SUBJECTNAME :STRENGTH OF MATERIALS

SUBJECT CODE: CE 2252

UNIT-1

ENERGY PRINCIPLES

PART-A **(1 MARKS)**

1**. The unit of stress in S.I units is**

a) n/mm^2 b)kN/mm^2 c)N/m^2 d)any one of these

2. **The deformation per unit length is called**

a) Tensile stress b) compressive stress c) shear stress d) strain

3**. The unit of strain is**

a)N-mm b)N/mm c)mm d)no unit

4) **Strain is equal to**

a) l/δl b)δl/l c)l.δl d)l+δl

5) **Hook law holds well up to**

a)yield point b)elastic limit c)plastic limit d)breaking point

6) **Whenever material is loaded within elastic limit, stress is…………strain.**

a) Equal to b) directly proportional to c) inversely proportional to.

7) **The ratio of linear stress to the linear strain is called.**

a) Modulus of rigidity b) modulus of elasticity c) bulk modulus d) Poisson's ratio

8) **The unit of modulus of elasticity is same as those of**

a) Stress, strain and pressure b) stress, force and modulus of rigidity

c) Strain, force and pressure b) stress, pressure and of rigidity

9) **When a change in length takes place, the strain is known as**

a) Linear strain b) lateral strain c) volumetric strain d) shear strain

10) The modulus of elasticity for mild steel is approximately equal to

a) 10 kN/mm^2 b) 80 kN/mm^2 c) 100 kN/mm^2 d) 210 Kn/mm^2

11.**young'smodulus may be defined as the ratio of**

a)linear stress to lateral strain b) lateral strain to linear stain

c) linear stress to linear strain d)shear stress to shear strain

12**. Modulus of rigidity may be defined as the ratio of**

a) linear stress to lateral strain b) lateral strain to linear stain

c) linear stress to linear strain   d)shear stress to shear strain

13. **The unit of young's modulus is same as that of stress**

a) equal to b) less than c) more then

14. **When a bars of different materials and same size are subjected to the same tensile force. If the bars have unit elongation in ratio of 2:5 then the ratio of modulus of elasticity of the two materials will be**

a) 2:5 b) 5:2 c) 4:3 d) 3:4

15. **Strainrosetters are used to**

Ultimate tensile) measure shear strain b) measure linear strain

c) Measure volumetric strain d) relieve strain

16. **The ultimate tensile stress for mild steel is……..the ultimate compressive stress**

a) equal to b) less than c) more then

17. **The maximum stress produced in a bar of tapering section is at**

a) Smaller end   b) larger end c) middle d) any where

18**. Modular ratio of the two materials is the ratio of**

a) Linear stress to linear strain b) shear stress to shear strain

c) Their modulus of elasticity d) their modulus of rigidities

19. **The shear modulus of most materials with respect to the modulus of elasticity is**

a) Equal to half   b) less than half c) more than half d) none of these

20. **a steel bar of 5 mm is heated from 15°c to 40°c and it is free to expand. The bar will induce**

a) No stress b) shear stress c) tensile stress d) compressive stress

ANSWERS:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
d	d	d	b	b	b	a	d	c	d	c	d	c	b	b	c	A	c	b	a

PART-B   (2 MARKS)

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

_ Strain = Change in length/Original length

e = _L/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 _ Strain

_ _ e

_ = Ee

E = _/e unit is N/mm^2

Where,

E - Young's modulus

_ - 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 = Stress

Strain

12. Define Bulk-modulus

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

K = Direct stress

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 = Shear stress

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

PART-C

(16 MARKS)

1.The following are the results of a tension test on a mild steel rod.

