VISION INSTITUTE OF TECHNOGY

B.TECH, CIVIL, 2nd YEAR

Introduction to Solid Mechanics [KCE-402]

UNIT-1 [Question Bank].

1. Explain the followings:-
   (A) Concept of stress, & its type [Normal stress, shear stress]
   (B) Concept of strain
   (C) Longitudingl & Lateral strain, Shear strain
   (D) Volumetric strain, Poisson's ratio,
   (E) Young's modulus of elasticity (E), Modulus of rigidity (C) and Bulk modulus.

2. Stress - strain diagram for ductile material.

3. Explain stress - strain diagram for Brittle materials.

4. Determine the value of young's modulus of Elasticity & poisson's ratio of a metalic bar of length 30 cm, breadth 4 cm & depth 4 cm. when the bar is subjected to an axial compressive load of 400 kN. the decrease in length is 0.075 cm & increase in bredth is 0.003 cm.

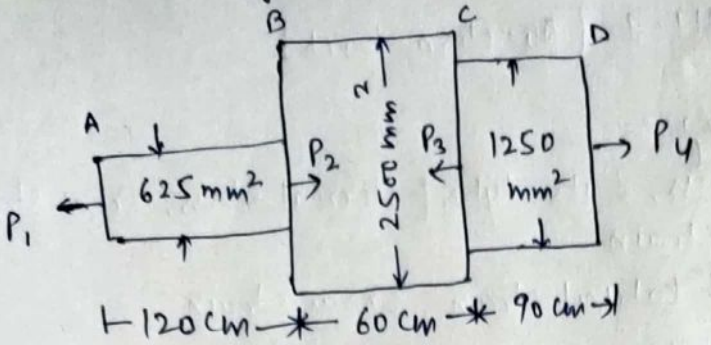
5. A steel bar 300 mm long, 50 mm wide & 40 mm thick is subjected to a pull of 300 kN in the direction of its length. Determine the volumetric strain.
   Take, $E = 2 \times 10^5$ N/mm^2 & $\mu = 0.25$.

6. A bar of 30 mm dia is subjected to a pull of 60 kN. the measured extension on gauge length of 200 mm is 0.1 mm & change in dia is 0.004 mm.
   Calculate,
   E, μ & K.

7. A bar of cross-section 8 mm x 8 mm is subjected to an axial pull of 7000 N. the lateral dimension of bar is found to be changed to 7.9985 mm x 7.9985 mm if modulus of rigidity = 0.8×10^5 N/mm^2
   Calculate, μ & E.

Bar of Varrying section

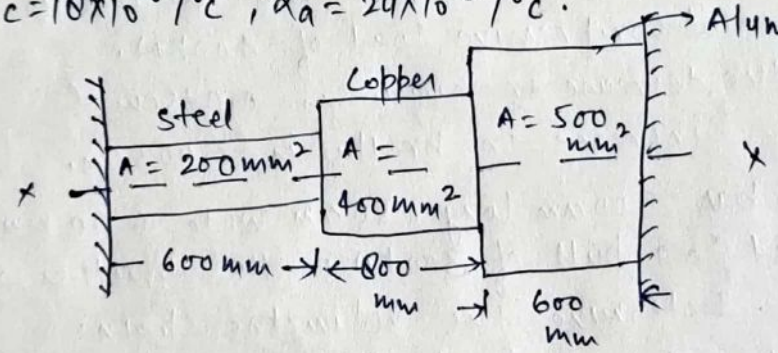
8. A member ABCD is subjected to point loads P_1, P_2, P_3 & P_4 as shown in fig.



Calculate the force P_2 necessary for equilibrium, if $P_1 = 45$ kN $P_3 = 450$ kN & $P_4 = 130$ kN. Determine total elongation of member assuming, $E = 2.1 \times 10^5$ N/mm².

9. Define Temperature stress.

A bar is made of three metals as shown in fig. & is rigidly held b/w two rigid supports. Determine the temp. Stress in each metal if bar temp is raised by 60°C. Take $E_s = 200$ kN/m², $E_c = 100$ kN/m², $\alpha_s = 12 \times 10^{-6}$ /°C $\alpha_c = 18 \times 10^{-6}$ /°C, $\alpha_a = 24 \times 10^{-6}$ /°C.



