K.S.K.COLLEGE OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING
REGULATION-2008
ACADEMIC YEAR :2015-2016 (ODD SEM)
SYLLABUS

Name of the Staff : Ms. M.GAYATHRI DEVI **Department : Civil Engg.**

Subject code & Subject : CE6302 – MOS **Year/sem : II/III**

CE6302- MECHANICS OF SOLIDS

UNIT I STRESS AND STRAIN

Stress and strain at a point - Tension, Compression, Shear Stress - Hooke's Law - Relationship among elastic constants - Stress Strain Diagram for Mild Steel, TOR steel, Concrete - Ultimate Stress - Yield Stress - Factor of Safety - Thermal Stresses - Thin Cylinders and Shells - Strain Energy due to Axial Force - Resilience - Stresses due to impact and Suddenly Applied Load - Compound Bars.

UNIT II SHEAR AND BENDING IN BEAMS

Beams and Bending- Types of loads, supports - Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load, UDL, uniformly varying load. Theory of Simple Bending - Analysis of Beams for Stresses - Stress Distribution at a cross Section due to bending moment and shear force for Cantilever, simply supported and overhanging beams with different loading conditions - Flitched Beams.

UNIT III DEFLECTION

Double integration method - Macaulay's methods - Area moment method - conjugate beam method for computation of slopes and deflections of determinant beams.

UNIT IV TORSION

Torsion of Circular and Hollow Shafts - Elastic Theory of Torsion - Stresses and Deflection in Circular Solid and Hollow Shafts - combined bending moment and torsion of shafts - strain energy due to torsion - Modulus of Rupture - Power transmitted to shaft - Shaft in series and parallel - Closed and Open Coiled helical springs - Leaf Springs - Springs in series and parallel - Design of buffer springs.

UNIT V COMPLEX STRESSES AND PLANE TRUSSES

2 D State of Stress - 2 D Normal and Shear Stresses on any plane - Principal Stresses and Principal Planes - Mohr's circle - Plane trusses: Analysis of plane trusses - method of joints - method of sections.

TEXT BOOKS:

1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2007.
2. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.

REFERENCES :

1. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.
2. Timoshenko.S.B. and Gere.J.M, "Mechanics of Materials", Van Nos Reinbhold, New Delhi 1995.
3. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, New Delhi,1995.
4. Junnarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol I, Charotar Publishing House, New Delhi 1997.
5. Ugural. A.C., "Mechanics of Materials", Wiley India Pvt. Ltd., New Delhi, 2013.

UNIT – 1 STRESS AND STRAIN

TWO MARKS

1. Define longitudinal strain and lateral strain.
2. Write down the relation between modulus of elasticity and modulus of rigidity.
3. State Hooke's law.
4. Define Bulk-modulus
5. Give the relationship between Bulk Modulus and Young's Modulus.
6. Define stress.
7. Define Resilience.
8. Define Poisson's ratio.
9. Draw the stress strain curve for TOR steel.
10. What is meant by factor of safety?

16 MARKS

1. Two vertical rods of steel and other of copper are each rigidly fixed at the top and 80 cm apart. Diameters and length of each rod are 3 cm and 3.5 cm respectively. A cross bar fixed to the rods at the lower ends carries a load of 6 kN such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take E for steel = 2×10^5 N/mm^2 and for copper = 1×10^5 N/mm^2 (16)

2. Derive an expression between the modulus of elasticity and modulus of rigidity. (16)

3. Draw stress – strain curve for a mild steel rod subjected to tension and explain about the salient points on it. (16)

4. Derive relations for normal and shear stresses acting on an inclines plane at a point in a strained material subjected to two mutually perpendicular direct stresses. (16)

5. Establish the relation between Young's modulus and bulk modulus. (16)

6. Establish the relation between Young's modulus and rigidity modulus. (16)

7. A weight of 200 kN is supported by three pillars of equal height, each 75 mm^2 in section. The central pillar is of steel and the other ones are of copper. The pillars are so adjusted that at a temperature of 20 degree C each carries equal loads. Find the stresses in each pillar at 120 degree C, Take $E_s = 2 \times 10^5$ N/mm^2 $E_c = 0.8 \times 10^5$ N/mm^2; $\alpha_s = 12 \times 10^{-6}$ /°C; $\alpha_c = 18.5 \times 10^{-6}$ /°C (16)

