Subject : STRENGTH OF MATERIALS I Semester : III

Sub code : CE 8301

TWO MARK QUESTIONS WITH ANSWERS
UNIT –1

1. Define stress.

When an external force acts on a body, it undergoes deformation. At the same time the body resists deformation. The magnitude of the resisting force is numerically equal to the applied force. This internal resisting force per unit area is called stress.

Stress = Force/Area

When a body is subjected to an external force, there is some change of dimension in the body. Numerically the strain is equal to the ratio of change in length to the original length of the body.= P/A unit is N/mm^2

2. Define strain

δ Strain = Change in length/Original length

e = δL/L

3. State Hooke's law.

It states that when a material is loaded, within its elastic limit, the stress is directly proportional to the strain.

Stress α Strain

σ α e

σ = Ee

E = σ/e unit is N/mm^2

Where,

E - Young's modulus

σ - Stress

e - Strain

4. Define shear stress and shear strain.

The two equal and opposite force act tangentially on any cross sectional plane of the body tending to slide one part of the body over the other part. The stress induced is called shear stress and the corresponding strain is known as shear strain.

5. Define Poisson's ratio.

When a body is stressed, within its elastic limit, the ratio of lateral strain to the longitudinal strain is constant for a given material.

Poisson' ratio (μ or 1/m) = Lateral strain /Longitudinal strain

6. State the relationship between Young's Modulus and Modulus of Rigidity.

$$E = 2G (1+1/m)$$

Where,

E - Young's Modulus

K - Bulk Modulus

1/m - Poisson's ratio

7. Define strain energy

Whenever a body is strained, some amount of energy is absorbed in the body. The energy which is absorbed in the body due to straining effect is known as strain energy.

8. Give the relationship between Bulk Modulus and Young's Modulus.

$$E = 3K (1-2/m)$$

Where,

E - Young's Modulus

K - Bulk Modulus

1/m - Poisson's ratio

9. What is compound bar?

A composite bar composed of two or more different materials joined together such that system is elongated or compressed in a single unit.

10. Define- elastic limit

Some external force is acting on the body, the body tends to deformation. If the force is released from the body its regain to the original position. This is called elastic limit .

11. Define – Young's modulus

The ratio of stress and strain is constant with in the elastic limit.

$$E = \frac{\text{Stress}}{\text{Strain}}$$

12. Define Bulk-modulus

The ratio of direct stress to volumetric strain**.**

$$K = \frac{\textbf{Direct stress}}{\textbf{Volumetric strain}}$$

13. Define- lateral strain

When a body is subjected to axial load P. The length of the body is increased. The axial deformation of the length of the body is called lateral strain.

13. Define- longitudinal strain

The strain right angle to the direction of the applied load is called lateral strain.

14. What is principle of super position?

The resultant deformation of the body is equal to the algebric sum of the deformation of the individual section. Such principle is called as principle of super position

15. Define- Rigidity modulus

The shear stress is directly proportional to shear strain.

$$N = \frac{\text{Shear stress}}{\text{Shear strain}}$$

16. State principle plane.

The planes, which have no shear stress, are known as principal planes. These planes carry only normal stresses.

17. Define principle stresses and principle plane.

Principle stress: The magnitude of normal stress, acting on a principal plane is known as principal stresses.

Principle plane: The planes which have no shear stress are known as principal planes.

18. What is the radius of Mohr's circle?

Radius of Mohr's circle is equal to the maximum shear stress.

19. What is the use of Mohr's circle?

To find out the normal, resultant stresses and principle stress and their planes.

20. List the methods to find the stresses in oblique plane?

1. Analytical method
2. Graphical method

UNIT –II

1. Define beam?

BEAM is a structural member which is supported along the length and subjected to external loads acting transversely (i.e) perpendicular to the center line of the beam.

2. What is mean by transverse loading on beam?

If a load is acting on the beam which perpendicular to the central line of it then it is called transverse loading.

3. What is Cantilever beam?

A beam one end free and the other end is fixed is called cantilever beam.

4. What is simply supported beam?

A beam supported or resting free on the support at its both ends.

5. What is mean by over hanging beam?

If one or both of the end portions are extended beyond the support then it is called over hanging beam.

6. What is mean by concentrated loads?

A load which is acting at a point is called point load.

7. What is uniformly distributed load.

If a load which is spread over a beam in such a manner that rate of loading 'w' is uniform through out the length then it is called as udl.

8. Define point of contra flexure? In which beam it occurs?

Point at which BM changes to zero is point of contra flexure. It occurs in overhanging beam.

9. What is mean by positive or sagging BM?

BM is said to positive if moment on left side of beam is clockwise or right side of the beam is counter clockwise.

10. What is mean by negative or hogging BM?

BM is said to negative if moment on left side of beam is counterclockwise or right side of the beam is clockwise.

11. Define shear force and bending moment?

SF at any cross section is defined as algebraic sum of all the forces acting either side of beam.

