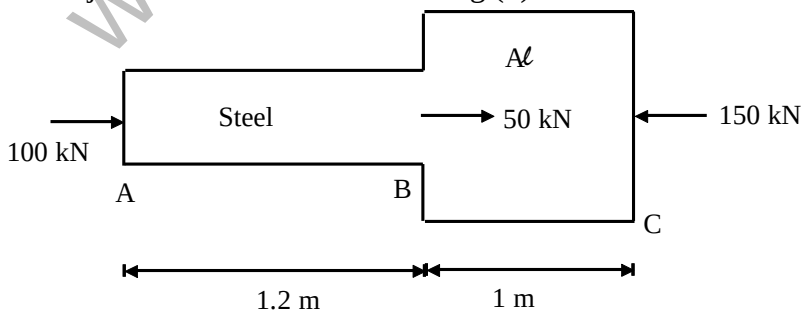

Fig. 1

Determine total deformation of the bar.

$E_{all} = 0.7\times10^5\ N/mm^2$

$E_{steel} = 2\times10^5\ N/mm^2$

b) A solid shaft is 100mm in diameter It transmits 120KW at 200rpm. Find the maximum intensity of shear stress induced and the angle of twist (θ) for a length of 6m. Take $C = 8\times10^4\ N/mm^2$. **7**

3. a) Explain theory of simple bending and assumptions associate with it. **4**

b) Draw the shear force and bending moment diagram for the beam shown in the fig.2. **9**

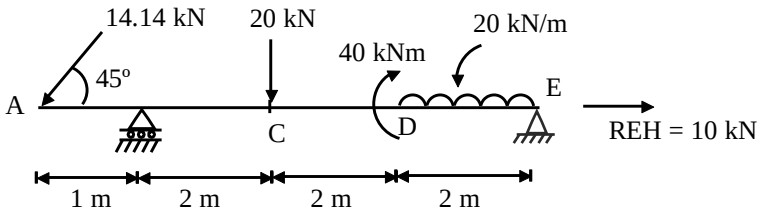

Fig. 2

OR

4. a) Derive the relation between slope, deflection and radius of curvature. **5**

b) A beam AB of 4m span is simply supported at the ends and is loaded as shown in fig. Determine. **8**

i) Deflection at C ii) Max deflection

iii) Slope at the end A

Given

$E = 200\times10^6\ kN/m^2$ &

$I = 20\times10^{-6}\ m^4$

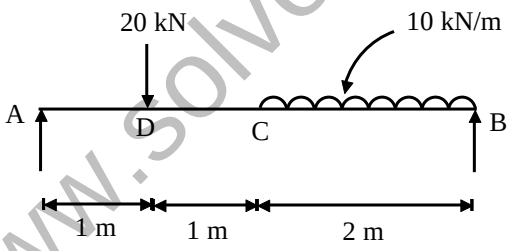

Fig. 3

5. a) Derive an expression for strain energy when a solid circular shaft is subjected to a torque T. **6**

b) A bar 100cm in length is subjected to an axial pull such that the maximum stress is equal to $150\ MN/m^2$ Its area of cross section is $2cm^2$ over a length of 95cm and for middle 5cm length it is only $1cm^2$. If $E = 200\ GN/m^2$. Calculate strain energy stored in the bar. **7**

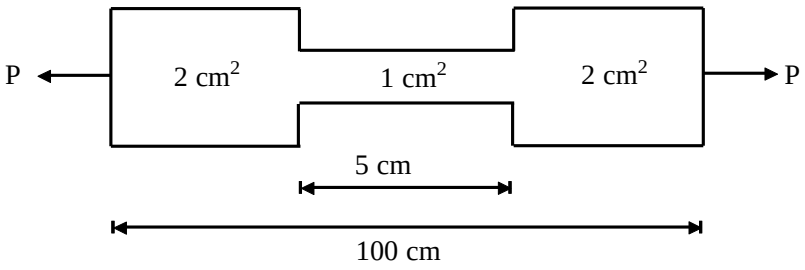

Fig. No. 4

OR

6. a) A uniform metal bar has a cross sectional area of 700mm^2 and length of 1.5m with an elastic limit of $160\text{N}/\text{mm}^2$. What is its proof resilience ? Find also the max value of an applied Load which may be suddenly applied with out exceeding the elastic limit. Calculate the value of the gradually applied load which will produce the same extension as that produced by the suddenly applied load. Take $E = 2\times10^5\ \text{N}/\text{mm}^2$. **7**

b) Derive castigliano's theorem. **6**

7. a) Determine the diameter of the piston rod if diameter of the cylinder is 0.3m. **7**

Max effective steam pressure in the cylinder $= 800\,\text{kN}/\text{m}^2$.
Distance from Piston to cross head centre = 1.5 m
FOS=4.
Assume
$\sigma_c = 330\,\text{MN}/\text{m}^2$
$\alpha = \frac{1}{30000}$ for both ends fixed.

b) A column is subjected to an axial load P on one end, derive an expression for Euler's load when the effective length of the column is twice its original length. **6**

OR

8. a) A steel bar of rectangular section $30\text{mm}\times40\text{mm}$ pinned at each end is subjected to axial compression. The bar is 1.75m long. Determine the buckling load and the corresponding axial stress using Euler's. Formula. Determine the minimum length for which the Euler's equation may be used to determine the buckling load, if the proportional limit of the material is $200\,\text{N}/\text{mm}^2$. Take $E = 2\times10^5\ \text{N}/\text{mm}^2$. **7**

b) Write various limitations for the use of Euler's formula. Also write the applicability of the Euler theory. **6**

9. a) Two planes AB and BC which are at right angles carry shear stresses of intensity $17.5\,\text{N}/\text{mm}^2$ while there planes also carry a tensile stress of $70\,\text{N}/\text{mm}^2$ and a compressive stress of $35\,\text{N}/\text{mm}^2$ resp. Determine the principal planes and stresses and also the max shear stress and the planes on which it acts. **7**

b) Explain in detain stresses due to pure shearing. **7**

OR

10. a) Derive the maximum and minimum principal stresses and maximum shear stresses when the member is subjected to different types of stresses simultaneously as shown in fig No.(5). **7**

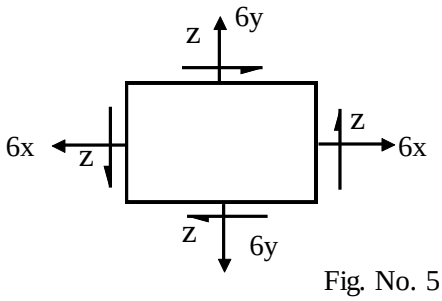

Fig. No. 5

b) At a point in a stressed body the principal stresses are $100 MN/mm^2$ (Tensile) & $60 MN/mm^2$ (Compare) Determine the normal stress and the shear stress on a plane inclined at 50^o to the axis of major principal stresses also calculate the maximum shear stress at the point. **7**

11. a) A steel shaft is subjected to an end thrust producing stress of 90MPa and the minimum shearing stress on the surface arising from torsion is 60 MPa. The yield point of the material in simple tension was found to be 300MPa calculate the FOS of shaft according to. **8**

i) Max shear stress theory
ii) Maximum distortion energy theory

b) Explain the following. **5**

i) Stress concentration
ii) Notch sensitivity.

OR

12. a) A solid shaft is subjected to a bending moment of 300Nm and a twisting moment of 225Nm. Find the diameter of the shaft with a factor of safety of 2 according to the maximum principal strain theory. Take $\sigma_y = 210 N/mm^2$ & $1/m = 0.25$. **7**

b) Briefly explain the Mises Henky theory of failure. **6**

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