QUESTION BANK ON STRENGTH OF MATERIAL

(MECHANICAL ENGINEERING - 3RD SEM)

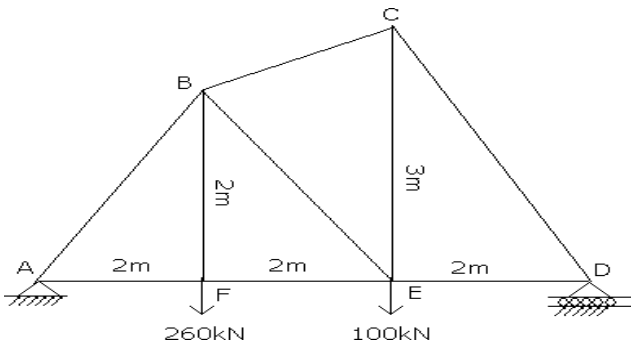
PREPARED BY

MR . N BIKASH RAO

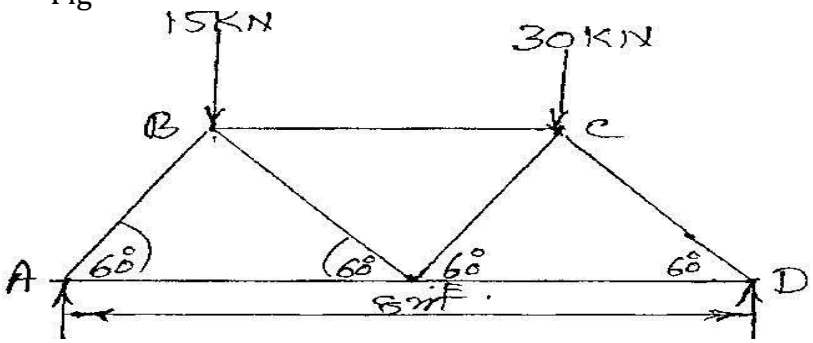
LECTURER ,MECHANICAL ENGINEERING,

GOVT. POLYTECHNIC NABARANGPUR

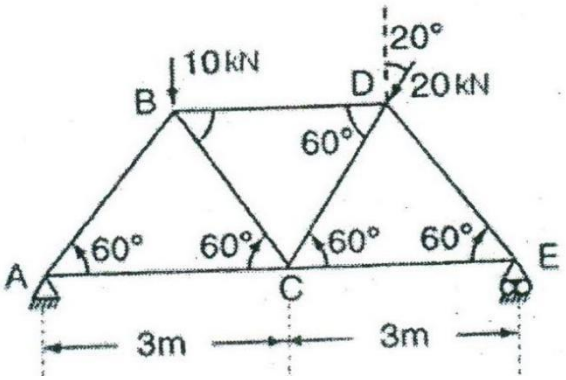
1. Analyse the frame shown in Fig.



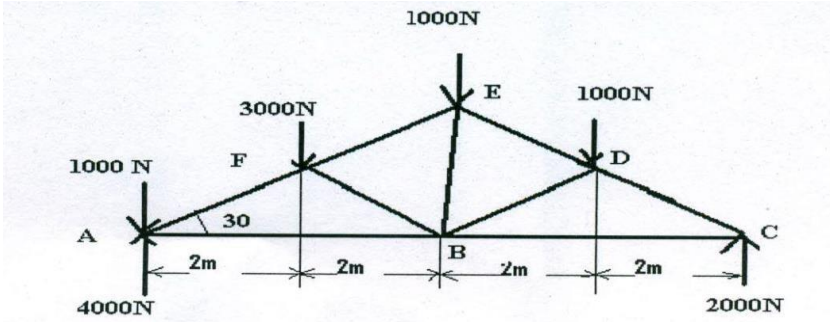
1. Find the magnitude and nature of forces in all the members of the truss shown in Fig



2. Find the forces in all the members of the truss as shown in the figure using method of joints.



3. Determine the force in member EB of the roof truss shown in the figure. Indicate whether the member is in tension or compression.



4. Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. What are the assumptions made in the above derivation ?
5. Derive the formula for the hoop stress in a thin cylindrical shell subjected to an internal pressure.
6. A gas cylinder of thickness 25 mm and has an internal diameter of 1500 mm. The tensile stress in the gas cylinder material is not to exceed 100 N/mm2. Calculate the allowable internal pressure of the gas inside the cylinder.

