IES GROUP OF INSTITUTIONS BHOPAL

RGPV BASED ASSIGNMET QUESTION.

SUBJECT- STRENTH OF MATERIALS (ME-303)

BRANCH- ME 3RD SEM

INTRUCTIONS. 1. All questions with their solution are submitted till 27 October 2014.

Q-1

A closely coiled helical spring is to carry a load of 500 N. Its mean coil diameter is to be 10 times that of the wire diameter. Calculate these diameters if the maximum shear stress in the material of the spring is to be 80 MN/m².

Q-2

Write down Euler's formula for calculating the critical load for a column (or) strut.

Q-3

11. (a) Three bars made of copper, zinc and aluminium of equal length are rigidly connected at their ends as shown in Fig. (i)

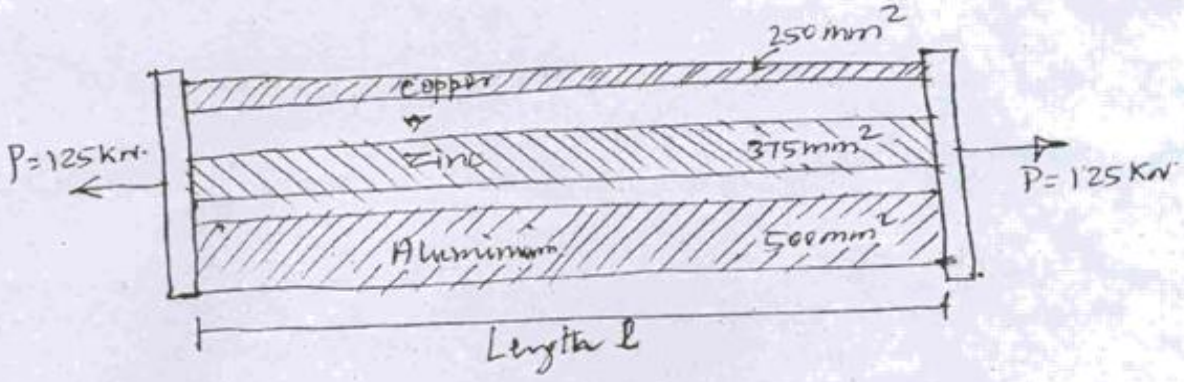

Fig. (i)

They have cross-sectional areas of 250 mm², 375 mm² and 500 mm² respectively. If the compound member is subjected to a longitudinal pull of 125 kN, estimate the proportion of load carried on each rod and the induced stresses. Take E_{cu} = 130 GN/m², E_{zn} = 100 GN/m², E_{al} = 80 GN/m². (16)

Q-4

A cylindrical drum 800 mm diameter and 3m long has a shell thickness of 10 mm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine the change in dimensions of the drum. $E = 200\ kN/mm^2$, Poisson's ratio = 0.25.

Q-5

The following data relate to a bar subjected to a tensile test :

Diameter of the bar = 30 mm

Tensile load P = 54 kN

Gauge length l = 300 mm

Extension of the bar $\delta_l = 0.112$ mm

Change in diameter $\delta_d = 0.00366$ mm

Calculate

(i) Poisson's ratio

(ii) The values of three modulii.

Q-6

A short bar of length 100 mm tapers uniformly from a diameter 40 mm to a diameter of 30 mm and carries an axial compressive load of 200 kN. Find the change in length of the bar.

Q-7

A steel rod of 20 mm passes centrally through a copper tube of 50 mm external diameter and 40 mm internal diameter. The tube and the rod is fixed at each end by rigid plates. If the temperature of the assembly is raised by 50° C, calculate the stresses developed in copper and steel. Take $E_s = 200\ kN/mm^2$, $E_c = 100\ kN/mm^2$, $\alpha_s = 12 \times 10^{-6}$ per °C, $\alpha_c = 18 \times 10^{-6}$ per °C.

Q-8

A closed coiled helical spring is to have a stiffness of 1200 N/m in compression with a maximum load of 60 N and maximum shearing stress of 120 N/mm². The solid length of the spring (i.e., coils are touching) is 50 mm. Find the diameters and the number of coils. G = 40 kN/mm².

Or

A hollow shaft with diameter ratio 3/8 is required to transmit 500 kW at 100 rpm, the maximum torque being 20% greater than the mean. The maximum shear stress is not to exceed 60 N/mm² and the twist in a length of 3 m is not to exceed 1.4°. Calculate the minimum diameters required for the shaft. C = 84 kN/mm².

Q-10

A brass rod 2 m long is fixed at both its ends. If the thermal stress is not to exceed 76.5 N/mm². Calculate the temperature through which the rod should be heated. Take the values of α and E as 17×10^{-6}/K and 90 GPa respectively.

Q-11

Calculate the maximum torque that a shaft of 125 mm diameter can transmit, if the maximum angle of twist is 1° in a length of 1.5 m. Take $C = 70 \times 10^3$ N/mm².