BM at any cross section is defined as algebraic sum of the moments of all the forces which are placed either side from that point.

12. When will bending moment is maximum?

BM will be maximum when shear force change its sign.

13. What is maximum bending moment in a simply supported beam of span 'L'

subjected to UDL of 'w' over entire span?

Max BM $=wL^2/8$

14. In a simply supported beam how will you locate point of maximum bending moment?

The bending moment is max. When SF is zero. Write SF equation at that point and equating to zero we can find out the distances 'x' from one end .then find maximum bending moment at that point by taking all moment on right or left hand side of beam.

15. What is shear force?

The algebric sum of the vertical forces at any section of the beam to the left or right of the section is called shear force.

16. What is shear force and bending moment diagram?

It shows the variation of the shear force and bending moment along the length of the beam.

17. What are the types of beams?

1. Cantilever beam
2. Simply supported beam
3. Fixed beam
4. Continuous beam
5. over hanging beam

18. What are the types of loads?

1. Concentrated load or point load
2. Uniform distributed load
3. Uniform varying load

19. In which point the bending moment is maximum?

When the shear force change of sign or the shear force is zero

20. Write the assumption in the theory of simple bending?

1. The material of the beam is homogeneous and isotropic.
2. The beam material is stressed within the elastic limit and thus obey hooke's law.
3. The transverse section which was plane before bending remains plains after bending also.
4. Each layer of the beam is free to expand or contract independently about the layer, above or below.
5. The value of E is the same in both compression and tension.

21. Write the theory of simple bending equation?

$M/I = F/Y = E/R$

M - Maximum bending moment

I - Moment of inertia

F - Maximum stress induced

Y - Distance from the neutral axis

E - Young's modulus

R - Constant.

UNIT –III

1. What are the methods for finding out the slope and deflection at a section?

The important methods used for finding out the slope and deflection at a section in a loaded beam are

1. Double integration method
2. Moment area method
3. Macaulay's method

The first two methods are suitable for a single load, where as the last one is suitable for several loads.

2. Why moment area method is more useful, when compared with double integration?

Moment area method is more useful, as compared with double integration method because many problems which do not have a simple mathematical solution can be simplified by the ending moment area method.

3. Explain the Theorem for conjugate beam method?

Theorem I : "The slope at any section of a loaded beam, relative to the original axis of the beam is equal to the shear in the conjugate beam at the corresponding section"

Theorem II: "The deflection at any given section of a loaded beam, relative to the original position is equal to the Bending moment at the corresponding section of the conjugate beam"

4. Define method of Singularity functions?

In Macaulay's method a single equation is formed for all loading on a beam, the equation is constructed in such away that the constant of Integration apply to all portions of the beam. This method is also called method of singularity functions.

5. What are the points to be worth for conjugate beam method?

1. This method can be directly used for simply supported Beam
2. In this method for cantilevers and fixed beams, artificial constraints need to be supplied to the conjugate beam so that it is supported in a manner consistent with the constraints of the real beam.

6. What are the different sections in which the shear stress distribution is to be obtained?

- Rectangular section
- Circular section
- I- section
- T- section
- Miscellaneous section

7. What do you mean by shear stress in beams?

The stress produced in a beam, which is subjected to shear forces is know as stresses.

8. What is the formula to find a shear stress at a fiber in a section of a beam?

The shear stress at a fiber in a section of a beam is given by

$$q = \frac{F \times A\bar{Y}}{I \times b}$$

F = shear force acting at a section
A = Area of the section above the fiber
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Y = Distance of C G of the Area A from Neutral axis
I = Moment of Inertia of whole section about N A
b = Actual width at the fiber

9. **What is the shear stress distribution rectangular section?**

The shear stress distribution rectangular section is parabolic and is given by

$q = F/2I [d^2 /4 – y^2]$
d = Depth of the beam
y = Distance of the fiber from NA

10. What is the shear stress distribution Circular section?

$q = F/3I [R^2-y^2]$

11. State the main assumptions while deriving the general formula for shear stresses

The material is homogeneous, isotropic and elastic

The modulus of elasticity in tension and compression are same.

The shear stress is constant along the beam width

The presence of shear stress does not affect the distribution of bending stress.

12. Define: Shear stress distribution

The variation of shear stress along the depth of the beam is called shear stress distribution

13. What is the ratio of maximum shear stress to the average shear stress for the rectangular section?

Q_{max} is 1.5 times the Q_{avg}.

14. What is the ratio of maximum shear stress to the average shear stress in the case of solid circular section?

Q_{max} is 4/3 times the Q_{ave}.

15. What is the shear stress distribution value of Flange portion of the I-section?

q= f/2I * (D2/4 - y)

D-depth

y- Distance from neutral axis

16. What is the value of maximum of minimum shear stress in a rectangular cross section?

Qmax=3/2 * F/ (bd)

17. What is the shear stress distribution for I-section?

The shear stress distribution I-section is parabolic, but at the junction of web and flange, the shear stress changes abruptly. It changes from $F/8I [D^2 – d^2]$ to $B/b \times F/8I [D^2 – d^2]$ where D = over all depth of the section

d = Depth of the web

b = Thickness of web

B = Over all width of the section.

