MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Estd. 2000

Department of Robotics and Automation
Question Bank - Academic Year (2019-2020)

Course Code & Course Name : 19RAC09 & Strength of Materials

Year/Sem/Sec : II/IV/A, B & C

Unit-I: Stress, Strain and Deformation of Solids
Part-A (2 Marks)

1. Define Hooke's Law with a graph.
2. List various Elastic Constants.
3. Define Poisson's Ratio.
4. A circular rod 2 m long and 15 mm diameter is subjected to an axial tensile load of 30kN. Calculate the elongation of the rod if the modulus of elasticity of the material of the rod is 120 KN/mm^2
5. Deduce the expression for stresses on an inclined plane when it is subjected to an axial pull.
6. Express Young's modulus in terms of Bulk and Rigidity modulus.
7. Invent the two equations used to find the forces in compound bars made of two materials subjected to tension.
8. Contrast compound bar from simple bar
9. Evaluate the load carried by a bar if the axial stress is 10 N/mm^2 and the diameter of bar is 10 mm.
10. Differentiate between rigid and deformable bodies.

Part-B (16 Marks)

1. Derive a relation for change in length of a uniformly varying circular bar subjected to axial load.
2. A Mild steel rod of 20 mm diameter and 300 mm long is enclosed centrally inside a hollow copper tube of external diameter 30 mm and internal diameter 25 mm. The ends of the rod and tube are brazed together, and the composite bar is subjected to an axial pull of 40 kN. If E for steel and copper is 200 GN/m^2 and 100 GN/m^2 respectively, find the stresses developed in the rod and the tube also find the extension of the rod.
3. Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50cm apart. Diameters and lengths of each rod are 2cm and 4m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N 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 x 10^5 N/mm^2 and E for copper = 1x 10^5 N/mm^2
4. At a certain point in a strained material, the stresses on two planes, at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by a shear stress of a magnitude of 10 N/mm^2. Find graphically or otherwise, the location of principal planes and evaluate the principal stresses

5.(i). A flat plate tapers uniformly from 200 mm to 100 mm width in a length of 500 mm and uniform thickness of 20 mm. determine the elongation of the tapering plate if it is subjected to an pull of 40KN & $E = 2\times10^5$ N/mm^2

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(ii). Derive the relationship between modulus of elasticity and Bulk modulus.

Unit-II : Transverse Loading on Beams and Stresses in Beam

Part-A (2 Marks)

1. Classify beams based on the supports.
2. Name the various types of loading.
3. Define shear force and bending moment
4. When the bending moment will be maximum?
5. Estimate the shear force and bending moment at a section 2 m from the free end A of a cantilever beam of 3 m long carries a load of 20 KN at its free end.
6. Differentiate UDL with UVL with respect to bending moment diagram.
7. Illustrate the shear stress distribution in a solid circular section
8. Summarize the assumptions in the theory of simple bending.
9. Compare the bending stress distribution and shear stress distribution for a beam of rectangular cross section
10. Describe the term "Point of contraflexure"

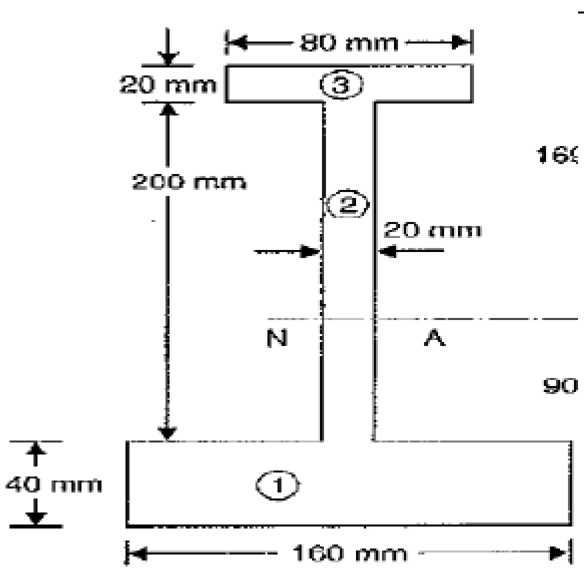
Part-B (16 Marks)

1. A simply supported beam of span 8 m long is subjected to two concentrated loads of 24kN and 48 kN at 2 m and 6 m from left support respectively. In addition it carries a UDL of 36 kN/m over the entire span. Draw shear force and bending moment diagrams. Mark the salient points.

2. A cantilever of length 6m carries two point loads of 2kN and 3kN at a distance of 1m and 6m from the fixed end respectively. In addition to this the beam also carries a uniformly distributed load of 1kN/m over a length of 2m at a distance of 3m from the fixed end. Draw the shear force and bending moment diagrams

3. A cross section of a beam in the form of a triangle with base 200mm and depth 300mm. If the shear stress on the beam is 60KN study the distribution determine the maximum shear stress.

4. A cast iron beam is of I-section as shown in Fig. The beam is supported on a span of 5 metres. If the tensile stress is not to exceed 20 N/ mm2, find the safe uniformly load which the beam can carry. Find also the maximum compressive stress.



5. A cantilever 1.5 m long is loaded with a uniformly distributed load of 2 KN/m run over a length of 1.25 m from the free end. It also carries a point load of 3 KN at a distance of 0.25 m from the free end. Draw the shear force and bending moment diagrams of the cantilever.