A cylindrical shell of 500 mm diameter is required to withstand an internal pressure of 4 MPa. Find the minimum thickness of the shell, if maximum tensile strength in the plate material is 400 N/mm² and efficiency of joint is 65%. Take factor of safety as 5.

A rectangular R.C simply supported beam of span 3 m and cross section 200 mm × 350 mm carries a point load of 100 kN at its mid span. Find the maximum slope and deflection of the beam if $E = 0.2 \times 10^5$ N/mm².

Q-14

A reinforced concrete column 500 mm × 500 mm in section is reinforced with 4 steel bars of 25 mm diameter, one in each corner, the column is carrying a load of 1000 KN. Find the stresses in the concrete and steel bars. Take E for steel = 210×10^3 N/mm² and E for concrete = 14×10^3 N/mm². (8)

Q-15

(a) A thin cylindrical shell 1.5 m long, internal diameter 300 mm and wall thickness 10 mm is filled up with a fluid at atmospheric pressure. If the additional fluid of 300×10^3 mm³ is pumped in the shell, find the pressure exerted by the fluid on the shell. Take E= 2×10^5 N/mm² and 1/m = 0.3. Also find the hoop stress induced.

Or

(b) (i) Derive a relation for deflection of a closely coiled helical spring subjected to an axial downward load W. (8)

(ii) A quarter elliptic leaf spring 60 cm long is made of steel plates of width 10 times the thickness. The spring is to carry a load of 3 KN and the end deflection is limited to 5 cm. The bending stress of the plates must not exceed 3000 N/mm². Find suitable values of the size and number of plates to be used. Take E = 2×10^5 N/mm². (8)

Q-18

(a) A solid shaft is subjected to a torque of 100 Nm. Find the necessary shaft diameter if the allowable shear stress is 100 N/mm² and the allowable twist is 3° per 10 diameter length of the shaft. Take C = 1×10^5 N/mm².

Or

(b) (i) State any four assumptions made in the theory of simple bending. (4)

(ii) Derive the bending formula (12)

$$\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$$

Q-20

(a) The internal and external diameter of a hollow shaft is in the ratio of 2 : 3. the hollow shaft is to transmit a 400 kW power at 120 rpm. The maximum expected torque is 15 % greater than the mean value. If the shear stress is not to exceed 50 MPa, find section of the shaft which would satisfy the shear stress and twist conditions.

Take $G = 0.85 \times 10^5$ MPa. (16)

Or

(b) Determine the bending stress, shear stress and total work done on an open coiled helical spring subjected to axial force having mean radius of each coil as 'r' and 'n" numbers of turns. (16)

Q-22

(a) A beam of length 6 m is simply supported at its ends and carries two point leads of 48 kN at a distance of 1 m and 3 m respectively from left and support. Find the deflection under each load, the maximum deflection and the point at which occurs. Assume $E = 2 \times 10^5$ MPa and $I = 85 \times 10^6$ MPa. Use Macaulay's method. (16)

Or

(b) Find the Euler's crippling load for a column with one end fixed and other end free. (16)

Q-24

(a) A cylindrical shell 1 m dia and 3 m length is subjected to an internal pressure of 2 MPa. Calculate the maximum thickness if the stress should not exceed 50 MPa. Find the change in dia and volume of shell. Assume Poisson's ratio of 0.3 and Young's modulus of 200 kN/mm^2. (16)

Or

(b) A thin cylindrical tube 80 mm internal diameter and 5 mm thick is closed at its ends. It is subjected to an internal pressure of 6 N/mm^2 and a torque of 2009600 kN-m. Find the hoop stress, longitudinal stress, maximum and minimum principle stresses and maximum shear stress. (16)

Q-26

(a) A thin cylinder is 3.5 m long, 90 cm in diameter, and the thickness of metal is 12 mm. it is subjected to an internal pressure of 2.8 N/mm². Calculate the change in dimensions of the cylinder and the maximum intensity of shear stress induced. Given E = 200 GPa and Poisson's ratio = 0.3.

Or

(b) The normal stress at a point on two mutually perpendicular planes are 140 MPa (Tensile) and 100 MPa (Compressive). Determine the shear stress on these planes if the maximum principal stress is limited to 150 MPa (Tensile). Determine also the following :

(i) Minimum principal stress,

(ii) Maximum shear stress and its plane and

(iii) Normal, shear and resultant stresses on a plane which is inclined at 30° anticlockwise to X plane.

Q-28

(b) A member ABCD is subjected to loads as shown in Fig Q 12(b). Find the value of P and determine the total change in length of the bar.

$E = 210\ KN/mm^2$.