18. How will you obtained shear stress distribution for unsymmetrical section?

The shear stress distribution for Unsymmetrical sections is obtained after calculating the position of N A.

19 Where the shear stress is max for Triangular section?

In the case of triangular section, the shear stress is not max at N A. The shear stress is max at a height of h/2

20. Where shear stress distribution diagram draw for composite section?

The shear stress distribution diagram for a composite section, should be drawn by calculating the shear stress at important points.

UNIT –IV

1. **Define Torsion**

When a pair of forces of equal magnitude but opposite directions acting on body, it tends to twist the body. It is known as twisting moment or torsion moment or simply as torque. Torque is equal to the product of the force applied and the distance between the point of application of the force and the axis of the shaft.

2. **What are the assumptions made in Torsion equation**

- The material of the shaft is homogeneous, perfectly elastic and obeys Hooke's law. ○ Twist is uniform along the length of the shaft
- The stress does not exceed the limit of proportionality
- The shaft circular in section remains circular after loading
- Strain and deformations are small.

3. Define polar modulus

It is the ratio between polar moment of inertia and radius of the shaft.

£ = polar moment of inertia = J

Radius R

4. Write the polar modulus for solid shaft and circular shaft.

£ = polar moment of inertia = J

Radius R

$J = \pi D^4$

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5. Why hollow circular shafts are preferred when compared to solid circular shafts?

- The torque transmitted by the hollow shaft is greater than the solid shaft.
- For same material, length and given torque, the weight of the hollow shaft will be less compared to solid shaft.

6. Write torsional equation

T/J=Cθ/L=q/R
T-Torque
J- Polar moment of inertia

C-Modulus of rigidity

L- Length

q- Shear stress

R- Radius

7. Write down the expression for power transmitted by a shaft

P=2πNT/60

N-speed in rpm

T-torque

8. Write down the expression for torque transmitted by hollow shaft

T= (π/16)*Fs*((D4-d4)/d4

T-torque

q- Shear stress

D-outer diameter

D- Inner diameter

9. Write down the equation for maximum shear stress of a solid circular section in diameter 'D' when subjected to torque 'T' in a solid shaft.

T=π/16 * Fs*D3

T-torque

q Shear stress

D diameter

10. Define torsional rigidity

Product of rigidity modulus and polar moment of inertia is called torsional rigidity

11. What is composite shaft?

Some times a shaft is made up of composite section i.e. one type of shaft is sleeved over other types of shaft. At the time of sleeving, the two shafts are joined together, that the composite shaft behaves like a single shaft.

12. What is a spring?

A spring is an elastic member, which deflects, or distorts under the action of load and regains its original shape after the load is removed.

13. State any two functions of springs.

1. To measure forces in spring balance, meters and engine indicators.
2. To store energy.

14. What are the various types of springs?

i. Helical springs

ii. Spiral springs

iii. Leaf springs

iv. Disc spring or Belleville springs

15. Classify the helical springs.

1. Close – coiled or tension helical spring.
2. Open –coiled or compression helical spring.

16. What is spring index (C)?

The ratio of mean or pitch diameter to the diameter of wire for the spring is called the spring index.

17. What is solid length?

The length of a spring under the maximum compression is called its solid length. It is the product of total number of coils and the diameter of wire.

$$Ls = n_t \, x \, d$$

Where, n_t = total number of coils.

18. Define spring rate (stiffness).

The spring stiffness or spring constant is defined as the load required per unit deflection of the spring.

$$K = W/y$$

Where W -load

Y – Deflection

19. Define pitch.

Pitch of the spring is defined as the axial distance between the adjacent coils in uncompressed state. Mathematically

$$\text{Pitch} = \frac{\text{free length}}{n-1}$$

20. Define helical springs.

The helical springs are made up of a wire coiled in the form of a helix and are primarily intended for compressive or tensile load.

21. **What are the differences between closed coil & open coil helical springs?**

The spring wires are coiled very closely, each turn is nearly at right angles to the axis of helix	The wires are coiled such that there is a gap between the two consecutive turns.
Helix angle is less than 10^o	Helix angle is large ($>10^o$)

UNIT V

1. **What is mean by perfect frame?**

If a frame is composed of such members, which are just sufficient to keep the frame in equilibrium, when the frame is supporting the external load, then the frame is know as perfect frame.

2. **What are the different types of frames?**

The different types of frame are:

- Perfect frame and
- Imperfect frame.

3. **What is mean by Imperfect frame?**

A frame in which number of members and number of joints are not given by $n = 2j – 3$ is know as imperfect frame. This means that number of members in an imperfect frame will be either more or less than $(2j – 3)$.

