**19CE2101 - STRENGTH OF MATERIALS**

**(Civil Engineering)**

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| **Course Category**  | Professional Core | **Credits** | 3 |
| **Course Type** | Theory | **Lecture - Tutorial -Practical** | 2 -1 -0 |
| **Pre-requisite**  | Engineering Mechanics | **Sessional Evaluation**  | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course Objectives** | 1. To understand the behavior of ductile and brittle materials under uni-axial loading.
2. To apply analytical and graphical method of Mohr’s circle for principal stresses and strains and understand theories of failures.
3. To construct shear force and bending moment diagrams of beams under various loads and study the relationships among shear force, bending moment and rate of loading.
4. To apply the concept of theory of simple bending for calculating flexural and shear stresses.
5. To calculate stresses and strains in thin and thick cylinders.
6. To implement the concept of theory of pure torsion for calculating shear stresses and understand the mechanical behavior of spring.
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| **Course Outcomes** | CO1 | Understand the types of material and their behavior under uni-axial loading. |
| CO2 | Calculate the principal stresses and strains by analytical methods and also by Mohr’s circle method.  |
| CO3 | Construct shear force and bending moment diagrams for various types of beams under different types of loading. |
| CO4 | Understand and analyze the variation of flexural and shear stresses across the cross-section due to shear force and bending moment. |
| CO5 | Calculate hoop and longitudinal stresses and strains in thin and thick cylinders.  |
| CO6 | Calculate shear stress due to pure torsion and understand the mechanical behavior of spring. |
| **Course Content** | **UNIT – I****SIMPLE STRESSES&STRAINS:**Properties of materials - Ductile and brittle; Concept of stress; Types of stress; Types of strain - Normal strain, shear strain and volumetric strain; Stress-Strain curves - Ductile (mild steel, HYSD bars), brittle (Concrete); Hooke’s law; Poisson’s ratio; Volumetric strain-Derivation of expression for volumetric strain of rectangular bar and cylindrical bar subjected to axial loading; Relation between Young’s modulus, shear modulus and bulk modulus; Analysis of prismatic bars subjected to axial loading- Uniform cross sections, varying sections and uniform tapering – circular, rectangular bars. Compound bars- Analysis of bars of composite sections. Factor of safety – Endurance limit.Introduction to thermal stresses – Analysis of thermal stresses – Expression for thermal stresses and strains in simple bars.**UNIT – II****PRINCIPAL STRESSES:**Introduction to compound stresses; Methods of analysis – Application of analytical methods for the analysis of members subjected to direct stress in one plane, in two mutually perpendicular planes, subjected to simple shear stress alone and direct stresses in two mutually perpendicular planes accompanied by simple shear stress.**INTRODUCTION TO GRAPHICAL METHOD**– Mohr’s circle-Application of graphical method for the above cases. **INTRODUCTION TO THEORIES OF FAILURE**(No derivations).**UNIT –III****SHEAR FORCE AND BENDING MOMENT IN BEAMS:** Concept of shear force and bending moment – Relation between shear force, bending moment and rate of loading at a section of beam; shear force and bending moment diagrams for simply supported and cantilever beams subjected to point loads, uniformly distributed load, uniformly varying loads, couple and their combinations; Concept of point of contra flexure; shear force and bending moment diagrams of an overhanging beam subjected to point loads, uniformly distributed load, uniformly varying loads, couple and their combinations.**UNIT –IV****FLEXURAL AND SHEAR STRESSES IN BEAMS**: Concept of theory of simple bending; Assumptions made in simple bending – Derivation of pure bending (simple bending) equation. Introduction to shear stress – Derivation of equation for general shear stress; Shear stress distribution diagrams for rectangular, circular, I-section and T-sections; Bending stresses in unsymmetrical sections – I-section and T- sections; Shear centre – Introduction - Derivation of expression for shear centre of I-section and Channel section.**UNIT –V****CYLINDERS:** Introduction – Types of cylinders - Thin cylinders - Expressions for hoop and longitudinal stresses - Efficiency of joints; Thick cylinders – Introduction - Lame’s theorems – Assumptions – Derivation of expressions (internal and external pressure); Compound cylinders – Introduction – Distribution of stresses (internal and external pressure).**UNIT – VI****TORSION OF CIRCULAR SHAFTS**: Theory of pure torsion - Assumptions made in pure torsion equation - Derivation of pure torsion expression for solid and hollow circular shafts; Transmission of power in solid circular shafts.**SPRINGS:**Introduction –Types of springs – Expression for deflection of close and open coiled helical springs under axial loading; Concept of springs in series and parallel; Carriage/leaf springs - Introduction- Expression for deflection. |
| **Textbooks****& Reference books** | **TEXTBOOKS:**1. S.Ramamruthamand R. Narayananan “*Strength of Materials*” Dhanpatrai publishing house, 2018.
2. R.K. Bansal, “*A TextbookofStrength of Materials*” Laxmi Publications, 6st edition, 2019.
3. Dr. H.J. Shah and S.B.Junnarkar“*Mechanics of Structures Vol-I*”, Charotor Publishing house, 32ndedition, 2016.

**REFERENCE BOOKS:**1. Timoshenko S, “*Strength of Materials Part 1 Elementary Theory and Problems*”, D. Van Nostrand Company, Incorporated, 3rdEdition, 2002.
2. Vazirani and Ratwani, “*Analysis of structures Vol-I*” Khanna Publishers, 16th Edition.
3. B.C. Punmia, “*SMTS-I, Strength of Materials*” Laxmi Publications,10thEdition, 2019.
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**CO-PO Mapping:**3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|   | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** | **j** | **k** | **l** |
| **CO1** | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 3 | 1 | - | - | - | - | - | 1 | 2 |
| **CO3** | 3 | 3 | 2 | 3 | 1 | - | - | - | - | - | 1 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | 2 | 2 |
| **CO6** | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 | 2 |