10. Explain strain Energy stored in body when Load is applied gradually

A tensile load of 60kN is gradually applied to a circular bar of 4cm and 5m long. If the value of $E = 2 \times 10^6$ N/mm². Determine,

(i) stretch in rod (ii) stress in rod,

(iii) strain energy absorbed by the rod,

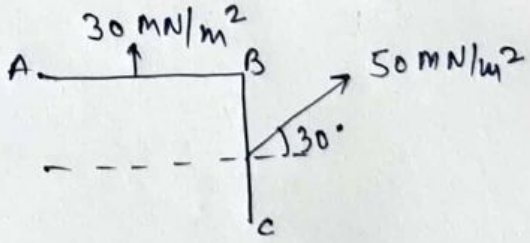
11. Explain the strain energy stored in a body, when load is applied suddenly. A steel rod is 2m long and 50 mm in diameter. An Axial pull of 100 kN is suddenly applied to rod. Calculate the instantaneous stress induced and also the instantaneous elongation produced in the rod. Take, $E = 200\ GN/m^2$.

12. Explain the concept of strain energy stored due to impact loading. The max^m instantaneous extension, produced by an unknown falling weight through a height of 4cm in a vertical bar of length 3m & x-sle area $5\ cm^2$, is 2.1 mm.
Determine,
(i) The instantaneous stress ~~produced~~ induced in the vertical bar, &
(ii) the value of unknown weight, Take $E = 2\times10^5\ N/mm^2$.

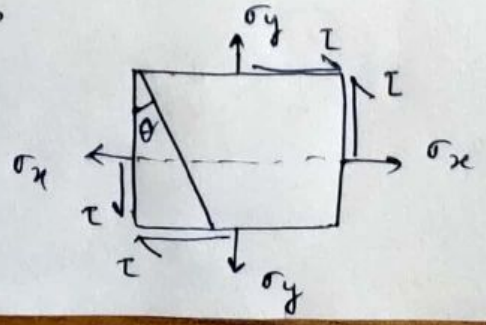
13. Explain the concept of principal plane & ~~plane~~ principal stress. also ~~Explain~~ ~~Stress~~ the principal stress ~~Mohr's Circle~~ when member subjected to direct stress in two mutually perdicular dir^n with simple shear stress.

14. If principal stresses are $10 MN/m^2$ & $2 MN/m^2$. find the stress action on the plane having 22.5° with the major principal plane. Find. resultant, normal and tangential stress.

15. Find out major & minor principal plane & stress and Intensity of max^m shear stress.



16. Draw Mohr's Circle for two perpendicular direct stress with state of simple shear.



17. An element has tensile stress of 500 MN/m² and a comp. stress of 350 MN/m² acting two perpendicular planes & equal shear stress of 100 MN/m² on these planes. By Mohr's circle, find Principal stresses and position of principal planes.

18. Explain the Principal stain theory of failure. in detail.

19. Explain Maximum shear stress theory of failure in detail.

VISION INSTITUTE OF TECHNOLOGY 07/02/2020

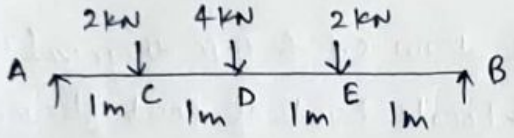
DEPARTMENT OF CIVIL ENGINEERING

Sub - Introduction to solid Mechanics [KCE-402]

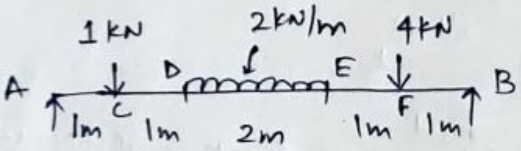
UNIT-2 [Question Bank]

Simple supported beam

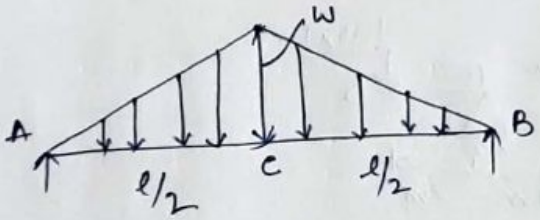
1. Draw shear force & BMD for S.S.B as shown in fig