4. **What is mean by deficient frame?**

If the number of member in a frame are less than (2j -3), then the frame is know as deficient frame

5. **What is mean by redundant frame?**

If the number of member in a frame are more than (2j -3), then the frame is know as deficient frame

6. **What are the assumptions made in finding out the forces in a frame?**

The assumptions made in finding out the forces in a frame are:

The frame is a perfect frame
The frame carries load at the joints
All the members are pin-joined.

7. What are the reactions of supports of a frame?

The frame are generally supported

(i) on a roller support or

(ii) On a hinged support.

8. How will you Analysis of a frame?

Analysis of a frame consists of

Determinations of the reactions at the supports and

Determination of the forces in the members of the frame

9. What are the methods for Analysis the frame?

Methods of joints,

Methods of sections, and

Graphical method.

10. How method of joints applied to Trusses carrying Horizontal loads.

If a truss carries horizontal loads (with or without vertical loads) hinged at one end supported on roller at the other end, the support reaction at the roller support end will be normal. Whereas the support reaction at the hinged end will consist of (i) horizontal reaction and (ii) vertical reaction

11. How method of joints applied to Trusses carrying inclined loads.

If a truss carries inclined loads hinged at one end supported on roller at the other end, the support reaction at the roller support end will be normal. Whereas the support reaction at the hinged end will consist of (i) horizontal reaction and (ii) vertical reaction

12. What is mean by compressive and tensile force?

The forces in the member will be compressive if the member pushes the joint to which it is connected whereas the force in the member will be tensile if the member pulls the joint to which it is connected.

13. How will you determine the forces in a member by method of joints?

While determining forces in a member by methods of joints, the joint should be selected in such a way that at any time there are only two members, in which the forces are unknown.

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Subject	**: STRENGTH OF MATERIALS I**	**Semester**	**: III**
Sub code	**: CE 8301**	**W.E.F**	**: JULY 2018**
Name of the faculty	**: R.PERUMAL.ME**	**Branch**	**: CIVIL**

QUESTIONS BANK

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

PART – A (2 Marks)

1. Distinguish between the following: Stress & Strain, Force & Stress, Tensile stress & Compressive stress.
2. Define modular ratio, Poisson's ratio & Hook's Law.
3. Write the relationship between bulk modulus, rigidity modulus and Poisson's ratio.
4. Draw stress – strain diagram for mild steel, brittle material and a ductile material and indicate salient points.
5. If the linear strain in a steel specimen is 0.001 and the lateral strain is 0.0003, find the Poisson's ratio.
6. What is the principle of Super position? Explain its uses.
7. Define the terms: Principal planes and Principal stresses. Also explain their uses.
8. Write a note on Mohr's circle of stresses.
9. Define stress and strain. What are the different types of stresses and strains? Define the terms: Elasticity, Elastic limit, Young's Modulus and Modulus of rigidity.
10. Draw the Mohr's circle for a state of pure shear and indicate the principal stresses.
11. What type of stress will be induced in a bar when the ends are restrained and subjected to (a) rise in temperature (b) fall in temperature?
12. Explain the significance of Mohr's circle and its uses.
13. Define working stress & allowable stress.
14. State whether the following statements are true or false.

    (a) On the planes having maximum or minimum principal stresses there will be minimum tangential stress.

    (b) Shear stresses on mutually perpendicular planes are numerically equal.
15. Define the term 'obliquity' and how it is determined.
16. What do you mean by rigid bodies and deformable solids?
17. What do you understand by the terms surface forces and body forces?

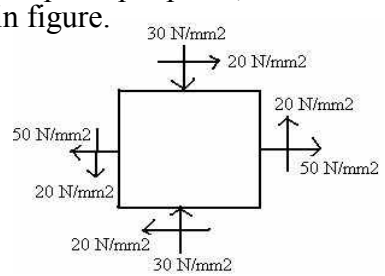
18. Write the relationship between 3 elastic constants.

19. Define lateral strain lateral stress.

20. Define Factor of safety.

PART-B (16 Marks)

1. Determine the direction of principal plane, normal stresses and tangential stress of the strained material as shown in figure.



2. The normal stresses acting on two perpendicular planes at a point in a strained material are 70 MN/ m^2 tensile, 35 MN/ m^2 compressive. In addition, shear stress of 40 N/mm^2 act on these planes. Calculate the following:

(i).The magnitude of the principle stresses

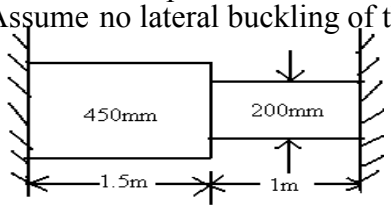
(ii).The direction of the principal planes

(iii).The magnitude of the maximum shear stress.

3. A steel tube 50mm external diameter 5mm thick encloses centrally a copper bar of 30 mm diameter. The bar and tube are rigidly connected together at the end at a temperature of 30°C.

The composite bar is subjected to an axial compressive load of 60kN and the temperature is raised to 150°C. Determine the stresses in the steel tube and copper rod $\alpha_s = 12x10^{-6}/°C$, $\alpha_{cu} = 18x10^{-6}/°C$, $E_s = 200$ GPa, $E_{cu} = 100$ GPa.

