UBMCC09 Strength of Materials

II year BE-Naval Architecture & Offshore Engineering (2017-2018)

Unit 1 Stress and Strain

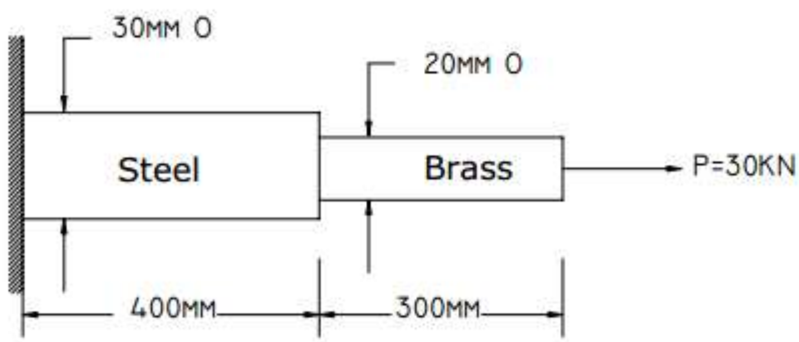
Part A

1. Define Load.
2. Define stress and strain.
3. State Hooke's Law?
4. Define elastic limit.
5. Differentiate Elasticity and Elastic limit
6. Define young's Modulus.
7. What are the Elastic Constants?
8. Define Shear stress and Shear strain.
9. Define modulus of rigidity.
10. Distinguish between rigid and deformable bodies.
11. Define volumetric strain
12. Define Poisson's Ratio.
13. Define tensile stress and compressive stress.
14. Define: Resilience, proof resilience and modulus of resilience.
15. Define thermal stress.
16. Obtain the relation between E and K.
17. What is Factor of Safety?
18. State the principle of Super Position.
19. State the relationship between Young's modulus (E) and Bulk modulus (K) Shear modulus(G).
20. What is strain energy and write its unit in S.I. system?

Part B

1. A steel bar 20mm in diameter, 2m long is subjected to an axial pull of 50kN. If $E=2x10^5$ N/mm^2 and m=3. Calculate the change in the 1.length, 2.diameter and 3.volume.
2. Explain briefly 1. Volumetric Strain 2. Volumetric stress 3. Shear strain.
3. Explain in detail stresses in compound bar.
4. An elastic rod 25mm in diameter, 200mm long extends by 0.25mm under a tensile load of 40kN. Find the intensity of stress, the strain and the elastic modulus for the material of the rod.
5. A bar of 30mm diameter is subjected to a pull of 60kN.The measured extension on gauge length of 200mm is 0.09mm and the change in diameter is 0.0039mm. Calculate the poisson's ratio and the value of the three moduli.
6. A prismatic steel bar 625mm long is stretched 0.625mm by a tensile force in KN. If the volume of the bar $410*10^3$ mm^3 Take E=2 X 105 N/mm^2.
7. A straight bar of steel rectangular in section is 3m long. The width of rod varies from 100mm at one end and 40mm of other end. A rod is subjected to an axial tensile load of 40KN and extension of the bar is limited to 0.5mm. Final minimum thickness required for bar material 2 X 105 N/mm^2.

