GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Mechanical/AgricultureEngineering				
Semester	III		Version	1.0.0.0	
Effective from Academic Year	2026-27		Effective for the batch Admitted in		JULY 2025
Course code	1ME3105	Course Name	Strength of Material		

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	1ME3105	Strength of Material	3	0	1	4	3	0	2	3	8	40	60	100	30	20	50	20	170

Abbreviation:	**CL-** Classroom Learning	**TL -** Tutorial Learning	**LL -** Laboratory Learning
	SLH - Self Learning Hours	**SLA -** Self Learning Assessment	**CE –** Continuous Evaluation
	SEE – Semester End Examination		

II. PRE-REQUISITES

Basic knowledge of Engineering mechanics/Applied mechanics

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

Industry and employers expect engineers and technical professionals to possess a thorough understanding of the mechanical behaviour of solids under various loading conditions. They should be able to apply principles of stress, strain, and material properties to analyze and design structural components.

IV. COURSE LEARNING OUTCOMES

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

CO1. Understand the fundamental concepts of stress (normal and shear) and strain (normal and shear) in different materials under various loading conditions. Determine and draw the Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) for statically determinate beams

CO2. Apply the Flexure Formula (or bending equation) and the Shear Stress Formula to calculate normal (bending) and shear stresses in beams of different cross-sections.Calculate the slope and deflection of beams using methods such as Area-Moment

CO3. Determine the M.IUnderstand the phenomenon of buckling in columns subjected to compressive loads

CO4. Determine the shear stress and angle of twist in circular shafts subjected to pure torsion, and calculate the power transmitted.

CO5. Behaviour & properties of engineering materials.

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 Direct Stress and Strain	**TLO 1.1**Apply Hooke's Law to determine the axial deformation of a material under load.	**1.1** Stress, strain, δl calculations. **1.2** Bars of varying cross-sections. **1.3** Composite section. **1.4** Elastic constants.	**10**	**10**

	TLO 1.2.Analyze a bar composed of segments with different cross-sectional areas, materials, or loads.**TLO 1.3** Analyze structures made of two or more different materials bonded together**TLO 1.4** Define and understand the physical significance of the key elastic constants **TLO 1.5**Calculate the free thermal expansion or contraction of a material due to a temperature change**TLO 1.6**Apply the concept of impact loading and equate the work done by the falling mass to the maximum strain energy stored**TLO 1.7** Identify and label the key points and regions on the resulting stress-strain curve (Proportional Limit, Elastic Limit, Yield Point, Ultimate Tensile Strength, Fracture Point)	**1.5** Thermal stress and strain. **1.6** Strain energy and impact load. **1.7** Tension test on mild steel.		
Unit-2 **Shear Force (S.F.)& BendingMoment (B.M.) in Beam**	**TLO 2.1**Derive and apply the mathematical relationship between the shear force (V) and the rate of change of bending moment. **TLO 2.2**Define and distinguish between a Simply Supported Beam and an Overhanging Beam based on their support conditions. **TLO 2.3**Develop the Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) for Simply Supported Beams and Overhanging Beams subjected to various load types	**2.1** Relation between S.F. and B.M Point of contra flexure & its importance. **2.2**Simply supported beam & over Hanging beam **2.3**S.F & B.M. Diagram, Sagging & Hogging bending moment	**10**	**06**

Unit-3 **Moment of Inertia**	**TLO 3.1**Explain the physical significance of the moment of inertia.Calculate the moment of inertia for simple areas about a given axis. **TLO 3.2** Prove the parallel axis Theorem, and use it to calculate the moment of inertia of a cross-section about any axis parallel to its centroidal axis **TLO 3.3**State and use the standard formulas for the Moment of Inertia about their centroidal axes for common geometric shapes	**3.1** Moment if Inertia, Section modulus & Radius of Gyration. **3.2** Parallel axis & Perpendicular axistheorem **3.3** Equations of M.I for standard figures	**09**	**05**
Unit-4 **Bending Stresses in Beam**	**TLO 4.1**Apply the knowledge of bending theory to understand how various loads cause a beam to deform **TLO 4.2** Calculate the maximum Bending Moment for simply supported and cantilever beams under common load conditions. **TLO 4.3** Analyze how the shear stress distribution changes with respect to the beam's material properties and cross-sectional geometry	**4.1** Bending theory&it assumptions. **4.2** Equation of maximum B.M & Shear stress. **4.3** Shear stress distribution diagram.	**06**	**05**
Unit-5 **Slope & Deflection of Beam**	**TLO 5.1**Understand Concepts: Define and distinguish between slope and deflection **TLO 5.2**Accurately determine the maximum slope and maximum deflection for common beam types and standard loading conditions	**5.1** Slope & Deflection. **5.2** Numerical on Slope & Deflection.	**06**	**04**

