

Unit 1

1. In mathematics, the quantity equal to the product of force and perpendicular distance from the line of action is called
- a) Moment
 - b) Tension
 - c) Shear
 - d) Compression

Answer: a) Moment

2. When a body is subjected to two equal and opposite pulls, it tends to -----, then the body is under-----
- a) Elongate, Tension
 - b) Shorten, Compression
 - c) Elongate, Compression
 - d) Shorten, Tension

Answer:a) Elongate, Tension

3. When a body is subjected to two equal and opposite pushes, it tends to -----, then the body is under-----
- a) Elongate, Tension
 - b) Shorten, Compression
 - c) Elongate, Compression
 - d) Shorten, Tension

Answer:b) Shorten, Compression

4. The property of a material capable of withstanding external loads without deformation is called
- a) Elasticity
 - b) Plasticity
 - c) Compressibility
 - d) Rigidity

Answer:d) Rigidity

5. The property of a material to return to its original shape after removal of load is called
- a) Elasticity
 - b) Plasticity
 - c) Compressibility
 - d) Rigidity

Answer: a) Elasticity

6. The resistance of a material against wear, indentation, and scratching is called
- a) Elasticity
 - b) Hardness
 - c) Rigidity
 - d) Toughness

Answer:b) Hardness

7. The property of a material to resist impact or shock loads is called
- a) Elasticity
 - b) Rigidity
 - c) Hardness
 - d) Toughness

Answer:d) Toughness

8. The property of a material to break into pieces without any deformation under the action of suddenly applied load is called
- a) Brittleness
 - b) Stiffness
 - c) Hardness
 - d) Toughness

Answer:a) Brittleness

9. The property of a material which can be drawn out into thin wires without rupture under tensile load is called
- a) Malleability
 - b) Ductility
 - c) Tenacity
 - d) Toughness

Answer: b) Ductility

10. The property of a material which undergoes permanent deformation and change in shape under compressive load is called
- a) Compressibility
 - b) Ductility
 - c) Malleability
 - d) Tenacity

Answer:a) Compressibility

11. Select the correct expression for stress in the following options:
- a) Stress = External force / Volume
 - b) Stress = External force / Length
 - c) Stress = External force / Cross-sectional area
 - d) Stress = Cross-sectional area / External force

Answer:c) Stress = External force / Cross-sectional area

12. Select the correct expression for strain in the following options:

- a) Strain = External force/ Cross-sectional area
 - b) Strain = External force / Length
 - c) Strain = Original Dimension / Change in Dimension
 - d) Strain = Change in Dimension / Original Dimension
- Answer: d) Strain = Change in Dimension / Original Dimension**

13. The unit of strain is

- a) N/m^2
- b) mm^2
- c) cm^2
- d) No unit

Answer: d) No unit

14. Internal resistance developed in a body to resist angular deformation under shear force is called

- a) Tensile
- b) Compressive
- c) Shear
- d) Combined

Answer: c) Shear

15. Strain produced due to stress in the longitudinal direction is called

- a) Linear
- b) Lateral
- c) Shear
- d) Volumetric

Answer: a) Linear

16. The strain produced due to the stress in all directions is called

- a) Linear Strain
- b) Lateral Strain
- c) Volumetric Strain
- d) Shear Strain

Answer: c) Volumetric Strain

17. Within the elastic limit, the ratio between the lateral strain to the linear strain is called

- a) Young's Modulus
- b) Rigidity Modulus
- c) Bulk Modulus
- d) Poisson's Ratio

Answer: d) Poisson's Ratio

18. Within the elastic limit, the ratio between the Direct Stress to the Volumetric strain is called

- a) Young's Modulus
- b) Rigidity Modulus
- c) Bulk Modulus
- d) Poisson's Ratio

Answer: c) Bulk Modulus

19. Within the elastic limit, the ratio between the Shear Stress to the Shear strain is called
- a) Young's Modulus
 - b) Bulk Modulus
 - c) Rigidity Modulus
 - d) Poisson's Ratio

Answer: c) Rigidity Modulus

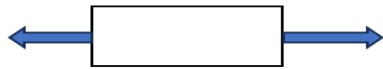
20. Within the elastic limit, the ratio between the Axial Stress to the linear strain is called
- a) Young's Modulus
 - b) Bulk Modulus
 - c) Rigidity Modulus
 - d) Poisson's Ratio

Answer: a) Young's Modulus

21. Which of the following is the unit for Poisson's Ratio?
- a) N/m^2
 - b) N/mm^2
 - c) N/cm^2
 - d) No unit

Answer: a) No unit

Analytical MCQs



22. Identify the type of force in the figure?

- a. Tension Force
- b. Compressive Force
- c. Shear Force
- d. Torsion Force

Answer: a. Tension Force

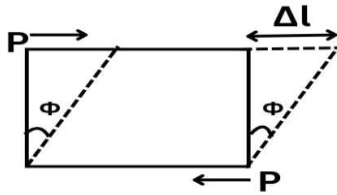


23. Identify the type of force in the figure?

- a. Tension Force
- b. Compressive Force

- c. Shear Force
- d. Torsion Force

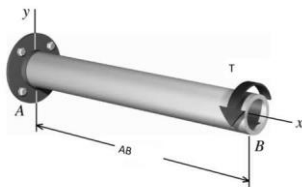
Answer: b. Compressive Force



24. Identify the type of force in the figure?

- a. Tension Force
- b. Compressive Force
- c. Shear Force
- d. Torsion Force

Answer: c. Shear Force



25. Identify the type of force in the figure?

- a. Tension Force
- b. Compressive Force
- c. Sheer Force
- d. Torsion Force

Answer: d. Torsion Force

26. Assertion–Reason Type

Assertion (A): A ductile material is generally preferred for structural members where sudden failure must be avoided.

Reason (R): A ductile material undergoes considerable deformation before fracture, providing warning of failure.

- A) Both A and R are true and R is the correct explanation of A
- B) Both A and R are true but R is not the correct explanation of A
- C) A is true but R is false
- D) A is false but R is true

Answer: A) Both A and R are true and R is the correct explanation of A

27. Table to Inference

The following table gives the properties of four materials:

Material	Elongation before fracture
P	2%
Q	28%
R	4%
S	1%

Based on the data, which material is most suitable where large deformation before failure is desirable?

- A) P
- B) Q
- C) R
- D) S

Answer: B) Q

28. Problematic Question

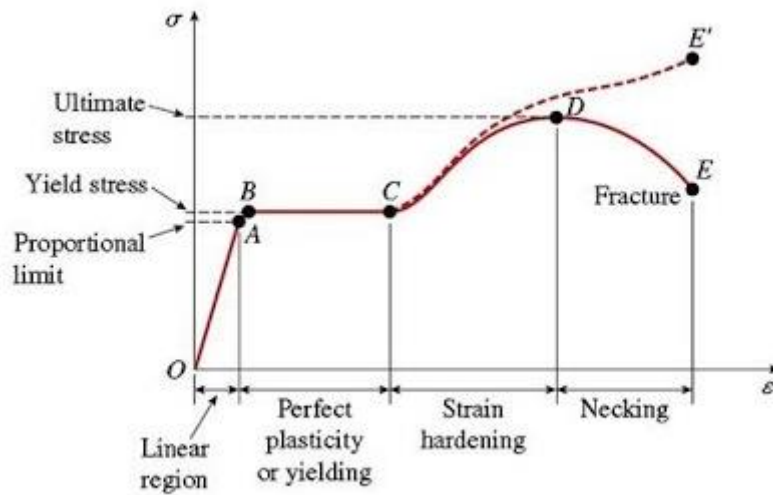
A steel bar of cross-sectional area 400 mm^2 is subjected to a tensile load of 80 kN. What is the tensile stress developed in the bar?