AB = 300 mm, BC = 200 mm, CD = 300 mm. $A_{AB} = 25\ mm^2$, $A_{BC} = 100\ mm^2$, $A_{CD} = 50\ mm^2$. (16)

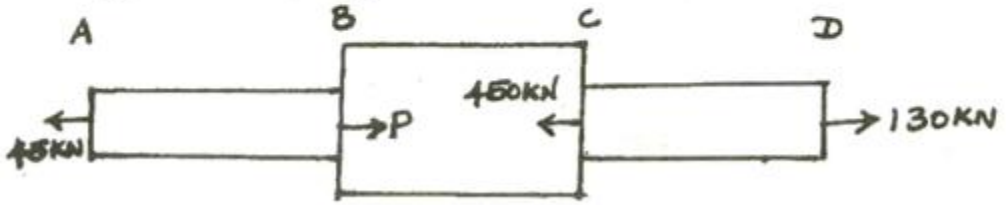

Fig Q 12(b)

Q-29

A cantilever of length 2a is carrying a load of W at the free end, and another load of W at its centre. Determine by moment area method, the slope and deflection of the cantilever at the free end. (16)

Q-30

(i) A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0039 mm. Calculate the Poisson's ratio and the value of the three moduli. (8)

(ii) A rectangular block 350 mm long, 100 mm wide and 80 mm thick is subjected to axial load as follows. 50 kN tensile in the direction of length, 100 kN compression in the direction of thickness and 60 kN tensile in the direction of breadth. Determine the change in volume, bulk modulus, modulus of rigidity. Take E = 2×10^5 N/mm^2 and Poisson's ratio = 0.25. (8)

Q-32

(a) A mild steel rod of 25 mm internal diameter and 400 mm long is enclosed centrally inside a hollow copper tube of external diameter 35 mm and internal diameter of 30 mm. The ends of the tube and rods are brazed together, and the composite bar is subjected to an axial pull of 50kN. If E for steel and copper is 200 GN/m^2 and 100 GN/m^2 respectively, find the stresses developed in the rod and tube. Also, find the extension of the rod.

Q-33

(b) A copper bar 50 mm in diameter is placed within a steel tube 75 mm in external diameter and 50 mm in internal diameter of exactly the same length. The two pieces are rigidly fixed together by two pins 18 mm in diameter, one at each end passing through the bar and the tube. Calculate the stress induced in the copper bar, steel tube and pins if the temperature of the combination is raised by 50°C. Take $E_s = 210$ GPa, $E_c = 105$ GPa, $\alpha_s = 11.5 \times 10^{-6}$ per ^0C, $\alpha_c = 17 \times 10^{-6}$ per ^0C.

Q-34

(a) A hollow steel shaft 10 cm external diameter and 5 cm internal diameter transmits 800 kW at 5000 r.p.m and is subjected to an end thrust of 40,000 N. Find the bending moment that may be safely applied to the shaft if the greater principal stress is not to exceed 100 N/mm^2.

Or

(b) A closely coiled helical spring is made of 6 mm wire. The maximum shear stress and the deflection under a load of 200 N is not to exceed 90 N/mm^2 and 1.1 cm respectively. Determine the number of coils and their mean radius. Take N or C = 0.84×10^5 N/mm^2.

Q-36

A simply supported beam of 6 m span carries a uniformly distributed load of 20 kN/m over the middle 2 m length and point loads of 10 kN and 20 kN at a distance of 1 m and 5 m from the left end. Draw the shear force and bending moment diagrams and determine the magnitude and position of the maximum bending moment.

Q-37

(a) A shell 4.50 m long, 900 mm in diameter is subjected to an internal pressure of 1.1 N/mm^2. If the thickness of shell is 8.5 mm, find the circumferential and longitudinal stresses. Find also maximum shear stress and changes in the dimensions of shell. E = 2.1×10^5 N/mm^2; 1/m = 0.33.

Or

(b) A point in a strained material is subjected to mutually perpendicular stress of 600 N/mm^2 (tensile) and 400 N/mm^2 (compressive). It is also subjected to a shear stress of 100 N/mm^2. Draw Mohr's circle, and find the principal stresses and maximum shear.

Q-39

(a) A cantilever of length 3 m carries two point loads of 2 kN at free end and 4 kN at a distance of 1 m from the free end. Find the deflection at free end using area moment method. Take E = 2×10^5 N/mm^2 and $I = 10^8$ mm^4.

Or

(b) A simply-supported beam of length 4m carries point loads of 3 KN each at a distance of 1m from each end. If $E = 2 \times 10^5$ N/mm^2 and $I = 10^8$ mm^4 for a beam, then using conjugate beam method, determine :

(i) Slope at each end and under each load.

(ii) Deflection under each load and at the centre.

Q-41

(a) Derive the expressions for hoop stress and longitudinal stress in a thin cylinder with ends closed by rigid flanges and subjected to an internal fluid pressure. Take the internal diameter and shell thickness of the cylinder to be 'd' and 't' respectively.

Q-42

(b) A point in a strained material is subjected to stresses shown in Figure Qn. 15 (b). Using Mohr's circle method, determine the normal and tangential stresses across the oblique plane. Check the answer analytically.