8. Derive relations for change in length, thickness and volume of thin cylinder subjected to an internal pressure. Also explain the failure of thin cylinders. (16)

UNIT – II SHEAR AND BENDING IN BEAMS

TWO MARKS

1. What are the types of beams?
2. What are the types of loads?
3. Write the assumption in the theory of simple bending.
4. Write the theory of simple bending equation.
5. Define shear force and bending moment.
6. Define point of contra flexure. In which beam it occurs?
7. What is mean by positive or sagging and negative or hogging BM?
8. When will bending moment is maximum? What is maximum bending moment in a simply supported beam of span 'L'subjected to UDL of 'W' over entire span?
9. In a simply supported beam how will you locate point of maximum bending moment?
10. A beam 3 m long, simply supported at its ends, is carrying a point load at its center. If the slope at the ends is 1° ,find the deflection at the mid span of the beam.

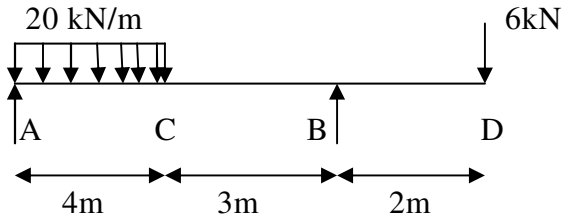
16 MARKS

1.A simply supported beam of span 8 m rests on supports 5 m apart. The right hand end is overhanging by 2 m and the left hand end is overhanging by 1 m. The beam carries an uniformly distributed load of 5 kN/m over the entire span. It also carries two point loads of 4 kN is at the extreme left of the beam wheras the load 6 kN is at the extreme right of the beam. Draw the SFD and BMD for the beam and find the points of contraflexure. (16)

2.A timber beam of rectangular section is to support a load of 30 kN uniformly distributed over a span of 4.6 m when the beam is S.S. It the depth of the section is to be twice the breadth, and the stress in timber is not to exceed 8 N/mm^2,find the dimensions of the cross section. How would you modify the cross section of the beam,if it carries a concentrated load of 30 kN placed at the centre with the same ratio of breadth to depth? (16)

3.An I section beam 375 mm x 200 mm has a web thickness of 15 mm and a flange thickness of 20 mm. If the shear force acting on the section is 60 x 10^3 N, find the maximum shear stress developed in the I section. Also sketch the shear stress distribution across the section. (16)

4.Draw shear force and bending moment diagram for the beam given in fig. (16)



5.State the assumptions made in the theory of Simple bending and derive the bending formula. (16)

6.An overhanging beam ABC of length 6 m is supported at A and B. The overhanging portion BC is of 2m length. A udl of intensity 2 kN/m acts over the entire span. Two point loads of intensity 5 kN and 3kN act at a distance of 2 m from the left support A and at the free end C respectively. Draw the SF and BM diagrams.Also locate the Point of contraflexure. (16)

7.A simply supported beam AB of span 5 m carries a udl of intensity 3 kN/m over a length of 2m from the left support A. The beam is also subjected to a clockwise couple of intensity 5kN-m at a distance of 4m from the left support A. Draw the shear force and bending moment diagrams. (16)

8.The cross section of a T- beam is as follows: flange thickness = 10 mm; width of flange = 100 mm; thickness of web = 10 mm; depth of web = 120 mm. If a shear force of 2kN is acting at a particular section of the beam. Draw the shear stress distribution across the cross section. (16)

9. A symmetrical I section beam has flanges 25 mm wide and 25mm thick and web of 500mm high and 25 mm thick. Calculate the maximum intensity of shear stress across the section of the beam, if it carries a shear force of 300 KNS at the section. (16)

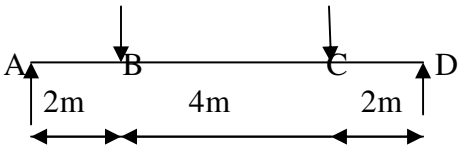
UNIT – III DEFLECTION

TWO MARKS

1. What are the methods for finding out the slope and deflection at a section?
2. Why moment area method is more useful, when compared with double integration?
3. Explain the Theorem for conjugate beam method.
4. Define method of Singularity functions.
5. What are the points to be worth for conjugate beam method?
6. State the main assumptions while deriving the general formula for shear stresses
7. What is mean by shear stress in beams? Define Shear stress distribution.
8. What is the shear stress distribution rectangular section and Circular Section?

