

CEH301-MECHANICS OF STRUTURES

Unit I SIMPLE STRESSES AND STRAINS

PART - A

1. Property that indicates the ability of a material to resist permanent deformation is

- A) Rigidity
- B) Elasticity
- C) Toughness
- D) Durability

Answer: A

2. The turning effect of a force about a point is called

- A) Stress
- B) Moment
- C) Strain
- D) Torque

Answer: B

3. A material returns to its original shape after removing the load. This property is called

- A) Plasticity
- B) Elasticity
- C) Hardness
- D) Brittleness

Answer: B

4. A material that can be drawn into wires possesses

- A) Malleability
- B) Toughness
- C) Ductility
- D) Rigidity

Answer: C

5. Which property helps a material resist scratching and wear?

- A) Hardness
- B) Elasticity
- C) Plasticity
- D) Durability

Answer: A

6. A rope used to lift a bucket mainly carries

- A) Compression
- B) Shear
- C) Tension
- D) Bending

Answer: C

7. Rivets connecting two steel plates are mainly subjected to

- A) Tensile stress
- B) Compressive stress
- C) Shear stress
- D) Bearing stress

Answer: C

8. The strain measured in the direction of applied load is called _____ strain.

- A) Lateral
- B) Longitudinal
- C) Volumetric
- D) Shear

Answer: B

9. The reduction in diameter of a stretched steel bar is due to

- A) Shear strain
- B) Lateral strain
- C) Thermal strain
- D) Volumetric strain

Answer: B

10. Hooke's law is valid only when the material loaded within the

- A) Plastic limit
- B) Ultimate limit
- C) Elastic limit
- D) Breaking limit

Answer: C

11. A material slowly changes its shape under a constant load for many years. This phenomenon is called

- A) Fatigue
- B) Creep
- C) Rigidity
- D) Elasticity

Answer: B

12. If the applied load is doubled within the elastic limit, the strain will

- A) Decrease
- B) Remain same
- C) Double
- D) Become zero

Answer: C

13. A material with a higher Young's modulus will show

- A) More elongation
- B) Less stiffness
- C) Greater stiffness
- D) More plasticity

Answer: C

14. A concrete column in a building mainly carries

- A) Tensile force
- B) Compressive force
- C) Shear force
- D) Torsion

Answer: B

15. Poisson's ratio is the ratio of

- A) Axial Stress / Axial strain
- B) Shear stress/shear strain
- C) Longitudinal strain / lateral strain
- D) Volume change / original volume

Answer: B

16. Young's modulus is the ratio of

- A) Axial Stress / Axial strain
- B) Shear stress/shear strain
- C) Longitudinal strain / lateral strain
- D) Volume change / original volume

Answer: A

17. Modulus of rigidity is the ratio of

- A) Axial Stress / Axial strain
- B) Shear stress/shear strain
- C) Longitudinal strain / lateral strain
- D) Volume change / original volume

Answer: B

18. A bridge member fails after many cycles of loading even though the load is not very high. The failure is due to

- A) Plasticity
- B) Fatigue
- C) Hardness
- D) Compressibility

Answer: B

19. Which elastic constant is used when a material is subjected to shear?

- A) Young's modulus
- B) Bulk modulus
- C) Modulus of rigidity
- D) Poisson's ratio

Answer: C

20. A force acting away from a member and trying to elongate it is

- A) Tensile force
- B) Compressive force
- C) Shear force
- D) Friction force

Answer: A

21. For an elastic material, the relation between elastic constants is

- A) $E = 2G(1 - \mu)$
- B) $E = 2G(1 + \mu)$
- C) $E = G(1 + 2\mu)$
- D) $E = 3G(1 - \mu)$

Answer: A

22. Assertion (A): An aluminium rod elongates more than a steel rod of the same size under the same tensile load.

Reason (R): Aluminium has a lower Young's modulus than steel.

- 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

23. Assertion (A): A material with high hardness is always tough.

Reason (R): Hardness and toughness represent different mechanical properties.

- 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: D

24. Assertion (A): A stretched steel bar becomes slightly thinner.

Reason (R): Longitudinal strain is accompanied by lateral strain.

- 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

25. Assertion (A): A steel rod and an aluminium rod of equal area carry the same tensile load.

Reason (R): Stress developed depends on the load and cross-sectional area, not on the material.

- 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

26. Assertion (A): A steel wire is preferred for lifting heavy loads.

Reason (R): Steel has high tensile strength.

