

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-5 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Structural analysis-II- 3150614

Unit-1: Statically Indeterminate Structure – Classical Methods

Repeated Questions:

1. **Analyze a continuous beam/frame using the Slope Deflection Method and draw the Bending Moment Diagram (BMD).**
 - **Appeared in:** SUMMER 2022 (Q1c, 07 Marks), WINTER 2023 (Q1c, 07 Marks), SUMMER 2025 (Q1c, 07 Marks).
 - **Details:** This is a core numerical problem. You will be given a continuous beam or a simple portal frame (with or without sway) and asked to find the end moments and draw the BMD.
2. **Analyze a beam/frame using the Moment Distribution Method and draw the BMD/SFD.**
 - **Appeared in:** SUMMER 2022 (Q2c OR, 07 Marks), WINTER 2023 (Q3c, 07 Marks), SUMMER 2025 (Q2c, 07 Marks), WINTER 2024 (Q3c, 07 Marks).
 - **Details:** Another fundamental numerical problem. Focus on continuous beams and frames (including those with sway).
3. **Write the assumptions made in the Slope Deflection Method.**
 - **Appeared in:** SUMMER 2022 (Q2a, 03 Marks), WINTER 2023 (Q3a, 03 Marks), WINTER 2024 (Q2a, 03 Marks).
4. **Define/Differentiate: Distribution Factor, Relative Stiffness, Stiffness, Carry-Over Factor/Moment.**
 - **Appeared in:** SUMMER 2023 (Q1b, 04 Marks), WINTER 2022 (Q2b, 04 Marks), WINTER 2024 (Q1b, 04 Marks).
5. **What is a portal frame? Discuss the causes of sway in a portal frame.**
 - **Appeared in:** SUMMER 2023 (Q2b, 04 Marks), WINTER 2022 (Q3b OR, 04 Marks), SUMMER 2025 (Q5b, 04 Marks).
6. **Derive the Slope Deflection Equations from fundamentals.**
 - **Appeared in:** SUMMER 2022 (Q1b, 04 Marks), WINTER 2023 (Q3b OR, 04 Marks), WINTER 2024 (Q2c, 07 Marks).

Other Important Questions:

1. **Write the steps for analysis of a plane frame with sway by the Moment Distribution Method.** (SUMMER 2024, Q5a OR, 03 Marks)
2. **Discuss the uses of the Slope Deflection Method.** (WINTER 2023, Q3a, 03 Marks; SUMMER 2023, Q5a OR, 03 Marks)
3. **Differentiate between the Slope Deflection Method and the Moment Distribution Method.** (SUMMER 2024, Q5a, 03 Marks)
4. **Derive shear equations for portal frames with side sway.** (WINTER 2023, Q2b, 04 Marks; SUMMER 2025, Q3b OR, 04 Marks; WINTER 2024, Q3b, 04 Marks)
5. **For a three-span continuous beam with support settlements, write the Slope Deflection Equations.** (WINTER 2022, Q4c OR, Numerical, 07 Marks) *This is a specific and advanced application.*

Unit-2: Statically Indeterminate Structures – Matrix Methods

Repeated Questions:

1. **Differentiate between the Stiffness Method and the Flexibility Method. Which method is more suitable for computer programming and why?**
 - **Appeared in:** WINTER 2023 (Q3a OR, 03 Marks), SUMMER 2023 (Q3b, 04 Marks), WINTER 2024 (Q3a OR, 03 Marks), SUMMER 2025 (Q5a, 03 Marks), SUMMER 2022 (Q5a OR, 03 Marks).
 - **Details:** This is arguably the most important theory question from this unit. The answer must include that the Stiffness Method is more suitable for computer programming because it follows a standard, systematic procedure that is easy to automate.
2. **Analyze a beam/frame using the Flexibility Method.**
 - **Appeared in:** SUMMER 2022 (Q4c, 07 Marks), SUMMER 2023 (Q2c OR, 07 Marks), WINTER 2022 (Q4c, 07 Marks), SUMMER 2025 (Q5c OR, 07 Marks).
 - **Details:** A key numerical problem. Often applied to propped cantilevers or simple frames (like an L-bent).
3. **Analyze a beam/frame using the Stiffness Method.**
 - **Appeared in:** SUMMER 2024 (Q1, 14 Marks combined), SUMMER 2022 (Q5c OR, 07 Marks).
 - **Details:** A comprehensive numerical problem requiring the formulation of the stiffness matrix, solving for displacements, and finding reactions and end moments.
4. **Formulate the Stiffness/Flexibility matrix for a cantilever beam.**
 - **Appeared in:** WINTER 2024 (Q4c, 07 Marks), WINTER 2022 (Q3c OR, 07 Marks).
 - **Details:** Tests fundamental understanding of these matrices for a basic structural element.
5. **State the characteristics of the Stiffness Matrix.**
 - **Appeared in:** WINTER 2023 (Q1b, 03 Marks), SUMMER 2025 (Q2a, 03 Marks).
6. **Derive the relation between Stiffness and Flexibility. / Show that stiffness and flexibility matrices are reciprocal.**
 - **Appeared in:** SUMMER 2023 (Q3a OR, 03 Marks), SUMMER 2025 (Q1b, 04 Marks), SUMMER 2022 (Q5a, 03 Marks).