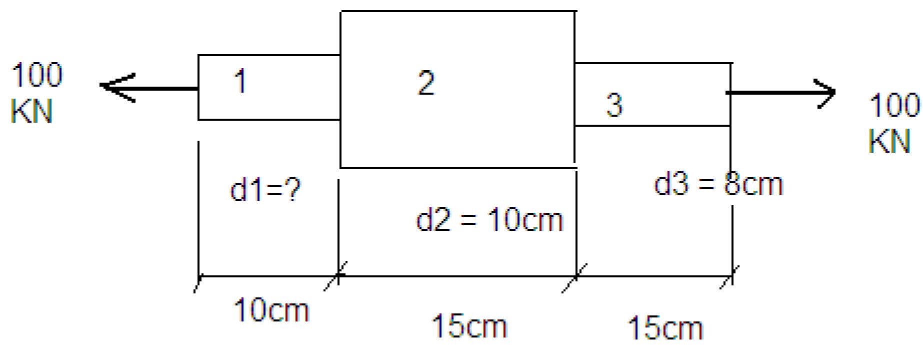
8. A bar of steel is of length 400mm and its uniform thickness 10mm. The width of the bar varies uniformly from 20mm at one end to 60mm at other end. Find out the axial deformation in the bar when it carries an axial force 20KN Take E=2 X 105 N/mm^2.
9. A rectangular block 350mm long, 100mm wide and 80mm thick is subjected to axial load as follows. 50kN tensile in the direction of length, 100kN compression in the direction of thickness and 60kN tensile in the direction of breadth. Determine the change in volume, bulk modulus, modulus of rigidity. Take E= 2x10^5 N/mm^2 and Poisson's ratio=0.25.
10. Draw the stress-strain curve for tension test on a M.S. specimen and mark the significant points on it.
11. Write the expression for Young's modulus (E) and Bulk modulus (K) Shear modulus(G).
12. Explain in details Elastic Constants.
13. A straight bar 450mm long is 20mm in diameter for the first 250mm length and 10mm diameter for the remaining length. If the bar is subjected to an axial pull of 10kN find the extension of the bar. Take E= 2x105 N/mm^2
14. The Composite bar shown in figure is subjected to a tensile force of 30 KN. The extension observed is 0.372mm. Find the Young Modulus of brass, If Young Modulus of steel is 2 X 105 N/mm^2



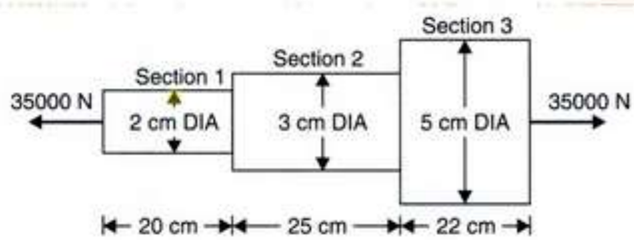
15. A rod of 2 m length and 40 mm diameter is subjected to a pull of 30 kN. The extension in length is 0.3 mm and the decrease in diameter is 0.0018 mm. Find the three moduli and Poisson's ratio.

Part C

1. Calculate the change in diameter of a short iron column when it carries a compressive load 800KN original diameter is 80mm and E=1*10^5 N/mm^2, poison ratio is 0.25.
2. A rod of 10mm diameter and a length of 200mm elongates 0.5mm and an axial load of 50KN. If the change in diameter is 0.1mm calculate the values of modulus of elasticity, poisson ratio bulk modulus and rigidity modulus.
3. A rod of a length 200mm and diameter 10mm is subjected to an axial force of 10KN. if E=2*10^{5}Mpa and poissons ratio is 0.3. Find the change in dimensions of the rod.
4. A round bar as shown in fig. is subjected to an axial tensile load of 100 KN. Determine (d) of the first part if the stress in the first bar is 100 MN/ m^3. Find also total elongation. Take E = 290GPa.



5. An axial pull of 35000N is acting on a bar consisting of three lengths as shown in fig. If the Young's modulus = 2.1×10^5 N/mm^2, determine: (i) stresses in each section and (ii) total extension of the bar.



6. A steel rod of 3cm diameter is enclosed centrally in a hollow copper tube of external diameter 5cm and internal diameter 4cm. The composite bar is then subjected to an axial pull of 45000N. If the length of each bar is equal to 15cm. Determine (i) The stresses in the rod and tube, and (ii) Load carried by each bar. Take E for steel = 2.1×10^5 N/mm^2 and for copper = 1.1×10^5 N/mm^2