Given

(i)Diameter of the rod, d=16mm

(ii)Gauge length for deformation measurement=50mm

(iii)Load at the proportionality limit, p_p=48.5KN

(iv) Extension at the proportionality limit=0.05mm

(v)Load at yield point,p_y=50.3KN
(vi)Ultimate load,p_u=90.0kn
(vii)Final length between gauge points, l_1=64mm
(viii)Diameter of the neck at fracture,d_1=13.7mm
To find
(i) Young's modulus at elastic limit
(ii) Yield stress
(iii)Ultimate stress
(iv) Percentage of elongation
(v)Percentage reduction in area.

2.A stepped bar consists of two portions of lengths 700mm and 900mm with area of cross sections 400mm^2 and 625mm^2 respectively. It is subjected to an axial pull of 100 kn. If E=200kn/mm^2.find the total elongation.

3.A steel aluminum composite strut has the following dada. They are bonded together by epoxy.
Given
Length =1200mm
Area of c/s aluminum=360mm^2
Area of c/s steel =200mm^2
E_s=200Gpa
4. A mild steel bar of 600mm^2 cross sectional area and 3m long is rigidly fixed between two plates at the ends. If the bar is heated through 80^0 c, obtain the stress in the bar.
5. A mild steel bar is subjected to a tension test. The diameter of the bar is 36mm and its gauge length is 200mm. when it is subjected to an axial tensile force of 150kn the extension of the bar is 0.14mm and the decrease in diameter is 0.006mm. Calculate the young's modulus. Poisson ratio, modulus of rigidity and bulk modulus of the material of the bar.

UNIT-2
INDETERMINATE BEAMS
PART-A (1 MARKS)

1. **When a bar is cooling to -5°c, it will develop**

a) No stress b) shear stress c) tensile stress d) compressive stress

2. **The thermal stress in a bar is……. Proportional to the change in temperature**

a) Young's modulus b) modulus of rigidity c) bulk modulus

3. **The thermal stress……. Upon the cross-sectional area of the bar**

a) Depends   b) does not depend c) increase   d) decrease

4. **The thermal or temperature stress is a function of**

a) Increase in temperature b) modulus of elasticity

c) Coefficient of linear expansion d) all of these

5. **The deformation of the bar per unit length in the force is known as**

a) Linear strain b) lateral strain c) volumetric strain d) shear strain

6. **The ration of the lateral strain to the linear strain is called**

a) Modulus of elasticity   b) modulus of rigidity c) bulk modulus

d) Poisson's ratio

7. **Poisson's ratio is the ratio of linear strain to the volumetric strain.**

a) True   b) false

8. **The Poisson's ratio for steel form**

a) 0.23 to 0.27 b) 0.25 to0.33 c) 0.31 to 0.34 d) 0.**32 to 0.42**

9. Thepoisson's ratio for cast iron varies from

a) 0.23 to 0.27 b) 0.25 to 0.33 c) 0.31 to 0.34 d) 0.32 to 0.42

10. **When a bar of length l, width b and thickness t is subjected to a push of P, its**

a) Length, width and thickness increases

b) Length, width and thickness decreases

c) Length increases, width and thickness decreases

d) Length decreases, width and thickness increases

11. **The volumetric strain is the ratio of the**

a) Original thickness to the change in thickness

b) Charge in thickness to the original thickness

c) Original volume to the change in volume

d) Change in volume to the original volume

12. When a rectangular bar of length l, breadth b and thickness t is subjected to an axial pull of P, then linear strain (£) is given by

a) £=P/b.t.E   b) £=b.t.E/P   c) £=b.t/P.E   d) £=p.E/b.t

13. **When a body is subjected to three mutually perpendicular stresses, of equal intensity, the ratio of direct stress to the corresponding volumetric strain is known as**

a) Young's modulus   b) modulus of rigidity c) bulk modulus

d)Poisson's ratio

14. **The relation betweenyoungsmodulus (E) and bulk modulus (K) is given by**

a)k=3m-2/m4 b) k=mE/3m-2   c) k=3(m-2)/mE d) mE/3(m-2)

