GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Civil Engineering		
Semester	III	Version	1.0.0.0
Effective from Academic Year	2026-27	Effective for the batch Admitted in	JULY 2025
Course code	1CI3101	Course Name	Mechanics of Structure – I

I. TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course code	Course Title	Teaching & Learning Scheme									Examination Scheme							
			Credit				Actual Contact Hrs/week			SLH	Total Learning Hrs/Week	TH			PR			SLA	Total
			CL	TL	LL	Total	CL	TL	LL			CE	SEE	Total	CE	SEE	Total		
DSC	1CI3101	Mechanics of Structure – I	4	0	1	5	4	0	2	4	10	40	60	100	30	20	50	20	170

Abbreviation:	**CL-** Classroom Learning	**TL -** Tutorial Learning	**LL -** Laboratory Learning
	SLH - Self Learning Hours	**NLH -** Notional Learning Hours	**SLA -** Self Learning Assessment
	FA - Formative Assessment (Term work +Mid Sem Exam +Attendance)		**SA -** Summative Assessment

II. PRE-REQUISITES

Basic knowledge of Engineering Mechanics

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

Apply strength of materials principles to analyze structural components and ensure safe, efficient, and code-compliant engineering designs in practical applications.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

CO1.Determine the moment of inertia of simple and built-up sections using centroid and axis theorems.

CO2.Analyze stress–strain behavior, elastic constants, and strain energy of materials under different loading conditions.

CO3.Evaluate direct, bending, and combined stresses in structural members subjected to eccentric loading.

CO4.Determine and draw shear force and bending moment diagrams for statically determinate beams under various loads.

CO5.Analyze bending, shear stresses, slope, and deflection of beams using standard theories and equations.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's) & CO's	Marks	Hours
Unit-1 Moment of inertia	**TLO 1.1** Define moment of inertia and state its importance in engineering applications. **TLO 1.2** Explain radius of gyration and use formulae to find MI of standard geometrical sections. **TLO 1.3** Apply parallel and perpendicular axis theorems to calculate MI. **TLO 1.4** Determine MI of symmetrical and unsymmetrical sections	**1.1** Define moment of inertia **1.2** Importance of MI in engineering applications **1.3** Define radius of gyration and formula for MI of standard geometrical sections **1.4** Parallel axis theorem and perpendicular axis theorem **1.5** Example of MI on symmetrical I-section, channel section, T-section. **1.6** Example of MI on an unsymmetrical section using the parallel axis theorem.	**10**	**08**

	using the parallel axis theorem.			
Unit-2 Direct Stress & Strain	**TLO 2.1** Define and explain stress, strain, elasticity, Hooke's law, and elastic constants using the stress–strain curve of mild steel. **TLO 2.2** Evaluate lateral strain, Poisson's ratio, bulk modulus, shear modulus, and their inter-relations with numerical problems. **TLO 2.3** Analyze composite and compound sections using the concept of modular ratio and thermal stress–strain behavior. **TLO 2.4** Determine stresses, deformation, and strain energy due to gradual, sudden, and impact loading conditions.	**2.1** Direct stress, Linear strain, Elasticity, Elastic limit, Hook's law, Modulus of Elasticity or Young's modulus, Stress Strain curve for Mild steel bar under tension with numerical problems. **2.2** Lateral stress and strain, Poisson's ratio, Volumetric strain, Bulk Modulus, relation between three moduli and numericals. **2.3** Basics Concepts of Shear Stress, Shear Strain & Modulus of Rigidity. **2.4** Concept of composite and compound section, modular ratio and numericals. **2.5** Concept of Thermal stress and strain, Thermal stresses for non-yielding and yielding conditions with numericals. **2.6** Stresses due to gradual, sudden and impact load, corresponding deformation, Strain energy, Resilience, Proof resilience and Modulus of resilience with numericals.	**10**	**10**
Unit-3 Combined Direct and Bending Stresses	**TLO 3.1** Differentiate between axial load and eccentric load acting on columns. **TLO 3.2** Explain the effect of eccentric loading on stress distribution in columns. **TLO 3.3** Determine maximum and minimum stresses in columns subjected to eccentric loads. **TLO 3.4** Evaluate the limit of eccentricity and no-tension condition for column sections.	**3.1** Axial load and eccentric load – definition and difference **3.2** Effect of axial and eccentric load on columns **3.3** Column subjected to eccentric loading **3.4** Stress distribution in columns **3.5** Maximum and minimum stresses in columns **3.6** Limit of eccentricity and no-tension condition **3.7** Rectangular column under eccentric load (numerical examples)	**10**	**10**
Unit-4 Shear Force and Bending Moment	**TLO 4.1** Differentiate determinate and indeterminate beams with examples. **TLO 4.2** Explain shear force, bending moment, and their sign conventions. **TLO 4.3** Calculate and draw S.F. and B.M. diagrams for common beams and loads.	**4.1** Statically Determinate and statically indeterminate beam examples. **4.2** Concept of Bending Moment and Shear Force in beam. **4.3** Sagging and Hogging Bending Moment. Positive and NegativeShear Force. **4.4** Point of Contra-flexure & its importance	**15**	**16**