Unit II Principal Stresses and strains

Part A

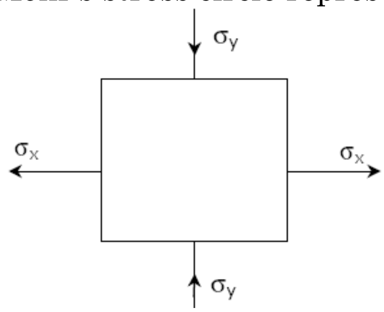
1. Define Uni-axial stress.
2. Define Bi-axial stress.
3. Define Tri-axial stress.
4. Define axial stress.
5. Define Hydrostatic stress.
6. Define aspect angle.
7. Define Principal planes.
8. Write expression for Maximum Principal stress when subjected to direct stress.
9. Write expression for Minimum Principal stress when subjected to direct stress.
10. State the use of Mohr's circle.
11. State the use of strain rosette.
12. Define complementary stresses.
13. Write expression for Maximum Principal stress when subjected to direct stress and shear.
14. Write expression for Minimum Principal stress when subjected to direct stress and shear.
15. Define Principal stresses.
16. Draw the Mohr's circle for a state of pure shear and indicate the principal stresses
17. Give two methods to compute principal stresses?
18. Define principal strain.
19. What is the value of value maximum shear stress when the principal stresses are P_1 and P_2?
20. An element is subjected to shear stress q only. Write the value of principal stress.

Part B

1. A metal block of 100 mm^2 cross sectional area carries an axial tensile load of 10 kN. For a plane inclined at 30^o with the direction of applied load, calculate: (a) Normal stress (b) Shear stress (c) Maximum shear stress.
2. Find the diameter of circular bar which is subjected to if the maximum allowable shear stress is 60N/mm^2 and axial force is 180KN
3. A rectangular ball of cross sectional area 12000mm^2 is subjected to an axial force of 360 KN. Determine the normal stress and shear stress on the section when it is inclined at an angle of 30^0 with normal cross section of thebar.
4. A prismatic bar of 500 mm^2 cross sectional area is axially loaded with a tensile force of 50 kN. Determine all the stresses acting on an element which makes 30^o inclination with the vertical plane.
5. At a point in a crank shaft the stresses on two mutually perpendicular planes are 30 MPa (tensile) and 15 MPa (tensile). The shear stress across these planes is 10 MPa.Find the normal and shear stress on a plane making an angle 300 with the plane of first stress. Find also magnitude and direction of resultant stress on the plane.
6. The principal tensile stresses at a point across two perpendicular planes are 100 MPa and 50 MPa. Find the normal and tangential stresses and the resultant stress and its obliquity on a plane at 200 with the major principal plane.
7. A body is subjected to a pure tensile stress of 100 units. What is the maximum shear produced in the body at some oblique plane due to the above?
8. A solid circular shaft of diameter 100 mm is subjected to an axial stress of 50 MPa. It is further subjected to a torque of 10 kNm. The maximum principal

stress experienced on the shaft is closest to ?

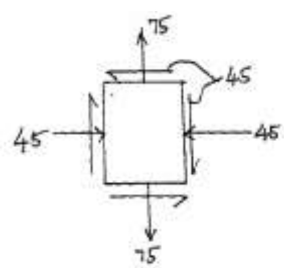
9. In a bi-axial stress problem, the stresses in x and y directions are (σx = 200 MPa and σy =100 MPa. The maximum principal stress in MPa ?
10. The normal stresses at a point are σx = 10 MPa and, σy = 2 MPa; the shear stress at this point is 4MPa. The maximum principal stress at this point is ?
11. The figure shows the state of stress at a certain point in a stressed body. The magnitudes of normal stresses in the x and y direction are 100MPa and 20 MPa respectively. The radius of Mohr's stress circle representing this state of stress is



12. If the two principal strains at a point are 1000 × 10^{-6} and -600 × 10^{-6}, then the maximum shear strain is?
13. A point in a strained material is subjected to two mutually perpendicular tensile stress of 200 MPa and 100 MPa. Determine the intensities of normal, shear and resultant stresses on a plane inclined at 30° with the axis of the minor tensile stress.
14. A point is subjected to a tensile stress of 250 MPa in the horizontal direction and another tensile stress of 100 MPa in the vertical direction. The point is also subjected to a simple shear stress of 25 MPa, such that when it is associated with the major tensile stress, it tends to rotate the element in the clockwise direction. What is the magnitude of the normal and shear stresses on a section inclined at an angle of 20° with the major tensile stress?
15. Direct tensile stresses of 120 MPa and 70 MPa act on a body on mutually perpendicular planes. What is the magnitude of shearing stress that can be applied so that the major principal stress at the point does not exceed 135 MPa? Determine the value of minor principal stress and the maximum shear stress.