- A) 100 N/mm^2
- B) 150 N/mm^2
- C) 200 N/mm^2
- D) 320 N/mm^2

Answer: C) 200 N/mm^2

29. Theoretical Description to Graph

A material is subjected to gradually increasing tensile load. Initially, stress increases directly in proportion to strain. After a certain point, this proportional relationship no longer exists.



Which portion of the stress–strain behaviour is being described?

- A) Region obeying Hooke's law
- B) Plastic region only
- C) Fracture region
- D) Creep region

Answer A) Region obeying Hooke's law

30. Three-Layer Matching

Match the following:

Property	Meaning	Application
P. Ductility	1. Resistance to indentation	a. Wires
Q. Hardness	2. Ability to undergo elongation	b. Wear-resistant surface
R. Toughness	3. Ability to absorb energy before fracture	c. Impact-resistant component

Which combination is correct?

- A) P–2–a, Q–1–b, R–3–c
- B) P–1–b, Q–2–a, R–3–c
- C) P–3–c, Q–1–a, R–2–b
- D) P–2–c, Q–3–b, R–1–a

Answer: A) P–2–a, Q–1–b, R–3–c

Unit 2

1. A support which offers only a vertical reaction called _____
 - a) Simple Support

- b) Roller Support
- c) Hinged Support
- d) Fixed Support

Answer: a) Simple Support

2. A support which offers vertical and horizontal reactions called _____
- a) Simple Support
 - b) Roller Support
 - c) Hinged Support
 - d) Fixed Support

Answer:c)Hinged Support

3. A support Which offers vertical, horizontal and moment reactions called _____
- a) Simple Support
 - b) Roller Support
 - c) Hinged Support
 - d) Fixed Support

Answer:d)Fixed Support

4. A beam with support conditions like one end is rigidly fixed end and other end free is called _____
- a) Cantilever beam
 - b) Simply supported beam
 - c) Fixed beam
 - d) Continuous beam

Answer:a)Cantilever beam

5. A beam with support conditions like both the ends are simply supported is known as _____
- a) Cantilever beam
 - b) Simply supported beam
 - c) Fixed beam
 - d) Continuous beam

Answer:a) Simply supported beam

6. A beam which has the support condition like both the ends are rigidly fixed is called _____
- a) Cantilever beam
 - b) Simply supported beam
 - c) Fixed beam
 - d) Continuous beam

Answer:c) Fixed beam

7. A beam which is resting on more than two supports is called _____

- a) Cantilever beam
- b) Simply supported beam
- c) Fixed beam
- d) Continuous beam

Answer:d) Continuous beam

8. The beam in which all the reaction components are determined by the use of three static equilibrium equations called _____
- a) Statically determinate beam
 - b) Statically Indeterminate beam
 - c) Mechanically determinate beam
 - d) Mechanically Indeterminate beam

Answer:a) Statically determinate beam

9. Which one of the following is an example of statically determinate beam?
- a) Cantilever beam
 - b) Fixed beam
 - c) Propped cantilever beam
 - d) Continuous beam

Answer:a)Cantilever beam

10. Which one of the following is an example of statically indeterminate beam?
- a) Cantilever beam
 - b) Fixed beam
 - c) Simply supported beam
 - d) Simply supported Over hanging beam

Answer:b)Fixed beam

11. The cantilever beam of length 'L' with a point load 'W' act at the free end, the maximum bending moment at _____
- a) Free end
 - b) Fixed end
 - c) At centre of span
 - d) At L/4 from fixed end

Answer:b)Fixed end

12. The cantilever beam of length 'L' with an udl of 'w N/m' act throughout the entire span, the maximum bending moment at _____
- a) Free end
 - b) Fixed end
 - c) At centre of span
 - d) At L/4 from fixed end

Answer:b) Fixed end

13. The cantilever beam of length 'L' with a point load 'W' act at the free end, the maximum bending moment will be _____
- a) WL at fixed end
 - b) $WL^2/2$ at fixed end
 - c) WL at free end
 - d) $WL^2/2$ at free end

Answer: a) WL at fixed end

14. The cantilever beam of length 'L' with an udl of 'w N/m' act throughout the entire span, the maximum bending moment will be _____
- a) wL^2 at fixed end
 - b) $wL^2/2$ at fixed end
 - c) wL^2 at free end
 - d) $wL^2/2$ at free end

Answer: b) $wL^2/2$ at fixed end

15. The SSB of length 'L' with a point load of 'W' act at the centre of span, the maximum bending moment at _____
- a) At both the ends
 - b) At centre of span
 - c) At L/4 from both ends
 - d) At L/8 from both ends

Answer: b) At centre of span

16. The SSB of length 'L' with a udl of 'w N/m' act throughout the entire span, the maximum bending moment at _____
- a) At both ends
 - b) At centre of the span
 - c) At L/4 from both ends
 - d) At L/8 from both ends

Answer: b) At centre of span

17. The SSB of Length 'L' with a point Load of 'W' act at the centre of Span, the maximum shear Force at _____
- a) At both ends
 - b) At centre of Span
 - c) At L/4 from both ends
 - d) At L/8 from both ends

Answer: a) At both ends

18. The SSB of length 'L' with a point load of 'W' act at the centre of Span, the maximum bending moment will be _____
- a) WL at the centre
 - b) WL/2 at the centre
 - c) WL/4 at the centre
 - d) $WL^2/8$ at the centre

Answer:c) $WL/4$ at the centre

19. The SSB of length 'L' with an udl 'w N/m' act throughout the entire span, the maximum shear force at _____
- a) At both ends
 - b) At centre of span
 - c) At $L/4$ from both ends
 - d) At $L/4$ from both ends

Answer:a) At both ends

20. The SSB of length 'L' with a udl of 'w N/m' act throughout the entire span, the maximum bending moment will be _____
- a) wL at the centre
 - b) $wL/2$ at the centre
 - c) $wL/4$ at the centre
 - d) $wL^2/8$ at the centre

Answer:d) $wL^2/8$ at the centre

Set 1: Types of Beams

Column A

- 1. Beam with both ends rigidly fixed
- 2. Beam resting on more than two supports
- 3. Example of statically determinate beam
- 4. Example of statically indeterminate beam
- 5. Beam in which reactions are determined by 3 equilibrium equations

Column B

- a) Continuous Beam
- b) Fixed Beam
- c) Statically Determinate Beam
- d) Cantilever Beam
- e) Propped Cantilever Beam

Answer Key: 1–b, 2–a, 3–d, 4–e, 5–c



21. Identify the support?
- a. Simple Support
 - b. Roller Support
 - c. Hinged Support
 - d. Fixed Support

Answer: c. Hinged Support



22. Identify the support?

- a. Simple Support
- b. Roller Support
- c. Hinged Support
- d. Fixed Support

Answer: a. Simple Support



23. identify the support?