Unit-6 **Column & Strut**	**TLO 6.1**Differentiate between a column and a strut, including their orientation, primary loading type. **TLO 6.2**Describe the four primary end conditions or support types for columns **TLO 6.3**Calculate the crippling load for a long column using the Euler formula.Identify and explain the limitations of the Euler formula, specifically noting its applicability only to long columns.	**6.1** Brief about column and strut and basic terms related its. **6.2**End conditions of Column. **6.3**Euler's Formula for Crippling load and its assumptions &limitations	**06**	**04**
Unit-7 **Combined Direct and Bending Stresses**	**TLO 7.1** Calculate the maximum and minimum normal stresses in a section subjected to a uniaxial eccentric load. **TLO 7.2** Define the "No-Tension" condition for materials weak in tension (like masonry, concrete, or brittle materials), which requires the resultant stress throughout the entire cross-section to be compressive or zero.	**7.1** Axial and eccentric load. Stress related to them. **7.2**.Limit of Eccentricity and core of section (kernel)	**06**	**05**
Unit-8 **Torsion**	**TLO 8.1**Define Torsion: State the definition of torsion and torque as applied to a circular shaft. **TLO 8.2**List and explain the primary assumptions made in the derivation of the classical torsion formula for circular shafts. **TLO 8.3**State and use the fundamental equation that relates power to torque	**8.1** Terms related to torsion. **8.2** Equations and assumptions of torsion. **8.3**Equations of power.	**05**	**04**

Unit-9 **Mechanical Properties of Materials**	**TLO 9.1**Select the appropriate class of material for a given engineering application based on required mechanical, thermal, and electrical properties. **TLO 9.2**Explain the purpose and significance of standardized mechanical testing in engineering design and quality control	**9.1** Classification of engineering materials. **9.2** Testing of materials (Tensile, Compressive, Hardness, Impact, Shear test.)	**02**	**02**

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL			
Sr. No.	**Practical/Laboratory Learning Outcome (LLO)**	**Practical Titles**	**Relevant COs**
1	**LLO 1.1** Identify and locate the key points and regions on the stress-strain curve for a ductile material (e.g., Mild Steel):	Draw Stress Strain Curve for Tension Test on Ductile Materials like Mild Steel.	CO1
2	**LLO 2.1**Define Young's Modulus (E) as the ratio of stress to strain in the elastic region.	Determine Young's Modulus of wire of Given Material.	CO1
3	**LLO 3.1**Define the Area Moment of Inertia (or Second Moment of Area, I) and understand its physical significance in the context of a beam's resistance to bending and a column's resistance to buckling.	Calculate Moment of Inertia of Given Section.	CO3
4	**LLO 4.1**Explain the concept of Column Buckling and the role of axial load. Identify and demonstrate the four main theoretical End Conditions.	Demonstrate End Conditions of Column.	CO3
5	**LLO 5.1**Define Compressive Strength as the maximum compressive stress a material can sustain before fracture or before exceeding a defined strain limit **LLO 5.2**Understand the difference in failure modes between brittle materials (shear fracture) and ductile materials(plastic deformation) under compression.	Find out Compressive Strength of Material using Compression Testing Machine	CO5
6	**LLO 6.1**Understand the principle of the Izod impact test and the purpose of the V-notch.	Calculate Impact Value of Mild Steel using IZOD Impact Test Apparatus.	CO5
7	**LLO 7.1** Able to define impact toughness brittle fracture, and the principle of the charpy test.	Calculate Impact Value of Mild Steel using Charpy Impact Test Apparatus.	CO5
8	**LLO 8.1**Able to define hardness and	Calculate Hardness of given material	

	the brinell hardness number and state the formula used for its calculation.	using Brinell Hardness Number machine.	CO5
9	**LLO 9.1**Define the concept of material hardness and explain the fundamental principle of the Rockwell Hardness Test, including the use of major and minor loads and the resulting depth of penetration	Calculate Hardness of given material using Rockwell Hardness machine.	CO5