15**. The ratio of bulk modulus to young's modulus for a Poisson's ratio of 0.25 with be**

a) 1/3   b)2/3   c) 1 d) 3/2

16**) When a cube is subjected to three mutually perpendicular tensile stresses of equal intensity the volumetric strain is**

a) 3σ/E(1-2/m)   b) E/3σ(1-2/m) c)3σ/E(2/m-1) d)E/3σ(2/m-1)

17**. The relation between modulus of elasticity and modulus of rigidity is given by**

a)c=mE/2(m+1) b) c=2(m+1)/mE C)2mE/m+1 d)c=m+1/2mE

18.**If the modulus elasticity of a material is twice its modulus of rigidity then the poisons ratio of the material equal to zero**

a) Length, width and thickness increases

b) Length, width and thickness decreases

c) Length increases, width and thickness decreases

d) Length decreases, width and thickness increases

11. The volumetric strain is the ratio of the

19. **The relation between young's modulus (E) shear modulus(C) and bulk modulus(K) is given by**

a)E=3K.C/3K+C b) E=6K.C/3K+C c)E=9K.C/3K+C d)E=12.C/3K+C

20.**The planes which carry no shear stress are known as principal planes** a)c=mE/2(m+1) b) c=2(m+1)/mE C)2mE/m+1 d)c=m+1/2mE

ANSWERS:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
c	b	c	d	a	d	A	b	c	c	d	d	c	d	b	a	a	b	c	A

PART-B (2 MARKS)

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 isknow 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.

14. Define thin cylinder?
If the thickness of the wall of the cylinder vessel is less than 1/15 to 1/20 of its internal diameter, the cylinder vessel is known as thin cylinder.

15. What are types of stress in a thin cylindrical vessel subjected to internal pressure?
These stresses are tensile and are know as
_ Circumferential stress (or hoop stress) and
_ Longitudinal stress.

16. **What is mean by Circumferential stress (or hoop stress) and Longitudinal stress?**
The stress acting along the circumference of the cylinder is called circumferential stress (or hoop stress) whereas the stress acting along the length of the cylinder is known as longitudinal stress.

17. What are the formula for finding circumferential stress and longitudinal stress?
Circumferential stress (f1) is given by as f1 = p x d / 2t x _l and the
longitudinal stress (f2) is given by f2 = p x d / 2t x _c
.

18. What are maximum shear stresses at any point in a cylinder?
Maximum shear stresses at any point in a cylinder, subjected to internal fluid pressure is given by f1 –f2 / 2 = pd / 8t

19. What are the formula for finding circumferential strain and longitudinal strain?
The circumferential strain (e1) and longitudinal strain (e2) are given by
e1 = pd / 2tE (1- 1/2m), e2 pd / 2tE (1/2 – 1/m).

20. What are the formula for finding change in diameter, change in length and change volume of a cylindrical shell subjected to internal fluid pressure p?
_d = pd2 /2tE (1 – 1/2m),

_L = pdL /2tE (1/2 – 1/m),
_V = pd /2tE (5/2 – 2/m) x volume,

21. What are the formula for finding principal stresses of a thin cylindrical shell subjected to internal fluid pressure p and a torque?

Major Principal Stress = f1 + f2 / 2 + _ {(f1 - f2 /2)2 + fs
2}
Minor Principal Stress = f1 + f2 / 2 -_ {(f1 - f2 /2)2 + fs
2}
Maximum shear stress = ½ [Major Principal Stress - Minor Principal Stress]
Where f1 = Circumferential stress,
f2 =Longitudinal stress,
fs =shear stress due to torque.

PART-C (16 MARKS)

1. A cylindrical pipe of diameter 1.5m and thickness 1.5cm is subjected to an internal fluid pressure of 1.2 N/mm^2
Given
d=1.5m
t=1.5cm=1.5x10^2m
p =1.2N/mm^2

2. A cylindrical shell 2.5m long and 0.9m in diameter is subjected to an internal pressure of 2 N/mm^2. The wall thickness is 12 mm.Determine the change in length and diameter. E=210Gpa. V=0.3.