7. A thin cylindrical shell is 3m long and 1m in internal diameter. It is subjected to internal pressure of 1.2 MPa. If the thickness of the sheet is 12mm, find the circumferential stress, longitudinal stress, changes in diameter, length and volume. Take E=200 GPa and μ= 0.3.
8. A Hollow shaft is to transmit 400 KW power at 120 rpm. If the shear stress is not exceed 60 N/mm2 and internal diameter is 0.65 of external diameter. Find the internal and external diameters assuming maximum torque is 1.5 times the mean
9. A hollow shaft of diameter ratio 3/8 is to transmit 395 kW at 120 rpm. The maximum torque being 24% greater than the mean, the shear stress is not to exceed 65 MPa and the twist in a length of 6 m is not to exceed 3 degrees. Calculate its external and internal diameters which would satisfy both the above said conditions. Take G=9.2×10 MPa.
10. A cylindrical vessel 2m long and 500mm in diameter with 10mm thick plates is subjected to an internal pressure of 3MPa.Calculate the change in volume of the vessel .Take E=200GPa and poissons ratio=0.3 for the vessel material.
11. A shaft is to be transmitted 100KW at 240 rpm. If the allowable shear stresses of the material is 60MPa. The shaft is not to twist more than 10 in a length of 3.5 mts. Find the diameter of the shaft based on strength and stiffness criteria. The modulus of rigidity of the material (N) is 80 X 103N/mm2.
12. A cylindrical vessel 3m long and 500mm in diameter with 10mm thick plates is subjected to an internal pressure of 3MPa.Calculate the change in volume of the vessel .Take E=210GPa and Poisson's ratio=0.3 for the vessel material
13. A thin cylindrical shell is 3m long and 1m in internal diameter. It is subjected to internal pressure of 1.2 MPa. If the thickness of the sheet is 12mm, find the circumferential stress, longitudinal stress, changes in diameter, length and volume. Take E=200 GPa and μ= 0.3.
14. A thin cylindrical shell is 3m long and 1m in internal diameter. It is subjected to internal pressure of 1.2 MPa. If the thickness of the sheet is 12mm, find the circumferential stress, longitudinal stress, changes in diameter, length and volume. Take E=200 GPa and μ= 0.3.
15. A hallow shaft of outside diameter 80 mm and inside diameter 50 mm is made of aluminium having shear modulus G = 27GPa. When the shaft is subjected to a torque T = 4.8 kN-m, what is the maximum shear strain and maximum normal strain in the bar?
16. Distinguish clearly the properties elasticity and plasticit
17. Define poisson's ratio. Mention its significance in material selection.
18. List different types of beams.
19. What is meant by the term point of contraflexure. Explain.
20. Find out section modulus for a rectangular beam having width 'b' and depth 'd'.
21. Draw shear stress distribution across the rectangular cross section of the beam if the beam is carrying a concentrated load P at mid point.
22. Explain moment area theorm-I applicable for beams.
23. What is the condition to be satisfied for a perfect truss? Explain.
24. A solid shaft is to be transmitted 25 kw by running at 800 rpm. Find the torque induced in the shaft material.
25. Develop the relationship between circumferential and longitudinal stress in case thin cylinder subjected to internal fluid pressure.
26. A cylindrical vessel 2m long and 500mm in diameter with 10mm thick plates is subjected to an internal pressure of 3MPa.Calculate the change in volume of the vessel .Take E=200GPa and poissons ratio=0.3 for the vessel material.
27. A solid steel shaft has to transmit 100 kW at 160 rpm. Taking allowable shear stress as 70 M Pa, find the suitable diameter of the shaft. The maximum torque transmitted in each revolution exceeds the mean by 20 %.
28. A cylindrical thin drum 800mm in diameter and 4m long is made of 10mm thick plates. If the drum is subjected to an internal pressure of 2.5MPa, determine its changes in diameter and length. Take E as 200GPa and poisons ratio as 0.25. A simply supported beam carries a U.D.L. of intensity 2.5 kN/m over entire span of 5 meters. The cross-section of the beam is a T-section having the dimensions Flange : 125 mm X 25 mm.
29. Explain theory of simple bending, and the assumptions made. Draw stress distribution diagram for a beam with rectangular section.
30. A timber beam of rectangle section is simply supported at the ends and carries a point load at the center of the beam. The maximum bending stress is 12 N/mm2 and maximum shearing stress is 1 N/mm2. Find the ratio of the span to the depth. A solid shaft of 200mm diameter gas the same cross sectional area as a hollow shaft of the same material with inside diameter of 150mm. Find

the ratio of powers transmitted by both the shafts at the same angular velocity.

