

GUJARAT TECHNOLOGICAL UNIVERSITY

DI -3 SEMESTER – OLD PAPER – W22 TO S25 – QUESTION BANK(English)

Subject Name & Code:

Mechanics of Structures- 4330602

Unit I - Direct Stress & Strain

Repeated Questions:

1. **Define: (i) Stress (ii) Strain (iii) Modulus of elasticity.**
 - Appeared in: S23 (Q1a, 03 marks), S24 (Q1a, 03 marks)
2. **Define: (i) Stress (ii) Elastic limit (iii) Poisson's ratio.**
 - Appeared in: S24 (Q1a, 03 marks)
3. **Define Modular ratio and Poisson's ratio. Write maximum possible value of Poisson's ratio.**
 - Appeared in: W22 (Q1a, 03 marks)
4. **Define linear strain, lateral strain and Poisson's ratio.**
 - Appeared in: W24 (Q1a, 03 marks)
5. **A steel bar, having cross sectional area of $X \text{ mm}^2$, is subjected to axial forces as shown in a figure. Determine the total elongation/change in length of the bar. Take $E = Y \text{ N/mm}^2$.**
 - Appeared in: S23 (Q1c, 07 marks), S24 (Q1c, 07 marks), S25 (Q1d, 08 marks)
[Figure and values change]

Other Important Questions:

1. **A weight of 20kN is to be lifted by a steel wire. If maximum stress in the wire is not to exceed 90 N/mm^2 , Calculate diameter of wire.**
 - Appeared in: S23 (Q1b, 04 marks)
2. **A mild steel bar 500mm long and 16mm square in cross section is subjected to (i) gradual (ii) sudden load of 10kN along length direction. Find strain energy in both cases.**
 - Appeared in: S23 (Q1c-OR, 07 marks)
3. **A steel bar 20 mm in diameter is subjected to tensile force of 85 kN. Calculate stress and strain produced in the steel bar. Take $E = 2 \times 10^5 \text{ N/mm}^2$.**
 - Appeared in: S24 (Q1b, 04 marks)
4. **An R.C.C. column of 500 mm x 500 mm in section is provided with 4 -20 mm diameter steel bars at each corner. This column is subjected to compressive force of 1000 kN. Calculate stress in steel and concrete. Take modular ratio = 15.**

- Appeared in: S24 (Q1c-OR, 07 marks)
- 5. **A steel bar 150mmx50mmx50mm is subjected to axial compressive force of 400KN. If $\mu=0.3$, $E=2 \times 10^5$ N/mm². Find change in dimensions of the bar. Also find strain energy stored and modulus of resilience.**
 - Appeared in: W22 (Q1c, 07 marks)
- 6. **A steel rod of 1.4m length and 20mm diameter hangs vertically and it has a collar securely attached at lower end. Find the maximum instantaneous stress, induced when a weight of 230N falls on the collar from a clear height of 138mm. Also find strain energy stored and modulus of resilience.**
 - Appeared in: W22 (Q1c-OR, 07 marks)
- 7. **The deformation in the diameter is 0.004 mm, when 32mm diameter bar subjected to 80 KN axial load. If shear modulus is 80GPa, find Young modulus, Bulk modulus and Poison's ratio.**
 - Appeared in: W24 (Q1c, 07 marks)
- 8. **A 400 mm square concrete column is reinforced with 4 bars of 16mm diameter mild steel. This composite section is subjected to axial compressive load of 800 KN .If Young's modulus for concrete and steel are 12.5 GPa and 200 GPa respectively then find stress developed in each material.**
 - Appeared in: W24 (Q1c-OR, 07 marks)
- 9. **Describe Hooke's law of elasticity.**
 - Appeared in: S25 (Q1a, 03 marks)
- 10. **A steel bar 2 m long and 18 mm in diameter is subjected to an axial tensile force of 40 kN. Find stress, strain and change in length of the bar. Take, $E = 2 \times 10^5$ N/mm².**
 - Appeared in: S25 (Q1b, 04 marks)
- 11. **A force of 200 kN is suddenly applied to steel bar of 20 mm diameter and 1.5 m length. Calculate strain energy stored in the bar. Consider, $E = 2 \times 10^5$ N/mm².**
 - Appeared in: S25 (Q1c, 07 marks)
- 12. **Define composite section and derive equation of composite section.**
 - Appeared in: W22 (Q1b, 04 marks)
- 13. **Draw and explain stress strain diagram for tension test of mild steel bar.**
 - Appeared in: W24 (Q1b, 04 marks)