3. A spherical shell of 1.4m diameter is subjected to internal pressure of 2.2N/mm^2. If the permissible stress in the material of the shell is 140N/mm^2 and the efficiency of the joint is 75% determine the minimum thickness of the shell required. Also determine the change in volume if E=2x$10^5$$N/mm^2$and v= 0.3.

4. A cylindrical shell 3m long has 1 m internal diameter and 15mm metal thickness. Calculate the circumferential and longitudinal stresses induced and also determine the change in diameter and change in length, if it is subjected to an internal pressure of 150N/cm^2.Take E=200$kN/mm^2$and v=0.3.

5. A thin cylindrical shell 1000mm long has 220mm external diameter. Thickness of metal is 10mm. it is filled with a fluid at atmospheric pressure. If an additional 25x10^3 of the fluid is pumped into the cylinder, find the pressure exerted by the fluid on the wall. Take E=2x$10^5$$N/mm^2$ and poisons ratio =0.3 find also the hoop.

UNIT-3

COLUMNS

PART-A **(1MARKS)**

1. **For the above question, the minimum normal stress will be**

a) 400 Map b) 500 Map c) 900MPa d) 1400 Map

2. **When a body is subjected to a direct tensile stress (σ) in one plane accompanied by a simple shear stress (τ), the normal stress is**

a) σ/2+1/2 b) σ/2-1/2

c)σ/2+1/2 d)1/2

3. **When a body is subjected to a direct tensile stress (σ) in one plane accompanied by a simple shear stress (τ) ,the maximum shear stress is**

a)σ/2+1/2 b)σ/2-1/2

c)σ/2+1/2 d)1/2

4. **A body is subjected to a direct tensile stress of 300MPa in one plane accompanied by a simple shear stress of 200MPa. The maximum normal stress will be**

a)-100MPab) 250 Map c) 300 Map d)400 Map

5**. For the above question, the maximum normal stress will be**

a) -100 Map b) 250 Map c) 300 Map d) 400MPa

6. **A body is subjected to a direct stress of 300MPa in one plane accompanied by a simple shear stress of**

200MPa.The maximum normal stress will be

a)-100 Map b)250 Map C) 300MPa D) 400MPa

7. **A body is subjected to a tensile stress of 1200 Map on one plane and another tensile stress of 600 Map on a plane at right angles to the former. It is also subjected to a shear stress of 400 Map on the same planes. The maximum normal stress will be**

a) 400 Map b) 500 Map c) 900MPa d) 1400 Map

8**. Forthe above question, the minimum normal stress will be**

a) 400 Map   b) 500 Map c) 900MPa d) 1400 Map

9**. For question No. 95, the maximum normal stress will be**

a) 400 Map   b) 500 MPac) 900MPa   d) 1400 Map

10**. A body is subjected to two normal stresses 20 kN/m^2 (tensile) and 10 kN/m^2 (compressive) acting perpendicular to each other. The maximum shear stress is**

a) 5 kN/m^2 b) 10 kN/m^2 c) 15 kN/m^2 d) 20 kN/m^2

11. For **biaxial stress the planes of maximum shear are at right angles to each other and are inclined at 45°to the principal planes.**

(a) Zero (b) maximum tensile (c) minimum tensile (d) maximum compressive

12. **The state of stress at a point in a loaded member is shown in. The magnitude of maximum shear stress is**

a) 10 Map b) 30 Map c) 50 Map d) 100 Map

13. **The maximum shear stress is equal to the radius of Mohr's circle.**

(i) Equal to (b) directly proportional to (c) inversely proportional (d) independent of