2. Draw S.f and BmD . and clearly mark the position of maxm B.m and determine its value.



3. Draw the SFD & BMD for U.V.L as shown in fig(a) & fig.(b)



fig(a)

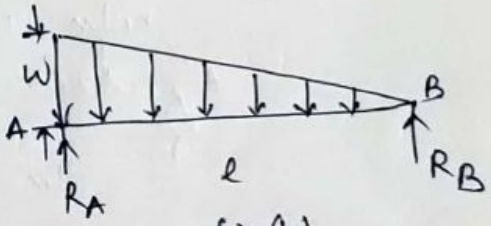
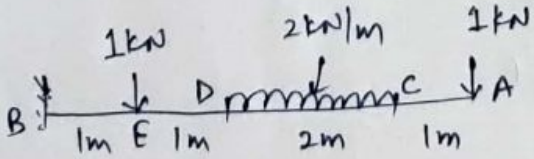


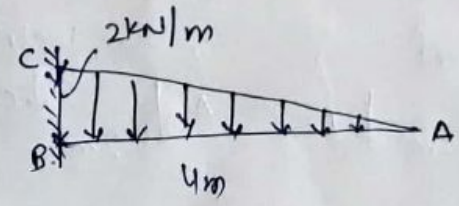
fig.(b)

Cantilever Beam

4. Draw shear force & B.M diagrams for Cantilever Beam .& maxm B.M.

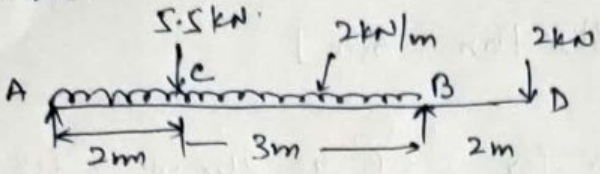


5. Draw S.f & B.M diagram. for a given Cantilever Beam

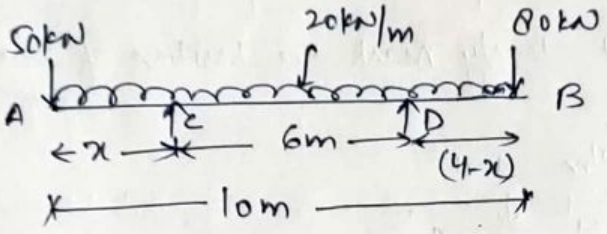


Overhanging Beam

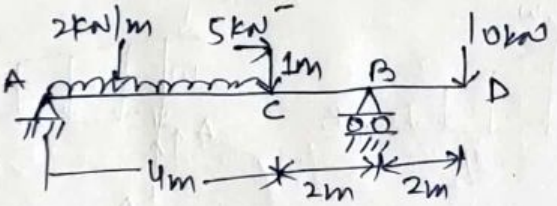
6. Draw S.f and B.M diagram for the loaded beam & also find point of contraflexure.



7. Determine position of supports & draw S.f & B.M diagram. (If Rx^n is Some) find the value of max^m B.M & Locate points of Contraflexure. if any.

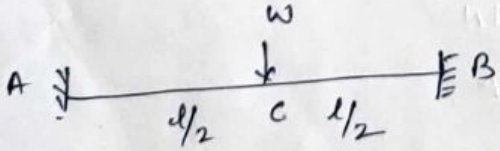


8. Draw the S.f & B.M diagram & find max^m Bending moment & Point of Contraflexure, if any.

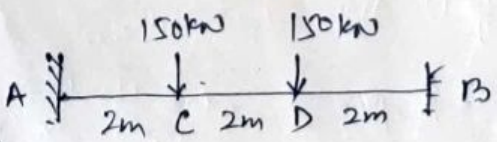


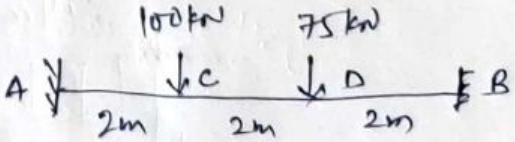
Fixed Beam

9. Fixed beam carrying a point load at mid span. Draw S.f & B.M diagram,



10. Draw S.f & B.M diagram. also find the max^m B.M & fixing moment at ends.





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DEPARTMENT OF CIVIL ENGINEERING