Unit II - Moment of Inertia

Repeated Questions:

1. **State and explain Parallel axis theorem.**
 - Appeared in: S24 (Q2a-OR, 03 marks), S23 (Q2a-OR, 03 marks)
2. **State and explain Perpendicular axis theorem.**
 - Appeared in: S24 (Q2a, 03 marks), S23 (Q2a, 03 marks)
3. **Determine moment of Inertia of a T-section about I_{xx} or I_{yy} .**
 - Appeared in: S24 (Q2b, 04 marks), S25 (Q2b, 04 marks) [Dimensions change]
4. **Determine moment of Inertia of an angle section about I_{xx} or I_{yy} .**
 - Appeared in: S24 (Q2b-OR, 04 marks), S25 (Q2b-OR, 04 marks) [Dimensions change]

Other Important Questions:

1. **Find “Radius of gyration” of a circular cross-section having its diameter 80 mm.**
 - Appeared in: S25 (Q2a-OR, 03 marks)
2. **Find the section modulus of a circular section having its diameter D along both the axes passing its center.**
 - Appeared in: S25 (Q2a, 03 marks)
3. **What will be the section modulus for following (i) rectangular section having dimension 240mm x 460mm. (ii) Circular section having diameter 300mm.**
 - Appeared in: S23 (Q2b, 04 marks)
4. **Find the moment of inertia (I_{xx} and I_{yy}) for the section shown in a figure.**
 - Appeared in: S23 (Q2b-OR, 04 marks)
5. **Find moment of inertia at the base of an angle section of size 100mm x 80mm x 20mm keeping longer leg vertical.**
 - Appeared in: W24 (Q3b, 04 marks)
6. **Find I_{XX} and I_{YY} of a hollow rectangle having external dimensions 300 x 500 mm and internal dimensions 200 x 400 mm.**
 - Appeared in: W24 (Q4a-OR, 03 marks)
7. **Find moment of inertia of an ISA 90x90x6mm.**
 - Appeared in: W22 (Q5c, 07 marks)
8. **A rectangular has width 400mm and depth 800mm. There are two holes each of 200mm diameter on y-y axis, one at 200mm and other at 600mm depth from top edge of rectangle. Calculate M.I on x-x and y-y axis.**
 - Appeared in: W22 (Q5c-OR, 07 marks)

9. **Explain (i) Moment of inertia (ii) Radius of gyration.**

- Appeared in: S23 (Q3b-OR, 04 marks)

10. **Define moment of inertia and radius of gyration with usual notations with their units.**

- Appeared in: W24 (Q4a, 03 marks)

Unit III - S.F. & B.M. in Beam

Repeated Questions:

1. **Draw Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) for a given beam.**
 - Appeared in: S23 (Q2c, 07 marks), S23 (Q2c-OR, 07 marks), S24 (Q2c, 07 marks), S24 (Q2c-OR, 07 marks), S25 (Q2c, 07 marks), S25 (Q2c-OR, 07 marks), W22 (Q2c, 07 marks) [Different beam configurations in each paper]
2. **Define/Explain/Describe Point of Contra flexure.**
 - Appeared in: S25 (Q5b, 04 marks), W24 (Q2a, 03 marks), W24 (Q2a-OR, 03 marks), W22 (Q2a, 03 marks)
3. **Define Shear force & Bending moment.**
 - Appeared in: W22 (Q2b, 03 marks)
4. **Describe points to be considered while drawing shear force diagram.**
 - Appeared in: S24 (Q3a, 03 marks)
5. **Describe points to be considered while drawing bending moment diagram.**
 - Appeared in: S24 (Q3a-OR, 03 marks)

Other Important Questions:

1. **A simply supported beam ABCD supported at A and D is 4m long. It is subjected to two point loads 12 kN and 18 kN at point B and C at a distance 1m and 2.5m from support A respectively. Draw only SF diagram / only BM diagram.**
 - Appeared in: W24 (Q2b, 04 marks), W24 (Q2b-OR, 04 marks)
2. **ABCDE is an overhang beam of 4m length resting on supports A and D, portion DE is overhung. Portions AB=BC=CD=DE=1m. It carries point loads of 8kN, 5kN and 3kN on points B, C and E respectively. Calculate S.F. and B.M values and draw SFD and BMD for the beam. Also find point of contra flexure if any.**
 - Appeared in: W24 (Q2c, 07 marks)
3. **ABCD is an overhang beam of 4m length resting on supports A and C, portion CD is overhung by 1m length carries 4kN/m U.D.L. while Portion AC carries 20kN/m U.D.L. It also carries a point load of 4kN at B, 1m from point A on its right. Calculate S.F. and B.M values and draw SFD and BMD for the beam. Also find point of contra flexure if any.**
 - Appeared in: W24 (Q2c-OR, 07 marks)
4. **A simply supported beam 6m long is carrying a u.d.l of 5kN/m over a length of 3m from the right end. Draw shear force and bending moment diagram. And locate point of contra flexure wherever require.**
 - Appeared in: W22 (Q2c, 07 marks)

5. **A beam ABCD, 4m long is overhanging by 1m and carries load shown in fig. Draw shear force and bending moment diagram. And locate point of contra flexure wherever require.**
 - Appeared in: W22 (Q2c-OR, 07 marks)
6. **Describe types of load with figure.**
 - Appeared in: W22 (Q2a-OR, 03 marks)
7. **Illustrate statically in-determinate beam with one example.**
 - Appeared in: W22 (Q2b-OR, 04 marks)
8. **Explain the type of supports of a beam with sketches.**
 - Appeared in: S25 (Q3a, 03 marks)
9. **Differentiate the statically determinate beam and statically indeterminate beam.**
 - Appeared in: S25 (Q3a-OR, 03 marks), S23 (Q3a-OR, 03 marks)
10. **Give relationship between shear force and bending moments.**
 - Appeared in: S23 (Q3a, 03 marks)
11. **Write the relationship between shear force and bending moment.**
 - Appeared in: S25 (Q5b-OR, 04 marks)
12. **A simply supported beam is having length of 4m. UDL of 5 kN/m is being applied over 1m length starting at 1m from left support to center point of beam and this beam is also loaded with point load of 10kN at 1m distance from right support. Draw shear force and bending moment diagram for this beam.**
 - Appeared in: S23 (Q3c-OR, 07 marks)

Unit IV - Bending & Shear Stress in Beam

Repeated Questions:

1. **Write assumptions made in the theory of bending.**
 - Appeared in: S24 (Q3b, 04 marks), S23 (Q3b, 04 marks), S25 (Q3b-OR, 04 marks)
2. **Draw shear stress distribution diagram for different cross-sections (Rectangular, Hollow rectangular, I-section, Circular).**
 - Appeared in: S24 (Q3b-OR, 04 marks), S23 (Q4b-OR, 04 marks)
3. **A beam of T-section is subjected to a shear force. Determine the maximum shear stress and draw the shear stress distribution diagram.**
 - Appeared in: S24 (Q3c-OR, 07 marks), W23 (Q3e, 07 marks), W22 (Q3c, 07 marks) [Dimensions and force values change]

Other Important Questions:

1. **State equation of bending with usual notations and write down two assumptions made in the theory of bending.**
 - Appeared in: W24 (Q3a, 03 marks)
2. **Define moment of resistance and modulus of section.**
 - Appeared in: W24 (Q3a-OR, 03 marks)
3. **Describe “neutral axis” and “moment of resistance” of a beam.**
 - Appeared in: S25 (Q3b, 04 marks)
4. **A simply supported beam has span and cross-section. It carries u.d.l. on entire span. Find maximum bending stress and stress on a layer at a given distance from the neutral axis.**
 - Appeared in: W24 (Q3c, 07 marks), S25 (Q3c-OR, 07 marks) [Values change]
5. **A rectangular beam is simply supported over a span. If the bending stress is not to exceed a given value, determine u.d.l. per meter which the beam can carry.**
 - Appeared in: S24 (Q3c, 07 marks)
6. **Calculate the maximum stress induced in a cast iron pipe of given dimensions when the pipe is supported simply at its ends and carries a point load at its centre.**
 - Appeared in: S23 (Q3c, 07 marks)
7. **A beam of triangular cross-section is subjected to a shear force. Find the value of maximum shear stress and sketch the shear stress distribution along the depth of the beam.**
 - Appeared in: W22 (Q3a-OR, 03 marks)
8. **An I section is used as a simply supported beam to carry u.d.l. over entire span. Draw shear stress distribution diagram for the beam.**
 - Appeared in: W22 (Q3c-OR, 07 marks)