14**. The energy stored in a body when strained within elastic limit is known as**

a) Resilience   b) proof resilience c) impact energy   d) modulus of resilience

15. **The proof resilience is the maximum strain energy which can be stored in a body.**

a) 400 Map b) 500 Map c) 900MPa d) 1400 Map

16. **Theproof resilience per unit volume of a material is known as modulus of resilience.**

a) Resilience   b) proof resilience c) impact energy   d) modulus of resilience

17**. Strain energy is the**

a)energy stored in a body when strained within elastic limits

b) Energy stored in a body when strained up to the breaking of a specimen

c) Maximum stain energy which can be stored in a body

d) Proof resilience per unit volume of a material

18**. Resilience is the**

a)energy stored in a body when strained within elastic limits

b) Energy stored in a body when strained up to the breaking of the specimen

c) Maximum strain energy with can be stored in a body

d) None of the above

19. **The strain energy stored in a body, when the load is gradually applied, is**

a) **σE/V** b) **σV/E** c) **σ^2E/2V** d) **σ^2V/2E**

20. The capacity of a strained body for doing work on the removal of the straining force

a) Strain energy b) resilience c) proof resilience d) impact energy

ANSWERS:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	b	d	d	A	d	a	a	b	C	c	b	a	d	a	c	d	d	d	b

PART-B (2 MARKS)

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 uniformthrough 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 OfBM 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.

PART-C **(16 MARKS)**

1..A beam is 7m long and is simply supported at 2.5m from the other end .There is a uniformly distributed load of 30kn per meter over together with point loads of 60kn at 1.5from 3m sketching the bending moment and shear force diagram. Calculate the maximum B.M and the point at which it occurs

2.Calculate the reactions, shears and bending moments on the beam. Draw the SFD and BMC.locate the points of contra flexure

3.A 75 mm wide and 12mm thick steel plate is bent into a circular are of radius 8.5m. Determine (i) the maximum bending stress induced (ii) the bending moment which will procedure the above maximum bending stress. $E=2X10^5 n/mm^2$

4.A beam of rectangular cross section 200mm deep and 100mm wide is subjected to a pure sagging bending moment of 500Knm. Determine the maximum bending stress in the beam. If the value of modulus of elasticity for the beam materials $200kn/mm^2$, find the radius of curvature of that portion of the beam. Also calculate the value of bending stress at a distance of 25mm below the top surface of the beam.

5.A hollow circular bar having external diameter 1.6times the inner diameter is used as a beam. If the bar is to be subjected to a bending moment of 72 kNm and the allowable bending stress in the beam is limited to 95 MN/m^2, find the inner and outer diameter of the bar.

UNIT –IV
STATE OF STRESS IN THREE DIMENSIONS

PART- A **(1 MARKS)**

1. **The bending moment at a section trends to bend or defect the beam and the internal stresses resist bending. The resistance offered by the internal stresses, to the bending is called**

a) Compressive stress b) shear stress c) bending stress d) elastic modulus

2**. When a beam is subject to a bending moment, the strain in a layer is the distance from the neutral axis.**

(i) Equal to (b) directly proportional to (c) inversely proportional (d) independent of

3. **When a beam is subjected to bending moment, the stress at any point is the distance of the point from the neutral axis**

(a) Equal to (b) directly proportional to (c) inversely proportional (d) independent of

4. **The neutral axis of the cross- section a beam is that axis at which the bending stress is**

(a) Zero (b) minimum (c) maximum (d) infinity

5**. The section modulus of a beam is given by**

(a)I/Y (BIY (c) y/I (d)M/I

6. **Thesection modulus of a rectangular section about an axis through its C.G, is**

(a)b/2 (b) d/2 (c)bd/2 (d) bd/6

7. **The section modulus of a circular section about an axis through its**

(a)πd/4 (b)πd/16 (c)πd/18 (d)πd/32

8**. When the cantilever beam is located at its free end, the maximum compressive stress shall developat**

(a) Bottomfibre (b) top fiber (c) neutral axis (d) centre of gravity

9**. A beam of uniform strength has**

(a) Same cross- section throughout the beam (b) same bending stress at every section (c) same bending moment at every at section (d) same shear stress at every section