4. A bar of non uniform diameter, as shown in figure is rigidly fixed. There is no expansion of the ends and there is no stress in the bar at a temperature of 22°C. If the temperature of the bar be raised to 45°C, find the forces applied by the rigid walls on the bar. E and coefficient of thermal expansion for the materials are 200 GN/m^2 and $11.7x10^{-6}/°C$ respectively. Assume no lateral buckling of the bar.



5. A body is subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress. Draw the Mohr's circle of stresses and explain how you will obtain the principal stresses and principal planes.

6. The normal stresses acting on two perpendicular planes at a point in a strained material are 100 MN/ m^2 tensile, 45 MN/ m^2 compressive. In addition, shear stress of 50 N/mm^2 act on these planes. Calculate the following:

(i).The magnitude of the principle stresses

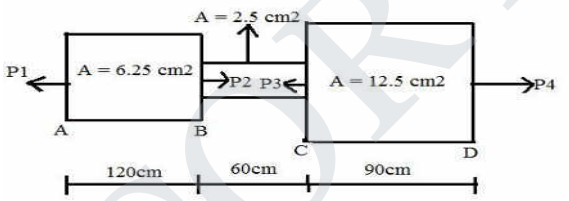
(ii).The direction of the principal planes

(iii).The magnitude of the maximum shear stress.

7. A M.S bar of 50mm square in size and 150mm long is subjected to an axial thrust of 200kN. Half the lateral strain is prevented by the application of uniform external pressure of certain intensity. If E = 200 GPa and Poisson's ratio 0.3. Calculate the change in the length of the bar.

8. An element in a stressed material has tensile stress of 500 N/mm^2 and compressive stress of 350 N/mm^2 acting on two mutually perpendicular planes and equal shear stresses of 100 N/mm^2 on these planes. Find the principal stresses and its planes. Find the plane of maximum shear stress and its plane.

9. A member ABCD is subjected to point loads P1, P2, P3 and P4 as shown in fig. Calculate the force P2 necessary for equilibrium if P1=4500kg, P3=45,000kg and P4=13,000kg. Determine the total elongation of the member, assuming E to be 2.10X10^6 kg/cm^2.



10. A solid circular bar of diameter 20mm when subjected to an axial tensile load of 40 KN, the reduction in diameter of the rod was observed as 6.4x10^{-3} mm. The Young modulus of the material of the bar is 67 GPa. Determine the following. a) Bulk modulus, b) Poisson's ratio, c) Modulus of rigidity, d) Change in length per meter and e) Change in volume of the bar per meter length.

UNIT II TRANSFER OF LOADS AND STRESSES IN BEAMS
PART – A (2 Marks)

1. Define beam and point of contra flexure.

2. Define and explain the following terms: Shear force, Bending moment, Shear force diagram & bending moment diagram.

3. What are the sign conventions for shear force & bending moment in general?

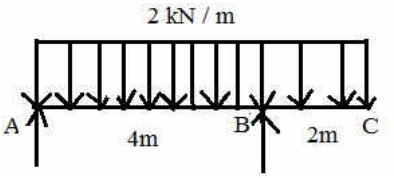
4. Draw the S.F. & B.M. diagrams for simply supported beam of length L carrying a point load W at its middle point.

5. What do you mean by point of contra flexure? Is the point of contra flexure and point of inflexion different?

6. Sketch any 2 types of supports used for a beam indicating the reactions in each case.

7. A cantilever beam of span 4m is subjected to a udl of 2 kN/m over its entire length. Sketch the bending moment diagram for the beam.

8. Draw the pattern of the S.F.D. for the beam shown in the figure.



9. Give the relationship between B.M. & S.F. and rate of loading in a beam.

10. How do you locate the point of maximum bending moment?

11. What do you understand by neutral axis & moment of resistance? How do you locate Neutral axis?

12. What do you mean by section modulus? Find an expression for section modulus for rectangular, circular & hollow circular sections.

13. Define and explain the terms: Modular ratio, flitched beams & Equivalent sections.

14. Define shear flow and Write down the bending equation.

15. (a).The plane of load should contain of load should contain one of the principal axes of inertia, so that the neutral axis is perpendicular to the plane of load –true or false.

(b).In the theory of simple bending neutral axis is the centroidal axis perpendicular the plane of load – true or false.

16. State the theory of simple bending and also assumptions made in the theory on bending?

17. A beam subjected to a bending stress of 5N/mm^2 and the section modulus is 3530 cm^3. What is the moment of resistance of the beam?

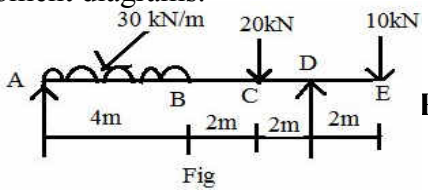
18. How would you find the bending stress in unsymmetrical sections?

