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06ME34

Third Semester B.E Degree Examination, Dec. 07 / Jan. 08
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note : ***1. Answer any FIVE full questions.***
2. Missing data, if any may suitably be assumed.

1 a. Explain clearly with neat sketches, if any, the following i) Proof stress ii) Secant Modulus iii) Elasticity iv) Strain Hardening. **(08 Marks)**

b. A stepped bar is subjected to an external loading as shown in fig. 1(b). Calculate the change in the length of the bar. Take E = 200 GPa for steel, E = 70 MPa for Aluminum and E = 100 GPa for Copper. **(08 Marks)**

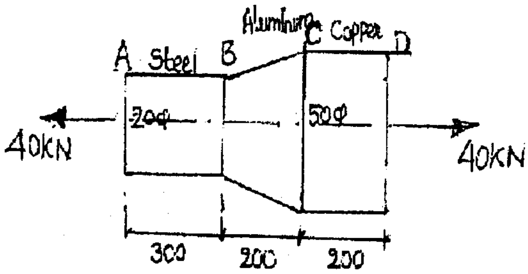

Fig. 1(b)

c. Explain briefly the Principle of Super position. **(04 Marks)**

2 a. Prove that volumetric strain is equal to sum of the three principal strains $\in_v = \in_x + \in_y + \in_z$. **(05 Marks)**

b. A cube of 100mm side is subjected to 10N/mm^2 (Tensile) 8N/mm^2 (compressive) and 6N/mm^2 (Tensile) acting along X, Y and Z planes respectively. Determine the strains along the three directions and the change in volume. Take Poissons ratio = 0.25 and $E = 2\times10^5$ N/mm^2. **(05 Marks)**

c. A steel tube of 25mm external diameter and 18mm internal diameter encloses a copper rod of 15mm diameter. The ends are rigidly fastened to each other. Calculate the stress in the rod and the tube when the temperature is raised from 15^0 to 200^{0}C. Take $\alpha_{st} = 11\times10^{-6}/\ ^0C$, $\alpha_{cu} = 18\times10^{-6}/\ ^0C$, E_{st} = 200 GPa, E_{cu} = 100 GPa. **(10 Marks)**

3 a. Derive expressions for Normal stress and shear stress on a plane inclined at θ to the vertical axis in a biaxial stress system with shear stress as shown in fig.3(a). Hence, prove that the sum of Normal stresses on any two mutually perpendicular planes are always constant. **(10 Marks)**

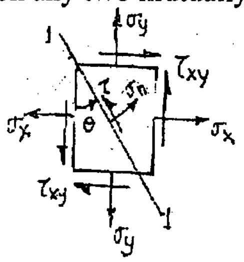

Fig.3(a)

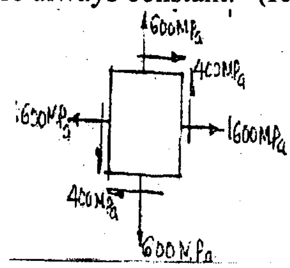

Fig. 3(b)

b. Using Mohr's circle, determine the principle stresses and the planes, Max. shear stress and the planes. Show the same on the elements separately. Refer fig.3(b). **(10 Marks)**

4 a. Prove that the volumetric strain in a thin cylinder is given by $\in_V = (2.\in_C + \in_L)$ Where $\in_C$ = hoop strain , $\in_L$ = long strain and express the same in terms of diameter of the cylinder (D), thickness (t), Youngs modulus (E), internal pressure (P) and Poisson's ratio (μ). **(10 Marks)**

b. A thick cylinder with Internal diameter 80mm and External diameter 120mm is subjected to an external pressure of 40 kN/m^2, when the internal pressure is 120 kN/m^2. Calculate the circumferential stress at external and internal surfaces of the cylinder. Plot the variation of circumferential stress and Radial pressure on the thickness of the cylinder. **(10 Marks)**

5 a. Briefly explain different types of beam supports. **(03 Marks)**

b. Derive expressions relating Load, Shear Force and Bending Moment (M) with usual notations. **(05 Marks)**

c. Draw SF and BM diagrams for the loading pattern on the beam shown in fig.5(c). Indicate where the Inflexion and contraflexure points are located. Also locate the maximum BM with its magnitude. **(12 Marks)**

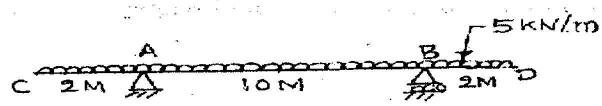

Fig. 5(c)

6 a. Prove that the maximum transverse shear stress is 1.5 times the average shear stress in a beam of a rectangular cross section. Plot the shear stress distribution. What assumptions are made in the above? **(10 Marks)**

b. A beam of T section has a length of 2.5m and is subjected to a point load as shown in the fig.6(b). Calculate the compressive bending stress and plot the stress distribution across the cross section of the beam. The maximum tensile stress is limited to 300 MPa. Calculate the value of W. **(10 Marks)**