- a. Simple Support
- b. Roller Support
- c. Hinged Support
- d. Fixed Support

Answer: d. Fixed Support

24. Identify the support?

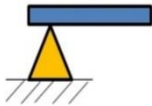
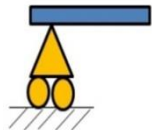


- a. Simple Support
- b. Roller Support
- c. Hinged Support
- d. Fixed Support

Answer: b. Roller Support

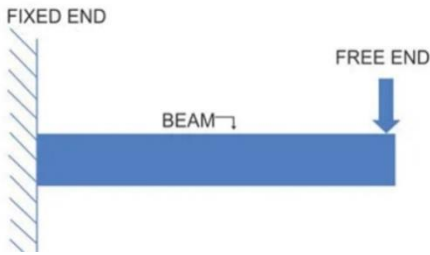
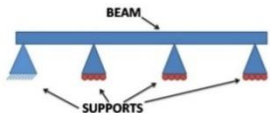
25. Match the following

1		A	Hinged Support
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2		B	Roller Support
3		C	Fixed Support

Answer: 1– C,2-A,3-B

26. Match the following

1		A	Simply Supported Beam
2		B	Continuous Beam
3		C	Cantilever Beam

Answer: 1– C,2-A,3-B

27. Identify the type of beam?

a. Simply Supported Beam



b. Cantilever Beam

- c. Propped Cantilever Beam
- d. Fixed Beam

Answer: c. Propped Cantilever Beam



28. Identify the type of beam?

- a. Simply Supported Beam
- b. Cantilever Beam
- c. propped Cantilever Beam
- d. Fixed Beam

Answer: d. Fixed Beam



29. Identify the type of beam?

- a. Simply Supported Beam
- b. Cantilever Beam
- c. propped Cantilever Beam
- d. Fixed Beam

Answer: b. Cantilever Beam



30. Identify the type of beam?

- a. Simply Supported Beam
- b. Continuous Beam
- c. Singly Overhanging Beam
- d. Fixed Beam

Answer: b. continuous Beam



31. Identify the type of beam?

- a. Simply Supported Beam
- b. Continuous Beam
- c. Singly Overhanging Beam
- d. Fixed Beam

Answer: c. Singly Overhanging Beam



32. Identify the type of beam?

- a. Simply Supported Beam
- b. Continuous Beam
- c. Doubly Overhanging Beam
- d. Singly Overhanging Beam

Answer: c. Doubly Overhanging Beam

Unit 3

1. A section having the same shape and size on either side of Centroid axis is called as _____
- a) Symmetrical Section
 - b) Asymmetrical Section
 - c) Regular Section
 - d) Irregular Section

Answer: a) Symmetrical Section

2. Which of the following is not a Geometrical property of any section,
- a) Shape
 - b) Size
 - c) Centroid
 - d) Mass

Answer: d) Mass

3. If the size and shape of a section varies from the Centroidal axis is called as _____
- a) Symmetrical Section

- b) Asymmetrical Section
- c) Regular Section
- d) Irregular Section

Answer:b)Asymmetrical Section

4. The plane figures have only areas but no mass, then the centre of area of such figures is known as
- a) Shape
 - b) Moment of Inertia
 - c) Centroid
 - d) Centre of gravity

Answer:c) Centroid

5. In a body through which the resultant of the weights of different parts of the body is assumed to be act at a single point is known as _____
- a) Shape
 - b) Moment of Inertia
 - c) Centroid
 - d) Centre of gravity

Answer:d) Centre of gravity

6. The axis which passes through the Centroid of the section and which divides the area of section into two equal portion is known as _____
- a) Equal axis
 - b) Same axis
 - c) Axis of Symmetry
 - d) Line axis

Answer:c) Axis of Symmetry

7. Select the correct expression for the moment of Inertia,
- a) Moment of Inertia = Area x distance
 - b) Moment of Inertia = Area x (Weight)²
 - c) Moment of Inertia = Area x (distance)²
 - d) Moment of Inertia = Area x Weight

Answer:c)Moment of Inertia = Area x (distance)²

8. Select the correct SI unit for Moment of Inertia
- a) mm⁴
 - b) mm³
 - c) mm².Kg
 - d) mm³.Kg

Answer:a)mm⁴

9. The ratio between the moment of Inertia about Centroidal axis and the distance of the extreme fibre is known as _____
- Young's Modulus
 - Shear Modulus
 - Section Modulus
 - Polar Modulus

Answer:c)Section Modulus

10. Select the correct expression for the parallel axis theorem _____
- $I_{AA} = I_{GG} - A\bar{Y}^2$
 - $I_{AA} = I_{GG} \times A\bar{Y}^2$
 - $I_{AA} = I_{GG} + A\bar{Y}^2$
 - $I_{AA} = I_{GG} \times A^2\bar{Y}$

Answer:c) $I_{AA} = I_{GG} + A\bar{Y}^2$

11. Select the correct expression for the perpendicular axis theorem
- $I_{ZZ} = I_{XX} * I_{YY}$
 - $I_{ZZ} = I_{XX} + I_{YY}$
 - $I_{ZZ} = I_{XX} - I_{YY}$
 - $I_{ZZ} = I_{XX} / I_{YY}$

Answer:b) $I_{ZZ} = I_{XX} + I_{YY}$

12. The moment of Inertia of a circular section of diameter D, about Centroidal axis is, $I_{GG} =$ _____

- $I_{GG} = \frac{\pi}{32} D^4$
- $\frac{\pi}{32} D^3$
- $I_{GG} = \frac{\pi^4}{8}$
- $I_{GG} = \frac{\pi}{64} D^4$

Answer:d) $I_{GG} = \frac{\pi}{64} D^4$

13. The moment of Inertia of a hollow circular section of outer diameter, D and inner diameter, d about Centroidal axis is $I_{GG} =$ _____

- $\frac{\pi}{64(D^4-d^4)}$
- $\frac{\pi}{64} (D - d)^4$
- $\frac{\pi}{32} (D - d)^4$
- $\frac{\pi}{32(D^4-d^4)}$

Answer: b) $\frac{\pi}{64} (D - d)^4$

14. Set 1: Moment of Inertia Basics

Column A

1. Moment of Inertia (M.I.)
2. Polar moment of inertia
3. Section Modulus
4. Parallel axis theorem
5. Radius of gyration

Column B

- a) M.I. about axis perpendicular to plane
- b) Resistance of section to bending
- c) $\sqrt{\frac{I}{A}}$
- d) $\frac{I_{xx}}{Y_{\max}}$
- e) $I_{AA} = I_{GG} + A\bar{Y}^2$