Unit-III : Torsion

Part-A (2 Marks)

1. Define torsional rigidity of the solid circular shaft.
2. Calculate 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.
3. When the hollow circular shafts are more suitable than solid circular shafts?
4. Summarize the assumptions made in torsional equation.
5. Formulate the mathematical expression for deflection of an open coiled helical spring.
6. Measure the torque which a shaft of 50 mm diameter can transmit safely, if the allowable shear stress is 75 N/mm^2
7. Show the difference in stiffness of two springs when they are connected in series and in parallel.
8. Define torsion.
9. Point out any two applications of leaf spring.
10. Quote the expressions for polar modulus of solid and hollow circular shaft.

Part-B (16 Marks)

1. Derive the expression for power transmitted by a shaft.
2. The internal and external diameter of a hollow shaft is in the ratio of 2:3. The hollow shaft is to transmit a 400kW power at 120rpm. The maximum expected torque is 15% greater than the mean value. If the shear stress not to exceed 50MPa, find section of the shaft which would satisfy the shear stress and twist condition. Take G= 0.85×10^5 MPa
3. A steel shaft is to require to transmit 75kW power at 100 rpm and the maximum twisting moment is 13% greater than the mean. Find the diameter of the steel shaft if the maximum stress is $70N/mm^2$. Also determine the angle of twist in a length of 3m of the shaft. Assume the modules of rigidity for steel as $90kN/mm^2$
4. 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 50 Mpa and shear modulus 0.82 x 10^5 MPa.

5. Derive the expression for angle of twist of two shafts when they are connected in series

Unit-IV : Deflection of Beams

Part-A (2 Marks)

1. List the important methods used to find slope and deflection.
2. Where does the maximum deflection occur in cantilever beam?
3. Where does the maximum deflection occur for simply supported beam loaded symmetrically about mid-point and having same cross- section through their length?
4. Calculate the maximum deflection of a simply supported beam carrying a point load of 100 KN at mid span. Span = 6 m, E= 20000 kN/m^2
5. Modify the cantilever beam with a point load at free end into conjugate beam.
6. Compare the moment area method with conjugate beam method for finding the deflection of a simply supported beam with UDL over the entire span.
7. A cantilever beam of spring 2 m is carrying a point load of 20 kN at its free end. Measure the slope at the free end. Assume EI = 12 x 103 kN-m^2
8. Define resilience.
9. Define strain energy.
10. Express the value of slope at the free end of a cantilever beam of constant EI

Part-B (16 Marks)

1. A beam AB of length 8 m is simply supported at its ends and carries two point loads of 50 kN and 40 kN at a distance of 2 m and 5 m respectively from left support A. Determine, deflection under each load, maximum deflection and the position at which maximum deflection occurs. Take E = 2 x 105 N/mm^2 and I = 8.5 X106 mm ^{4}
2. Explain the Macaulay's method for finding the slope and deflection of beams with example.
3. Explain the conjugate beam method for finding the deflection of beams with example.
4. Explain double integration method for finding deflection of beams with example
5. A simply supported beam AB of span 4m, carrying a load of 100 kN at the mid span C has cross sectional moment of inertia 24 x 10^6 mm^4 over the left half of the span and 48 x 10^6 mm^4 over the right half. Find the slope at two supports and the deflection under the load. Take E = 200 GPa

Unit-V : Thin Cylinders, Spheres and Thick Cylinders

Part-A (2 Marks)

1. A cylindrical pipe of diameter 1.5 m and thickness 1.5 cm is subjected to an internal fluid pressure of 1.2 N/mm^2. Calculate the longitudinal stress developed in the pipe.
2. Estimate the thickness of the pipe due to an internal pressure of 10 N/mm^2 if the permissible stress is 120 N/mm^2. The diameter of pipe is 750 mm.
3. A spherical shell of 1 m diameter is subjected to an internal pressure 0.5N/mm^2. Discover the thickness of the shell, if the allowable stress in the material of the shell is 75 N/mm^2.
4. Formulate an expression for the longitudinal stress in a thin cylinder subjected to an uniform

internal fluid pressure.

5. Assess the thickness of the pipe due to an internal pressure of 10 N/mm^2 if the permissible stress is 120 N/mm^2. The diameter of pipe is 750 mm.
6. When the longitudinal stress is in a thin cylinder is zero?
7. List out the formulae for finding change in diameter, change in length and change in volume of a thin cylindrical shell subjected to internal fluid pressure p.
8. Discuss about wire wounded thin cylinder
9. Give the expression for hoop stress for thin spherical shells
10. Define circumferential stress.

Part-B (16 Marks)

1. Derive the expressions for change in dimensions of a thin cylinder due to internal pressure.
2. A thin cylindrical shell 3 m long has 1m internal diameter and 15 mm metal thickness. Calculate the circumferential and longitudinal stresses induced and also the change in the dimensions of the shell, if it is subjected to an internal pressure of 1.5 N/mm^2 Take $E = 2x10^5$ N/mm^2 and poison's ratio =0.3. Also calculate change in volume.
3. Explain briefly about thin spherical shell and derive the expression for hoop stress in thin spherical shell.
4. A cylindrical shell 3 m long, 1 m internal diameter and 10 mm thick is subjected to an internal pressure of 1.5 N/mm^2. Calculate the changes in length, diameter and volume of the cylinder. E = 200 kN/mm^2, Poisson's ratio = 0.3.
5. A spherical shell of 2m diameter is made up of 10mm thick plates. Calculate the change in diameter and volume of the shell, when it is subjected to an internal pressure of 1.6 MPa. Take E = 200 GPa and 1/m = 0.3