16 ARKS

1.Determine the slope at the supports and maximum deflection for the beam given in fig. Use Macaulay's method. E = 2 x 10^5 N/mm^2, I = 20 x 10^6 mm^4 (16)



2.A beam ABC is simply supported at A and B and free end at C. The span AB carries a udl of intensity 12 kN/m and the end C carries a point load of intensity 20 N. If AB = 4m and BC = 1m, find the (16)
(i) Slope and deflection at C
(ii)Deflection at the centre of the span AB. Take EI = 5 x 10^4 kNm^2.

3.A steel tube 1027mm thick and 100mminternal diameter is plugged at each end to form a closed coil cylinder with internal length of 250mm.The tube is completely filled with oil and subjected to compressive load of 45 kN.Find (16)
(i)The pressure produced in the coil
(ii)The resulting circumferential stress in the tube wall.
Take E = 2.1 x 10^5 N/mm^2,K= 2667 N/mm^2 and poissons ratio(1/m) = 0.28.

4.A boiler shell is to be made of 20mm thick plate having a limiting tensile stress of 110N/mm^2. If the efficiency of the longitudinal and circumferential joints are 75% and 25 % respectively, determine (16)
(i)The maximum permissible diameter of the shell for an internal pressure of 2 N/mm^2
(ii)Permissible intensity of internal pressure when the shell diameter is 1.5m.

5.A compound tube consists of steel tube 170mm external dia and 10mm thickness and an outer brass tube 190mm external dia and 10 mm thickness. The two tubes are of same length. The compound tube carries an axial load of 1MN.Find the stresses and the load carried by each tube and the amount by which it shortens. Length of each tube is 200mm.E for steel is 200GN/m^2 and E for brass is 100 GN/m^2. (16)

UNIT – IV TORSION

TWO MARKS

1. Define Torsion
2. What are the assumptions made in Torsion equation?
3. Why hollow circular shafts are preferred when compared to solid circular shafts?
4. Explain torsional equation.
5. Write down the expression for power transmitted by a shaft.
6. Write down the expression for torque transmitted by hollow shaft.
7. What is the ratio of maximum shear stress to the average shear stress for the rectangular and circular section?
8. What are the various types of springs?
9. What is solid length?
10. Define pitch.

16 MARKS

1.A leaf spring carries a central load of 3.5 kN. The leaf spring is to be made of 10 steel plates 6 cm wide and 8 mm thick. If the bending stress is limited to 160 N/mm^2, determine: (16)
(i)Length of the spring
(ii)Deflection at the centre of the spring.

2.The stiffness of a close coiled helical spring is 2 N/mm of compression under a maximum load of 50 N. The maximum shear stress produced in the wire of the spring is 120 N/mm^2. The solid length of the spring is given as 6 cm. Find the diameter of the wire, mean diameter of the coils and the number of coils required. Take C = 5 x 10^4 N/mm^2. (16)

3.Derive expressions for the deflection bending stress and shear stress included in an open coiled helical spring subjected to an axial load ‘w’. (16)

4.Derive the torsion equation foe a solid circular shaft of diameter ‘d’ and length ‘l’ which is fixed at one end subjected to torque of intensity “T” at the free end. (16)

5.List the assumptions made in the torsion theory of circular shafts. (16)

6.In a close-coiled helical spring, the diameter of each coil is to be 12 times the diameter of the spring and the maximum shear stress is not to exceed 75 N/mm^2. Maximum permissible deflection under a load of 500 N is 12 cm. Taking shear modulus as 8 x 10^4 N/mm^2. Determine the number of coils, diameter of the coil and energy stored in the spring. (16)

7.A shaft has to transmit 300kW power at 120rpm.Determine (16)
(i)The necessary diameter of solid circular section.
(ii)The diameter of hollow circular section with the internal diameter 2/3 of the external diameter assuming the allowable stress as 70 N/mm^2.
Also calculate the percentage saving in the material.Take density of the material as 77 N/m^3.