- 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

27. A rod of original length 1000 mm becomes 1002 mm under tension. The longitudinal strain is

- A) 0.0002
- B) 0.002
- C) 0.02
- D) 0.2

Answer: B

28. If tensile stress = 200 MPa and tensile strain = 0.001, Young's modulus is

- A) 20 GPa
- B) 100 GPa
- C) 200 GPa
- D) 400 GPa

Answer: C

29. If longitudinal strain is 0.004 and lateral strain is 0.001, Poisson's ratio is

- A) 0.20
- B) 0.30
- C) 0.25
- D) 0.40

Answer: C

30. If a bar of area 100 mm² carries a tensile load of 10,000 N, the tensile stress is _____ N/mm².

- A) 100
- B) 10
- C) 1000
- D) 1

Answer: A

PART – B

1. A brass bar of 10mm x 10mm size and 400mm length is subjected to an axial compression of 12kN. The decrease in length and increase in lateral dimensions are found to be 0.5mm and 0.004mm respectively. Determine the elastic constant of brass.
2. A steel flat 500mm length, 60mm width and 20mm thickness is subjected to an axial compression of 168kN. Calculate the final dimensions and final volume of the flat if its modulus of elasticity and poisson's ratio are 2.1×10^5 N/mm² and 0.3 respectively
3. A metal bar of 20mm x 20mm size and 800mm length is subjected to an axial compression of 50 kN. The decrease in length and increase in lateral dimensions are found to be 0.75 mm and 0.006 mm respectively. Determine the elastic constants of the metal bar
4. A mild steel flat 150mm wide and 20mm thick and 5000mm long carries a tensile load of 300 kN, If $E = 2.1 \times 10^5$ N/mm² and $\nu = 0.25$ Calculate the change in length, width and volume of the bar.
5. A solid bar 50 mm wide, 12 mm thick and 300 mm long is subjected to an axial pull of 84 kN. Find the change in the length, width, thickness and the volume of the bar. Take $E = 2 \times 10^5$ N/mm² and Poisson's ratio = 0.32

Unit II SHEAR FORCE AND BENDING MOMENT IN BEAMS

PART - A

1. A beam fixed at one end and free at the other end is called a

- A. Simply supported beam
- B. Cantilever beam
- C. Continuous beam
- D. Overhanging beam

Answer: B

2. A simply supported beam has

- A. Two fixed supports
- B. One fixed and one roller support
- C. One pin and one roller support
- D. Two roller supports

Answer: C

3. Which support prevents translation as well as rotation?

- A. Roller support
- B. Pin support
- C. Fixed support
- D. Link support

Answer: C

4. The beam that extends beyond one of its supports is called as

- A. Cantilever beam
- B. Continuous beam
- C. Overhanging beam
- D. Fixed beam

Answer: C

5. A beam resting on more than two supports is called

- A. Cantilever beam
- B. Continuous beam
- C. Fixed beam
- D. Overhanging beam

Answer: B

6. Which equation is used to check the rotational equilibrium of a beam?

- A. $\Sigma H = 0$
- B. $\Sigma V = 0$
- C. $\Sigma M = 0$
- D. $\Sigma L = 0$

Answer: C

7. A beam having more unknown reactions than equilibrium equations is called

- A. Simple beam
- B. Determinate beam
- C. Indeterminate beam
- D. Cantilever beam

Answer: C

8. Type of Force that acts along the length of a member is called

- A. Transverse load
- B. Axial load
- C. Impact load
- D. Wind load

Answer: B

9. The weight of a water tank placed at one point on a beam is an example of

- A. Uniformly distributed load
- B. Varying load
- C. Concentrated load
- D. Axial load

Answer: C

10. The self-weight of a concrete slab acting on a beam is generally treated as

- A. Point load
- B. Uniformly distributed load
- C. Varying load
- D. Axial load

Answer: B

11. Shear force at any section of a beam is the algebraic sum of

- A. Moments
- B. Horizontal forces
- C. Vertical forces
- D. Reactions only

Answer: C

12. For a cantilever beam carrying a point load at its free end, the maximum bending moment occurs at

- A. Mid-span
- B. Free end
- C. Fixed end
- D. Quarter span

Answer: C

13. For a cantilever beam carrying a point load at its free end, the shear force is maximum at

- A. Free end
- B. Fixed end
- C. Mid-span
- D. One-third span

Answer: B

14. For a simply supported beam carrying a central point load, the maximum bending moment occurs at

- A. Left support
- B. Right support
- C. Mid-span
- D. Quarter span

Answer: C

15. The bending moment at the supports of a simply supported beam is

- A. Maximum
- B. Minimum
- C. Zero
- D. Constant

Answer: C

16. The shear force changes suddenly at the location of

- A. UDL
- B. UVL
- C. Point load
- D. Support settlement

Answer: C

17. The bending moment diagram for a simply supported beam carrying a uniformly distributed load is

- A. Rectangle
- B. Triangle
- C. Parabola
- D. Straight line

Answer: C

18. The shear force diagram for a beam carrying only a uniformly distributed load is

- A. Horizontal line
- B. Inclined straight line
- C. Parabola
- D. Circle

Answer: B

19. If there is no load between two sections of a beam, the shear force diagram between them will be

- A. Curved
- B. Horizontal
- C. Inclined
- D. Parabolic

Answer: B

20. The slope of the bending moment diagram at any section is equal to the

- A. Load intensity
- B. Reaction
- C. Shear force
- D. Span length

Answer: C

21. The point where the shear force changes from positive to negative generally corresponds to

- A. Minimum bending moment
- B. Maximum bending moment
- C. Zero reaction
- D. Maximum deflection