9. **A cantilever beam of a given span is loaded with u.d.l. over its entire length. The cross-section of the beam is given. Draw shear stress distribution for the section having maximum shear force.**
- Appeared in: S25 (Q3c, 07 marks)
10. **A rectangle beam is simply supported over a span. If the beam is subjected to central point load, find maximum bending stress induced in the beam section.**
- Appeared in: W22 (Q3a, 03 marks)

Unit V - Slope and Deflection

Repeated Questions:

1. **Define: (i) Slope (ii) Deflection (iii) Flexural rigidity.**
 - Appeared in: S24 (Q4a, 03 marks)
2. **Define “Slope” and “Deflection” of a beam with example.**
 - Appeared in: S25 (Q4a-OR, 03 marks)
3. **A cantilever beam with a point load at its free end. Find maximum slope and deflection.**
 - Appeared in: S24 (Q4b, 04 marks), W24 (Q4b, 04 marks), W22 (Q4b-OR, 04 marks) [Values change]
4. **A simply supported beam carries a point load at center. If slope at support is given, calculate the maximum deflection of beam.**
 - Appeared in: S24 (Q4b-OR, 04 marks), S25 (Q4b-OR, 04 marks) [Values change]

Other Important Questions:

1. **List the methods to find out slope and deflection of a beam.**
 - Appeared in: S25 (Q4a, 03 marks)
2. **State factors affecting slope and deflection.**
 - Appeared in: S24 (Q4a-OR, 03 marks)
3. **A cantilever beam of span carries a u.d.l. over entire span. Find maximum slope and deflection.**
 - Appeared in: W24 (Q4c-OR, 07 marks), W22 (Q4b, 04 marks), S25 (Q5b, 04 marks) [Values and load types change]
4. **A simply supported beam carries a u.d.l. over entire span. If deflection at the centre is not to exceed a given value, calculate span of the beam.**
 - Appeared in: S25 (Q4b, 04 marks)
5. **A simply supported beam is subjected to a point load of 100kN at center. The beam has maximum deflection of 5mm. Find effective span length of beam given E and I.**
 - Appeared in: S23 (Q4a, 03 marks)
6. **Determine the slope and deflection of the free end of a cantilever beam of length 3m which is carrying a uniformly distributed load of 10kN/m over entire span.**
 - Appeared in: S23 (Q4b, 04 marks)
7. **A cantilever beam 120mm wide and 150mm deep is 1.8m long. Determine the slope and deflection at the free end of the beam, when it carries a point load of 20kN at its free end.**
 - Appeared in: W22 (Q4b-OR, 04 marks)

8. **A wooden beam with given dimensions and span. Determine the load that can be placed at its centre to cause the beam a deflection of 10mm.**
 - Appeared in: W22 (Q3b-OR, 04 marks)
9. **A cantilever beam having cross section is of a given length. What UDL should it carry to produce a deflection of 6mm at free end? Also find slope.**
 - Appeared in: W22 (Q3b, 04 marks)
10. **A brass bar is rigidly fixed. Calculate the temperature stress induced when it is heated.**
 - Appeared in: S23 (Q4a-OR, 03 marks)
11. **An impact load is released from a height and applied at the end of a steel bar. Find instantaneous stress induced in bar.**
 - Appeared in: S23 (Q4c-OR, 07 marks)

Unit VI - Analysis of Truss

Repeated Questions:

1. **Find forces in all the members of a truss shown in a figure by method of joints.**
 - Appeared in: S24 (Q4c, 07 marks), S24 (Q5c, 07 marks), S23 (Q4c, 07 marks), W24 (Q4c, 07 marks), W22 (Q4c, 07 marks), W22 (Q4c-OR, 07 marks), S25 (Q4c, 07 marks), S25 (Q4c-OR, 07 marks) [Different truss figures in each paper]
2. **Differentiate between Perfect truss and Redundant truss / Deficient truss.**
 - Appeared in: W23 (Q4a, 03 marks), S23 (Q5a, 03 marks), S25 (Q5a-OR, 03 marks)
3. **Write assumptions made in the analysis of truss.**
 - Appeared in: S24 (Q5a, 03 marks), S23 (Q5a-OR, 03 marks)

Other Important Questions:

1. **Find forces in all the members of a truss shown in a figure by graphical method.**
 - Appeared in: S24 (Q4c-OR, 07 marks), W24 (Q4f, 08 marks)
2. **Explain Perfect, Deficient and Redundant truss.**
 - Appeared in: W23 (Q4a, 03 marks)
3. **Distinguish between truss and beam.**
 - Appeared in: W24 (Q4a-OR, 03 marks), S24 (Q5a-OR, 03 marks), S25 (Q5a, 03 marks)
4. **Define truss, frame and beam.**
 - Appeared in: W22 (Q4a-OR, 03 marks)
5. **Differentiate between perfect and imperfect frame.**
 - Appeared in: W24 (Q5a, 03 marks)

Unit VII - Column & Strut

Repeated Questions:

1. **Explain column end conditions and effective length with sketch.**
 - Appeared in: W23 (Q5b, 04 marks), S23 (Q5b-OR, 04 marks)
2. **Define crippling load and write equation of crippling load for Euler's formula.**
 - Appeared in: W22 (Q5a, 03 marks)
3. **Write assumptions made in Euler's theory.**
 - Appeared in: S23 (Q5b, 04 marks)
4. **A hollow circular column with given dimensions and end conditions. Calculate Euler's buckling/crippling load or actual length.**
 - Appeared in: S23 (Q5c, 07 marks), S24 (Q5c, 07 marks) [Values and specifics change]

Other Important Questions:

1. **Differentiate between Strut and Column.**
 - Appeared in: W23 (Q5a-OR, 03 marks), W22 (Q5a-OR, 03 marks)
2. **State the formula for crippling load for different end conditions.**
 - Appeared in: W24 (Q4b-OR, 04 marks)
3. **A hollow cast iron column with given dimensions and end conditions (one end fixed, other hinged). Find the safe load by using Rankine's formula.**
 - Appeared in: W23 (Q5d, 07 marks)
4. **A steel column fixed at both ends. Using given details, determine safe load by Rankine's formula.**
 - Appeared in: S25 (Q5c-OR, 07 marks)
5. **A circular steel column with given end conditions (fixed at one end, hinged at other). Calculate safe load carrying capacity using Euler's formula.**
 - Appeared in: S25 (Q5c, 07 marks)
6. **A T-section used as a column with both ends hinged. Given E, determine Euler's buckling load.**
 - Appeared in: S24 (Q5c-OR, 07 marks)
7. **A rectangular column fixed at both ends. Find Euler's crippling load.**
 - Appeared in: S23 (Q5c-OR, 07 marks)
8. **A hollow alloy tube with both ends pinned extends under a tensile load. Find the buckling load and safe load with given F.O.S.**
 - Appeared in: W22 (Q5b, 04 marks)
9. **Find the Euler's crippling load for a hollow cylindrical steel column of given dimensions with both ends hinged. Also calculate crippling load by Rankine's formula.**
 - Appeared in: W22 (Q5b-OR, 04 marks)
10. **A concrete column, rectangular shaped with given end conditions (fixed one end, hinged other). Determine safe buckling load using Euler's formula with F.O.S.**
 - Appeared in: S24 (Q5c-OR, 07 marks)
11. **Explain determinate and indeterminate beam with examples.**
 - Appeared in: S24 (Q5b, 04 marks)
12. **What do you understand from 'principle of superposition' for bars of varying cross sections? Explain it in detail.**
 - Appeared in: W24 (Q5b-OR, 04 marks)
13. **Explain types of load and types of beam with sketch.**
 - Appeared in: S24 (Q5b-OR, 04 marks)