31. Derive the expression for circumferential stress for a thin cylinder.
32. A shell 3.25m long and 1m diameter is subjected to an internal pressure of 1.2 N/mm2. If the thickness to the shell is 10mm, find the circumferential and longitudinal stresses. Find also the maximum shear stress and changes in dimensions of the shell. Take E = 200 kN/mm2, poissons ratio=0.3.
33. A steel beam of I – section, 200mm deep and 160mm wide has 16 mm thick flanges and 10mm thick web. The beam is subjected to a shear force of 200 KN. Determine the shear stress distribution over the beam section if the web of the beam is kept horizontal. Web:175mmX25mm. A cantilever beam of length 4m carries point loads 1KN, 2KN and 3KN at 1m, 2 m and 4m respectively from fixed end. Draw the shear force and bending moment diagrams for the beam.
34. Derive an expression to find out the section modulus for 'I' section. A rectangular beam of 100mm wide is subjected to maximum shear force 100KN. Find the depth of beam if the shear stress is 6N/mm2
35. Explain the procedure to do the analysis of frames by using tension coefficient method.
36. Explain with neat sketches, what is Beam, Frame, Truss? Explain the torsional moment of resistance of the shafts.
37. A thin cylindrical shell is 3m long and 1m in internal diameter. It is subjected to internal pressure of 1.2 MPa. If the thickness of the sheet is 12mm, find the circumferential stress, longitudinal stress, changes in diameter, length and volume. Take E=200 GPa and μ= 0.3.
38. Derive the relationship between Elatic Moduli E, G and K from fundamentals of solid mechanics.
39. Derive the formula for elongation of uniformly tapered circular cross section bar under axial load. Also deduce the relation for strain energy stored in the bar. Find the angle of twist per metre length of a hollow circular shaft of 100 mm external and 60 mm internal diameter, if the shear stress is not to exceed 35 M Pa. Take C = 85 G Pa. Calculate the maximum shear stress for the section of the beam.
40. Proof ResilienceDetermine the change in length breadth and thickness of steel bar which is 5m long, 40 mm wide 30 mm thick and is subjected to axial pull of 35KN in the direction of its length. (E=2×105N/mm2 Poisson's ratio=0.3.
41. Derive the equation to find out hoop stress and longitudinal stress in thin cylinder subjected to internal pressure.
42. A thin cylindrical shell is 3m long and 1m in internal diameter. It is subjected to internal pressure of 1.2 MPa. If the thickness of the sheet is 12mm, find the circumferential stress, longitudinal stress, changes in diameter, length and volume. Take E=200 GPa and μ= 0
43. Determine the young's modulus and Possion's ratio of a metallic bar of length 25cm breadth 3cm depth 2cm when the beam is subjected to an axial compressive load 240KN. The decrease in length is given by 0.05cm and increase in breadth 0.002
44. Write the differences among Gradual, Sudden, Impact and Shock loadings with the help of expressions.
45. A steel rod and two copper rods together support a load of 370 kN as shown in fig. The cross sectional area of steel road is 2500 mm2 and of each copper road is 1600 mm2. Find the stresses in the roads. Take E for steel is 2x105 N/mm2 and for copper is 1x105 N/mm2.
46. Beam ABCD is simply supported at B and C and has overhangs at each end. The beam length between A and B is 'L' and each overhang has length L/ 3. A uniform load of intensity q acts on entire length of the beam. Draw the shear- force and bending-moment diagrams for this beam.
47. Draw SF and BM diagrams for the cantilever shown in Fig .
48. Derive and Prove the following relation , Where M is moment applied on the beam, I is moment of Inertia, σ is bending stress, y is the distance between neutral axis and extreme fiber, E is young's modules, R is Radius if curvature.
49. A rectangular beam of 100mm wide and 150mm deep is subjected to Shear force of 30KN, Determine ratio of Maximum shear stress to Average shear stress. Derive the equation which is used to find out the shear stress.
50. A simply supported beam span 14m, carrying concentrated loads of 12KN and 8KN at two points 3mts and 4.5m from the two ends respectively. Moment of Inertia I for the beam is 160 x103 mm4 and E = 210KN/mm2. Calculate deflection of the beam at points under the two loads by macaulay's method.
51. A Cantilever beam AB 6 mts long is subjected to u.d.l of w KN/m spread over the entire length. Assume rectangular cross-section with depth equal to twice the breadth. Determine the

minimum dimension of the beam so that the vertical deflection at free end does not exceed 1.5 cm and the maximum stress due to bending does not exceed 10 KN/cm2. E = 2 X 107 N/ cm2.