Answer: B

22. A simply supported beam of span 6 m carries a 12 kN point load at its centre. If the load is increased to 24 kN, the maximum bending moment becomes

- A. 18 kN·m
- B. 24 kN·m
- C. 36 kN·m
- D. 72 kN·m

Answer: C

23. A cantilever beam carries a 10 kN load at its free end. If the beam length is doubled, the maximum bending moment becomes

- A. Same
- B. Double
- C. Three times
- D. Four times

Answer: B

24. A cantilever beam carries a UDL over its entire span. If the span is doubled while the load intensity remains the same, the maximum bending moment becomes

- A. Double
- B. Three times
- C. Four times
- D. Eight times

Answer: C

25. A simply supported beam carries a UDL over its entire span. The total load acting on the beam is 24 kN. The reaction at each support is

- A. 6 kN
- B. 12 kN
- C. 18 kN
- D. 24 kN

Answer: B

26. A simply supported beam carries a central point load of 20 kN. If the load is moved closer to one support, the maximum bending moment will

- A. Increase
- B. Decrease
- C. Remain unchanged
- D. Become zero

Answer: B

27. Assertion (A): A cantilever beam can carry loads even though it is supported at only one end.

Reason (R): The fixed support resists both forces and moments.

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

Answer: A

28. Assertion (A): An overhanging beam is a type of simply supported beam.

Reason (R): A part of the beam extends beyond one or both supports.

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

Answer: B

29. Assertion (A): Shear force changes suddenly at the point where a concentrated load acts.

Reason (R): A concentrated load causes an abrupt change in the vertical force.

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

Answer: A

30. Assertion (A): A determinate beam can always be analysed using the equations of static equilibrium.

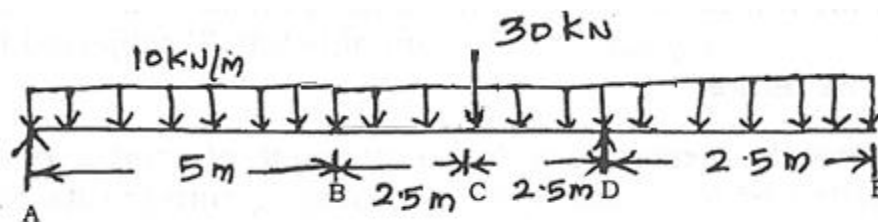
Reason (R): The number of unknown reactions is equal to the number of available equilibrium equations.

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

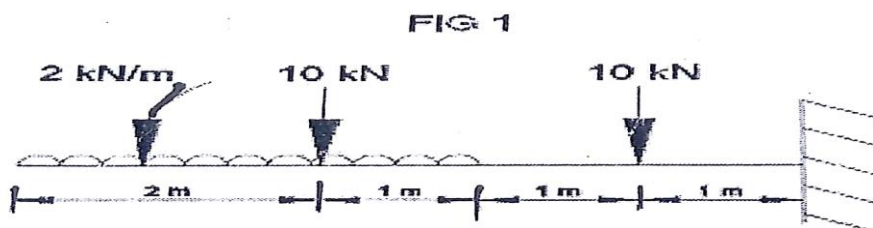
Answer: A

PART – B

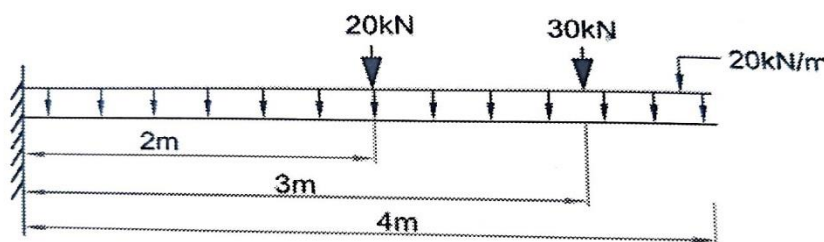
1. A cantilever of 4m length is fixed at the left end. It carries point loads of 40kN, 30kN and 20kN at 1m, 2m, and 3m respectively from the fixed end in addition to an u.d.l of 10kN/m throughout the length. Sketch the S.F. and B.M. diagrams showing values at salient points
2. Draw SFD and BMD for the beam shown in the following FIG. Also mark the values at significant points



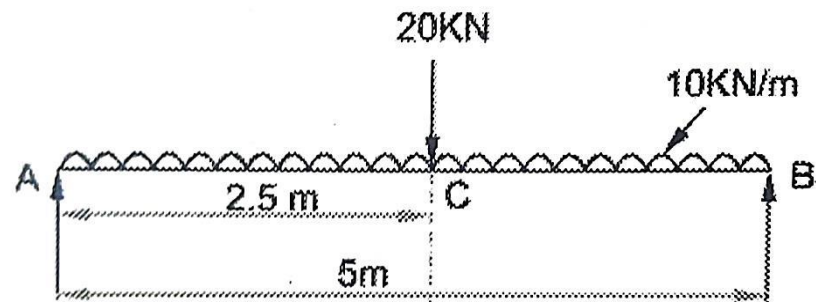
3. Analyse the cantilever beam shown in the following FIG and draw SFD and BMD showing values at the salient points