19. What do you understand by the assumption, plane section remain plane even after the application of load?

20. Draw the bending stress distribution for a symmetrical I section.

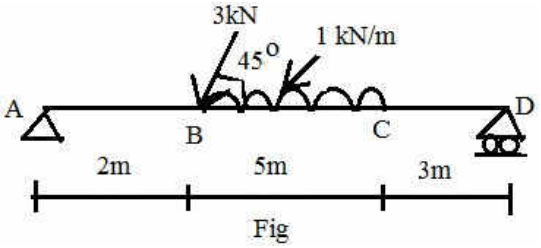
PART-B (16 Marks)

1. For the loaded beam shown in Fig determine (i) The reaction at each support (ii) The bending moment under the loads and hence the maximum bending moment. Also draw the shear force and bending moment diagrams.



Fig

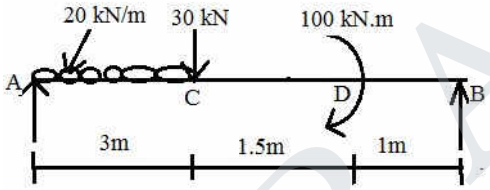
2. Draw the shear force and bending moment diagram for the beam shown in Fig. Indicate maximum positive bending moment and its location.



Fig

3. A beam 6m long and simply supported at each end has a uniformly distributed load of 800 N/m extending from the left end to a point 2 m away. There is also a clockwise couple of 1500 Nm. applied at the centre of the beam AB. Draw the shear force and bending moment diagrams for the beam and find the maximum bending moment.

4. Draw shear force and bending moment diagram for the beam shown in Fig.



5. A cantilever of length 4m carries a of 3KN/m run over the whole length and two point loads of 4KN and 2.5KN are place 1m and 2m respectively from the fixed end. Draw the shear force and BM diagram.

6. A T – section of a beam has the following dimensions width of the flange 100mm, overall depth 80mm, thickness of the web 10mm, thickness of flange 10mm. Determine the maximum bending stress in the beam, when the bending moment of 200 Nm is acting one of the section.

7. Two wooden planks 50mm x 150mm in section is used to form a Tee section as shown in fig. if a bending moment of 3400 Nm is applied with respect to the neutral axis. Find the extreme fibre stresses and the total tensile force.

8. A flitched beam consists of two timber joist 100mm wide and 240mm deep with a steel plate 180mm deep and 10mm thick placed symmetrically between the timber joists and well clamped. Determine

i) The maximum fibre stress when the maximum fibre stress in wood is 80 kg/cm^2.

ii) The combined moment of resistance if the modular ratio is 18.

9. A rectangular beam of width 100 mm and depth 200 mm is simply supported over a span of 6 m and carries a central concentrated load of 20 kN. Determine the maximum bending and shear stress in the beam and indicate where in the beam they occur. Plot the distribution of the stresses across the depth at any cross-section.

10. A rolled steel joist of section has the following dimension.

Flange width = 250 mm; Flange thickness = 25 mm

Overall depth = 800 mm; Web thickness = 12 mm

Calculate the safe 'UDL' per meter length of beam, if the beam, if the effective span is 8m and the maximum stress in steel is 100 N/mm^2.

UNIT III DEFLECTION OF BEAMS
PART – A (2 Marks)

1. What are the methods for finding out the slope and deflection at a section?
2. Why moment method is more useful when compared with double integration?
3. What is a conjugated beam?
4. Draw the variation of shear stress for a Tee section?
5. Sketch the shear stress distribution for a circular section. Indicate also the layer at which maximum stress occurs?
6. A cantilever beam of span 'L' is subjected to a concentrated load 'w' at free end. What would be the maximum slope and deflection?
7. Relate the rate of loading, shear stress, bending moment, slope and deflection by integral equations?
8. What is a shear center?
9. Write the maximum value of deflection for a cantilever beam of length L, constant EI and carrying concentrated load W at the end?
10. State the two theorems in moment area method?
11. Write the differential equation of deflection of a bent beam?
12. What are the boundary conditions for a simply supported end?
13. When Macaulay's method is preferred?
14. What is meant by double integration method?
15. What is meant by deflection of beams?
16. When do you prefer Moment area method?
17. What is the slope at the support for a simply supported beam of length L, constant EI and carrying central concentrated load?
18. What is meant by determinate and indeterminate beams?
19. What are the values of slope and deflection for a cantilever beam of length 'L' subjected to Moment 'M' at the free end?
20. Write the relation between deflection of bending moment and flexural rigidity for a beam?

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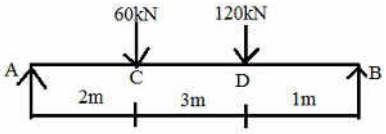
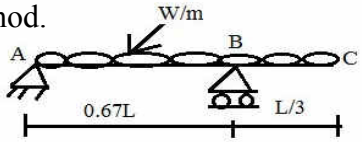
PART-B (16 Marks)

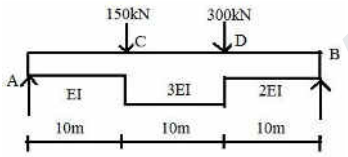
1. Obtain the deflection under the greater load for the beam shown in fig using the conjugate beam method.