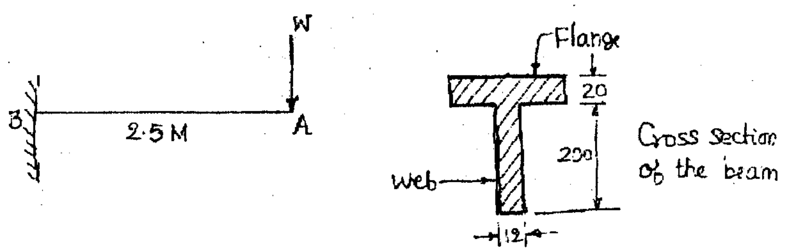

Fig. 6(b) All dimensions are in mm.

7 a. A beam of length 4m is simply supported at the ends and carries two concentrated loads of 20kN and 30kN at distance 1.5m and 2.5m from left end. Refer fig.7(a). Find the deflection at mid span. Take E = 200 GPa and Moment of Inertial $I = 3\times10^8$ mm^4 of the cross section. **(10 Marks)**

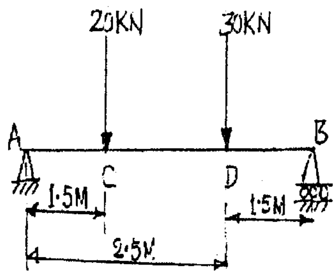

Fig. 7(a)

b. Derive an expression relating slope, deflection and radius of curvature in a beam from first principle in terms E, I and M, with usual notations. **(07 Marks)**

c. Explain how the deflection in beams can be reduced. **(03 Marks)**

8 a. Derive an expression for the critical load in a column subjected to compressive load, when one end is fixed and the other end free. **(10 Marks)**

b. Find the diameter of the shaft required to transmit 60kW at 150 rpm if the maximum torque is 25% of the mean torque for a maximum permissible shear stress of 60 MN/m^2. Find also the angle of twist for a length of 4m. Take G = 80 GPa. **(10 Marks)**

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06ME34

Third Semester B.E. Degree Examination, June/July 08

Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions choosing at least two questions from each section.***
2. ***Assume suitable data wherever necessary.***

PART A

1 a. Define Hook's law, modulus of elasticity, elasticity and strain. **(04 Marks)**

b. Derive an expression for the total extension of the tapered circular bar cross section of diameter D and d, when it is subjected to an axial pull of load P. **(06 Marks)**

c. For the laboratory tested speciman the following data were obtained:
   - i) Diameter of the speciman = 25 mm
   - ii) Length of speciman = 300 mm
   - iii) Extension under the load of 15 KN = 0.045 mm
   - iv) Load at yield point = 127.65 KN
   - v) Maximum load = 208.60 KN
   - vi) Length of the speciman after failure = 375 mm
   - vii) Neck diameter = 17.75 mm

   Determine : i) Young's modulus ii) Yield point stress iii) Ultimate stress iv) Percentage elongation v) Percentage reduction in area. **(10 Marks)**

2 a. Derive the relationship between Young's modulus and modulus of rigidity in the form of $E = \dfrac{9GK}{3K+G}$. **(06 Marks)**

b. Derive an expression for extension of the bar due to its self weight only having area 'A' and length 'L' suspended from its top. **(04 Marks)**

c. A 12 mm diameter steel rod passes centrally through a copper tube 48 mm external diameter and 36 mm internal diameter and 2.50 m long. The tube is closed at each end by 24 mm thick steel plates which are secured by nuts. The nuts are tightned until the copper tube is reduced in length by 0.508 mm. The whole assembly is then raised in temperature by 60°C. Calculate the stresses in copper and steel before and after raising the temperature, assuming the thickness of the plates remain to be unchanged.
Take $\alpha_S = 1.2 \times 10^{-5}$ per °C, $\alpha_C = 1.75 \times 10^{-5}$ per °C
$E_S = 2.1 \times 10^5 \text{ N/mm}^2$, $E_C = 1.05 \times 10^5 \text{ N/mm}^2$ **(10 Marks)**

3 a. What are principal stresses and principal planes? **(02 Marks)**

b. Explain procedure for construction of Mohr's circle with tensile, compressive and shear stresses acting on the component. **(06 Marks)**

c. The state of stress in two dimensionally stressed body is as shown in figure Q3 (c). Determine the principal planes, principal stresses, maximum shear stress and their planes. **(12 Marks)**