4. Analyse the beam shown in the following FIG and draw SFD and BMD showing values at the salient points



5. Draw SFD and BMD for the beam shown in the following FIG. Also mark the values at significant points



Unit III GEOMETRICAL PROPERTIES OF SECTIONS

PART - A

1. Which of the following is an example of an antisymmetrical section ?

- A. L-section
- B. T-section
- C. Z - section
- D. C section

Answer: C

2. An unequal angle (L-section) is classified as

- A. Symmetrical section
- B. Anti-symmetrical section
- C. Asymmetrical section
- D. Circular section

Answer: C

3. The centroid of a symmetrical section always lies

- A. At one end
- B. On its axis of symmetry
- C. Outside the section
- D. At the bottom edge

Answer: B

4. For a uniform circular disc, the centre of gravity and centroid

- A. Coincide
- B. Are at opposite ends
- C. Are on the circumference
- D. Cannot be located

Answer: A

5. Which property indicates the tendency of a body to resist a change in its state of rest or motion?

- A. Rigidity
- B. Inertia
- C. Elasticity
- D. Toughness

Answer: B

6. The moment of inertia of a section mainly indicates its resistance to

- A. Compression
- B. Bending
- C. Tension
- D. Shearing

Answer: B

7. A beam with a larger moment of inertia will generally

- A. Bend more
- B. Bend less
- C. Break immediately
- D. Carry no load

Answer: B

8. The polar moment of inertia is mainly associated with the resistance of a material to

- A. Tension
- B. Compression
- C. Twisting
- D. Shearing

Answer: C

9. Radius of gyration represents the distribution of

- A. Load
- B. Area
- C. Stress
- D. Strain

Answer: B

10. Two sections have the same area. The section with the larger radius of gyration has

- A. Better resistance to buckling
- B. Lower weight
- C. Lower strength
- D. Higher density

Answer: A

11. Which of the following property is commonly used in the design of beams subjected to bending?

- A. Radius of gyration
- B. Section modulus
- C. Density
- D. Poisson's ratio

Answer: B

12. A beam with a larger section modulus can generally resist

- A. Smaller bending moment
- B. Greater bending moment
- C. Smaller shear force
- D. Greater axial load only

Answer: B

13. Polar modulus is mainly used in the design of

- A. Columns
- B. Shafts
- C. Beams
- D. Slabs

Answer: B

14. An I-section is preferred as a beam because it has

- A. Smaller moment of inertia
- B. Larger moment of inertia
- C. Smaller area
- D. Uniform thickness only

Answer: B

15. Which property of a beam section is improved by placing more material away from the neutral axis?

- A. Density
- B. Moment of inertia
- C. Elasticity
- D. Hardness

Answer: B

16. Which statement is correct regarding centre of gravity and centroid?

- A. They are always different.
- B. They are the same for a uniform body.
- C. They are applicable only to beams.
- D. They cannot be determined.

Answer: B

17. Increasing the depth of a beam has the greatest effect on its

- A. Colour
- B. Moment of inertia
- C. Weight only
- D. Density

Answer: B

18. A hollow circular section is often preferred over a solid circular section because, for the same amount of material it provides

- A. Lower moment of inertia
- B. Better bending resistance
- C. Lower strength
- D. Greater weight

Answer: B

19. Which quantity has the unit of mm^4 ?

- A. Polar Modulus
- B. Moment of inertia
- C. Radius of gyration
- D. Section Modulus

Answer: B

20. If the shape of a section changes while keeping the same area, the moment of inertia

- A. Never changes
- B. May change
- C. Becomes zero
- D. Depends only on weight

Answer: B

21. Engineers use the moment of inertia of a section mainly to study its

- A. Resistance to bending
- B. Weight
- C. Colour
- D. Thermal expansion

Answer: A

22. The moment of inertia of a section about its centroidal axis is $400 \times 10^6 \text{ mm}^4$. The area is $10,000 \text{ mm}^2$. The radius of gyration is

- A. 100 mm
- B. 200 mm
- C. 300 mm
- D. 400 mm

Answer: B

23. The radius of gyration of a section is 50 mm and its area is $4,000 \text{ mm}^2$. The moment of inertia is

- A. $5 \times 10^6 \text{ mm}^4$
- B. $10 \times 10^6 \text{ mm}^4$
- C. $15 \times 10^6 \text{ mm}^4$
- D. $20 \times 10^6 \text{ mm}^4$

Answer: B

24. A beam section has a moment of inertia of $720 \times 10^6 \text{ mm}^4$. The distance from the neutral axis to the extreme fibre is 120 mm. The section modulus is