Other Important Questions:

1. **Explain various types of skeletal structures.** (SUMMER 2023, Q5a, 03 Marks; SUMMER 2022, Q4a OR, 03 Marks)
2. **Define: Action and Displacement.** (WINTER 2022, Q2a, 03 Marks)
3. **Explain the essential features of the Stiffness Method.** (SUMMER 2022, Q4b OR, 04 Marks)
4. **Calculate the Degree of Static Indeterminacy (SI) and Kinematic Indeterminacy (KI) for a given structure.** (SUMMER 2024, Q1a & Q2a, 03 Marks each) *This is a fundamental starting point for matrix methods.*
5. **With appropriate illustration, show that $[S] = [F]^{-1}$ (Stiffness matrix is the inverse of the Flexibility matrix).** (SUMMER 2024, Q2c OR, 07 Marks)

Unit-3: Energy Principles - Approximate Methods

Repeated Questions:

1. **State and prove/explain Castigliano's First Theorem.**
 - **Appeared in:** WINTER 2024 (Q1a, 03 Marks), WINTER 2022 (Q1b, 03 Marks), SUMMER 2025 (Q4b, 04 Marks).
2. **Calculate the deflection/slope for a beam/frame using Castigliano's First Theorem.**
 - **Appeared in:** WINTER 2024 (Q1c, 07 Marks), SUMMER 2024 (Q3, 14 Marks combined), WINTER 2023 (Q3b, 04 Marks), SUMMER 2025 (Q3b, 04 Marks).
 - **Details:** A very common numerical problem. Applied to beams (cantilever, simply supported) and framed structures (bent bars, portals).
3. **Write a short note on Castigliano's Second Theorem and discuss its uses.**
 - **Appeared in:** WINTER 2024 (Q3b OR, 04 Marks), WINTER 2022 (Q4b, 04 Marks).
4. **Use Castigliano's Second Theorem to find fixed end moments or analyze indeterminate structures.**
 - **Appeared in:** WINTER 2023 (Q3c OR, Numerical, 07 Marks), SUMMER 2025 (Q3c OR, Numerical, 07 Marks).
5. **Determine reactions for a propped cantilever beam under UDL using the principle of minimum strain energy.**
 - **Appeared in:** WINTER 2024 (Q4b, 07 Marks). *This is a direct application of energy principles to indeterminacy.*
6. **Explain the fictitious load method used to solve deflection problems.**
 - **Appeared in:** SUMMER 2023 (Q2a, 03 Marks), SUMMER 2025 (Q3a, 03 Marks), WINTER 2022 (Q5a, 03 Marks).

Other Important Questions:

1. **Discuss the limitations of Castigliano's First Theorem.** (SUMMER 2023, Q4a OR, 03 Marks)
2. **Enlist the steps of the Unit Load Method to analyze indeterminate structures.** (WINTER 2023, Q4b, 04 Marks; SUMMER 2025, Q2b, 04 Marks) *Note: The Unit Load Method is derived from Castigliano's Second Theorem.*
3. **Write assumptions made in the cantilever method of approximate analysis.** (WINTER 2024, Q4a, 03 Marks; SUMMER 2023, Q4b OR, 04 Marks)
4. **Analyze a portal frame using Castigliano's Second Theorem and draw BMD.** (SUMMER 2023, Q4c, 07 Marks)

Unit-4: Structure Subjected to Moving Load

Repeated Questions:

1. **Define an Influence Line Diagram (ILD). What is its use/significance?**
 - **Appeared in:** WINTER 2023 (Q2a, 03 Marks), SUMMER 2023 (Q4a, 03 Marks), WINTER 2022 (Q4a, 03 Marks), SUMMER 2025 (Q4a OR, 03 Marks).
2. **State and explain Muller-Breslau's Principle.**
 - **Appeared in:** SUMMER 2022 (Q1a, 03 Marks), SUMMER 2023 (Q3a, 03 Marks), WINTER 2024 (Q4a, 03 Marks), SUMMER 2025 (Q5b OR, 04 Marks).
3. **Draw ILDs for support reactions, Shear Force (SF), and Bending Moment (BM) for a simply supported beam.**
 - **Appeared in:** SUMMER 2023 (Q4b, 04 Marks), SUMMER 2025 (Q4b OR, 04 Marks), SUMMER 2022 (Q5b, 04 Marks).
4. **For a given moving load (UDL or series of point loads), calculate the maximum SF/BM at a specific section of a simply supported beam using ILDs.**
 - **Appeared in:** SUMMER 2023 (Q5c OR, 07 Marks), SUMMER 2024 (Q4b, 04 Marks), SUMMER 2025 (Q2c, 07 Marks).
 - **Details:** A classic numerical problem testing the practical application of ILDs.
5. **Draw Qualitative ILDs for functions (reaction, SF, BM) of a continuous beam or a rigid frame.**
 - **Appeared in:** WINTER 2023 (Q3b OR, 04 Marks), WINTER 2024 (Q5b, 04 Marks), SUMMER 2022 (Q3b OR, 04 Marks).
6. **Draw Quantitative ILDs for reactions/SF/BM for a continuous beam and calculate ordinates at specific intervals.**
 - **Appeared in:** SUMMER 2022 (Q4c, 07 Marks), WINTER 2024 (Q5c, 07 Marks), SUMMER 2024 (Q4b,c, 11 Marks combined).

Other Important Questions:

1. **What is the difference between Qualitative and Quantitative Influence Lines?** (SUMMER 2022, Q5b OR, 04 Marks)
2. **Explain the characteristics of ILDs for statically indeterminate structures.** (WINTER 2023, Q4b, 04 Marks; SUMMER 2022, Q4b, 04 Marks)
3. **Draw the ILD for a reaction in a continuous beam (specific problem).** (WINTER 2023, Q2c OR, 07 Marks; SUMMER 2025, Q3c, 07 Marks)