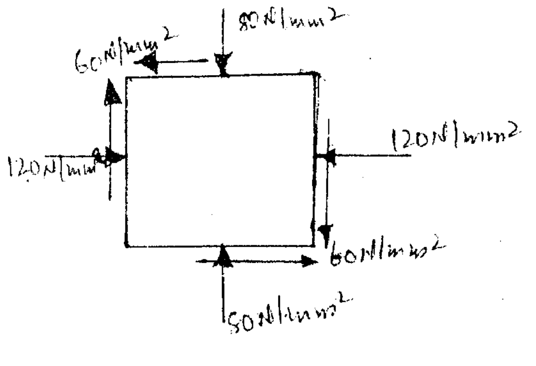

Fig. Q3 (c)

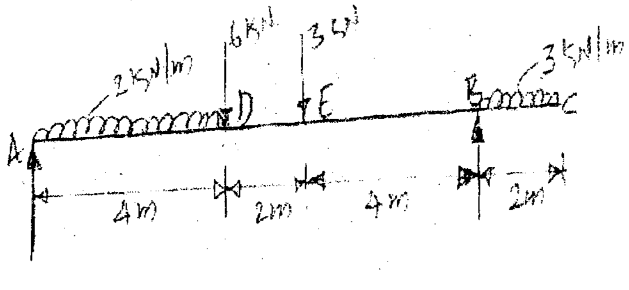

Fig. Q5 (b)

4 a. What are the differences between thin and thick cylinder? **(02 Marks)**

b. Derive Lamme's equation for thick cylinder. **(08 Marks)**

c. A thin cylindrical shell 1.2 m in diameter and 3 m long has a metal wall thickness of 12 mm. It is subjected to an internal fluid pressure of 3.2 MPa. Find the circumferential and longitudinal stress in the wall. Determine change in length, diameter and volume of the cylinder. Assume E = 210 GPa and $\mu = 0.3$ **(10 Marks)**

PART B

5 a. Define shear force, bending moment, point of contraflexture and beam. **(04 Marks)**

b. Draw shear force and bending moment diagram for beam shown in figure Q 5 (b), indicating the principal values. **(16 Marks)**

6 a. Prove that maximum shear stress in a rectangular section of width b and depth d is equal to 1.5 times of its average shear stress. **(06 Marks)**

b. Explain neutral axis and modulus of section as applied to beam. **(04 Marks)**

c. An unequal angle section shown in figure Q6 (c) is used as a simply supported beam over a span of 2 m and uniformly distributed load of 10 kN/m, inclusive of its own weight. Determine the maximum tensile and compressive stresses in the section. **(10 Marks)**

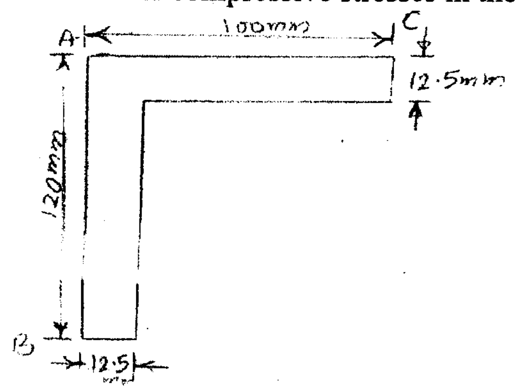

Fig. Q6 (c)

7 a. For simply supported beam with uniformly distributed load over whole length show that the maximum deflection is equal to $\frac{-5}{384}\frac{WL^4}{EI}$. **(05 Marks)**

b. A beam AB of span 6 m is simply supported at the ends and is loaded as shown in figure Q7 (b). Determine i) deflection at C ii) maximum deflection and iii) slope at the end A. Take $E = 2 \times 10^5$ N/mm², $I = 2 \times 10^7$ mm⁴. **(15 Mark**

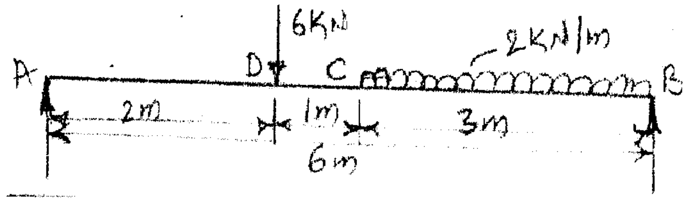

Fig. Q7 (b)

8 a. Derive the torsion formula, in the standard form $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$ and list all the assumptions made while deriving the same. **(08 Marks)**

b. A hollow column of C.I. whose outside diameter is 200 mm, has thickness of 20 mm. It is 4.5 m long and is fixed at both the ends. Calculate the safe load by Rankine's formula using a factor of safety of 4. Calculate slenderness ratio and the ratio of Euler's and Rankine's critical loads. Take $\sigma_C = 550$ N/mm², $\alpha = \frac{1}{1600}$ and $E = 8 \times 10^4$ N/mm². **(12 Marks)**

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06ME34

USN

Third Semester B.E. Degree Examination, Dec 08 / Jan 09
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions, selecting at least TWO from each part.***