Introduction to Solid Mechanics [KCE-402]

Question Bank, [UNIT-3]

1. Discuss the concept of Simple Bending with suitable diagram.
2. Define the Nature of Bending stress with clean & clear diagram.
3. Discuss the Bending equation with its Assumptions.
4. Write a short Note on.
   (A) Neutral layer / Neutral Axis.
   (B) Section Modulus
5. Explain the Expressions of section modulus for different sections.
   (A) Rectangular section.
   (B) Hollow Rectangular section.
   (C) Circular section.
   (D) Hollow Circular section.
6. A rectangular beam 100 mm wide and 200 mm deep is used over a span of 4m with a distributed load of 1500 N/m. Determine
   (A) Maximum stress developed at a section 1m from right support.
   (B) Position and magnitude of maximum stress developed.
7. A Cast Iron water main 12m long, of 500 mm inside dia & 25 mm wall thickness runs full of water and is supported at its ends. Calculate the maximum stress in the metal, if density of Cast Iron is 7200 kg/m^3 & that of water is 1000 kg/m^3.
8. A Cantilever floor has carry a load of 300/m^2. the joist are rectangular in section 30 cm deep & 12 cm wide have a span of 4.2 m. How far apart may the Centre line of joists are placed so the bending stress in each joist does not exceed 10 kN per cm square

9. Write a short Note with suitable diagram.
   (A) Torque / Torsion (T)
   (B) Angle of twist (θ)
   (C) Torsional Rigidity (K)
   (D) Power transmitted by shaft (P)
   (E) Polar moment of Inertia (J)
   (F) Polar modulus, Z_p.

10. Discuss the Assumption of torsion equation also Explain the Torsion equation for Solid Circular shaft.

11. A Circular bar made of Cast Iron is to resist an occasional torque of 2.2 kN/m acting in transverse plane. If the allowable stress in compression, tension and shear are 100 MN/m², 35 MN/m² & 50 MN/m² respectively, Determine:
   (A) Diameter of bar
   (B) Angle of twist under applied torque per meter length of bar.

12. Differentiate Solid & Hollow shafts on the basis of strength & weight.

13. A Solid Cylindrical shaft is to transmit 300 kW at 100 rpm.
   (A) If the shear stress is not to exceed 80 MN/m², find the diameter.
   (B) what percentage saving in weight would be obtained, if this shaft is replaced by a hollow one whose Internal dia equals 0.6 of the external dia, the length, the material and maximum shear stress being the same.

14. Explain the Concept of shafts Connected in series and parallel with suitable diagram

15. A propellers shaft of 240 mm external dia and 180 mm Internal dia has to transmit 1100 kW at 100 rpm. If additionally subjected to B.M of 10 kN-m & thrust of 200 kN. Determine:
   (A) Principal stresses and their planes
   (B) Maximum shear stress.

16. A hollow shaft is subjected to a torque of 40 kN-m and B.M of 30 kN-m The internal diameter of half is one half the external diameter. If the maximum shear stress is not exceed 80 MN/m². Find the diameter of shaft.

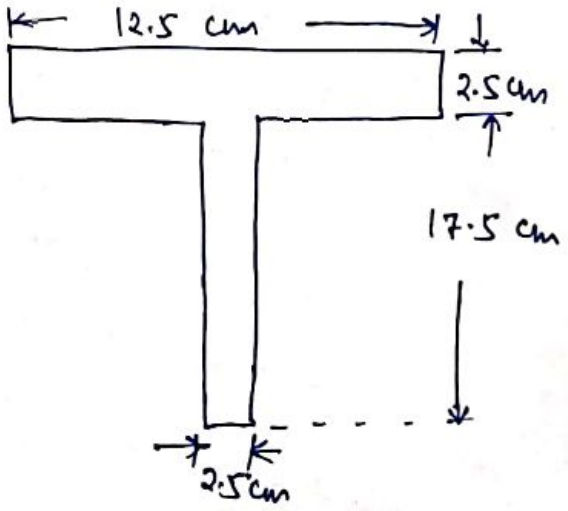
17. Draw the shear stress distribution for the following sections

(A) Rectangle
(B) Solid Circle
(C) Hollow Circle
(D) T-section
(E) L-section
(F) I-section
(G) Composite section
(H) Cross-section

18. A Timber beam 150 mm X 250 mm in cross-section is simply supported at its end and has a span of 3.5 m. The maximum safe allowable stress in bending is 7500 KN/m². Find the max^m safe U.D.L which the beam can carry. what is maximum shear stress in the beam for the U.D.L Calculated.