Answer Key: 1–b, 2–a, 3–d, 4–e, 5–c

15. Set 2: M.I. of Solid/Hollow Sections**Column A**

1. Hollow circular section
2. Solid circular section
3. Square section
4. Solid rectangular section
5. Radius of gyration

Column B

- a) $I = \frac{\pi D^4}{64}$
- b) $I = \frac{\pi(D^4 - d^4)}{64}$
- c) $I = \frac{bd^3}{12}$
- d) $\sqrt{(I / A)}$
- e) $I = \frac{a^4}{12}$

Answer Key: 1–b, 2–a, 3–e, 4–c, 5–c

16. For an asymmetrical section, the centroid is generally determined by:

- A. Inspection only
- B. Taking moments of component areas
- C. Measuring the perimeter
- D. Finding the maximum dimension

Answer: B. Taking moments of component areas

17. An I-section is generally symmetrical about:

- A. Horizontal axis only
- B. Vertical axis only
- C. Both horizontal and vertical centroidal axes
- D. Neither axis

Answer: C. Both horizontal and vertical centroidal axes

18. The area of a hollow circular section is:

- A. $\frac{\pi}{4}(D^2 + d^2)$
- B. $\frac{\pi}{4}(D^2 - d^2)$

C. $\pi(D - d)$

D. $\pi(D + d)$

Answer: B. $\frac{\pi}{4}(D^2 - d^2)$

19. The moment of inertia of a rectangle of breadth b and depth d , about its centroidal horizontal axis, is:

A. $\frac{bd^2}{12}$

B. $\frac{bd^3}{12}$

C. $\frac{b^3d}{12}$

D. $\frac{bd^3}{6}$

Answer: B. $\frac{bd^3}{12}$

20. The moment of inertia of a solid circular section of diameter D about its centroidal diameter is:

A. $\frac{\pi D^2}{4}$

B. $\frac{\pi D^3}{32}$

C. $\frac{\pi D^4}{64}$

D. $\frac{\pi D^4}{32}$

Answer: C. $\frac{\pi D^4}{64}$

21. The polar moment of inertia of a solid circular section of diameter D is:

A. $\frac{\pi D^4}{16}$

B. $\frac{\pi D^4}{32}$

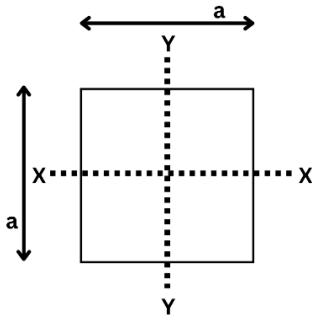
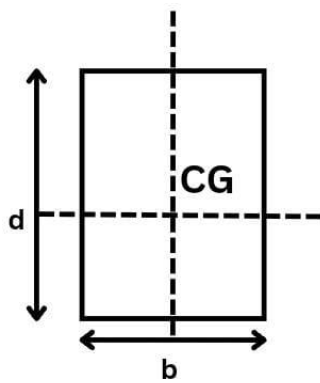
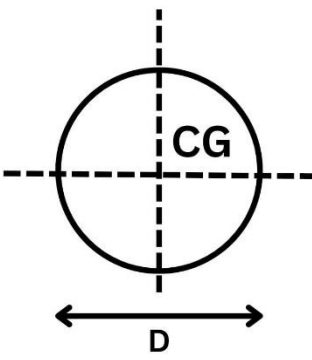
C. $\frac{\pi D^4}{64}$

D. $\frac{\pi D^3}{32}$

Answer: B. $\frac{\pi D^4}{32}$

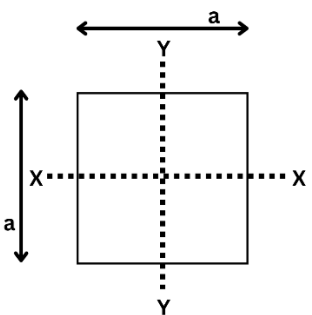
22. Match the following:

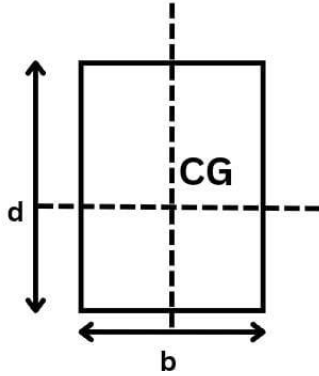
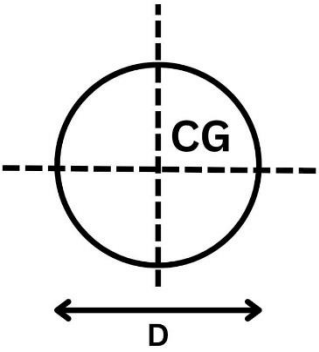
Shape	$\bar{Y}$
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1		A	$\frac{d}{2}$
2		B	$\frac{D}{2}$
3		C	$\frac{a}{2}$

Answer: 1– C,2-A,3-B

23. Match the following:

Shape		I_{xx}	
1		A	$\frac{bd^3}{12}$

2		B	$\frac{\pi D^4}{64}$
3		C	$\frac{a^4}{12}$

Answer: 1– C,2-A,3-B

24. Assertion–Reason Type

Assertion (A): The centroid of a symmetrical rectangular section lies at its geometric centre.

Reason (R): The area of the section is symmetrically distributed about both its centroidal axes.

- A) Both A and R are true and R is the correct explanation of A
- B) Both A and R are true but R is not the correct explanation of A
- C) A is true but R is false
- D) A is false but R is true

Answer: A) Both A and R are true and R is the correct explanation of A

25. Incomplete Data to Decision

A T-section is divided into two simple rectangles for determining its centroid. The areas of the two rectangles are A_1 and A_2 , and their centroidal distances from a reference axis are y_1 and y_2 .

Which expression should be used to determine the distance of the centroid from the reference axis?

- A) $(A_1 + A_2)/(y_1 + y_2)$
- B) $(A_1y_1 + A_2y_2)/(A_1 + A_2)$
- C) $A_1A_2/(y_1 + y_2)$
- D) $A_1y_1 + A_2y_2$

Answer: B) $(A_1y_1 + A_2y_2)/(A_1 + A_2)$

26. Moment of Inertia – Inference

Two rectangular sections have the same cross-sectional area. Section A has its material distributed farther from the centroidal axis than Section B.

Which statement is correct?

- A) Section A has lower moment of inertia
- B) Section A has higher moment of inertia
- C) Both have the same moment of inertia
- D) Moment of inertia is independent of area distribution

Answer: B) Section A has higher moment of inertia

27. Radius of Gyration – Analytical

The moment of inertia of a section about an axis is $4.5 \times 10^6 \text{ mm}^4$, and its area is $50,000 \text{ mm}^2$.

The radius of gyration about the given axis is:

- A) 3 mm
- B) 6 mm
- C) 9.49 mm

D) 90 mm

Answer: C) 9.49 mm

28. Section Modulus – Numerical

A rectangular section has a breadth of 100 mm and depth of 200 mm. Its moment of inertia about the centroidal horizontal axis is $I = bd^3/12$.