10**. The bending stress in a beam is bending moment**

(a) Equal to (b) less than (c) more than (d) directly proportional to

11. **The neutral axis of a beam is subjected to stress**

(a) Zero (b) maximum tensile (c) minimum tensile (d) maximum compressive

12. **In a beam subjected to pure bending the intensity of stress in any fiber is the distance of the fiber from the neutral axis**

(a) Equal to (b) less than (c) more than (d) directly proportional

13. **When a rectangular beam is loaded transversely, the maximum tensile stress is developed on the**

A) Top layer b) bottom layer c) neutral axis d) every cross section

14**. When the rectangular beam is loaded transversely, the maximum compressive stress developed on the**

a) Top layer b) bottom layer c) neutral axis d) every cross section

15. **At the neutral axis of a beam, shear stress is**

a) Zero b) minimum c) maximum d) infinity

16. **The ratio of maximum shear stress developed in rectangular beam and circular beam of a same cross sectional area is**

a)2/3 b)3/4 c)1 d)9/8

17. **A beam of triangular section is placed, with its base horizontal. The maximum shear stress occur at**

a) apex of triangle b) mid of the height

c) Center of gravity of angle d) base of triangle

18**. The maximum shear stress developed in a beam of rectangular section is …………………. Of average shear stress**

a) Equal to b) 4/3 times c) 1.5 times d) twice

19. **A rectangular beam of length l supported at its ends carries a central point load W. the maximum deflection occurs**

a) At the ends b) at the center c) at l/3 from both ends d) none of these

20. When the rectangular beam is loaded transversely, the maximum compressive stress developed on the

a) Top layer b) bottom layer c) neutral axis d) every cross section

ANSWERS:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	c	b	d	d	a	a	b	d	A	b	d	d	d	b	c	c	b	d	d

PART-B **(2 MARKS)**

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

$\bar{Y}$ = 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.

PART-C **(16 MARKS)**

1. A cantilever of length 2.8 m carries audl of 14 KN/m over the entire span. If the moment of inertia of the beam is 10^8 mm and value of E =2.1×10^5 N/mm^2, derive expression for slope and deflection. Find these values at the free end.

2. A beam of rectangular cross section is 250mm wide and 300mm deep and of length 6m is simply supported and carries a uniformly distributed load of 10KN/m over the entire span. Calculate the (i) shear force at 2m from the left support (ii) shear stress distribution at every 100mm level from the top surface. Sketch the shear distribution

3. The cross section of a beam is if the maximum shear force in the beam is 180KN; obtain the distribution of shear stress across the depth of the beam.

4.. Find the diameter of a solid shaft to transmit a power of 112.5 kw at 269r.p.m take the allowable shear stress as 60N/mm^2 .The maximum torque transmitted at each revolution exceeds the mean by 20%.

UNIT –V
ADVANCED TOPICS IN BENDING OF BEAMS

PART-A (1 MARKS)

1. **A shaft of diameter of diameter D is subjected to a twisting moment and a bending moment .if the maximum bending stress is equal to maximum shear stress developed, then M is equal to**

(a)T/2 (b)T ()c) 2T (d) 4T

2**. In spring balance, the spring is used**

(a) To apply forces (b) to measure forces (c) to absorb (d) to store strain energy

3. **The spring is breaks and clutches are used to**

(a) To apply forces (b) to measure forces (c) to store strain energy (d) to absorb shocks

4**. A spring used to absorb shocks and vibrations is**

(a) Conical spring (b) torsion spring (c) leaf spring (d) disc spring

5. **The load required to procedure a unit deflection in a spring is called**

(a) Flexural rigidity (b) torsion rigidity (c) spring stiffness (d) young's modulus

6. **A leaf spring is supported at the**

(a) Ends and loaded at the centre (b) centre and loaded at the ends (c) ends and loaded anywhere (d) centre and loaded anywhere

7. **When a closely – coiled spring is subjected to an axial load it is said to be under**