19. An I-Section beam 340 mm X 240 mm has a web thickness of 10 mm and flange thickness of 20 mm. It carries a shearing force of 100 KN. Sketch the shear stress distribution across the section.

20. A Simply supported beam carries udL of intensity 2.5 KN/m over the entire span of 5 m. the cross-section of the beam is a T-Section having dimensions as shown in fig. Calculate the max^m Shear stress for the section of beam



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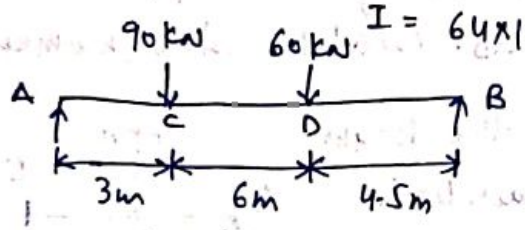
DEPARTMENT OF CIVIL ENGINEERING

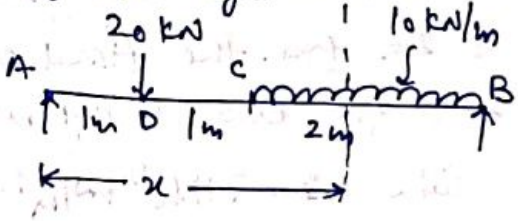
Introduction to Solid Mechanics, [KCE-402]

Question Bank, [UNIT-4]

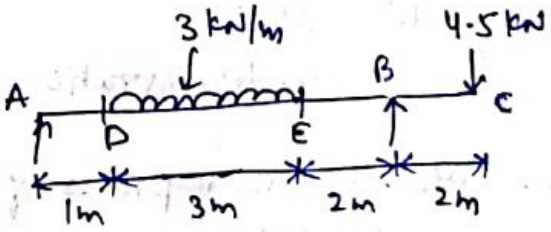
1. Establish the relation between slope, deflection and Radius of curvature. with suitable diagram.
2. Discuss the steps involved in Macaulay's method with an example.
3. Calculate the deflection under two loads at C & D. also find the maximum deflection, Take, $E = 210 \times 10^{-6}$ KN/m^2, By Macaulay's method. $I = 64 \times 10^{-4}$ m^4



4. A beam AB of 4m span is simply supported at the ends and is loaded as shown in fig. Determine. (By Macaulay's method)
   (A) Deflection at C,
   (B) Maximum deflection, and
   (C) Slope at the end A
   Take, $E = 200 \times 10^6$ KN/m^2 & $I = 20 \times 10^{-6}$ m^4



5. Determine the following for an overhanging beam ABC, supported at A and B and loaded as shown in fig. (By Macaulay's method)
   (A) Deflection at free end, C
   (B) Max^m deflection b/w A and B.
   Take, $E = 200 \times 10^6$ KN/m^2
   $I = 13.5 \times 10^{-6}$ m^4

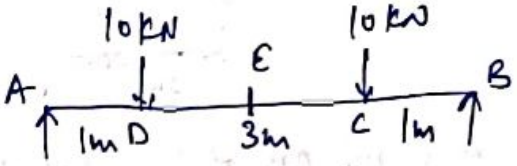


6. A Cantilever beam of length L, loaded with udl of w per unit length over the whole span. find the slope and deflection equation at free of a beam. (Using Macaulay's method)

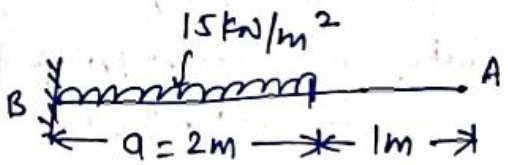
7. Derive the Expressions for the slope and deflection for simply supported beam by using moment area method.