PART – A

1 a. Define i) Poisson's Ratio ii) Bulk modulus iii) Factor of safety. **(03 Marks)**

b. Derive an expression for total deformation of a tapering rectangular bar of cross – section b_1 and b_2, when it is subjected to an axial force 'P'. **(07 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in fig.1(c). Determine magnitude of force P, such that net deformation in the bar does not exceed 1mm. E for steel is 200 GPa and that for Aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively. **(10 Marks)**

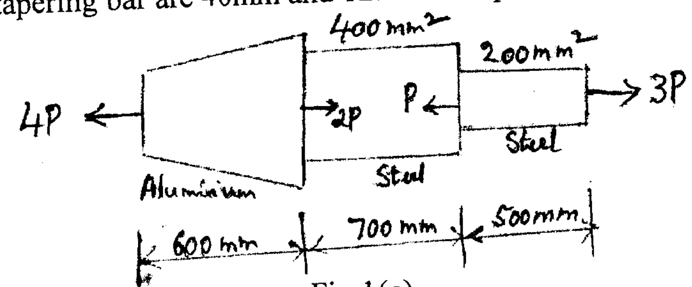

Fig.1(c)

2 a. Derive an expression for relationship between Young's modulus, modulus of Rigidity and Poisson's ratio. **(10 Marks)**

b. A compound bar is made of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide and 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1 meter. If the temperature is raised by 80^0C, determine the stresses in each metal and change in length. Take $E_s = 200\ GN/m^2$; $E_c = 100\ GN/m^2$; $\alpha_s = 12\times 10^{-6}/^0C$; $\alpha_c = 17\times 10^{-6}/^0C$. **(10 Marks)**

3 a. Define Principal Stresses and Principal Planes. **(03 Marks)**

b. Prove that the sum of normal stresses on any two mutually perpendicular planes is a constant in a general two dimensional stress system. **(07 Marks)**

c. A plane element is subjected to stresses as shown in fig.3(c). Determine principal stresses, maximum shear stress and their planes. Sketch the planes determined. **(10 Marks)**

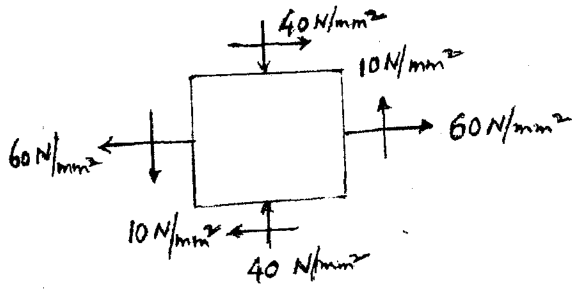

Fig.3(c)

4 a. Derive an expression for circumferential and longitudinal stress for thin cylinder. (10 Marks)
b. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure of $80N/mm^2$. Find the maximum and minimum hoop stresses across the section. Also sketch radial and hoop stresses distribution across the section. (10 Marks)

PART – B

5 a. What are the different types of beams? Explain briefly. (05 Marks)
b. For the beam shown in fig.5(b), draw shear force and Bending moment diagram. Locate the point of contra flexure if any. (15 Marks)

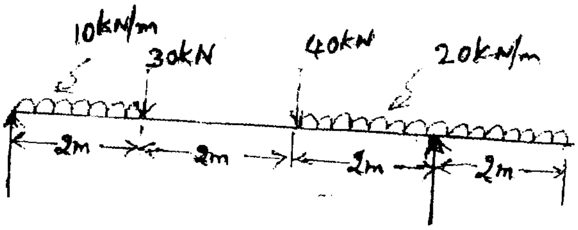

Fig.5(b)

6 a. Derive an expression $E\frac{d^2y}{dx^2} = M$ with usual notations. (10 Marks)
b. Determine the deflection under the loads in the beam shown in fig.6(b). Take flexural rigidity as EI through out. (10 Marks)

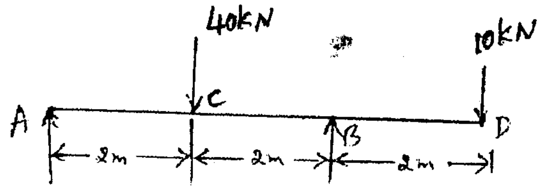

Fig.6(b)

7 a. What are the assumptions made in simple theory of bending? (04 Marks)
b. Derive an expression for relationship between Bending stress and Radius of curvature. (06 Marks)
c. A Cantilever of square section 200mm × 200mm, 2 meter long just fails in flexure when a load of 12kN is placed at its free end. A beam of same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. (10 Marks)

