25CVMJ203: Analysis of Determinate Structures

w. e. f. Academic Year:	**2026-27**
Semester:	**3rd**
Category of the Course:	**PCC**
Prerequisite:	Basic knowledge of Engineering Mechanics, including equilibrium of forces and moments. Understanding of free-body diagrams and resolution of forces. Fundamental concepts of vectors and basic mathematics.
Rationale:	The course builds a strong theoretical and analytical base for structural engineering. It enhances students' ability to visualize structural response, apply equilibrium concepts, and develop confidence in solving real-world structural problems of determinate beams, trusses, and frames. The subject forms the foundation for advanced structural analysis and structural design courses in Civil Engineering. Hence, it is a core subject in the Civil Engineering curriculum.

Course Outcomes:

After Completion of the Course, the student will be able to:

	Course Outcome (CO)	**RBT Level (Cognitive Domain)**	**Marks % Weightage**
CO1	Understand structural systems and compute Static and Kinematic Indeterminacy.	Understand, Remember	**15%**
CO2	Analyze beams for shear force, bending moment, slope, and deflection.	Apply, Analyze	**15%**
CO3	Evaluate slope and deflection of beams using methods such as Moment Area Method, Macaulay's Method, and Conjugate Beam Method.	Understand, Analyze, Create	**20%**
CO4	Analyze plane trusses and frames for internal forces.	Analyze, Evaluate	**25%**
CO5	Develop influence line diagrams for beams under moving loads.	Analyze, Apply	**25%**

Teaching and Evaluation Scheme:

Teaching Scheme					**Examination Scheme**				
L	**T**	**P**	**C**	**Hrs/Week**	**IE**	**Theory**	**CIA**	**Practical**	**Total Marks**
2	1	0	3	3	40	60	30	20	150

IE: Internal Evaluation
CIA: Continuous Internal Assessment
Theory: Theory Exam (End Semester)
Practical: Practical Exam (End Semester)

Detailed Syllabus:

Topic		Hrs.	% of Weightage
UNIT: 1	**Fundamentals**	**4**	**15%**
Introduction to structural systems like beams, plane (2D) and space (3D) trusses, plane (2D) and space (3D) frames, grids, Introduction to SI and KI, Calculation of SI and KI			
UNIT: 2	**Analysis of Beams**	**4**	**15%**
Calculation of shear force and bending moment diagrams for beams subjected to point loads, UDL, UVL, and Moment.			
UNIT: 3	**Slope deflection method**	**6**	**20%**
Calculation of slope and deflection for beams subjected to point loads and UDL using the moment area method for the cantilever beam, Macaulay's method, and the conjugate beam method for the simply supported beam.			
UNIT: 4	**Analysis of Trusses and Frames**	**8**	**25%**
Calculation of axial forces in plane trusses using the Method of joints and Method of sections. Calculation of axial force, shear force, and bending moment diagrams in plane frames subjected to point loads and UDL			
UNIT: 5	**Influence Line Diagrams**	**8**	**25%**
Influence line diagrams for support reactions, shear force, and bending moment for simply supported beams for a point load, several point loads, UDL shorter and longer than the span			
		30	**100**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks in Percentage				
Understand	**Analyze**	**Evaluate**	**Analyze**	**Apply**
15	**15**	**20**	**25**	**25**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

Reference Books:

1. Structural Analysis by R. C. Hibbeler, 11th Edition, published by Pearson Education, ISBN: 9789354497841
2. Structural Analysis by Aslam Kassimali, 6th Edition (SI Units), published by Cengage Learning India, ISBN: 9788131518866
3. Structural Analysis by Devdas Menon, 3rd Edition, published by Narosa Publishing House / Alpha Science International, ISBN: 9788184875973
4. Basic Structural Analysis by C. S. Reddy, 3rd Edition, published by Tata McGraw-Hill Education, ISBN: 9780070702769
5. Elementary Structural Analysis by Charles H. Norris, John B. Wilbur, and Senol Utku, 4th Edition, published by McGraw-Hill Education, ISBN: 9780070659339
6. Analysis of Structures (Volume I & II) by V. N. Vazirani and M. M. Ratwani, latest editions, published by Khanna Publishers, ISBN (Vol. I): 9788174091406
7. Matrix Analysis of Framed Structures by W. Weaver Jr. and J. M. Gere, 3rd Edition,

published by Van Nostrand Reinhold / Springer-Verlag (New York), ISBN: 9780442234850 / 9780412078613

Teaching Learning Method

- Lecture-based teaching-learning
- Individual learning/self-study
- Inquiry-based learning
- Game-based learning
- Expeditionary learning (Real-world problems)
- Technology-based Learning
- Learning through problem-solving

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs/ PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions (Lecture)
CO1	Understand structural systems and compute Static and Kinematic Indeterminacy.	PO1, PO2,PO3,PSO1, PSO2	Understand, Apply	Conceptual and Procedural	4
CO2	Analyze beams for shear force, bending moment, slope and deflection.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	Apply, Analyze	Conceptual and Procedural	4
CO3	Evaluate slope and deflection of beams using methods such as Moment Area Method, Macaulay's Method, and Conjugate Beam Method.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	Analyze, Evaluate	Conceptual and Procedural	6
CO4	Analyze plane trusses and frames for internal forces.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	Apply, Analyze	Conceptual and Procedural	8
CO5	Develop influence line diagrams for beams under moving loads.	PO1, PO2, PO3, PO4, PSO1, PSO2	Analyze, Evaluate	Conceptual and Procedural	8

Mapping of COs with POs & PSOs:

CO	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	3	0	0	0	0	0	0	0	0	3	3
CO2	3	3	3	3	3	0	0	0	0	0	0	3	3
CO3	3	3	3	3	3	0	0	0	0	0	0	3	3
CO4	3	3	3	3	3	0	0	0	0	0	0	3	3
CO5	3	3	3	3	0	0	0	0	0	0	0	3	3

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration

This course integrates sustainability by promoting safe, efficient, and economical structural analysis and design practices. It emphasizes optimum utilization of materials, stability of infrastructure, load assessment, and resilient structural systems essential for sustainable development. The course aligns with SDG 4, SDG 9, SDG 11, and SDG 12.

SDG Mapping with Course Outcomes

CO	Course Outcome	Relevant SDGs	Justification
CO1	Describe structural systems and determine Static and Kinematic Indeterminacy for various structures	SDG 4, SDG 9	Builds engineering knowledge and understanding of structural systems for innovation
CO2	Analyze beams for shear force, bending moment, slope, and deflection under different loading conditions.	SDG 9, SDG 11	Supports safe and reliable structural infrastructure development
CO3	Evaluate slope and deflection of beams using Moment Area Method, Macaulay's Method, and Conjugate Beam Method	SDG 9, SDG 12	Encourages efficient structural design and optimum material use.
CO4	Analyze plane trusses and frames to determine internal forces in members.	SDG 9, SDG 11	Promotes resilient structures and sustainable infrastructure systems.
CO5	Develop influence line diagrams for beams subjected to moving loads and interpret their applications.	SDG 9, SDG 11, SDG 12	Helps in safe bridge/transport structure design with efficient load management.