8. Derive the expressions for slope & deflection, using moment area method.
   (A) Cantilever beam with a point load at free end.
   (B) Cantilever beam with a point load at any point.
   (C) Cantilever beam with uniformly distributed load.
   (D) Simply supported beam with UDL

9. A simply supported beam 5m long carries point load of 10kN each at points 1m from ends. Calculate using (moment area method).
   (A) Max^{m} slope & deflection in the beam
   (2) Slope & deflection under each load.
   Take, $EI = 1.2 \times 10^{4}$ kN m^2.



10. A Cantilever 3m long is loaded with UDL of 15kN/m over a length of 2m from the fixed end. Determine the slope & deflection at the free end, using moment area method.
   Take, $E = 2.1 \times 10^{8}$ kN/m^2
   $I = 0.000095$ m^4.



11. Write a short note on:
   (A) Column
   (B) Strut
   (C) Slenderness ratio
   (D) Buckling factor
   (E) Classification of columns
   (F) Safe load

12. Discuss Assumptions of Euler's theory & Euler formula with neat sketch.

13. Explain the ~~ten~~ Column by its ends condition using neat sketch.

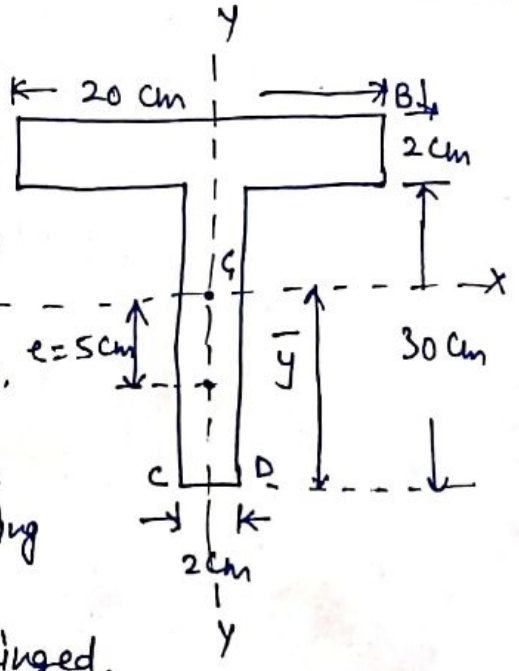
14. A bar of length 4m, when used as a simply supported beam and subjected to udl of 30 kN/m over the whole span, deflects 15mm at the centre. Determine the crippling loads when it is used as a column with following end conditions:
(A) Both end pinned
(B) Both end fixed
(C) One end fixed & other end is pinned.

15. Explain the Combined direct stress & Bending stress with stress distribution curve.

16. Discuss Middle Third Rule for the following sections:
(A) Rectangular section (C) Circular Section
(B) Hollow Rectangular s/c

17. A load of 75 kN is carried by column made of Cast Iron. the external dia and internal dia are 200mm & 180mm respectively. If the eccentricity of the load is 35 mm find.
(A) The maximum & minimum stress intensities.
(B) Upto what eccentricity, there is no tensile stress in the Column

18. A T-beam is used as a short column & is subjected to a vertical load of 100 kN at a point on the Y-Y axis distant 5cm from the C.G of T-S/c & the below the C.G. Determine the max^m Comp. Stress in strut. T-S/c has the following dimension.



19. A round steel rod of dia 15mm and length of 2m, subjected to a Compressive load using Euler's eq^n.
Find, buckling load, if both ends are hinged.
also find the eccentricity & max^m Compressive stress.
Take, $E = 2.1 \times 10^5 \text{ N/mm}^2$ & $\sigma_y = 250 \text{ N/mm}^2$, where,
σ_y = yield stress.

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DEPARTMENT OF CIVIL ENGINEERING

Introduction to Solid Mechanics [KCE-402]

Thin Cylinder Question Bank, [UNIT-5]

1. Explain the followings with suitable diagram. [Thin Cylinder]
   (A) Circumferential / Hoop stresses
   (B) Longitudinal stresses
   (C) Max^{m} shear stress

2. Express the change in dimensions of a thin cylindrical shell due to an internal pressure.

3. A boiler shell is to be made of 15 mm thick plate having tensile stress of 120 MN/m^2. If the efficiencies of longitudinal and circumferential joints are 70% and 30% respectively. Determine:
   (A) Max^{m} permissible dia of shell for an internal pressure of 2 MN/m^2.
   (B) Permissible intensity of internal pressure when the shell dia is 1.5 m.

