LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering (710)

Bachelor of Engineering (B.E.) – Semester – III

Course Code:	**017103391**
Course Name:	**Strength of Materials**
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	Mathematics 1 (017101191), Engineering Mechanics (017102291), Physics (017101192)

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
4	**1**	**0**	**5**	**50**

Syllabus

Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Introduction of Stress and Strain**			**6 (12.5 %)**
	1.1 Types of loads, Gradual, sudden, Impact and shock loading.	---	Endurance limit and fatigue failure (017103502– Unit- 1.2), Concepts of stresses and Strain, Combinations of Axial, Shear, Torsional and Bending loads (017103402 – Unit- 3.1)	
	1.2 Stress and types of stress, Strain and types of strain, Compressive stress, Tensile stress, Shear stress and complementary stress, Bending stress, Principal stress, Strain and types of strain, Linear strain, Lateral strain and Shear strain	Concept of load stress strain (017101192-Unit- 2.1)	Mechanical properties and stress – strain diagram (017103404 – Unit- 1.6), Forging process, types, applications and types of hammer, defects (017103401 - Unit- 8.3), Rolling process, types, applications and defects (017103401 - Unit- 8.4), Dimensions of flywheel rim (017103392 -Unit - 10.2), Flywheel in punching press (017103392 -Unit -	

			10.3), , Bolted Joint: Simple and Eccentric loading, Torque requirement for bolt tightening (017103402 – Unit-9.3), Crushing and Bearing stress (017103402 – Unit-4.1), Types of failure, strength and efficiency of joint (017103402 – Unit- 10.2), Stress concentration (017103502– Unit- 1.1), S-N Diagram, design for reversed stresses and cumulative damage (017103502– Unit- 1.4), Soderberg, Gerber, Goodman and modified-Goodman criteria (017103502– Unit- 2.1), Combined stresses (017103502– Unit- 2.2), Helical spring: style of ends, stresses, correction factors, and deflection (017103502– Unit-3.2), Multi-Leaf Spring (017103502– Unit- 4.1)	
	1.3 Hook's law, Tension test on mild steel, Stress strain Characteristics, Modulus of elasticity, Equation of deformation	Hook's law and stress strain diagram (017101192- Unit-2.2)	Concept of Elastic and Plastic deformation, Strain Hardening, Hot working and Cold working process (017103401 - Unit-8.2),	
	1.4 Bars of varying section, Bars of uniformly varying cross section	---		
	1.5 Analysis of stress for statically determinate structures and indeterminate structures	---		
02	**Elastic Constants**			**5 (10%)**
	2.1 Poisson's ratio, Volumetric strain, Biaxial and tri-axial deformations	---		
	2.2 Elastic constant and relation between three elastic constants[(Young's modulus, Modulus of rigidity, Poisson's ratio) and (Young's modulus, Modulus of rigidity, Bulk modulus)]			

	2.3 Multi-axial application(uniaxial, biaxial, triaxial).	---		
03	**Thermal Stresses**			**4 (7.5%)**
	3.1 Stresses due to thermal effect, Thermal Strain, Coefficient of thermal expansion, Thermal stress for body with and without yielding.	---		
	3.2 Application in Composite and Compound bars	---		
04	**Shear Force and Bending Moment**			**6 (12.5 %)**
	4.1 Concept of shear force and bending moment	Support reactions (017102291- Unit-06)	Design of solid and hollow circular shaft subjected to torque and combined loading (017103402 – Unit-6.1), Concentric springs, surge phenomenon (017103502– Unit-3.4), Application of Dunkerley's method for estimating the critical speed of shafts (017103601 – Unit – 8.3)	
	4.2 Sign conventions	---		
	4.3 Relation between bending moment, shear force and rate of loading	Basic differentiation and integration (017101191-Unit-03)		
	4.4 Bending moment and shear force diagrams for statically determinate beams (Simply supported beam, Over hanging beam, Cantilever beam)	---		
	4.5 Point of contraflexure, point and magnitude of maximum bending moment	---		
05	**Flexural Stresses**			**5 (10%)**
	5.1 Basics of pure bending	---		
	5.2 Assumptions and derivation of theory of simple bending	Basic differentiation and integration (017101191-Unit-03)		
	5.3 Neutral axis, Maximum bending moment (Moment of Resistance), Determination of bending stresses, section modulus of rectangular and circular (solid and hollow), I,T,Angle and channel sections	Centroid and centre of gravity (017102291-Unit- 8), Moment of inertia of planar cross sections (017102291-Unit- 9)		
06	**Shear Stresses**			**5 (10%)**
	6.1 Derivation of formula for Shear	Basic differentiation	Design against static	