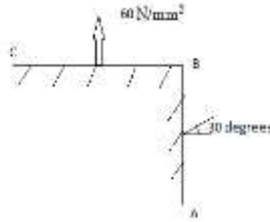
Part C

1. The state of stress (in N/mm^2) acting at a certain point of the strained material is shown in Fig. Compute (i) The magnitude and nature of principal stresses and (ii) The orientation of principal planes.



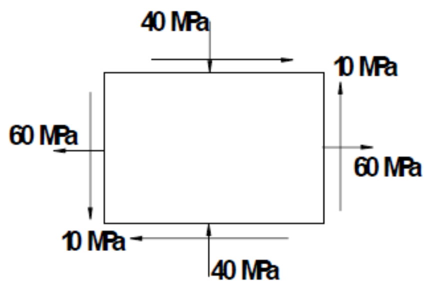
2. At a point in a strained material the principal stresses are 100 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Determine normal stress, shear stress, resultant stress on a plane inclined at 50 degrees to the axis of the major principal stress. Also determine the maximum shear stress at the point.

3. The intensity of the resultant stress on a plane AB (as shown in fig) at a point in a material under stress is 80N/mm^2 and is inclined at 30o to the normal tp that plane. The normal component of stress on another plane BC, at right angles to the plane AB is 60N/mm^2. Determine the following:
   A) The resultant stress on the plane BC
   B) The principal stresses and therir directions
   C) The maximum shear stresses and their planes.



4. Draw Mohr's circle for principal stresses of 80N/mm^2 tensile and 50 N/mm^2 compressive and find the resultant stresses on the plane making 22^o and 64^o with major principal plane. Find also the normal and tangential stresses on these planes.

5. A plane element is subjected to stresses as shown in fig. Determine principal stresses maximum shear stress and their planes. Sketch the planes determined.



6. At a point in a bracket the normal stresses on two mutually perpendicular planes are of 120 N/mm^2 tensile and 60 N/mm^2 tensile. The shear stress across these planes 30 N/mm^2. Find using the Mohr's stress circle, the principal stresses and maximum shear stress at the point.

Unit III Shear force and Bending Moment

Part A

1. Define beam?

2. What is mean by transverse loading on beam?
3. What is Cantilever beam?
4. What is simply supported beam?
5. What is mean by over hanging beam?
6. What is mean by concentrated loads?
7. What is uniformly distributed load.
8. Define point of contra flexure? In which beam it occurs?
9. What is mean by positive or sagging BM?
10. What is mean by negative or hogging BM?
11. Define shear force and bending moment?
12. When will bending moment is maximum?
13. What is the maximum bending moment in a simply supported beam of span 'L' subjected to UDL of 'w' over entire span?
14. In a simply supported beam how will you locate point of maximum bending moment?
15. What is shear force?
16. Why shear force and bending moment diagram?
17. What are the types of beam?
18. What are the types of load on a beam?
19. In which point the bending moment is maximum?
20. Draw the SF and BM diagrams for a simply supported beam 2m long carrying a gradually varying load from zero at one end to 2500N/m at the other end.