2. For the beam shown in fig show that the deflection at the free end is $WL^4/684EI$. Use Macaulay's method.



3. Using conjugate beam method, obtain the slope and deflections at A, B, C and D of the beam shown in fig. take E = 200GPa and I = $2x10^{-2}$ m^4.



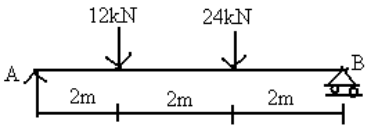
4. A simple beam of span 10m carries a udl of 3kN/m. The section of the beam is a T having a flange of 125x125mm and web 25x175mm. For the critical section obtain the shear stress at the neutral axis and at the junction of flange and the web. Also draw the shear stress distribution across the section.

5. A beam of channel section 120x60mm has a uniform thickness of 15mm. Draw the shear stress distribution for a vertical section where the shear force is 50kN. Find the ratio between the maximum and mean shear stress.

6. A beam AB of span 10m is simply supported at end A and B and is located as shown in figure. Take E = $200x10^6$ kN/m^2 and I = $8.5x10^8$ mm^4. Find the position and magnitude deflection using Macaulay's method.

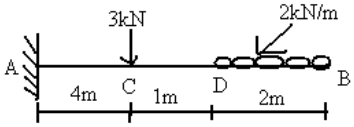
7. A cantilever of length 2.5m is loaded with an udl of 10 kN/m over a length 1.5m from the fixed end. Determine the slope and deflection at the free end. Determine the slope and deflection at the free end of the cantilever L = $9500cm^4$, E = 210 GN / m^2 using Moment area method.

8. Using double integration method, determine the deflection under the loads of the beam shown in fig.



9. A steel cantilever of 2.5m effective length carries a load of 25kN at its free end. If the deflection at the free end is not exceed 40mm. What must be the I value of the section of the cantilever. Take E = 210 GN/m^2 using moment area method.

10. Find the slope and deflection at the free end of the cantilever shows in fig. Take EI $=1x10^{10}kN/mm^2$.



UNIT 4- TORSION

PART – A (2 Marks)

1. What are the assumptions made in the theory of torsion?
2. Define torsion and polar modulus?
3. Write Torsional equation.
4. Why hollow circular shafts are preferred when compared to solid circular shafts?
5. Write the expression for power transmitted by a shaft.
6. The torque transmitted by a hollow shaft is given by …….....
7. What is leaf spring?
8. A circular shaft is subjected to a torque of 10kNm. The power transmitted by the shaft is 209.33kW. Find the speed of shaft in revolution per minute.
9. Define spring Indeed and spring stiffness.
10. What is a stepped shaft?
11. Compare close coiled and open coiled springs under the action of an axial load.
12. What is the value of maximum shear stress in a close coiled helical spring subjected to an axial force?
13. State the types of stresses when a closed coiled spring is subjected to (i) axial load and (ii) axial twisting moment.
14. Write the equation for strain energy stored in a shaft due to torsion.
15. What is the equivalent bending moment for a shaft subjected to moment M and torsion T?
16. A shaft is having a diameter of 30mm. What is its polar moment of inertia?
17. How will you apply a moment to produce bending in a shaft?
18. How will you apply a moment to produce torque in a shaft?
19. Write the expression for vertical deflection of the closed coiled helical spring due to axial load W.
20. What is spring? State various types of springs.

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PART-B (16 Marks)

1. i) Derive the torsion equation for a circular shaft of diameter'd' subjected to torque 'T'.

   ii) Find the torque that can be transmitted by a thin tube 6 cm mean diameter and wall thickness 1 mm. the permissible shear stress is 6000 N/cm^2.

2. A close coiled helical spring is made of a round wire having 'n' turns and the mean coil radius R is 5 times the wire diameter. Show that the stiffness of the spring = 2.05 R/n. If the above spring is to support a load of 1.2kN with 120mm compression. Calculate mean radius of the coil and number of turns assuming G = 8200 N/mm^2 and permissible shear stress, $\lambda_{allowable}$ = 250 N/mm^2.

3. A steel shaft ABCD having a total length of 2400mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameters 80mm and 50mm respectively, BC is solid and 80mm diameter. CD is also solid and 70mm in diameter. If the angle of twist is same for each section, determine the length of each portion and the total angle of twist. Maximum permissible shear stress is 50 MPa and shear modulus $0.82x10^5$ MPa.

4. It is required to design a close coiled helical spring which shall deflect 1mm under and axial load of 100N at a shear stress of 90 MPa. The spring is to be made of round wire having shear modulus of $0.8x10^5$ MPa. The mean diameter of the coil is to times that at the coil wire. Find the diameter and length of the wire.