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

- Identify and photograph various machine components and their operational contexts where the primary load is an axial (tensile or compressive) force.
- Gather photographic examples of machine elements constructed using common structural profiles, specifically I-sections, angle sections, channel sections, and built-up sections.
- Document (with photographs) various machine components and the applications in which they are primarily subjected to bending moment and shear force.
- Find and photograph different operational scenarios and machine components where the primary stress or loading is torsion (twisting moment).
- Research and compile data on machine components where surface or bulk hardness is a critical functional requirement, specifying the material and the required hardness value.

Mini projects

- Design and build a small bridge (e.g., a simple beam or a truss) using limited, low-strength materials like Popsicle sticks, paper, or straws.
- Design and build a simple setup to measure the central deflection of beams made of different materials (e.g., wood, plastic, thin metal) and different cross-sections (rectangular, I-section).
- To create a small-scale, functional model (even a manually operated one) of a tensile testing machine to demonstrate the principles of force application and elongation measurement
- To demonstrate the phenomenon of twisting in circular shafts and calculate the modulus of rigidity (G)

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1	Universal Tensile Testing Machine.
2	Compressive Testing Machine.
3	SEARL's Apparatus to find Young's Modulus.
4	Different section for Moment of Inertia.
5	IZOD Impact Test Apparatus.
6	CHARPY Test Apparatus.
7	Brinell Hardness Testing machine.
8	Rockwell Hardness Testing machine

IX. LIST OF REFERENCE BOOKS			
Sr.No.	**Title**	**Author**	**Publication**
1	Strength of Materials	Dr. R. K. Bansal	Laxmi Publication
2	Strength of Materials	Dr.R.P.Rethaliya	Atul Prakashan
3	Strength of Materials	R. S. Khurmi	S. Chand
4	Strength of Materials	Dr.D.S Bedi	Khanna Publication
5	Strength of Materials & Mechanics of Structures	Dr. B C Punamia	S.Chand.

X. LINK OF LEARNING WEB RESOURCE	
1	https://nptel.ac.in/courses/105104160 (NPTEL Course :- Mechanics of Solids by IIT, Kanpur)
2	https://www.youtube.com/watch?v=GkFgysZC4Vc&list=PL27C4A6AEA552F9E6 (NPTEL Video Lectures by IIT,Kharagpur)
3	www.vlab.co.in (Virtual Lab by Ministry of Education, Government of India)
4	en.wikipedia.org/wiki/ Shear and moment diagram
5	www.freestudy.co.uk/mech%20prin%20h2/stress.pdf
6	www.engineerstudent.co.uk/stress_and_strain.html
7	https://www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE							
Unit	**Unit Title**	**Aligned COs**	**Learning Hours**	**R-Level**	**U-Level**	**A-Level**	**Total Marks**
1	Direct Stress and Strain	CO1	10	2	4	4	10
2	Shear Force (S.F.)& Bending Moment(B.M.)in Beam	CO1	6	1	4	5	10
3	Moment of Inertia	CO3	5	3	2	4	9
4	Bending Stresses inBeam	CO2	5	2	2	2	6
5	Slope &Deflection ofBeam	CO2	4	3	1	2	6
6	Column & Strut	CO3	4	2	2	2	6
7	Combined Direct and Bending Stresses	CO2	5	2	2	2	6
8	Torsion	CO4	4	1	2	2	5
9	Mechanical Propertiesof Materials	CO5	2	1	1	0	2
		Grand Total	45	17	20	23	60

XII. COs AND POs AND PSOs MAPPING										
Course Outcomes (COs)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	2	0	0	0	2	0	0
CO2	2	2	0	2	1	0	0	3	2	1
CO3	3	3	2	1	2	0	0	2	2	1
CO4	2	3	1	2	2	0	0	3	1	1
CO5	3	2	0	0	2	0	0	3	2	0