8 a. Define Slenderness Ratio and derive Euler's expression for buckling load for column with both ends hinged. (10 Marks)
b. A solid shaft rotating at 500 rpm transmits 30kW. Maximum torque is 20% more than mean torque. Allowable shear stress 65 MPa and modulus of rigidity 81GPa, angle of twist in the shaft should not exceed 1^0 in 1 meter length. Determine suitable diameter. (10 Marks)

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Third Semester B.E. Degree Examination, June-July 2009

Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least Two questions from each part.***

PART – A

1 a. Define the following terms:
i) Elastic limit; ii) True stress; iii) Factor of safety; iv) Poisson's ration. **(04 Marks)**

b. Prove that the extension of uniform bar due to self weight is half of the extension when the load equal to its self weight is applied at the end of the suspended bar. **(08 Marks)**

c. A prismatic bar ABCD is subjected to loads P_1, P_2 and P_3 as shown in the Fig.1(c). The bar is made of steel with modulus of elasticity E = 200 GPa and cross sectional area A = 225 mm^2. Determine the deflection 'δ' at the lower end of the bar due to applied loads. **(08 Marks)**

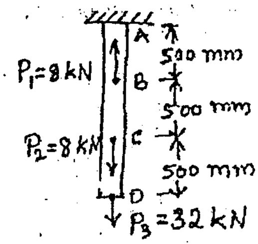


Fig.1(c).

2 a. Establish a relationship between the modulus of elasticity and the modulus of rigidity. **(10 Marks)**

b. At room temperature the gap between bar A and bar B shown in Fig.2(b) is 0.25mm. What are the stresses induced in the bars, if the temperature rise is 35^0C?

Given $A_a = 1000\ mm^2$ $\quad A_b = 800\ mm^2$
$E_a = 2 \times 10^5\ N/mm^2$ $\quad E_b = 1 \times 10^5\ N/mm^2$
$\alpha_a = 12 \times 10^{-6}\ /^\circ C$ $\quad \alpha_b = 23 \times 10^{-6}\ /^\circ C$
$L_a = 400$ mm $\quad L_b = 300$ mm **(10 Marks)**

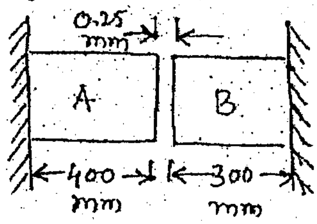


Fig.2(b).

3 a. Construct the Mohr's circle for a point in the machine member subjected to pure shear of 50 MPa. Determine the maximum and the minimum stresses induced and orientation of their planes. **(08 Marks)**

b. A point in a machine is subjected to stresses as shown in Fig.3(b). A circle of diameter 200 mm on the member is converted in to ellipse after the application of stresses. Determine major and minor axes of the ellipse and their orientations. Take E = 2 x 10^5 MPa and the Poisson's ratio, μ = 0.3. **(12 Marks)**

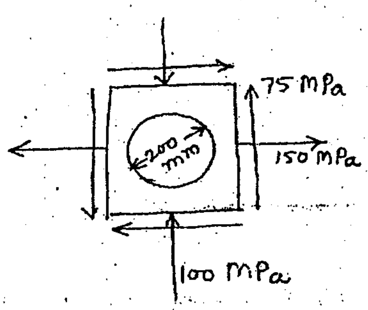


Fig.3(b).

4 a. Briefly discuss the stresses developed and their distribution along the thickness of the walls of pressure vessels. (04 Marks)

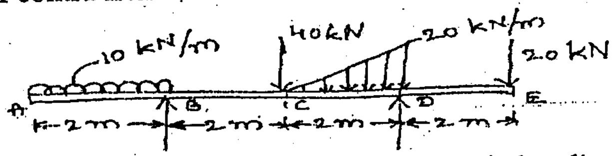
b. A thin cylinder of diameter 'd', thickness 't' is subjected to an internal pressure of 'p'. Prove that the change in volume, $dV = \frac{Pd}{4tE}(5 - 4\mu)\,V$, where, E = Young's modulus of elasticity, μ = Poisson's ratio and V = volume of the pressure vessel. (08 Marks)

c. A thick cylinder of internal diameter 160 mm is subjected to an internal pressure of 40 N/mm^2. If the allowable stress in the material is 120 N/mm^2, find the required wall thickness of the cylinder. (08 Marks)

PART – B

5 Draw the shear force and bending moment diagrams for a overhanging beam shown in Fig.5 and locate the points of contra flexure. (20 Marks)

Fig.5.