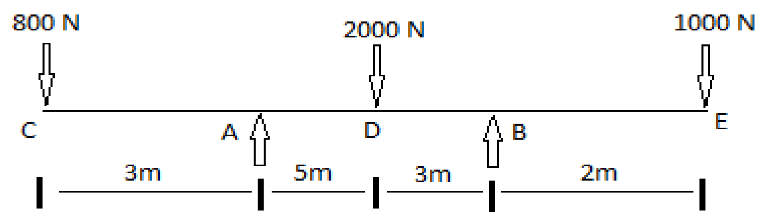
Part B

1. What are the different types of beam? Explain briefly.
2. Draw the shear force diagram for a cantilever beam of span 4m and carrying a point load of 50 KN at mid span.
3. A cantilever beam 3 m long carries a load of 20 KN at its free end. Calculate the shear force and bending moment at a section 2 m from the free end.
4. A Simply supported beam of effective span 6 m carries three point loads of 30 KN, 25 KN and 40 KN at 1m, 3m and 4.5m respectively from the left support. Draw the SFD and BMD.
5. A Simply supported beam of length 6 metres carries a UDL of 20KN/m throughout its length and a point of 30 KN at 2 metres from the right support. Draw the shear force and bending moment diagram.
6. Write down relations for maximum shear force and bending moment in case of a cantilever beam subjected to uniformly distributed load running over entire span.
7. Draw the shear force diagram for a cantilever beam of span 4 m and carrying a point load of 50 KN at mid span.
8. Draw shear force and bending moment diagrams for a 6m long simply supported beam that carries a point load of 12kN at 2m from the left end.
9. A point load of 20kN is applied at the free end of a cantilever of 10m long. Draw the SF and BM diagrams for the cantilever.
10. What is the maximum bending moment and shear force in a simply supported beam of span 'L' subjected to UDL of 'w' over entire span?
11. What is mean by negative or hogging BM?

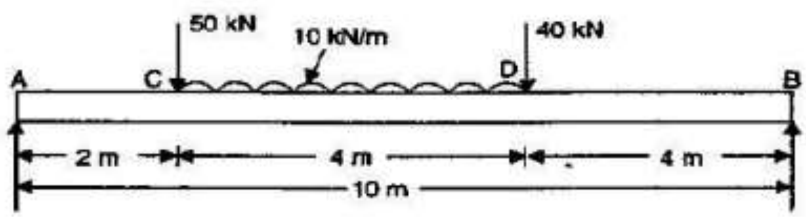
12. What will be the shape of bending moment and shear force diagrams for different types of load in a cantilever beam.
13. A simply supported beam is subjected to u.d.l of 20kN per unit length throughout its length 10m. Calculate the value of maximum bending moment.
14. A cantilever beam is subjected to u.d.l of 10kN per unit length throughout its length 10m. Calculate the value of maximum bending moment.
15. State the relationship between shear force and bending moment.

Part C

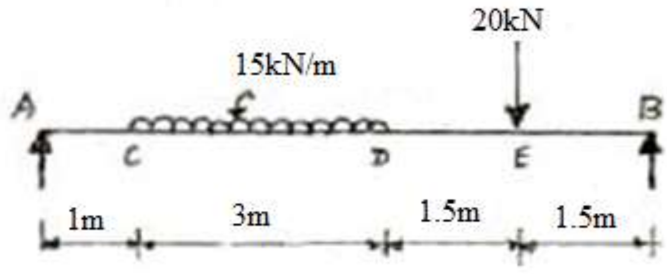
1. Draw Shear force and Bending moment diagrams for the beam which is loaded as shown in fig. And also determine the point of contraflexure.



2. A Cantilever 1.5 m long carries a load of 1000N at its free end, and another load 1000N at a distance of 0.5 m from the free end. Draw shear force and bending moment diagrams for the cantilever.
3. A simply supported beam of length 10m carries the uniformly distributed load and two point loads as shown in Fig. Draw the S.F and B.M diagram for the beam and also calculate the maximum bending moment.