- A. $3 \times 10^6 \text{ mm}^3$
- B. $4 \times 10^6 \text{ mm}^3$
- C. $5 \times 10^6 \text{ mm}^3$
- D. $6 \times 10^6 \text{ mm}^3$

Answer: D

25. The area of a plate is doubled while its radius of gyration remains unchanged. The moment of inertia becomes

- A. Half
- B. Same
- C. Double
- D. Four times

Answer: C

26. The section modulus of a beam is $8 \times 10^6 \text{ mm}^3$. If the distance to the extreme fibre is doubled while the moment of inertia remains unchanged, the new section modulus becomes

- A. $2 \times 10^6 \text{ mm}^3$
- B. $4 \times 10^6 \text{ mm}^3$
- C. $8 \times 10^6 \text{ mm}^3$
- D. $16 \times 10^6 \text{ mm}^3$

Answer: B

27. Assertion (A): The centroid of a square plate is at its geometric centre.

Reason (R): A square has two axes of symmetry that intersect at its centre.

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

Answer: A

28. Assertion (A): Two sections having the same area can have different moments of inertia.

Reason (R): Moment of inertia depends on how the area is distributed about the axis.

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

Answer: A

29. Assertion (A): A section with a larger moment of inertia always has a larger area.

Reason (R): Moment of inertia depends on both the amount and distribution of area.

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

Answer: D

30. Assertion (A): The perpendicular axis theorem is applicable to plane laminae.

Reason (R): It relates the polar moment of inertia to the moments of inertia about two mutually perpendicular axes in the same plane.

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

Answer: A

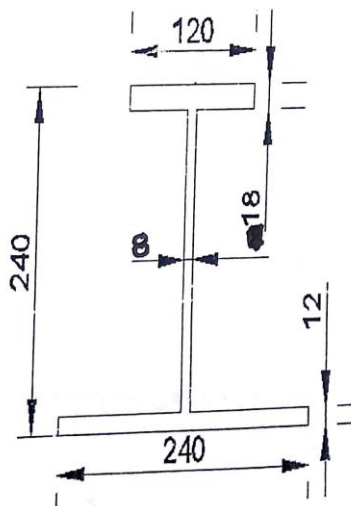
PART – B

1. Find the centre of gravity of $100\text{mm} \times 150\text{mm} \times 30\text{mm}$ T – Section.
2. A T-section has a flange width of 150mm and thickness of 20mm . The overall depth of the section is 120mm and thickness of web is 20mm . Locate the position of centroid and determine the moment of inertia about its centroidal axes.

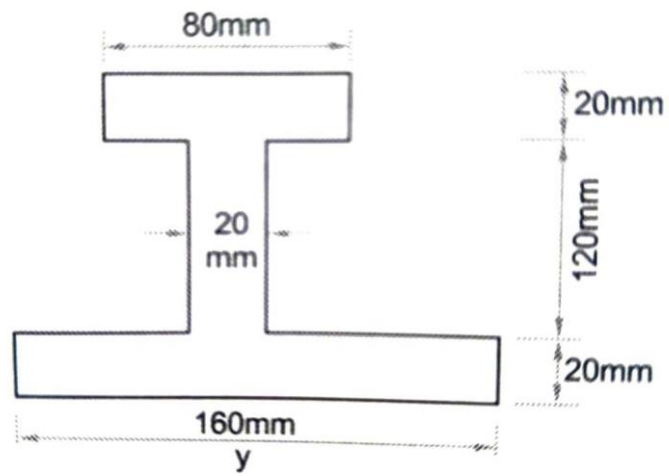
3. The following data corresponds to an unequal I – Section.
 - i. Size of the top flange – $150\text{mm} \times 25\text{mm}$
 - ii. Size of the bottom flange – $250\text{mm} \times 25\text{mm}$
 - iii. Size of the web – $225\text{mm} \times 25\text{mm}$

Determine the position of centroid and determine the moment of inertia about its centroidal axes.

4. Determine the moment of inertia of the section given in the following FIG about its centroidal axis. All dimensions given are in mm



5. Determine the moment of inertia of the I – section given in the following FIG about its centroidal axis. All dimensions given are in mm



Unit IV STRESSES IN BEAMS

PART - A

1. A beam subjected to transverse loads mainly develops

- A. Torsional stress
- B. Bending stress
- C. Bearing stress
- D. Thermal stress

Answer: B

2. In a simply bent beam, the top fibres are generally subjected to

- A. Tensile stress
- B. Compressive stress
- C. Shear stress
- D. Bearing stress

Answer: B

3. The bottom fibres of a simply supported beam carrying downward loads are generally under

- A. Compression
- B. Tension
- C. Shear
- D. Torsion

Answer: B

4. The neutral axis is the axis along which the bending stress is

- A. Maximum
- B. Minimum
- C. Zero
- D. Constant

Answer: C

5. In a homogeneous beam of uniform cross-section, the neutral axis passes through the

- A. Top fibre
- B. Bottom fibre
- C. Centroid
- D. Support

Answer: C

6. The maximum bending stress usually occurs at the _____ of the beam

- A. Neutral axis
- B. Centre
- C. Extreme fibres
- D. Supports only

Answer: C

7. If the bending moment acting on a beam is doubled, the bending stress will

- A. Remain unchanged
- B. Become half
- C. Double
- D. Become four times

Answer: C

8. The moment of resistance developed in a beam acts to

- A. Increase bending
- B. Resist the external bending moment
- C. Increase deflection
- D. Reduce beam length