	stresses and its application for Rectangular, Circular, T, I Sections	and integration (017101191-Unit-03)	and fluctuating loads (017103502– Unit- 3.3)	
	6.2 Shear stress distribution for various cross section(Rectangular, Circular, T, I Sections)	Centroid and centre of gravity (017102291- Unit- 08), Moment of inertia of planar cross sections (017102291- Unit- 09)		
07	**Principal Stresses and Strains**			**6 (12.5 %)**
	7.1 Introduction, Sign convention, Normal, Tangential, resultant stress on an inclined plane	---		
	7.2 Principal plane and principal stresses (Calculate principal stress and locate principal plane)	---		
	7.3 Maximum shear stress, Element subjected to principal stresses	---		
08	**Mohr's Circle**			**4 (7.5%)**
	8.1 Mohr's circle of stress	---		
	8.2 Mohr's circle for a body subjected to direct stress in one plane and two plane (with or without shear stress).	---		
	8.3 Pure shear	---		
09	**Torsion**			**4 (7.5%)**
	9.1 Derivation of equation of torsion	---	Design of solid and hollow circular shaft subjected to torque and combined loading (017103402 – Unit-6.1), Forms of thread, Single and Multiple threaded screw, Terminology of power screw (017103402 – Unit- 8.1)	
	9.2 Assumptions, application of theory of torsion equation to solid and hollow circular shaft, torsional rigidity.	Moment of inertia of planar cross sections (017102291- Unit- 09)	Helical torsion and spiral springs, shot peening of springs (017103502– Unit-3.5), Epicyclic-Train and Bevis-Gibson torsion dynamometers (017103502– Unit-9.4), Welded joint subjected to bending and torsion (017103502– Unit-10.3), Torsional Vibration (017103601 – Unit – 7)	
10	**Strain Energy**			**5 (10%)**
	10.1 Elastic strain energy due to	---		

	gradual loading, sudden loading, impact loading, shear and bending			
	10.2 Resilience	---		

Proposed Theory + Practical Evaluation Scheme by Academicians (% Weightage Category Wise and it's Marks Distribution)					
L:	**4**	**T:**	**1**	**P:**	**0**
Note : In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject. Each Test will be of 25 Marks. Each Test Syllabus Weightage: Range should be 20% - 30%					
Group (Theory or Practical)	**Group (Theory or Practical) Credit**	**Total Subject Credit**	**Category**	**% Weightage**	**Marks Weightage**
Theory	**5**	**5**	MCQ	41%	41
Theory			Theory Descriptive (Mainly Queries or Programme)	0%	0
Theory			Formulas and Derivation	18%	18
Theory			Numerical	41%	41
Expected Theory %	**100%**		**Calculated Theory %**	**100%**	**100**
Practical	**0**		Individual Project	0%	
Practical			Group Project	0%	
Practical			Internal Practical Evaluation (IPE)	0%	
Practical			Viva	0%	
Practical			Seminar	0%	
Expected Practical %	**0%**		**Calculated Practical %**	**0%**	**0**
Overall %	**100%**			**100%**	**100**

Course Outcome	
	Upon completion of the course students will be able to
1	Learn the fundamental concepts stress and strain of solids and able to apply for finding out stress, strain and deformation with the help of elastic constants.
2	Evaluate the stress and strain under the application of thermal & flexural stress. Also, Understand the bending moment, shear force diagram to evaluate the real complex problems.
3	Analyze the shear stress distribution for different types of statically determinate beam elements with homogeneous and composite structures. Also, stresses & strains of structures by analytical methods.
4	Apply the concept of shear stress, torsion & strain energy using graphical (Mohr's circle) approaches.
Suggested Reference Books	
1	Mechanics of Materials By Beer and Johnston
2	Strength of Materials By S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd
3	Strength of Materials By R. K. Bansal, Lakshmi Publications House Pvt. Ltd.
4	Strength of Materials By R. Subramanian, Oxford University Press

5	Strength of Materials By R.S. Khurmi, S. Chand Publications

List of Open Source Software/Learning Website	
1	http://nptel.ac.in