52. A shaft is to be transmitted 100KW at 240 rpm. If the allowable shear stresses of the material is 60MPa. The shaft is not to twist more than 10 in a length of
53. 3.5 mts. Find the diameter of the shaft based on strength and stiffness criteria. The modulus of rigidity of the material (N) is 80 X 103N/mm2.
54. 11 A cylindrical vessel 3m long and 500mm in diameter with 10mm thick plates is subjected to an internal pressure of 3MPa.Calculate the change in volume of the vessel .Take E=210GPa and Poisson's ratio=0.3 for the vessel material.
55. Draw stress-strain curve for a mild steel rod subjected to tension and explain about the salient points on it.
56. A vertical tie, fixed rigidly at the top end consist of a steel rod 2.5 m long and 20 mm diameter encased throughout in a brass tube 20 mm internal diameter and 30 mm external diameter. The rod and the casing are fixed together at both ends. The compound rod is loaded in tension by a force of
57. 10 kN. Calculate the maximum stress in steel and brass. Take Es=2x105N/mm2 and Eb=1x105N/mm2.
58. A steel tube 50mm in external diamerter and 3mm thick encloses centrally a solid copper bar of 35mm diameter. The bar and the tube are rigidly connected together at the ends at a temperature of 20 0C. Find the stress in each metal when heated to 1700C. Also find the increase in length, if the original length of the assembly is 350mm. Take αs=1.08 x 10-5 per 0C and αc=1.7 x 10 -5 per 0C . Take Es =2X105 N/mm2 , Ec =1X105 N/mm2.
59. A 30m long horizontal beam carries a uniformly distributed load of 1 kN/ m on the whole length along with a point load of 3 kN at the right end. The beam is freely supported at the left end. Determine the position of the second support so that the maximum bending moment on the beam is as small as possible. Also draw the shear force and bending moment diagrams indicating main values.
60. A Beam A B C, 5m long has one support at the end A and other support at B, 8m from A. It carries a point load of 4kN at the middle point of AB and a point load of 3kN at C Draw SFD and BMD.
61. a) A simply supported symmetric I-section has flanges of size 200 mmX 15 mm and its overall depth is 520 mm. Thickness of web is 10mm. It is strengthened with a plate of size 250 mm X 12mm on compression side. Find the moment of resistance of the section if permissible stress is 160 M Pa. How much uniformly distributed load it can carry if it is used as a cantilever of span 3.6m.
62. b) A simply supported beam of 2m span carries a U.D.L. of 140 kN/m over the whole span. The cross section of the beam is T-section with a flange width of 120mm, web and flange thickness of 20mm and overall depth of 160mm. Determine the maximum shear stress in the beam and draw the shear stress distribution for the section.
63. Derive the relation between E, G, K.
64. What is proof resilience and modulous of resilience?
65. A steel tube of 30 mm external diameter and 25 mm internal diameter encloses a gun metal rod of 20 mm diameter to which it is rigidly joined at each end. The temperature of the whole assembly is raised to 1400C and the nuts on the rod are then screwed lightly home on the ends of the tube. Find the intensity of stress in the rod when the common temperature has fallen to 300C. The value of E for steel and gun metal are 2.1x105N/mm2 and 1x105N/mm2 respectively. The linear co efficient of expansion for steel and gun metal are 12 x 10-6 per 0C and 20 x 10-6 per 0C.
66. Draw SF and BM diagrams for the cantilever shown in Fig
67. A horizontal beam AB of length 4m in hinged at A and supported on rollers at B. the beam carries inclined loads of 100N, 200N and 300N incised towards the roller support at 600; 450 and 300 Respectively to the horizontal, at 1m, 2m and 3m respectively from
68. draw the SF and BM diagrams.