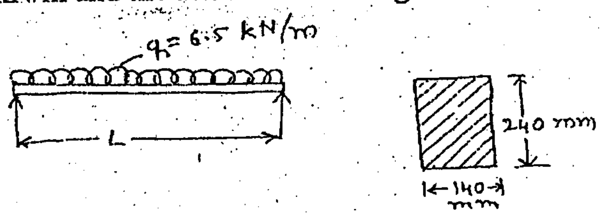


6 a. State the assumptions made in developing the theory of simple bending. (04 Marks)

b. Derive an expression for the bending stress and the radius of curvature for a straight beam subjected to pure bending. (08 Marks)

c. Determine the maximum allowable span length 'L' for a simple beam as shown in Fig.6(c). The beam is of rectangular cross section (140 mm x 240 mm) subjected to a uniformly distributed load q = 6.5 kN/m and the allowable bending stress is 8.2 MPa. (08 Marks)

Fig.6(b).



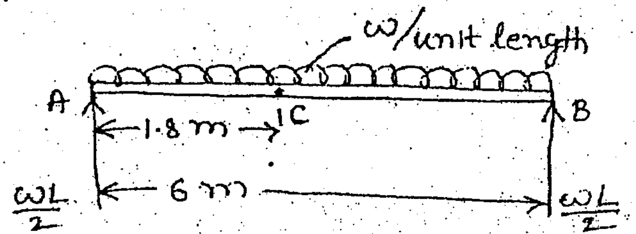
7 a. Derive an expression with usual notations for the maximum deflection in a beam subjected to point load at the mid span. (08 Marks)

b. A steel girder of 6m length acting as a beam carries a uniformly distributed load w N/m run throughout it's length, as shown in Fig.7(b). If $I = 30 \times 10^{-6}\ m^4$ and depth 270 mm, calculate:

i) Magnitude of 'w' so that the maximum stress developed in the beam section does not exceed 72 MN/m^2.

ii) The slope and deflection in the beam at a distance of 1.8 m from one end. Take $E = 200\ GN/m^2$. (12 Marks)

Fig.7(b).



8 a. A hollow steel shaft 3m long must transmit a torque of 25 kN-m. The total angle of twist in this length is not to exceed 2.5^0 and allowable shearing stress is 90 MPa. Determine inside and outside diameter of the shaft if G = 85 GPa. (10 Marks)

b. Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at it's both ends. Take $E = 2.05 \times 10^5\ N/mm^2$. Also, determine the crippling load by Rankin's formula using constants as 335 N/mm^2 and $\frac{1}{7500}$. (10 Marks)

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06ME34

Third Semester B.E. Degree Examination, Dec.09-Jan.10
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each Part.***

PART - A

1 a. Define i) stress ii) principle of super position. **(04 Marks)**

b. A member ABCD is subjected to point loads as shown in fig.Q1(b), calculate i) Force P necessary for equilibrium ii) Total elongation of the bar. Take E = 210 GN/m^2.

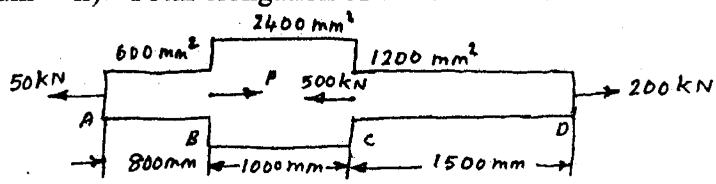

Fig.Q1(b) **(06 Marks)**

c. Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 500mm apart. Diameters and lengths of each rod are 20mm and 4m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5kN, such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take $E_s = 2 \times 10^5$ N/mm^2 and $E_c = 1 \times 10^5$ N/mm^2. **(10 Marks)**

2 a. Define Bulk modulus. Derive an expression for Young's modulus in terms of bulk modulus and Poisson's ratio. **(08 Marks)**

b. i) Define Thermal stress. **(02 Marks)**

ii) Calculate the values of the stress and strain in portion AC and CB of the steel bar shown in Fig Q2b (ii). A close fit exists at both the rigid supports at room temperature and the temperature is raised by 75^{0}C. Take E = 200GPa and $\alpha = 12 \times 10^{-6}$ per ^{0}C for steel. Area of cross – sections of AC is 400 mm^2 and of BC is 800 mm^2. **(10 Marks)**

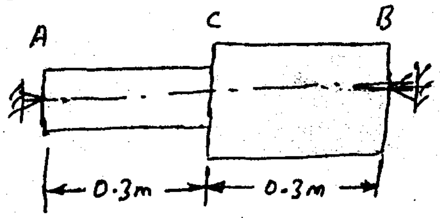

Fig.Q2b(ii)

3 a. Define i) principal stress ii) principal strain. **(04 Marks)**

b. A machine component is subjected to the stresses as shown in Fig. Q3(b). Find the normal and shearing stresses on the section AB inclined at an angle of 60^0 with x – x axis. Also find the resultant stress on the section. Verify the above results by drawing Mohr's circle.