The section modulus about the same axis is:

A) $3.33 \times 10^5 \text{ mm}^3$

B) $6.67 \times 10^5 \text{ mm}^3$

C) $1.33 \times 10^6 \text{ mm}^3$

D) $3.33 \times 10^6 \text{ mm}^3$

Answer: B) $6.67 \times 10^5 \text{ mm}^3$

29. Solid and Hollow Section – Decision

A solid circular section and a hollow circular section have the same outer diameter. Material is removed from the centre to form the hollow section.

Which statement is correct regarding the moment of inertia about the centroidal axis?

A) Hollow section has greater moment of inertia because material is removed

B) Hollow section has the same moment of inertia

C) Hollow section has lower moment of inertia than the solid section

D) Moment of inertia becomes zero

Answer: C) Hollow section has lower moment of inertia than the solid section

30. Parallel Axis Theorem – Application

The moment of inertia of a rectangular component about its own centroidal axis is I_G . Its area is A , and the centroidal axis is at a distance h from another parallel reference axis.

Which expression correctly determines the moment of inertia about the reference axis?

A) $I = IG - Ah^2$

B) $I = IG + Ah^2$

C) $I = IG + Ah$

D) $I = IG/A + h^2$

Answer: B) $I = IG + Ah^2$

Unit 4

1. The resistance developed in the beam due to twisting moment is known as _____

- a) Bending Stress
- b) Shearing Stress
- c) Tensile Stress
- d) Torsional Stress

Answer: d) Torsional Stress

2. At a particular layer which the bending stress is zero is called _____

- a) Perpendicular Axis
- b) Parallel Axis
- c) Neutral Axis
- d) Zero Axis

Answer: c) Neutral Axis

3. Neutral axis is a layer in the cross section of the beam where the bending stress is _____

- a) Maximum
- b) Minimum
- c) One (unity)
- d) Zero

Answer: d) Zero

4. When a beam is bent due to application of a constant bending moment and there is no shear is said to be in state of _____

- a) Simple shear
- b) Simple bending
- c) Pure bending
- d) Both b & c

Answer: d) Both b & c

5. A beam is subjected to a bending moment it is resisted by a internal moment setup inside the beam section, this internal moment is known as _____

- a) Moment of Resistance
- b) Moment of force

- c) Moment of Momentum
- d) Torsional moment

Answer: a) Moment of Resistance

6. Select the correct expression of simple bending equation

- a) $\frac{M}{I} = \frac{G}{J} = \frac{E}{R}$
- b) $\frac{M}{I} = \frac{\sigma_{max}}{Y} = \frac{E}{R}$
- c) $\frac{M}{R} = \frac{\sigma_{max}}{I} = \frac{E}{Y}$
- d) $\frac{M}{R} = \frac{\sigma_{max}}{Y} = \frac{E}{I}$

Answer: d) $\frac{M}{I} = \frac{\sigma_{max}}{Y} = \frac{E}{R}$

7. Which of the following assumption is not in the theory of simple bending

- a) Elastic limit is not exceeded and it obeys hooks law
- b) The value of σ is different in tension and compression
- c) The effect of lateral stress and strain is negligible
- d) The transverse sections are plane before and after bending

Answer: b) The value of σ is different in tension and compression

8. Select the correct expression for curvature of beam

- a) $\frac{1}{R} = \frac{MI}{E}$
- b) $\frac{1}{R} = \frac{ME}{I}$
- c) $\frac{1}{R} = \frac{M}{EI}$
- d) $\frac{1}{R} = \frac{E}{MI}$

Answer: c) $\frac{1}{R} = \frac{M}{EI}$

9. The radius of curvature $\left(\frac{1}{R}\right)$ is inversely proportional to _____

- a) Torsional Rigidity
- b) Flexural Rigidity
- c) Modulus of Rigidity
- d) Shear Rigidity

Answer: b) Flexural Rigidity

10. Select the correct expression of stiffness equation

- a) $\frac{M}{E} = \frac{R}{I}$
- b) $\frac{M}{R} = \frac{E}{I}$
- c) $\frac{M}{I} = \frac{E}{R}$
- d) $\frac{M}{R} = \frac{I}{E}$

Answer: c) $\frac{M}{I} = \frac{E}{R}$

11. The radius of curvature $\left(\frac{1}{R}\right)$ is directly proportional to the _____
- Bending Moment
 - Moment of Inertia
 - Young's Modulus
 - Section Modulus

Answer: a) Bending Moment

12. Select the correct expression for strength equation

- $\frac{M}{Y_{max}} = \frac{\sigma_{max}}{I}$
- $\frac{M}{I} = \frac{R}{E}$
- $\frac{M}{I} = \frac{\sigma_{max}}{Y_{max}}$
- $\frac{M}{E} = \frac{\sigma_{max}}{Y_{max}}$

Answer: c) $\frac{M}{I} = \frac{\sigma_{max}}{Y_{max}}$

13. In simple bending equation, the section modulus z, directly proportional to _____ and inversely proportional to _____ of the beam

- Stress, Moment
- Moment, Moment
- Stress, Stress
- Moment, Stress

Answer: d) Moment, Stress

14. Select the correct expression for section modulus (Z)

- $Z = \frac{\sigma}{M}$
- $Z = \frac{M}{\sigma}$
- $Z = \frac{E}{M}$
- $Z = \frac{E}{I}$

Answer: b) $Z = \frac{M}{\sigma}$

15. Types of Bending Stresses

Column A

- Tensile stress
- Compressive stress
- Neutral axis

Column B

- Stress at the top fibre in a simply supported beam under sagging
- Stress at the bottom fibre in a simply supported beam under sagging
- Occurs at extreme fibres farthest from neutral axis

Column A**Column B**

4. Maximum bending stress

d) Axis passing through centroid where bending stress is zero

Answer Key: 1–b, 2–a, 3–d, 4–c

16. Bending Theory and Equations**Column A****Column B**

1. Simple bending theory

a) Maximum bending moment a section can resist

2. Moment of resistance

b) Assumes plane sections remain plane after bending

3. Flexure equation

c) EI (E = modulus of elasticity, I = moment of inertia)

