**20CE2202 - STRUCTURAL ANALYSIS**

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

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| **Course Objectives** | 1. To apply the various methods for calculating slope and deflection of beams under point and uniformly distributed loads. 2. To calculate the crippling load of columns for different end conditions subjected to axial load and moments and estimate stresses in sections subjected to direct load and bending moment. 3. To analyse and draw the shear force and bending moment diagrams of propped cantilever and fixed beams under various loading conditions including the effect of sinking of supports. 4. To analyze and draw the shear force and bending moment diagrams of continuous beams using Clapeyron’s theorem of three moments. 5. To understand the concept of energy theorems and calculate the slope and deflection of beams and trusses. 6. To calculate the support reactions, shear force, and bending moment of determinate structures using influence line diagram method. | |
| **Course Outcomes** | CO1 | Determine the slope and deflection of determinate beams under various loading conditions. |
| CO2 | Analyze the columns subjected to different loading conditions and also calculate the stresses subjected to direct load and bending moment. |
| CO3 | Calculate and draw shear force diagram and bending moment diagram for propped cantilever and fixed beams. |
| CO4 | Calculate and draw shear force diagram and bending moment diagram for continuous beams using Clapeyron’s theorem. |
| CO5 | Apply the energy theorems for determining slope and deflection of beams and trusses. |
| CO6 | Analyze determinate beams subjected to moving loads using influence line diagram method. |
| **Course Content** | **UNIT – I**  **SLOPE AND DEFLECTION OF STATICALLY DETERMINATE BEAMS:** Relationship between curvature, slope and deflection (Differential equation for 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.  **DIRECT AND BENDING STRESSES:** Stresses under the combined action of direct loading and bending moment – Core of a section – Circular and rectangular (solid and hollow).  **UNIT – III**  **ANALYSIS OF STATICALLY INDETERMINATE BEAMS:**  **PROPPED CANTILEVER BEAMS:** Analysis of propped cantilevers for point loads and uniformly distributed loads– Shear force and bending moment diagrams.  **FIXED BEAMS**: Analysis of fixed beams for point loads, uniformly distributed loads, uniformly varying load, shear force and bending moment diagrams– Effect of sinking of supports.  **UNIT – IV**  **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 – Effect of sinking of supports – Shear force and bending moment diagrams.  **UNIT – V**  **ENERGY THEOREMS**: Strain energy due to axial load, bending moment and shear force – Castigliano’s first theorem for beams – Castigliano’s second theorem for indeterminate trusses.  **UNIT – VI**  **INFLUENCE LINES:** Influence lines for reactions, shear force and bending moment for determinate structures – Maximum shear force and bending moment for single, two and multipoint loads – UDL longer than span - UDL shorter than span and EUDL. | |
| **Textbooks and Reference books** | **TEXTBOOKS:**   1. T.S. Thandavamoorthy, *Structural Analysis,* Oxford University Press, 1st edition, 2011. 2. R. Vaidyanathan, Dr. P. Perumal, *Structural Analysis*, Laxmi Publications, 3rd (Revised) edition, 2019. 3. R.K. Bansal, *A Text Book of Strength of Materials*, Laxmi Publications, 6th edition, 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 and M. M. Ratwani, *Analysis of Structures* *Vol. I & II*, Khanna Publishers, 17th edition, 2016. | |

**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 |
| **CO2** | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 2 |
| **CO3** | 2 | - | 1 | - | - | - | - | - | - | - | - | 2 |
| **CO4** | 2 | - | 1 | - | - | - | - | - | - | - | - | 2 |
| **CO5** | 3 | - | - | - | - | - | - | - | - | - | - | 2 |
| **CO6** | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 2 |