5. A solid circular shaft transmits 75kW power at 200rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed one degree in 2m length of shaft and shear stress is not exceed 50 N/mm^2. Assume the modulus of rigidity of the material of the shaft as 100 kN/mm^2.

6. A shaft has to transmit 110 kW at 160rpm. If the shear stress is not to exceed 65N/mm^2 and the twist in a length of 3.5m must not exceed 1^o, find a suitable diameter. Take C = $8x10^4$ N/mm^4.

7. A leaf spring 750mm long is required to carry a central load of 8kN. If the central deflection is not to exceed 20mm and the bending stress is not to be greater than 200N/mm^2. Determine the thickness, width and number of plates. Assume the width of the plates is 12 times, their thickness and modulus of elasticity of the springs material as 200kN/mm^2.

8. A closely coiled helical spring made out of a 10mm diameter steel bar has 12 complete coils, each of mean diameter of 100mm. Calculate the stress induced in the section of rod, the deflection under the pull and the amount of energy stored in the spring during the extension. It is subjected to an axial pull of 200N. Modulus of rigidity is $0.84x10^5$ N/mm^2.

9. A close coiled helical spring has a stiffness of 5N/mm. its length when fully compressed with adjacent coils touching each other is 40 cm. the modulus of rigidity of the material of the spring is 0.8x10N/mm^2. Determine the wire diameter and mean coil diameter if their ratio is 1/10. What is the corresponding maximum shear stress in the spring?

10. A circular shaft of 1000mm diameter and 2m length is subjected to a twisting moment which creates a shear stress of 20N/mm^2 at 30mm from the axis of the shaft. Calculate the angle of twist and the strain energy stored in the shaft. Take G=$8x10^4$ N/mm^2.

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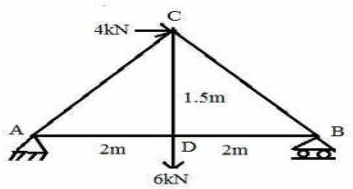
UNIT V ANALYSIS OF TRUSSES

PART – A (2 Marks)

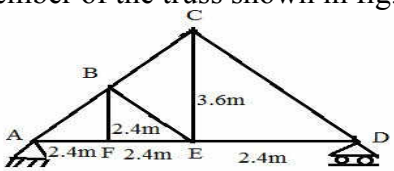
1. State the advantages of method of sections over the method of joints in the analysis of plane trusses.
2. What is a frame? How are frames classified?
3. Explain determinate and stable frame.
4. What are the equations of equilibrium for a truss as a whole and for a joint?
5. Method of joints is applicable only when the number of unknown forces at the joint under consideration is not more than _____.
6. What is tension co – efficient Method and Method of joints?
7. Write the expression for longitudinal strain and circumferential strain in the case of thin cylindrical shells.
8. What are the assumptions made in analyzing thin spherical shells?
9. A spherical shell of 800 mm is subjected to an internal pressure of 2 N/mm^2. Find the thickness of the shell if the allowable stress in the material of the shell is 100 N/mm^2
10. Define Deficient frame and redundant frame.
11. Define perfect and imperfect frame.
12. Explain the Methods of sections and Method of joints?
13. Write the equation of longitudinal strain in a cylindrical shell, which is subjected to an internal fluid pressure 'P'.
14. Define circumferential stress and longitudinal stress.
15. How to increase the strength of a thin cylinder?
16. The volumetric strain of a thin spherical shell is ---------- that of the linear strain.
17. In a perfect truss consists of 15 members, the number of joints are----------.
18. State any four methods of analyzing a frame.
19. What is the condition for a plane frame to be perfect?
20. Distinguish between thin walled cylinder and thick walled cylinder.

PART-B (16 Marks)

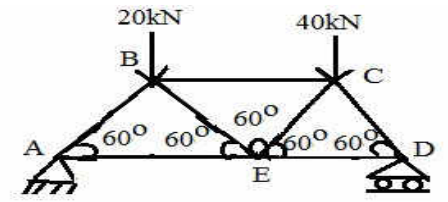
1. Find the forces in the members of the truss shown in Fig.



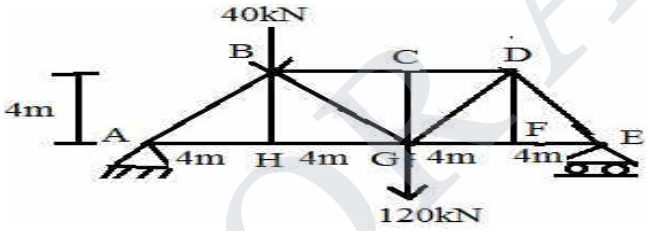
2. Find the forces in the member of the truss shown in fig. by method of sections.



3. Find the forces in all the members of the girder shown in Fig. by the method of joints, indicating whether the force is compressive or tensile.



4. Determine the forces in all members of a truss as shown in fig.



5. For the truss shown in fig find the forces in members CD, CB, BD and AE by method of joints.