(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1239 Roll No. 1 2 0 3 2 0 0 0 9 5

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2013-14

MECHANICS OF SOLIDS

Time : 3 Hours *Total Marks : 100*

Note :–Attempt **all** the Sections.

SECTION–A

1. Attempt **all** parts. Write in brief : **(2×10=20)**

   (a) Draw the stress – strain diagram for ductile and brittle materials.

   (b) Write down the generalized Hook's Law.

   (c) Write short notes on the classification of beams.

   (d) A cantilever beam with uniformly distributed load over the whole span, find out the slope and deflection of the beam at the free end.

   (e) A solid shaft is 100 mm in diameter. It transmits 120 KW at 200 rpm. Find the maximum transmit torque.

   (f) If two springs of stiffness k are connected in series, find the equivalent stiffness of the spring.

   (g) Write the formula of volumetric strain in the thin shells due to the stresses generated in the shells.

(h) An 800 mm diameter pipe contains a fluid at a pressure of 30 N/mm^2. If the safe stress in tension is 120 N/mm^2. Find the thickness of the pipe.

(i) Write down the assumptions of the theory for curved beam.

(j) What is the principal planes and principal stress ?

SECTION–B

2. Attempt any **six** parts of the following : **(5×6=30)**

(a) A steel bar of 25 mm diameter is acted upon by forces shown in Fig. 1. Determine the total elongation of the bar. Take E = 200 kN/mm^2.

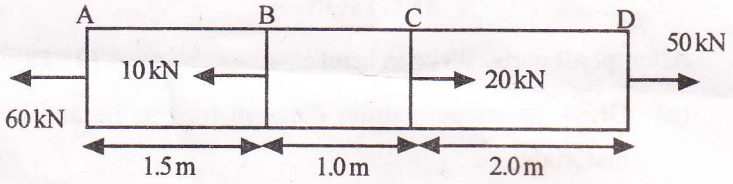

Fig. 1

(b) If a bar is stretched in such a manner that all the lateral strain is prevented, what is the value of the modified modulus of elasticity and modified Poisson's ratio ? Take μ as the Poisson's ratio.

(c) At a point in a block, the stresses on two mutually perpendicular planes are 40 N/mm^2 (tensile) and 20 N/mm^2 (tensile). The shear stress across these planes is 10 N/mm^2. Find using Mohr's stress circle, the magnitude and direction of the resultant stress on plane making an angle of 30° with the plane of the first stress.

(d) A bar 4 m long and 6 cm diameter hangs vertically and has a collar securely attached at the end. Find the maximum stress induced when a weight of 3000 kg falls 1 cm on the collar. Take $E = 2.05 \times 10^6$ kg/cm^2.

(e) A 30 cm × 16 cm rolled steel joist of I – section has flanges 11 mm thick and web 8 mm thick. Find the safe uniformly distributed load that this section will carry over a span 5 m if the permissible stress is limited to 120 N/mm^2.

(f) Give the limits of eccentricity in the following cases :

(i) Rectangular section

(ii) Circular section.

(g) An I – section 340 mm × 200 mm has a web thickness of 10 mm and flange thickness of 20 mm. It carries a shearing force of 1000 kN. Sketch the shear stress distribution across the section.

(h) Derive an expression for maximum stress setup in the body subjected to gradual and sudden load.

SECTION–C

3. Attempt any two parts of the following : **(5×2=10)**

(a) Write a note on significance of the theories of failure. And also explain the MISES – HENKY theory.

(b) At a point in a steel member, the major principal stress is 200 N/mm^2 and the minor principal stress is compressive. If the tensile yield stress is 250 N/mm^2, find the minor principal stress at which yielding will commence, using;

(i) Maximum strain energy theory

(ii) Maximum shear strain energy theory.

Take Poisson's ratio (μ) = 0.25.