4. Draw the shear force and bending moment diagrams in the following cases of cantilevers:
   i) Span of 10m with uniformly distributed load of 3kN/m for 6m starting from the free end.
   ii) Span of 10m with uniformly distributed load of 3kN/m for 6m starting from the fixed end.
   iii) Span of 14m with uniformly distributed load of 3kN/m for 6m starting 4m and ending at 10m from the fixed end.
5. A cantilever of 2m length carries a point load of 20 KN at 0.8 m from the fixed end and another point of 5 KN at the free end. In addition, a u.d.l. of 15 KN/m is spread over the entire length of the cantilever. Draw the S.F.D, and B.M.D.
6. For the simply supported beam loaded as shown in Fig. , draw the shear force diagram and bending moment diagram. Also, obtain the maximum bending moment.



Unit IV Bending and Shear stresses in beams

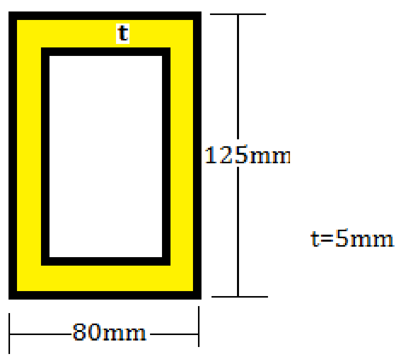
Part A

1. What is pure bending?
2. Define section modulus.
3. Define Moment of resistance.
4. State the theory of simple bending?
5. Write the bending equation?
6. A simply supported 200mm wide, 300mm deep and 4m long beam. Determine the bending stress at the point which is 60mm below the top surface and 1.2m from left end.
7. Write the formula to find Section modulus for rectangular section.
8. Write the formula to find Section modulus for hollow rectangular section.
9. Define Shear centre.
10. Define Shear stress.
11. Define Neutral axis.
12. What are the assumptions made in the theory of simple bending?
13. Define neutral axis of a cross section.
14. What is the maximum Value of shear stress in a triangular section?
15. Write the Euler Bernoulli's Equation or (Bending stress formula) or Bending equation.
16. Define Flexural Rigidity.
17. Define Bending stress.
18. Define Flexural stress.
19. Write the formula to find Section modulus for circular section
20. Write the formula to find Section modulus for hollow circular section.

Part B

1. A cantilever beam of span 3 m carries a point load of 10kN at the free end. What is the value of support moment?
2. A 120mm wide and 10mm thick steel plate is bent into a circular arc of 8m radius. Determine the maximum value of stress produced. Also find the bending moment which will produce the maximum stress. E=200GPa.
3. A 200mm X80mm I beam is to be used as a simply supported beam of 6.75m span. The web thickness is 6mm and the flanges are of 10mm thickness. Determine what concentrated load can be carried at a distance of 2.25m from one support if the maximum permissible stress is 80MPa.

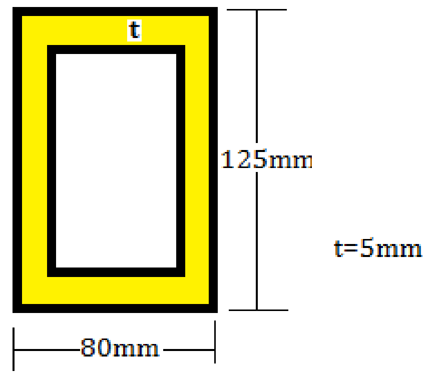
4. A pipe of external diameter 3 cm and internal diameter 2 cm and of length 4 m is supported at its ends. It carries a point load of 65 N at its centre. The sectional modulus of the pipe will be?
5. Write about section modulus of rectangular section.
6. A timber beam of 140mm wide and 180mm deep section is reinforced by 10mmX3140mm steel plates at the top and bottom. The beam is subjected to a bending moment of 24kN-m. Determine the stresses in the beam.
7. A steel band saw blade 12.5mm wide and 0.75mm thick. It is driven by two 1.2m diameter pulleys. Determine the maximum stress developed in the blade. Find also the magnitude of the internal moment. Take E=2X105 N/mm^2.
8. The moment of inertia of a beam section 500mm deep is 69.49x107 mm^4. Find the longest span over which abeam of this section, when simply supported, could carry a uniformly distributed load of 50kN per metre run. The flange stress in the material is not to exceed 110N/mm2.
9. A cast iron pipe of external diameter 60mm and 10mm thickness and 5 metre long is supported at its ends. The pipe carries a point load of 100N at its centre. Calculate the maximum flexural stress induced, due to the point load.
10. A steel beam of hollow section of outer side 100mm and inner side 80mm is used on a span of 4m. Find the uniformly distributed load the beam can carry if the bending stress is not to exceed 120N/mm^2.
11. A rectangular beam 100mm wide is subjected to a maximum shear force of 50000N the corresponding maximum shearing stress being 3N/mm^2. Find the depth of the beam.
12. A timber beam 100mmx200mm in section is simply supported on a span of 3m. It carries two point loads 48kN each at distances of 1m and 2m from the left support. Determine the maximum shear stress for the beam.
13. Figure shows the section of a tube of aluminum alloy. Determine the maximum moment that can be applied to the tube if the permissible bending stress is 125N/mm^2. Find also the radius of curvature of the tube as it bends. Take E=72800N/mm^2.