4. Section modulus

d) $M / I = \sigma / y = E / R$

5. Flexural rigidity

e) $I / y_{\max}$

Answer Key: 1–b, 2–a, 3–d, 4–e, 5–c

17. The bending stress in a beam subjected to simple bending varies:

- A. Uniformly
- B. Parabolically
- C. Linearly
- D. Exponentially

Answer: C. Linearly

18. The SI unit of section modulus Z is:

- A. mm^2
- B. mm^3
- C. mm^4
- D. kN/m^2

Answer: B. mm^3

19. The SI unit of moment of inertia of a beam section is:

- A. mm^2
- B. mm^3
- C. mm^4
- D. N/mm^2

Answer: C. mm^4

20. The unit of bending stress is:

- A. N
- B. N/mm

C. N/mm^2

D. $\text{N}\cdot\text{mm}$

Answer: C. N/mm^2

21. The unit of flexural rigidity EI is:

A. N

B. $\text{N}\cdot\text{mm}$

C. $\text{N}\cdot\text{mm}^2$

D. N/mm^2

Answer: C. $\text{N}\cdot\text{mm}^2$

22. The SI unit of bending moment is:

A. N

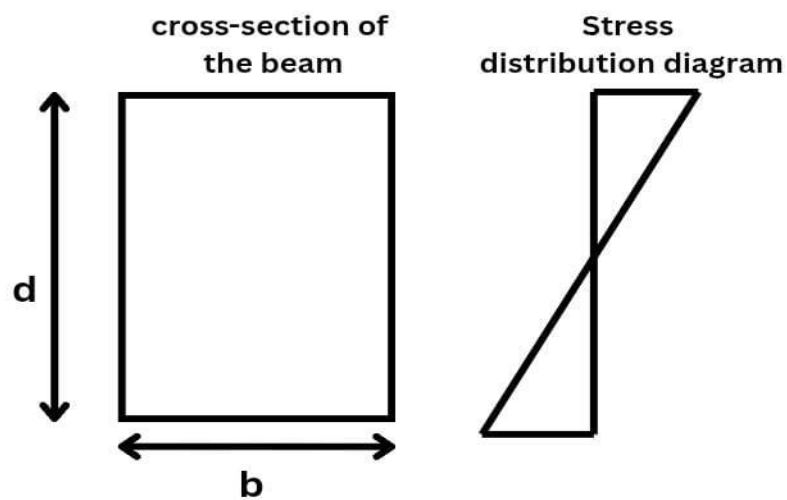
B. N/mm

C. $\text{N}\cdot\text{mm}$

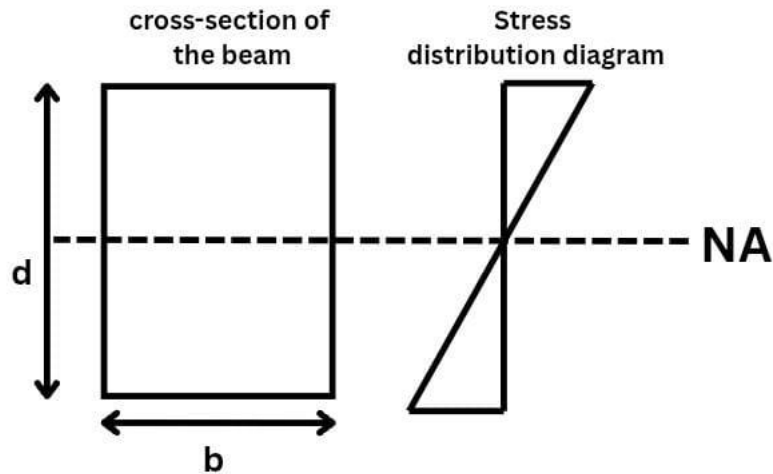
D. N/mm^2

Answer: C. $\text{N}\cdot\text{mm}$

23. Draw the neutral axis for the below diagram.



Answer:



24. Flexure Equation – Inference

For a beam subjected to bending moment M , the flexure equation is

$$M/I = \sigma/y = E/R.$$

If the distance y from the neutral axis is increased while M and I remain constant, the bending stress will:

- A) Decrease
- B) Increase
- C) Remain constant
- D) Become zero

Answer: B) Increase

25. Bending Stress Distribution

A simply supported beam of uniform cross-section is subjected to symmetrical loading. Consider a rectangular cross-section.

Where will the maximum bending stress occur?

- A) At the neutral axis
- B) At the centroid
- C) At the extreme fibres
- D) At the shear centre

Answer: C) At the extreme fibres

26. Numerical – Bending Stress

A beam has a moment of inertia of $8 \times 10^6 \text{ mm}^4$. The maximum distance from the neutral axis to the extreme fibre is 100 mm. If the bending moment is 40 kNm, the maximum bending stress is:

- A) 25 N/mm²

- B) 50 N/mm²
- C) 75 N/mm²
- D) 100 N/mm²

Answer: B

27. Section Modulus – Decision

Two beams have the same material and are subjected to the same bending moment. Beam A has a larger section modulus than Beam B. Which statement is correct?

- A) Beam A develops higher bending stress
- B) Beam A develops lower bending stress
- C) Both develop the same bending stress
- D) Section modulus has no relation to bending stress

Answer: B) Beam A develops lower bending stress

28. Flexural Rigidity – Analytical

Two beams have the same material and cross-sectional shape. Beam A has twice the Young's modulus of Beam B.

Which beam has greater flexural rigidity EI , assuming both have the same moment of inertia?

- A) Beam A
- B) Beam B
- C) Both are equal
- D) Cannot be determined

Answer: A) Beam A

29. Curvature – Inference

According to the bending theory, $M/I = E/R$.

For a beam with constant E and I , if the bending moment increases, the radius of curvature R will:

- A) Increase
- B) Decrease
- C) Remain constant
- D) Become infinite

Answer: B

30. Neutral Axis and Centroidal Axis

For a homogeneous beam of uniform material and symmetrical cross-section subjected to simple bending, the neutral axis generally:

- A) Passes through the centroid
- B) Passes through the extreme fibre
- C) Lies outside the beam
- D) Coincides with the top surface

Answer: A) Passes through the centroid

Unit 5

1. The main members supporting roof covering materials and the external load is known as _____
 - a) Ties
 - b) Rafters
 - c) Struts
 - d) Nodes

Answer: b) Rafters

2. The members of a truss having tensile stresses is known as _____
 - a) Ties
 - b) Rafters
 - c) Struts
 - d) Nodes

Answer: a) Ties

3. The inclined members of a roof truss having compressible stresses is known as _____
 - a) Ties
 - b) Rafters
 - c) Struts
 - d) Nodes

Answer: c) Struts

4. If a frame can be analysed completely by using the three equilibrium equations then the frame is called _____
 - a) Determinate Frame
 - b) Indeterminate Frame
 - c) Unstable Frame
 - d) Moving Frame

Answer: a) Determinate Frame

5. If a frame cannot be analysed by using the three equilibrium equations alone then the frame is called _____

- a) Determinate Frame
- b) Indeterminate Frame
- c) Unstable Frame
- d) Moving Frame

Answer: b) Indeterminate Frame

6. If the number of members of a frame are just sufficient to keep it in equilibrium without change in its shape under external loads called as _____
- a) Perfect Frame
 - b) Imperfect Frame
 - c) Unstable Frame
 - d) Moving Frame

Answer: a) Perfect Frame

7. If the number of members of a frame are not sufficient to keep it in equilibrium under the external loads is called as _____
- a) Perfect Frame
 - b) Imperfect Frame
 - c) Unstable Frame
 - d) Moving Frame

Answer: b) Imperfect Frame

8. A perfect frame is one which will satisfy the following expression is _____
- a) $m = 3j - 3$
 - b) $m = 3j + 3$
 - c) $m = 2j + 3$
 - d) $m = 2j - 3$

Answer: d) $m = 2j - 3$

9. An imperfect frame is one which not satisfy the following expression is _____
- a) $m = 3j - 3$
 - b) $m = 3j + 3$
 - c) $m = 2j + 3$
 - d) $m = 2j - 3$

