Aryabhatta Knowledge University

Mechanics of solid-1

Sem. iv 2013 Time 3hr Full marks: 70

Attempt any five questions in which question no 1 is compulsory

1. Answer any seven from the following in short:

(a) Explain internal and external forces.
(b) Discuss generalized Hooke's law.
(c) Define the terms 'longitudinal strain', 'lateral strain' and 'poison's ratio'.
(d) What do you mean by strain energy? Illustrate clearly with suitable example.
(e) How do you find the maximum bending moment in a beam?
(f) How can you determine the maximum instantaneous deflection of a beam subjected to impact loading?
(g) Define the term 'pure torsion'.
(h) Distinguish between major and minor principal stresses.
(i) State the criteria for a thin cylinder. What types of stresses are induced in a thin cylindrical shell subjected to an internal pressure?
(j) Define helical spring .name the two important types of helical springs.

2. A steel bolt of 12 mm diameter passes through a brass tube of 16 mm diameter, 25 cm long and 20 mm external diameter. The bolt is tightened by nut at 15 degree Celsius so as to exert a compressive force 1500 kg on the tube .calculate the stress in each (a) 15 degree Celsius (b) when the temperature of the tube and bolt is raised to 50 degree Celsius.
Take
$E_s = 2x10^6 kg/cm^2$
$\alpha_s = 12x10^{-6}/°c$
$E_b = 1x10^6 kg/cm^2$
$\alpha_b = 19x10^{-6}/°c$

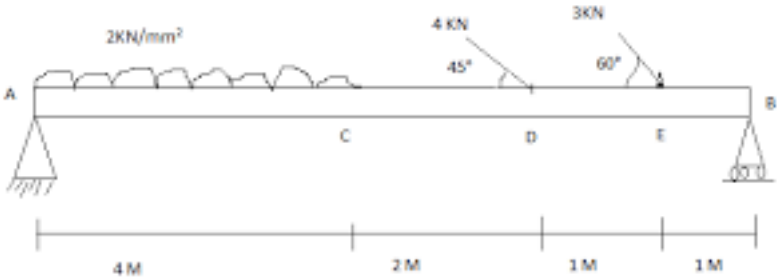
3. Derive the torsion formula
$T/J = T/r = G\theta/L$
With assumption where all terms indicate usual meanings.

4. A close –coiled helical spring, consisting of 8 coils , each having mean diameter 80 mm and wire diameter 10 mm . The spring is fixed at one end and twisting moment of 10 Nm applied axially at other end in such a way that the spring tends to open . Determine (a) the maximum bending stress produced in the wire of the spring ,(b)the angle of twist ,(c) the resistance and (d) the number of turns after the application of torque. Take, E=2x10^5N/mm^2.

5. Show that in a strained material under two dimensional stress system , the sum of normal components of stresses acting on any two mutually perpendicular planes is constant . the principal stresses at a point in a strained material are $\sqrt{(\sigma_1^2+\sigma_2^2)}/2$

6. Cast iron T section having overall depth 150 mm, flange and web 30 mm is used as bracket. The length of the bracket is 300mm. If the tensile stress is restricted to 20 n/mm^2 , what will then be placed at the top of bracket ? What will then be the compressive stress developed?

7. Draw the shear force ,bending moment and axial force diagrams for the beam supported and loaded as shown in the figure below:



8. A cantilever AB of 6 m length is subjected to a u.d.l. of intensity w t/m spread over the entire length. Assuming rectangular cross section with depth equal to twice breadth , determine the minimum dimensions of the beam so that the vertical deflection at the free end of does not exceed 1.5 cm and the maximum bending stress does not exceed 1000 kg/cm^2 .Take E=2 x 10^6 kg/cm^2

9. Two round bars of varying diameter A and B are shown in Fig . Below made of same material. An axial blow on bar A produces a maximum stress of 100 N/mm^2.Find the maximum stress produced by the same blow on the bar B. If the bar B is also stressed to 100 N/mm^2, find the ratio of strain energies stored in the bars A and B.