14. A wooden beam 200mmX200mm is simply supported on a span of 6m.When the beam is loaded with a 14kN load at each one-third span point, it failed. Find the modulus of rupture.
15. A steel beam of hollow square section of 60mm outer side and 50mm inner side is simply supported on a span of 4m. Find the maximum concentrated load the beam can carry at the middle of the span if the bending stress is not to exceed 120N/mm^2.

Part C

1. Write the assumptions made in theory of simple bending.
2. Figure shows a rectangular tube section of an aluminum alloy whose ultimate stress is 405N/mm^2. Determine the bending moment for which the factor of safety will be 3. Find also the corresponding radius of curvature. Take E=7X10^4 N/mm^2.



3. A simply supported cast iron square beam of 800mm length and 15mmX15mm in section fails on applying a load of 360N at the mid span. Find the maximum uniformly distributed load that can be applied safely to a 40mm wide, 75mm deep and 1.6m long cantilever made of the same material.
4. A Simply supported beam of span 10m is 350mm deep. The section of the beam is symmetrical. The moment of inertia of the section is 9.5X10^{7}mm^4. If the permissible bending stress is 120N/mm^2, find i) the safe point load that can be applied at the centre of the span ii) The safe uniformly distributed load that can be applied on the span. Neglect the dead load of the beam.
5. A timber beam 15 cm wide and 20 cm deep carries uniformly distributed load over a span of 4 m and is simply supported. If the permissible stresses are 30 N/mm^2 longitudinally and 3 N/mm^2 transverse shear, calculate the maximum load which can be carried by the timber beam.
6. A timber beam 100mm wide and 150mm deep supports a uniformly distributed load over a span of 2m. If the safe stresses are 28N/mm^2 in bending and 2N/mm^2 in shear, calculate the maximum load which can be supported by the beam.

Unit V Torsion

Part A

1. Define torsional rigidity of the solid circular shaft.
2. Distinguish between closed coil helical spring and open coil helical spring.
3. What is meant by composite shaft?
4. What is called Twisting moment?
5. What is Polar Modulus?
6. Define: Torsional rigidity of a shaft.
7. What do mean by strength of a shaft?
8. Write down the equation for Wahl factor.
9. Define: Torsional stiffness.
10. What are springs? Name the two important types.
11. How will you find maximum shear stress induced in the wire of a close-coiled helical spring carrying an axial load?
12. Write the expressions for stiffness of a close coiled helical spring.
13. Find the minimum diameter of shaft required to transmit a torque of 29820 Nm if the maximum shear stress is not to exceed 45 N/mm^2.
14. Find the torque which a shaft of 50 mm diameter can transmit safely, if the allowable shear stress is 75 N/mm^2.
15. Differentiate open coiled helical spring from the close coiled helical spring and state the type of stress induced in each spring due to an axial load
16. What is spring index (C)?
17. State any two functions of springs.
18. Write the polar modulus for solid shaft and circular shaft.
19. What are the assumptions made in Torsion equation
20. Write an expression for the angle of twist for a hollow circular shaft with external diameter D, internal diameter d, length l and rigidity modulus G.