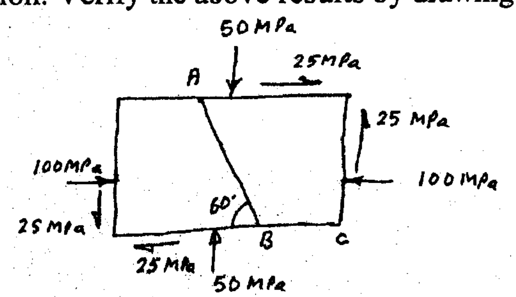

Fig.Q3(b) **(16 Marks)**

4 a. Derive an expression for circumferential stress and longitudinal stress for a thin shell subjected to an internal pressure. (06 Marks)

b. Derive an expression for the radial pressure and hoop stress for a thick spherical shell. (06 Marks)

c. A thick spherical shell of 200mm internal diameter is subjected to an internal fluid pressure of 7 N/mm^2. If the permissible tensile stress in the shell material is $8N/mm^2$, find the thickness of the shell. (08 Marks)

PART - B

5 Draw the bending moment and shear force diagrams for the beam loaded as shown in fig. Q5. (20 Marks)

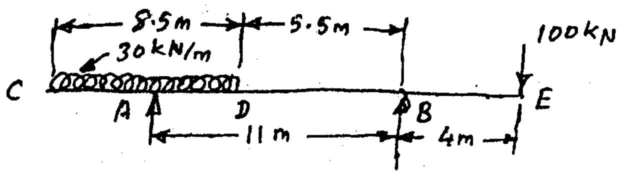

Fig.Q5

6 a. Prove the relations $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$ with usual notations. (10 Marks)

b. A T – shaped cross – section of a beam in fig.Q6(b) is subjected to a vertical shear force of 100kN. Calculate the shear stress at the neural axis and at the junction of the web and the flange. M.I. about the horizontal neutral axis is $0.0001134\ m^4$. (10 Marks)

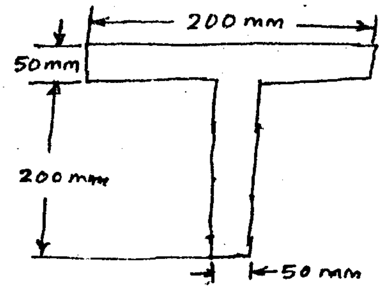

Fig.Q6(b)

7 A beam of length 6m is simply supported at its ends and carries two point loads of 40kN at a distance of 1m and 3m respectively from the left support. By using Macaulay's method, determine : a) deflection under each load b) maximum deflection c) the point at which maximum deflection occurs. Given $E = 2 \times 10^5\ N/mm^2$ and $I = 85 \times 10^6 mm^4$. (20 Marks)

8 a. Two shafts of the same material and of same lengths are subjected to the same torque, if the first shaft is of a solid circular section and the second shaft is of hollow circular section, whose internal diameter is 2/3 of the outside diameter and the maximum shear stress developed in each shaft is the same, compare the weights of the shafts. (10 Marks)

b. A 1.5m long column has a circular cross section of 50mm diameter. One of the ends of the column is fixed in direction and position and other end is free. Take factor of safety as 3, calculate the safe load using :

i) Rankine's formula, take yield stress = $560N/mm^2$ and $a = \frac{1}{1600}$ for pinned ends.

ii) Euler's formula, Young's modulus for C.I. = $1.2 \times 10^5\ N/mm^2$. (10 Marks)

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USN

06ME34

Third Semester B.E. Degree Examination, May/June 2010
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

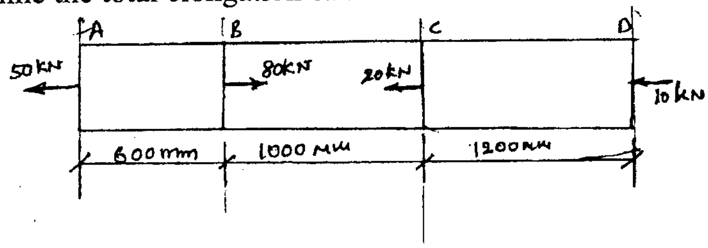
PART – A

1 a. Explain : i) Poisson's ratio ; ii) Young's modulus. **(04 Marks)**

b. Mention the assumptions made in the theory of simple stress and strain and derive the equation $dl = PL/AE$. **(06 Marks)**

c. A brass bar having a cross sectional area of 1000 mm^2 is subjected to axial forces as shown in Fig.1(c). Determine the total elongation of the bar if E = 105 GPa . **(10 Marks)**

Fig.1(c)