Answer: B

9. The bending equation relates bending moment, stress, radius of curvature and

- A. Density
- B. Young's modulus
- C. Shear modulus
- D. Poisson's ratio

Answer: B

10. The quantity EI is known as

- A. Polar modulus
- B. Flexural rigidity
- C. Section modulus
- D. Radius of gyration

Answer: B

11. A beam with greater flexural rigidity will

- A. Bend more
- B. Bend less
- C. Fail earlier
- D. Have lower strength

Answer: B

12. Curvature of a beam increases when

- A. Radius of curvature increases
- B. Radius of curvature decreases
- C. Beam length increases
- D. Beam width increases

Answer: B

13. The bending stress at the neutral axis is

- A. Maximum compression
- B. Maximum tension
- C. Zero
- D. Uniform

Answer: C

14. The variation of bending stress over the depth of a beam is

- A. Uniform
- B. Linear
- C. Parabolic
- D. Cubic

Answer: B

15. A beam having a larger section modulus can safely resist

- A. Smaller bending moment
- B. Greater bending moment
- C. Greater shear force only
- D. Smaller axial force

Answer: B

16. The strength equation is mainly used to determine

- A. Beam deflection
- B. Safe bending stress
- C. Radius of curvature
- D. Shear force

Answer: B

17. Two beams have the same material but different moments of inertia. The beam with the larger moment of inertia will

- A. Bend more
- B. Bend less
- C. Have lower strength
- D. Develop greater shear stress

Answer: B

18. If the distance from the neutral axis increases, the bending stress

- A. Decreases
- B. Remains constant
- C. Increases
- D. Becomes zero

Answer: C

19. The centroidal axis and neutral axis coincide when the beam is

- A. Homogeneous and under simple bending
- B. Non-uniform
- C. Curved initially
- D. Hollow only

Answer: A

20. A beam is said to be stronger in bending if it has

- A. Lower section modulus
- B. Higher section modulus
- C. Smaller width only
- D. Smaller depth only

Answer: B

21. The bending equation is applicable within the

- A. Plastic range
- B. Elastic limit
- C. Fracture point
- D. Creep range

Answer: B

22. A beam is subjected to a bending moment of 30 kN·m. If the section modulus is $150 \times 10^3 \text{ mm}^3$, the bending stress developed is

- A. 100 N/mm²
- B. 150 N/mm²
- C. 200 N/mm²
- D. 250 N/mm²

Answer: C

23. Two beams carry the same bending moment. Beam A has a section modulus of $200 \times 10^3 \text{ mm}^3$, while Beam B has $400 \times 10^3 \text{ mm}^3$. The beam with lower bending stress is

- A. Beam A
- B. Beam B
- C. Both have the same stress
- D. Cannot be determined

Answer: B

24. A beam has a flexural rigidity $EI = 8 \times 10^{12} \text{ N·mm}^2$. If $E = 2 \times 10^5 \text{ N/mm}^2$, the moment of inertia is

- A. $20 \times 10^6 \text{ mm}^4$
- B. $30 \times 10^6 \text{ mm}^4$
- C. $40 \times 10^6 \text{ mm}^4$
- D. $50 \times 10^6 \text{ mm}^4$

Answer: C

25. A beam is subjected to a bending moment of 60 kN·m. If the section modulus is doubled, the bending stress becomes

- A. Double
- B. Four times
- C. Half
- D. Unchanged

Answer: C

26. A beam has a section modulus of $300 \times 10^3 \text{ mm}^3$. If the bending moment increases from 30 kN·m to 60 kN·m, the bending stress will

- A. Remain the same
- B. Become half
- C. Double
- D. Become four times

Answer: C

27. Assertion (A): The neutral axis and centroidal axis coincide in a homogeneous beam under simple bending.

Reason (R): The beam material is assumed to be homogeneous and obey Hooke's law.

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

Answer: B

28. Assertion (A): Increasing the moment of inertia of a beam reduces its deflection.

Reason (R): Flexural rigidity increases with the moment of inertia.

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

Answer: A

29. Assertion (A): A beam made of steel is generally stiffer than a wooden beam of the same size.

Reason (R): Steel has a higher Young's modulus than wood.

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

Answer: A

30. Assertion (A): The moment of resistance developed in a beam always acts in the direction opposite to the external bending moment.

Reason (R): The beam develops internal stresses to maintain equilibrium.

