**19CE2201 - STRUCTURAL ANALYSIS - I**

**(Civil Engineering)**

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

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| **Course Objectives** | 1. To understand the various methods for calculating slope and deflection of beams. 2. To analyze the columns for different end conditions subjected to axial load and moments. 3. To analyze the sections for stresses subjected to direct load and moment and understand the concept of cables. 4. To be capable of analysing and drawing of shear force and bending moment diagrams of propped cantilever and fixed beams under various loading conditions including effect of sinking of supports. 5. To be able to analyze and draw the shear force and bending moment diagrams of continuous beams using Clapeyron’s theorem of three moments. 6. To understand the concept of energy theorems and be able to calculate the slope and deflection of beams. | |
| **Course Outcomes** | CO1 | Determine the slope and deflection of determinate beams under various loading conditions. |
| CO2 | Analyze the columns subjected to different loading conditions. |
| CO3 | Analyze the sections for stresses subjected to direct load and moment and analysis of cables. |
| CO4 | Calculate and draw SFD and BMD for propped and fixed beams. |
| CO5 | Calculate and draw SFD and BMD for continuous beams using Clapeyron’s theorem. |
| CO6 | Understand energy theorems and apply the same to analyze the structures. |
| **IMP: *Application of the concepts covered in every unit must be demonstrated using an appropriate software. This should be followed by an exercise.*** | | |
| **Course Content** | **UNIT – I**  **SLOPE AND DEFLECTION OF STATICALLY DETERMINATE BEAMS:** Relationship between curvature, slope and deflection (Differential equation for the elastic line of a beam) –Slope and deflection of cantilevers and simply supported beams by double integration method, Macaulay’s method, moment area method and conjugate beam method for point loads, uniformly distributed loads and combination of these loads.  **UNIT – II**  **COLUMNS:** Introduction – Unsupported and effective lengths of columns – Slenderness ratio – Types of columns – Types of failure of columns – Crippling load. Assumptions made in Euler’s theory – Expressions for Euler’s crippling load of columns for various end conditions; limitations of Euler’s theory; Introduction to expression for Rankine’s theory Eccentrically loaded columns (without initial curvature).  **UNIT – III**  **DIRECT AND BENDING STRESSES:** Stresses under the combined action of direct loading and B.M. – Core of a section – Circular, rectangular (solid and hollow) and triangular.  **CABLES:** Assumptions, Parabolic and Catenary cables.  **UNIT – IV**  **ANALYSIS OF STATICALLY INDETERMINATE BEAMS:**  **PROPPED CANTILEVER BEAMS:**Analysis of propped cantilevers for point loads uniformly distributed loads and couple – Shear force and bending moment diagrams.  **FIXED BEAMS**: Analysis of fixed beams for point loads,UDL, uniformly varying load, couple shear force and bending moment diagrams– Effect of sinking of supports.  **UNIT – V**  **ANALYSIS OF CONTINUOUS BEAMS**: Introduction –Clapeyron’s theorem of three moments – Analysis of continuous beams with constant moment of inertia with one or both ends fixed – Continuous beam with overhang – Continuous beam with different moment of inertia for different spans – Effect of sinking of supports – Shear force and bending moment diagrams.  **UNIT – VI**  **ENERGY THEOREMS**: Strain energy due to axial load, bending moment and shear force – Maxwell’s reciprocal’s, Betti’s theorems – Castigliano’s first theorem and unit load method – Deflection of simple beams and pin -jointed trusses. | |

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| **Textbooks and Reference books** | **TEXTBOOKS:**   1. T.S. Thandavamoorthy, *Structural Analysis,*Oxford University Press, 2011. 2. R. Vaidanathan, Dr. P. Perumal, *Structural Analysis*,Laxmi Publications,Revised edition,2019. 3. R.K. Bansal,*A Text Book of Strength of Materials*, Laxmi Publications, 6thedition, 2019.   **REFERENCE BOOKS:**   1. G.S. Pandit, S.P. Gupta, R. Gupta, *Theory of Structures*, Vol.I, McGraw Hill Publications. 2. C.K.Wang, *Intermediate Structural Analysis*, McGraw Hill Education, Indian edition, 2017. 3. V. N. Vazirani, M.M. Ratwani, *Analysis of Structures* Vol. I & II, Khanna Publishers. |

**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 | 3 | 2 | 2 | 1 | 1 | - | 2 | 1 | 2 | 3 |
| **CO2** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | 2 | 1 | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | 2 | 1 | 2 | 3 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | 2 | 1 | 2 | 3 |
| **CO5** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | 2 | 1 | 2 | 3 |
| **CO6** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | - | 2 | 1 | 2 | 3 |