8.A closed coil helical spring is to have a stiffness of 900 N/min compression (16)
with a maximum load of 45 n and a minimum shearing stress o120 N/mm^2.
The solid length of the spring is 45 mm.Find the wire diameter, mean coil radius and number of coils.Take N=40000 N/mm^2.

UNIT – V COMPLEX STRESSES AND PLANE TRUSSES

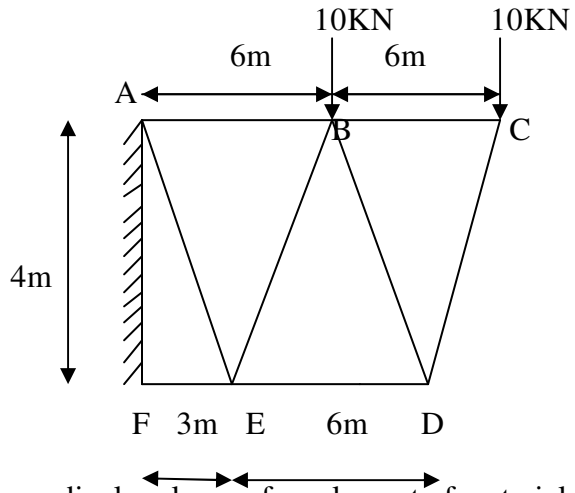
TWO MARKS

1. What is mean by perfect frame?
2. What are the different types of frames?
3. What is mean by Imperfect frame?
4. What is mean by deficient frame?
5. What is mean by redundant frame?
6. What are the assumptions made in the analysis of a pin-jointed plane truss?
7. Define principle stresses and principle plane.
8. List the methods of analysing plane trusses.
9. How method of joints applied to Trusses carrying inclined loads?
10. What is Mohrs circle ?

16 MARKS

1. An elemental cube is subjected to tensile stress of 60 N/mm^2 and 20 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 20 N/mm^2 on these planes. Draw the mohr's circle of stresses and determine the magnitudes and directions of principal stresses and also the greatest shear stress. Also check the result by analytical method. (16)

2. Determine the forces in the given truss. (16)



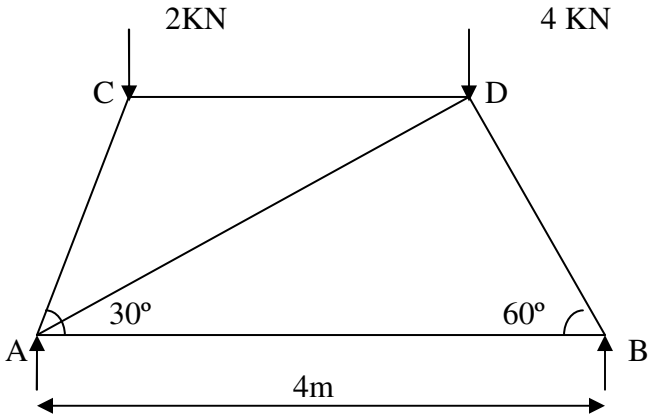
3. Two mutually perpendicular planes of an element of material are subjected to direct stresses of 60 N/mm^2 (tensile) and 20 N/mm^2 (compressive) and shear stress of 20 N/mm^2. Find (16)
   (i)The principal stresses and orientation of principal planes
   (ii)Find the maximum shear stress, the orientation of the plane of maximum shear stress and the normal stress on the plane of maximum shear stress.

4.The state of stresses at a point on two mutually perpendicular planes is as below (16)
σ_x = 160MPa (tension); σ_y = 80 MPa (Compression) and τ = 50 MPa (acting in the positive direction on the positive X plane)

Determine the following :

(i) Principal stresses and their planes
(ii) Maximum shear stress
(iii) Normal and shear stress on a plane which is inclined 30^o anticlockwise to positive x plane.

5.Find the forces in the members of the truss shown in fig. using method of joints. (16)



6.An element in a stressed material has tensile stress of 500 N/mm^2 a 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. (16)

7.Determine the forces in all the members of the frame shown in fig. use method of joints . (16)