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

Answer: A

PART – B

1. A test specimen of certain material, 60mm wide and 40mm deep fails under a bending moment of 300 Nm. A Simply supported rectangular beam is made of the same material and is required to carry an u.d.l. of 10kN/m over a span of 5m safely. Determine the minimum dimensions of the beam required. Assume a factor of safety of 2 for the material
2. A steel plate of width 120 mm and of thickness 20 mm is bent into a circular arc of radius 10m. Determine the maximum stress induced and the bending moment which will produce the maximum stress. Take $E = 2 \times 10^5 \text{ N/mm}^2$
3. A simply supported beam of span 6 m is 300 mm wide and 600 mm deep. It is subjected to a maximum bending moment of 45 KN m. Find the following:
 - (i) Maximum bending stress in the beam
 - (ii) Bending stress at 100 mm above the neutral axis.
4. A rectangular beam 200 mm deep and 300 mm wide is simply supported over a span of 8 m. What will be the uniformly distributed load per meter the beam can carry, if the bending stress is not to exceed 120 N/mm^2 ?
5. The moment of inertia of beam section 500 mm deep is $69.47 \times 10^7 \text{ mm}^4$ Find the longest span over which a beam of this section, when simply supported, could carry a uniformly distributed load of 50 KN per meter run. The flange stress in the material is not to exceed 110 N/mm^2

Unit V PIN JOINTED FRAMES

PART - A

1. A truss has 7 joints and 11 members. The frame is

- A. Perfect
- B. Deficient
- C. Redundant
- D. Indeterminate

Correct Answer: A

2. A truss has 6 joints and 8 members. The frame is

- A. Perfect
- B. Deficient
- C. Redundant
- D. Indeterminate

Answer: B

3. A truss has 5 joints and 9 members. The frame is

- A. Perfect
- B. Deficient
- C. Redundant
- D. Unstable

Answer: C

4. The members of a truss carry which of the following force only

- A. Shear force
- B. Axial force
- C. Bending force
- D. Twisting force

Answer: B

5. A force of 100 N acts horizontally. Its vertical component is

- A. 0 N
- B. 50 N
- C. 100 N
- D. 200 N

Answer: A

6. If a force acts vertically downward, its horizontal component is

- A. Equal to the force
- B. Half the force
- C. Zero
- D. Double the force

Answer: C

7. When using the method of joints, it is preferable to begin with a joint having only

- A. Four unknown member forces
- B. Three unknown member forces
- C. Two unknown member forces
- D. No members connected

Answer: C

8. The method of sections is preferred when the force in

- A. Every member is required
- B. A few members is required
- C. Only support reactions are required
- D. Only zero-force members are required

Answer: B

9. At an unloaded joint, if only two non-collinear members meet, both members are generally

- A. Compression members
- B. Tension members
- C. Zero-force members
- D. Redundant members

Answer: C

10. A frame can be analysed using only the equations of equilibrium. It is

- A. Redundant
- B. Indeterminate
- C. Determinate
- D. Deficient

Answer: C

11. A redundant frames are generally

- A. Determinate
- B. Indeterminate
- C. Deficient
- D. Unstable

Answer: B

12. The force in a truss member is usually classified as

- A. Tensile or compressive
- B. Shear or bending
- C. Twisting or bearing
- D. Dynamic or static

Answer: A

13. A frame has fewer members than required for a perfect frame. It is called

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

Answer: B

14. A perfect frame is generally

- A. Unstable
- B. Determinate
- C. Redundant
- D. Asymmetrical

Answer: B

15. A pin joint in a truss mainly allows the connected members to

- A. Bend freely
- B. Rotate freely
- C. Stretch freely
- D. Twist freely

Answer: B

16. If the number of members in a perfect frame is increased without changing the number of joints, the frame becomes

- A. Deficient
- B. Redundant
- C. Unstable
- D. Hinged

Answer: B

17. Which of the following is not a reason for using a truss instead of a solid beam over a long span?

- A. Less material is required
- B. Lower self-weight
- C. Members carry mainly axial forces
- D. Members carry large bending moments

Answer: D

18. When a force is resolved into horizontal and vertical components, the resultant of the two components is

- A. Smaller than the original force
- B. Equal to the original force
- C. Greater than the original force
- D. Zero

Answer: B

19. During truss analysis, the external load is assumed to be transferred from one member to another through

- A. The centroid
- B. The nodes
- C. The neutral axis
- D. The section modulus

Answer: B

20. Which method is generally faster when the force in only three interior members is required?

- A. Method of Joints
- B. Method of Sections
- C. Graphical Method
- D. Trial Method

Answer: B

21. An engineer removes one unnecessary member from a redundant frame. The frame is most likely to become

- A. Perfect
- B. Deficient
- C. Unstable
- D. Fixed

Answer: A

22. A truss has 12 joints. How many members are required for a perfect frame?

- A. 19
- B. 20
- C. 21
- D. 22

Answer: C

23. A force of 100 N acts at 45° to the horizontal. The horizontal component is approximately

- A. 50 N
- B. 71 N
- C. 87 N
- D. 100 N

Answer: B

24. A force of 200 N acts at 60° to the horizontal. The vertical component is

- A. 100 N
- B. 173 N
- C. 200 N
- D. 50 N

Answer: B

25. A truss has 9 joints and 14 members. How many additional members are required to make it a perfect frame?

- A. 1
- B. 2
- C. 3
- D. No additional member

Answer: A

26. Assertion (A): Members of a pin-jointed truss are assumed to carry only axial forces.

Reason (R): The members are connected by pin joints at their ends.