2 a. Define : i) Modulus of rigidity ; ii) Volumetric strain. **(04 Marks)**

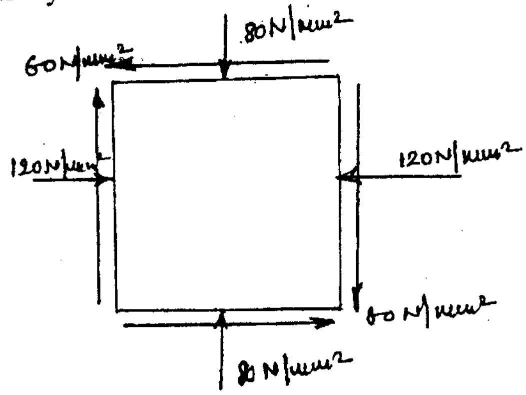
b. Explain the reason for development of stress in bars, when their temperature rises or falls. Accordingly calculate the nature and magnitude of stress induced in the rod of 2 m length and 20 mm diameter, when its temperature rises by 70°C, with both ends constrained. Take $E = 1 \times 10^5$ N/mm^2 and $\alpha = 1.2 \times 10^{-5}$/°C. **(06 Marks)**

c. A composite section comprises of a steel tube 10 cm internal diameter and 12 cm external diameter, fitted inside a brass tube of 14 cm internal diameter and 16 cm external diameter. The assembly is subjected to a compressive load of 500 kN. Find the load carried by the tube and the stresses induced in them. The length of tube is 150 cm. Take E_{steel} = 200 GPa and E_{brass} = 100 GPa. What is the change in length of tubes? **(10 Marks)**

3 a. The longitudinal strain of a cylindrical bar of diameter 3 cm and length 1.5 m is four times the lateral strain during a tensile test. Determine the modulus of elasticity and bulk modulus. Also determine the change in volume when the bar is subjected to a hydrostatic pressure of 100 MPa. Take E = 100 GPa. **(10 Marks)**

b. The state of stress in a two dimensionally stressed body is shown in Fig.3(b). Determine the principal planes, principal stress, maximum shear stress and their planes. Schematically represent these planes on x – y coordinates. **(10 Marks)**

Fig.3(b)



4 a. Obtain an expression for the volumetric strain of a thin cylinder, subjected to internal fluid pressure. **(08 Marks)**

b. Determine the hoop stress and radial pressure across the section of a thick cylinder of internal diameter 40 cm and thickness 10 cm, when it contains a fluid at a pressure of 8 N/mm^2. Also sketch the distribution of hoop stress and radial pressure. **(12 Marks)**

PART – B

5 a. Explain the terms:
   i) Sagging bending moment
   ii) Hogging bending moment
   iii) Point of contra flexure. **(06 Marks)**

b. Draw shear force and bending moment diagrams for the loading pattern on the beam shown in Fig.5(b). Indicate where the inflexion and contra flexure points are located. Also locate the maximum bending with its magnitude. **(14 Marks)**

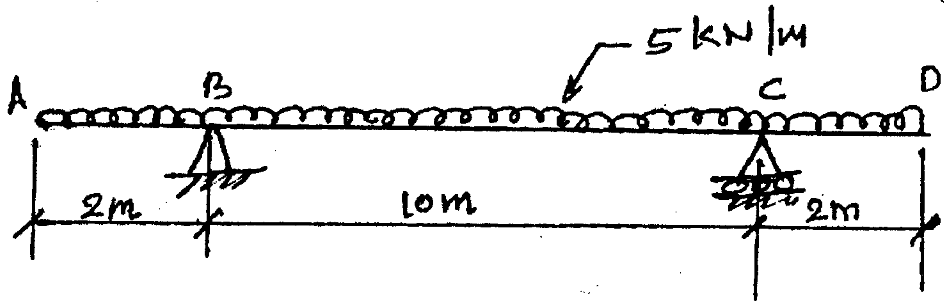


Fig.5(b)

6 a. Show that the maximum shear stress for a rectangular section is 1.5 times the average shear stress. **(06 Marks)**

b. A 'T' section of flange 120 mm x 12 mm and overall depth 200 mm, with 12 mm web thickness is loaded, such that, at a section it has a moment of 20 kNM and shear force of 120 kN. Sketch the bending and shear stress distribution diagram, marking the salient values. **(14 Marks)**

7 a. Distinguish between slope and deflection. Explain the same with examples for a simply supported beam and a cantilever. **(06 Marks)**

b. A beam AB of 6 m span is simply supported at the ends and is loaded with a point load of 6 kN at 2 m from left support and uniformly distributed load of 2 kN/m for the second half of the beam. Find:
   i) Deflection at mid span
   ii) Maximum deflection
   iii) Slope at left support

   Take E = 20 GPa and I = 2×10^7 mm^4. **(14 Marks)**

8 a. Derive the expression for Euler's buckling load for a column with its one end fixed and the other end free. **(06 Marks)**

b. A solid shaft transmits 250 kW at 100 rpm. If the shear stress is not to exceed 75 MPa, what should be the diameter of the shaft? It this shaft is to replaced by a hollow shaft, whose diameter ratio is 0.6, determine the size and percentage having in weight, the maximum shear stress being the same. **(14 Marks)**

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