(c) A beam AB of 4 m span is simply supported at the ends and is loaded as shown in Fig.2. Determine :

(i) deflection at C,

(ii) maximum deflection, and

(iii) slope at end A. Take E = 2 × 10^5 N/mm^2 and I = 1000 cm^4.

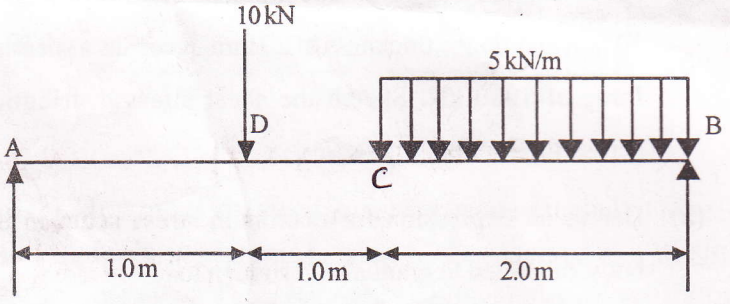

Fig. 2

4. Attempt any **two** parts of the following : **(5×2=10)**

(a) A closely coiled helical spring is made of 10 mm diameter steel rod, the coils having 10 complete turns and a mean diameter of 80 mm. Calculate the increase in

number of turns and the bending stress induced in the section, if it is subjected to an axial thrust of 10 Nm. Take $E = 2.1 \times 10^5$ N/mm^2.

(b) A hollow rectangular masonry pier is 1.2 m × 0.8 m, overall the wall thickness being 0.15 m. A vertical load of 100 kN is transmitted in the vertical plane bisecting 1.2 m side at an eccentricity of 0.1 m from the geometrical axis of the section. Calculate the maximum and minimum stress in the section.

(c) A solid round bar 60 mm in diameter and 2.5 m long is used as a strut. One end of the strut is fixed, while other end is free. Find the safe crippling load for the strut using Euler's formula. Assume E = 200 GN/mm^2 and factor of safety = 3.

5. Attempt any **two** parts of the following : **(5×2=10)**

(a) Calculate the thickness of the metal necessary for a cylindrical shell of internal diameter of 80 mm to withstand an internal pressure of 25 N/mm^2, if the maximum permissible tensile stress is 125 N/mm^2.

(b) Write short notes on :

(i) Lame's theory of thick cylinders

(ii) Compound cylinder.

(c) A steel shaft of 3 Cm diameter and 1 m long is rigidly fixed at the ends. A twisting moment of 600 Nm is applied at a distance of 250 mm from one end. Calculate :

(i) a fixing couple at the ends,

(ii) the maximum shear stress,

(iii) the angle of twist of the section where the twisting moment has been applied. Take $C = 0.82 \times 10^6$ N/mm^2.

6. Attempt any **two** parts of the following : **(5×2=10)**

(a) A channel section has overall depth of 250 mm, flange width of 125 mm, flange thickness of 20 mm and web thickness of 20 mm. Find the approximate location of the shear centre.

(b) Show the shear stress variation in the following section :

(i) Rectangle

(ii) Solid circle.

(c) A beam AB of length L is loaded with a couple applied at an intermediate point. Calculate the slopes at the ends and the deflection under the point of application of the couple.

7. Attempt any **two** parts of the following : **(5×2=10)**

(a) A steel rod 2 m long is heated through a temperature of 100 °C. Find the stresses induced in the rod, if coefficient of linear expansion 0.000012/°C. Take $E = 2 \times 10^6$ kg/cm^2.

(b) A leaf spring has 12 plates each 50 mm wide and 5 mm thick, the longest plate being 600 m long. The greatest bending stress is not to exceed 180 N/mm^2 and the central deflection is 15 mm. Estimate the magnitude of the greatest central load that can be applied to the spring. $E = 0.206 \times 10^6 N/mm^2$.

(c) Derive an expression for the buckling load of the columns/struts with one end fixed and other is hinged.