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

Answer: A

27. Assertion (A): Every imperfect frame is a deficient frame.

Reason (R): An imperfect frame may be either deficient or redundant.

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

Answer: D

28. Assertion (A): A perfect frame can be analysed using only the equations of static equilibrium.

Reason (R): A perfect frame is generally a determinate frame.

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

Answer: A

29. Assertion (A): Loads in a truss are assumed to act at the joints.

Reason (R): This assumption helps the members carry only axial forces.

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

Answer: A

30. Assertion (A): A zero-force member has no importance in a truss.

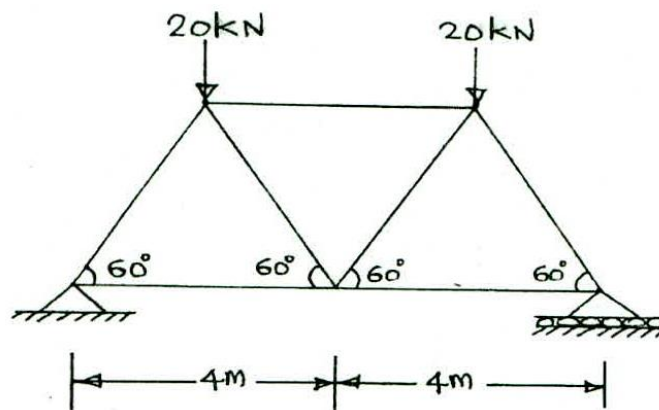
Reason (R): Zero-force members may become active under different loading conditions.

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

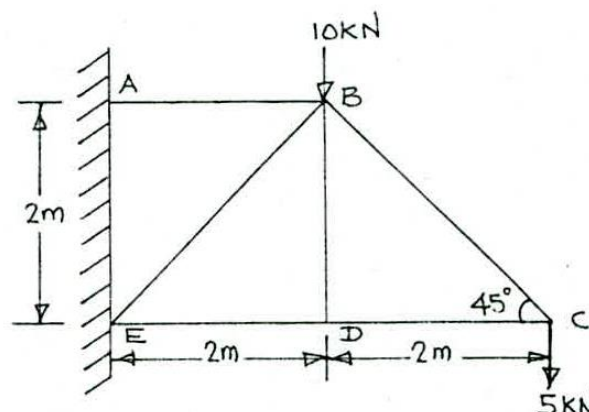
Answer: D

PART – A

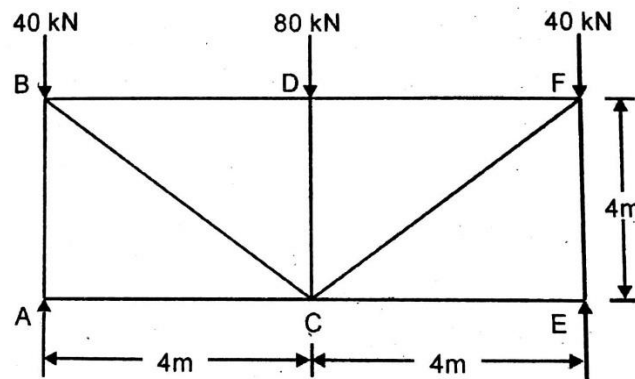
1. Analyze the frame and determine the member forces given in the following FIG by method of joints



2. Analyze the frame and determine the member forces given in the following FIG by method of joints

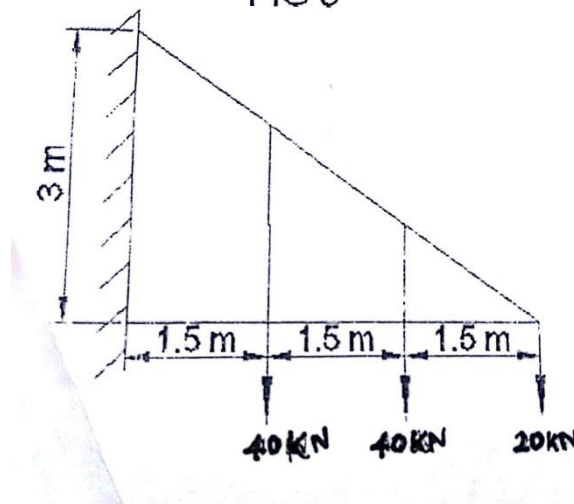


3. Analyze the frame and determine the member forces given in the following FIG by method of joints



4. Analyze the frame and determine the member forces given in the following FIG by method of joints

FIG 5



5. Analyze the frame and determine the member forces given in the following FIG by method of joints