		4.5 Calculation of Bending Moment and Shear Force at various sections of cantilever, simply supported and overhang beam subjected to point load and or u.d.l. **4.6** S.F. & B.M. Diagram for above beams		
Unit-5 Bending & Shear Stresses In Beam	**TLO 5.1** Explain bending theory, neutral axis, sectional modulus, and bending stress in beams. **TLO 5.2** Apply bending theory to determine bending stress in rectangular and circular beam sections. **TLO 5.3** Analyze shear stress distribution in simple and standard structural sections using shear stress equations. **TLO 5.4** Solve numerical problems on bending and shear stress distribution and draw stress distribution curves.	**5.1** Bending Theory Equation, Bending stress, Sectional Modulus, Neutral Axis **5.2** Apply Bending theory to Statically Determinate beams having rectangular or circular section **5.3** Problems on bending stress in beam section **5.4** Shear Stress equation, Shear Stress Distribution Diagram for Solid & HollowRectangular And Circular Section. Apply shearStress Equation & Draw Shear Stress Distribution Diagram for I, T, Channel &Angle Section. Problems on shear stress distribution at different levels for simple cross sections and draw their distribution curves.	**10**	**10**
Unit-6 Slope and Deflection	**TLO 6.1** Explain the concepts of slope, deflection, and flexural rigidity of beams. **TLO 6.2** Apply standard formulae to determine maximum slope and deflection of cantilever and simply supported beams under common loading conditions. **TLO 6.3** Solve numerical problems on slope and deflection for beams with different supports and loads.	**6.1** Concept of Slope & Deflection of beams. **6.2** Flexural rigidity and its significance. **6.3** Formulas (without derivation) of maximum slope & deflection for cantilever beams subjected to point load at free end and u.d.l.Over the entire span. **6.4** Formulas (without derivation) of maximum slope & deflection for simply supported beams subjected to point load at center and u.d.l.over the entire span **6.1** Examples of simply supported, cantilever and overhanging beams with different load conditions.	**05**	**06**

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL			
Sr. No.	**Practical/Laboratory Learning Outcome (LLO)**	**Practical Titles**	**Relevant COs**
1	**LLO 1.1** Compute the moment of inertia for standard and built-up sections by solving multiple numerical problems.	Solve at least six problems pertaining to Moment of Inertia (MI).	CO1

2	**LLO 1.2** Conduct a tensile test on mild steel and plot the stress–strain curve to identify material properties.	Conduct tension tests on a given sample of mild steel and draw a stress strain curve.	CO2
3	**LLO 1.3** Perform a compressive strength test on a concrete cube and interpret test results.	Conduct a compressive strength test on a concrete cube.	CO2
4	**LLO 1.4** Analyze real-life engineering problems involving combined stresses in structural members.	Solve at least Six real life problems based on combined stresses.	CO3
5	**LLO 1.5** Prepare and interpret shear force and bending moment diagrams for beams under various loading conditions.	Prepare shear force and bending moment diagrams for at least ten problems.	CO4
6	**LLO 1.6** Evaluate bending and shear stresses in beams by solving practical, real-life problems.	Solve at least Six real life problems based on bending & shear stresses' calculation.	CO5
7	**LLO 1.7** Measure and compare deflection of simply supported and cantilever beams with different sectional properties.	Perform deflection test on a simply supported and cantilever beam with different sectional properties.	CO5

VII. SUGGESTED MICRO PROJECT / ASSIGNMENTS / ACTIVITIES FOR SELF LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

- Compare tensile strength and cost of three locally available structural steel bars.
- Prepare spreadsheet to calculate the support reactions of statically determinate beams.
- Prepare spreadsheet to calculate the bending stress and shear stress in a beam having a rectangular or circular section.
- Prepare spreadsheet to calculate slope and deflection of simply supported beam and cantilever beam for various load cases.

Mini projects

- Prepare charts of maximum bending moment and shear force values in standard beams.
- Draw & identify difference between Bending stress distribution & Shear stress distribution diagrams for square, rectangular, circle, hollow square, rectangular, circle, T- section, & symmetrical I- section.
- Collect information of three continuous beams having different support conditions on actual sites and study the reinforcement provided.

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1	Compression Testing Machine.
2	Universal testing Machine
3	A model of simply supported beam and cantilever beam.

IX. LIST OF REFERENCE BOOKS

Sr.No.	Title	Author	Publication
1	Mechanics of Structures (Vol.-I)	Dr. H.J. Shah & S.B. Junnarkar	Charotar Publication

2	Strength of Materials	R. S. Khurmi & N. khurmi	S. Chand & Company
3	Strength of Materials	S. Ramamrutham	Dhanpat Rai Publishing Company(P) Ltd.
4	Strength of Materials	Dr. B. C. Punamia , Er. Ashokkumar Jain Dr. Arun Kumar Jain	Laxmi Publications

X. LINK OF LEARNING WEB RESOURCE	
1	https://nptel.ac.in/courses/105105108
2	https://nptel.ac.in/courses/105104160
3	https://www.vlab.co.in/broad-area-civil-engineering
4	https://www.coursera.org/learn/mechanics-1

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Moment of inertia	CO1	08	4	3	3	10
2	DirectStress &Strain	CO2	10	4	4	2	10
3	Combined Direct and Bending Stresses	CO3	10	4	3	3	10
4	Shear Force and Bending Moment	CO4	16	4	5	6	15
5	Bending &ShearStresses InBeam	CO5	10	3	3	4	10
6	Slope and Deflection	CO5	6	1	1	3	05
	Grand Total		60	20	19	21	60

XII. COs AND POs AND PSOs MAPPING

Course outcome (Cos)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	0	1	3	1	2
CO2	3	3	1	2	0	0	1	3	1	2
CO3	3	3	2	1	0	0	1	3	2	3
CO4	3	3	2	1	0	0	1	3	2	3
CO5	3	3	2	2	1	1	2	3	2	3

Legend**s:** -3- High 2-Moderate/Medium 1-Slight/Low 0-None