Answer: d) $m = 2j - 3$

10. If the number of members are less than that is required to keep it in equilibrium is called as _____
- a) Indeterminate Frame
 - b) Perfect Frame
 - c) Deficient Frame
 - d) Redundant Frame

Answer: c) Deficient Frame

11. If the number of members is more than that is required to keep it in equilibrium is called as _____
- Indeterminate Frame
 - Perfect Frame
 - Deficient Frame
 - Redundant Frame

Answer: d) Redundant Frame

12. Roof Truss Members

Column A

- Main members supporting roof covering
- Members under tensile stress
- Inclined members under compressive stress
- Member joining two or more members

Column B

- Ties
- Rafters
- Nodes
- Struts

Answer Key: 1–b, 2–a, 3–d, 4–c

13. Types of Frames

Column A

- Frame analysed by 3 equilibrium equations
- Frame that cannot be analysed by 3 equations
- Frame with sufficient members for stability
- Frame with insufficient members for stability

Column B

- Indeterminate Frame
- Determinate Frame
- Imperfect Frame
- Perfect Frame

Answer Key: 1–b, 2–a, 3–d, 4–c

14. Frame Terminology

Column A

- Members experiencing compression
- Members experiencing tension
- Joints of a frame
- Frame moving and change shape under load
- Frame stable but with extra members

Column B

- Ties
- Struts
- Redundant Frame
- Nodes
- Unstable Frame

Answer Key: 1–a, 2–b, 3–d, 4–, 5–e

15. Frame Equations

Column A

1. Perfect frame condition
2. Imperfect frame condition
3. Number of members less than required
4. Number of members more than required
5. Determinate frame
6. Indeterminate frame

Column B

- a) $m \neq 2j - 3$
- b) $m = 2j - 3$
- c) Redundant Frame
- d) Deficient Frame
- e) Cannot be solved with 3 equilibrium equations alone
- f) Can be solved with 3 equilibrium equations

Answer Key: 1–b, 2–a, 3–d, 4–c, 5–f, 6–e

16. A truss is a structure composed mainly of:

- A. Curved members
- B. Pin-jointed straight members
- C. Fixed-ended beams
- D. Slabs and columns

Answer: B. Pin-jointed straight members

17. The points at which two or more members of a truss meet are called:

- A. Rafters
- B. Ties
- C. Nodes
- D. Slings

Answer: C. Nodes

18. A member subjected primarily to compressive force is called a:

- A. Tie
- B. Sling
- C. Strut
- D. Rafter

Answer: C. Strut

19. A deficient frame is generally:

- A. Stable and rigid
- B. Unstable
- C. Redundant
- D. Perfect

Answer: B. Unstable

20. A frame having more members than required for a perfect frame is called:

- A. Deficient frame
- B. Perfect frame
- C. Redundant frame
- D. Simple frame

Answer: C. Redundant frame

21. In the method of joints, equilibrium is applied at:

- A. Supports only
- B. Each joint
- C. Centre of the span only
- D. Maximum-load point only

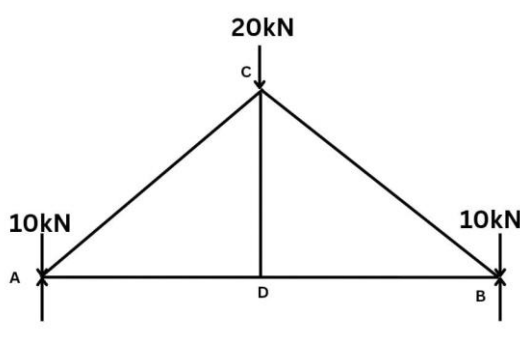
Answer: B. Each joint

22. For a plane truss joint, the equations of equilibrium used in the method of joints are:

- A. $\sum F_x = 0$ and $\sum F_y = 0$
- B. $\sum M = 0$ only
- C. $\sum F_x = 0$ only
- D. $\sum F_y = 0$ and $\sum M = 0$

Answer: A. $\sum F_x = 0$ and $\sum F_y = 0$

23. Find the member with Zero Force in the given Truss.

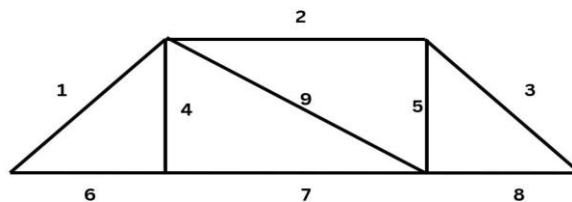


- a. AC
- b. BC
- c. CD
- d. DA

Answer: c.CD

24. Identify the type of frame.

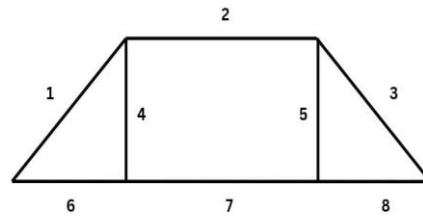
- a. Perfect Frame
- b. Deficient Frame
- c. Redundant Frame
- d. None of the above



Answer: c. Perfect Frame

25. Identify the type of frame.

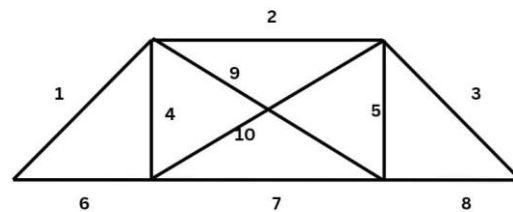
- a. Perfect Frame
- b. Deficient Frame
- c. Redundant Frame
- d. None of the above



Answer: b. Deficient Frame

26. Identify the type of frame.

- a. Perfect Frame
- b. Deficient Frame
- c. Redundant Frame
- d. None of the above



Answer: c. Redundant Frame

27. Symmetrical Truss – Inference

A simply supported perfect truss is geometrically and symmetrically loaded about its centre line.

Which statement is correct?

- A) The reactions at the two supports are equal
- B) The left reaction is always zero
- C) The right reaction is always twice the left reaction
- D) Both support reactions must be horizontal

Answer: A) The reactions at the two supports are equal

28. Nature of Force

During the method of joints, a calculated member force is found to be +15 kN when tensile force is assumed initially.

What does this indicate?

- A) The member carries 15 kN compression
- B) The member carries 15 kN tension
- C) The member carries zero force

D) The member is indeterminate

Answer: B) The member carries 15 kN tension

29. Classification – Inference

A plane truss has 6 joints and 9 members. Using $m = 2j - 3$, which statement is correct?

A) The truss is deficient

B) The truss is perfect

C) The truss is redundant

D) The truss is unstable because it has too few joints

Answer: B) The truss is perfect

30. Member Force – Decision

In a truss, a member is subjected to forces that act away from its joints along the member.

The member is therefore in:

A) Compression

B) Tension

C) Bending

D) Shear

Answer: B) Tension

Descriptive Questions

Unit I

1. Write about any five Mechanical Properties of Material.
2. A rod 1 m long and 20mm x 20mm in cross section is subjected to a pull of 100 kN. If the modulus of elasticity of the material is $2 \times 10^5 \text{ N/mm}^2$. Determine the elongation of the bar.
3. What are the four elastic constants of materials? Provide their definitions and corresponding formulas.