Part B

1. Write about the theory of pure torsion.
2. State the assumptions in the theory of pure torsion.
3. Derive the equation of power transmitted by a shaft.
4. Write the Comparison of solid and hollow shaft
5. Write the Comparison of Shaft in series and Shaft in parallel
6. A solid circular shaft of 200 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft. If the value of maximum shear stress induced is 60 N/mm^2.
7. Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240MPa. If the shaft diameter is doubled then the maximum shear stress developed corresponding to the same torque will be?
8. The diameter of shaft A is twice the diameter or shaft B and both are made of the same material. Assuming both the shafts to rotate at the same speed, the maximum power transmitted by B is?
9. The outside diameter of a hollow shaft is twice it's inside diameter. The ratio of its torque carrying capacity to that of a solid shaft of the same material and the same outside diameter is?

10. Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240MPa. If the shaft diameter is doubled, then what is the maximum shear stress developed corresponding to the same torque?
11. A shaft can safely transmit 90 kW while rotating at a given speed. If this shaft is replaced by a shaft of diameter double of the previous one and rotated at half the speed of the previous, the power that can be transmitted by the new shaft is?
12. A hollow shaft of outer diameter 40 mm and inner diameter of 20 mm is to be replaced by a solid shaft to transmit the same torque at the same maximum stress. What should be the diameter of the solid shaft?
13. A close-coiled helical spring has coil diameter to wire diameter ratio of 6. The spring deflects 3 cm under an axial load of 500N and the maximum shear stress is not to exceed 300MPa. Find the diameter and the length of the spring wire required. Shearing modulus of wire material = 80GPa.
14. A close-coiled spring has mean diameter of 75 mm and spring constant of 90 kN/m. It has 8 coils. What is the suitable diameter of the spring wire if maximum shear stress is not to exceed 250 MN/m^2? Modulus of rigidity of the spring wire material is 80 GN/m2. What is the maximum axial load the spring can carry?
15. A close-coiled helical spring has wire diameter 10 mm and spring index 5. If the spring contains 10 turns, then the length of the spring wire would be?

Part C

1. Determine the diameter of a solid shaft which will transmit 300 KN at 250 rpm. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 10 in a shaft length 2m. Take modulus of rigidity as 1 x 10^5 N/mm^2.
2. A steel shaft ABCD having a total length of 2400 mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameters 80 mm and 50 mm respectively, BC is solid and 80 mm diameter. CD is also solid and 70 mm 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 50Mpa and shear modulus 0.82 x 10^{5}MPa
3. It is required to design a closed coiled helical spring which shall deflect 1mm under an axial load of 100 N at a shear stress of 90Mpa. The spring is to be made of round wire having shear modulus of 0.8 x 10^{5}Mpa. The mean diameter of the coil is 10 times that of the coil wire. Find the diameter and length of the wire.
4. The stiffness of close coiled helical spring is 1.5N/mm of compression under a maximum load of 60 N. The maximum shear stress in the wire of the spring is 125 N/mm^2. The solid length of the spring (when the coils are touching) is 50 mm. Find the diameter of coil, diameter of wire and number of coils. C = 4.5.
5. A helical spring of circular cross-section wire 18 mm in diameter is loaded by a force of 500 N. The mean coil diameter of the spring is 125mm. The modulus of rigidity is 80kN/mm^2. Determine the maximum shear stress in the material of the spring. What number of coils must the spring have for its deflection to be 6 mm?
6. It is required to design a closed coiled helical spring which shall deflect 1mm under an axial load of 100 N at a shear stress of 90Mpa. The spring is to be made of round wire having shear modulus of 0.8 x 10^{5}Mpa. The mean diameter of the coil is 10 times that of the coil wire. Find the diameter and length of the wire.