4. A cylindrical vessel whose ends are closed by means of rigid flange plate is made, if steel plate 3 mm thick. The Internal length & dia of vessel are 50 cm & 25 cm respectively. Determine longitudinal & circumferential stresses in cylindrical shell due to an internal fluid ~~presen~~ pressure of 3 MN/m^2. Also determine increase in length, dia & volume of the vessel.
   Take, $E = 200$ GN/m^2 and $\frac{1}{m} = 0.3$.

5. A Thin spherical shell 1 m in dia with its wall of 1.2 m thick is filled with a fluid at atmospheric pressure. what intensity of pressure will be developed in it if 175 cm^3 more of fluid is pumped into it? Also, Calculate the circumferential stress at that pressure and increase in diameter.

Thick Cylinder

6. Explain Lame's theory of thick cylinder with neat sketch.
7. Write a short note on longitudinal and shear stresses developed in thick cylinder.
8. A pipe of 200mm internal diameter and 50 mm thickness carries a fluid at a pressure of $10 MN/m^2$. Calculate the max^m & min^m intensities of circumferential stresses across the section.

   Also sketch the radial pressure (stress) distribution & circumferential stress distribution across the section.

9. Calculate the thickness of metal necessary for a cylindrical shell of internal diameter 160 mm to withstand an internal pressure of $25 MN/m^2$. If maximum permissible tensile stress is $125 MN/m^2$.
10. Write down the Expressions of Radial stress (σ_r), Circumferential stress (σ_c) and Longitudinal Stress (σ_l) for thick cylindrical shell.
11. The external diameter of steel collar is 240mm & internal dia decreases by 0.15mm, when shrunk on to a solid steel shaft of 150 mm dia. find.
    (A) Radial pressure between the collar and the shaft
    (B) Circumferential stress at the inner surface of the tube:
    (C) Reduction in diameter of shaft.

    $E = 205 GN/m^2$, & poission's ratio = 0.304.
12. A Thick spherical shell of 180 mm internal diameter is subjected to an internal fluid pressure of $24 MN/m^2$. If the permissible tensile stress is $120 MN/m^2$. find the thickness of shell.

Springs

13. Write the Expression of deflection & Energy stored in a close-coiled helical spring with Axial load. (Circular & Rectangular section)

14. A closely coiled helical spring is to carry a load of 500 N. its mean coil diameter is to be 10 times of the wire diameter. Calculate these diameters if the maximum shear stress in the material of the spring is to be 80 MN/m^2.

15. Write the Expression of [illegible] energy stored in a closed coiled helical spring subjected to Axial twist.

16. A closely coiled helical spring made of wire 5mm in dia & having an Inside dia of 40mm joins two shafts. the effective no. of coils b/w the shafts is 15 and 0.735 KW is transmitted through the spring at 1000 rpm. Calculate the relative axial twist in degrees b/w the ends of spring & also the Intensity of bearing stress in the material. $E = 200\ GN/m^2$.

17. An open coiled helical spring made from wire of circular cross-section is required to carry a load of 120N. The wire diameter is 8mm and mean coil radius is 48 mm. If the helix angle of the spring is 30° and number of turns is 12, Calculate :

(A) Axial deflection

B) Angular rotation of free end with respect to the fixed end of the spring.

Take, $G_{steel} = 80\ GN/m^2$, $E_{steel} = 200\ GN/m^2$.

18. A Composite spring has two closed coiled springs connected in series; one spring has 12 coils of mean diameter of 25mm and wire dia 2.5 mm. Find the wire dia of the other spring. if it has 15 coils of mean dia 40mm. The stiffness of composite spring is 1.5 KN/m.

Determine the greatest load that can be carried by composite spring and corresponding extension if max^m stress is 250 MN/m^2.

$G = 80\ GN/m^2$.