(a) Bending (b) shear (c) torsion (d) crushing

8. **Two closely coiled helical spring are equal in all respects but the number of turns of spring is half that .the ratio of deflection in spring**

(a)1/8 (b)1/4 (c) ½ (d) 2

9**. A closed- coiled helical spring is cut into two hales. The stiffness of the resulting spring will be**

(a) Same (b) double (c) half (d) one- fourth

10. **In a riveted joint, when the number of rivets decreases from the inner most row to outer most row, the joint is said to be**

(a) Chain riveted (b) zigzag riveted (c) diamond riveted (d) none of these

11**. Thecentre to centre distance, between two consecutive rivets in a row, is called**

(a) Margin (b) pitch (c) back pitch (d) diagonal pitch

12. **Thedistance between the centre of a rivet hole to the nearest edge of plate, is called**

(a) Margin (b) pitch (c) back pitch (d) diagonal pitch

13. **Rivets are generally specified by**

(a) Thickness of plates to be jointed (b) overall length (c) shank diameter (d) diameter of head

14. **The object of caulking in riveted joints is to make the joint**

(a) Free from corrosion (b) stronger in tension (c) free from stress (d) leak- proof

15. **A riveted joint may be fail by**

(a) Tearing of the plate at an angle (b) tearing of the plate cross a row of rivet (c) shearing of rivets (d) any one of these

16**. A double strap butt joint with equal straps is**

(a) Always in single shear (b) always in double shear (c) either in single shear or double shears (d) none of theses

17. Whenever material is loaded within elastic limit, stress is…………strain.

a) Equal to b) directly proportional to c) inversely proportional to.

18**) The ratio of linear stress to the linear strain is called.**

a) Modulus of rigidity b) modulus of elasticity c) bulk modulus d) poison's ratio

19.) **The unit of modulus of elasticity is same as those of**

a) Stress, strain and pressure b) stress, force and modulus of rigidity

c) Strain, force and pressure b) stress, pressure and of rigidity

20. **When a change in length takes place, the strain is known as**

a) Linear strain b) lateral strain c) volumetric strain d) shear strain

ANSWERS:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	b	a	c	c	c	c	d	c	c	c	d	c	c	d	B	c	b	a	d

PATR-B **(2 MARKS)**

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

o The material of the shaft is homogeneous, perfectly elastic and obeys Hooke's law.

o Twist is uniform along the length of the shaft

o The stress does not exceed the limit of proportionality

o The shaft circular in section remains circular after loading

o 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 = _ D4

32

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=C_/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=2_NT/60

N-speed in rpm

T-torque

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

T= (_/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=_/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

Pitch=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 veryclosely, each turn is nearly at rightangles to the axis of helix

The wires are coiled such that thereis a gap between the two consecutive turns.

Helix angle is less than 10_o Helix angle is large (>10_o)

PART-C **(16 MARKS)**

1. A solid circular shaft of diameter 230mm transmits 187.5kw at 220r,p,m find the maximum shear stress induced in the shaft.

2.. A hollow shaft, the internal diameter of which is 0.7 times the external diameter, is to transmit 380 kw at 140 r.p.m. the shear stress is not to exceed 70 N/mm$^{2.}$ Find the external and internal diameter assuming that the maximum torque is 1, 25 times the mean.

3.. A carriage spring consists of 6 plates of steel, the cross section of each plat being 60mm wide and 6 mm thick. The length of the longest plate is 1040mm. the central load required to straighten the spring is 4KN. Modulus of elasticity of the material of the spring=2x10N/mm

4..A close helical spring carries an axial load of 300N, it has 12 coils of wire diameter 16mm. the mean coil diameter is 250 mm.

5.. A shaft is required for transmitting a power of 60 Kw running at a speed of 750 r.p.m. if the available shaft material has permissible shear strength of 36 N/mm and rigidity modulus of 96Kn.mm design a hollow shaft such that the inner diameter is 0.6 times the outer diameter.