4. Find Bulk Modulus and Shear Modulus of a material having Young Modulus of $2 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio as 0.3.
5. Case-Based / Problematic Analytical Question

A steel bar of 25 mm diameter and 2 m original length is subjected to an axial tensile load of 100 kN. The bar elongates by 1 mm. Assume the Young's modulus of steel as 200 GPa.

Determine:

- a) The cross-sectional area of the bar.
- b) The tensile stress developed in the bar.
- c) The longitudinal strain.
- d) The Young's modulus using the calculated stress and strain.
- e) Comment on whether the calculated value agrees with the given material property.

Unit II

1. A Cantilever Beam of span 7.5m carries a point load of 20kN at free end. Draw SFD and BMD.
2. A Cantilever Beam of span 4m carries a udl of 2kN/m acting at full entire length. Draw SFD and BMD.
3. A Simply Supported Beam of span 7m carries a udl of 15kN/m throughout its span. Draw SFD and BMD.
4. Explain types of support with neat diagram.
5. Case-Based / Problematic Analytical Question – 10 Marks

A simply supported beam AB of span 6 m carries a central point load of 20 kN.

Answer the following:

- a) Identify the type of beam and support conditions at A and B. (2 Marks)
- b) Determine the vertical reactions at supports A and B. (2 Marks)
- c) Calculate the shear force immediately to the left and right of the point load. (2 Marks)
- d) Determine the bending moment at the centre of the beam. (2 Marks)

e) Based on the calculated values, state the nature of the SFD and BMD and indicate the location of maximum bending moment. (2 Marks)

Unit III

1. Write short note on

Radius of Gyration, Section Modulus, Polar Modulus and Moment of Inertia.

2. For the I - Section has a top flange=100mm x 20mm, bottom flange =200mm x 20mm, web = 150mm x 20mm. Determine the position of Neutral axis and Moment of Inertia of I section about xx and yy axes.

3. Determine the moment of Inertia of rectangular section 200mm X 500mm about XX and YY axes. Also determine the Section Modulus & radius of gyration about the two axes.

4. a) Explain briefly about Parallel axis theorem and Perpendicular axis theorem.

b) Sketch any two examples for symmetrical, Anti symmetrical and asymmetrical shapes.

5. Case-Based / Problematic Analytical Question – 10 Marks

A T-section consists of a flange 150 mm wide and 20 mm thick and a centrally placed web 20 mm wide and 100 mm deep below the flange.

Taking the bottom of the web as the reference axis, determine:

a) The area of the flange and web. (2 Marks)

b) Locate the centroid of the complete T-section from the bottom of the web using the principle of moments of areas. (3 Marks)

c) Determine the moment of inertia of the T-section about its centroidal horizontal axis using the parallel-axis theorem. (3 Marks)

d) Calculate the section modulus about the centroidal horizontal axis. (1 Mark)

e) State whether the centroidal axis is an axis of symmetry for the T-section and justify your answer. (1 Mark)

Unit IV

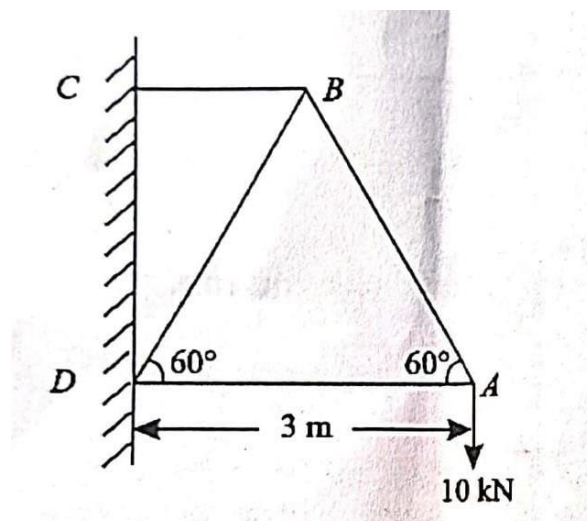
1. A Simply supported beam of span 7m carries a point load of 50kN at its centre. Its Cross section is rectangle of size 320mm X 420mm. Determine Maximum Bending Stress.
2. a) Write about bending Stress. Draw typical bending stress distribution diagram for a beam.
b) Write any four assumptions of simple bending theory with its equation.
3. A Steel wire of 8mm diameter is bent into Circular shape of 6m radius. Determine the maximum stress induced in the wire. Take $E = 2 \times 10^5 \text{ N/mm}^2$.
4. Determine the Maximum moment of resistance of a rectangular beam having Cross section of 300mm X 400mm, if the bending stress not exceeding 5 N/mm^2 .
5. Case-Based / Numerical Analytical Question – 10 Marks

A simply supported beam of span 7 m carries an udl of 18kN/m over the entire span. The beam has a rectangular cross-section of assuming depth as twice the width. The Stress of the beam material is not exceed 7.5 N/mm^2 .

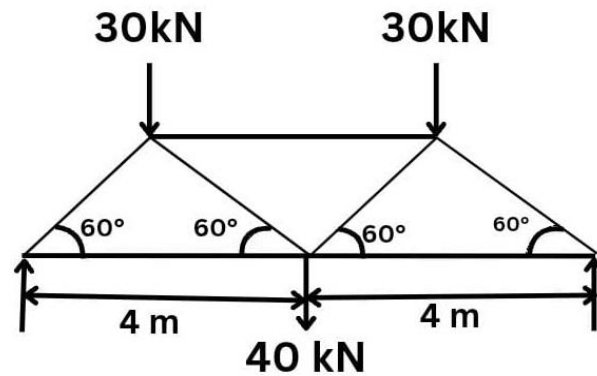
- a) The maximum bending moment in the beam.
- b) The required section modulus.
- c) The width and depth of the rectangular cross-section.
- d) Check whether the calculated dimensions satisfy the allowable bending stress of 7.5 N/mm^2 .

Unit V

1. a) What is frame? Also explain Classification of frame with neat diagram.
b) Define: Rafter, Tie, Sling.
2. Find the magnitude and Nature of forces in Cantilever truss as shown in figure by method of joints.



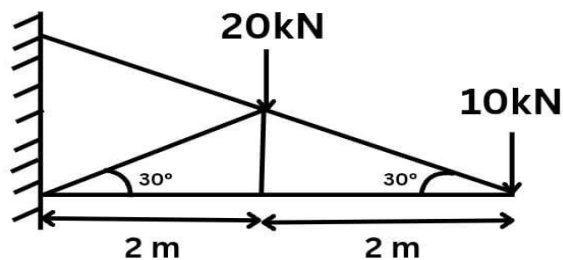
3. Determine the magnitude and Nature of forces in the members of truss as shown in figure by method of joints.



4. Determine the magnitude and nature of forces in all the members of the truss shown in the figure by the Method of Joints.

Determine:

- The reactions at the fixed support.
- The force in each member of the truss.
- State whether each member is in tension or compression.
- Identify any zero-force member, if present.



5. Determine the magnitude and Nature of forces in the members of truss as shown in figure by method of joints.

