# STRUCTURAL ENGINEERING

**V Semester: CE**

| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CIA | SEE | Total |
| ACEB13 | CORE | 2 | 1 | - | 3 | 30 | 70 | 100 |
| Contact Classes: 30 | Tutorial Classes: 15 | Practical Classes: Nil | | | | Total Classes: 45 | | |

## I. COURSE OVERVIEW:

The course of Structural Engineering comprises a set of fundamental theorems of mechanics that obey physical laws required to study and predict the behavior of structures for computation of deformations, internal forces and stresses. This course mainly discusses the energy, force and displacement methods for the analysis of arches, determinate and indeterminate beams and trusses. This course also includes the effects of rolling loads on bridge girders and truss girders. Through this course content engineers can analyze the response of various structural members under different loading conditions for design, safety and serviceability.

## II. OBJECTIVES:

**The course should enable the students to:**

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|---|---|
| I | The behavior of arches under the action of uniformly distributed loads and concentrated loads. |
| II | The concepts of energy methods for analyzing the components of various industrial structures. |
| III | The analysis of indeterminate beams and rigid frames by displacement methods for designing framed structures. |
| IV | The concept of rolling loads and influence lines for analyzing the bridge girders and truss girders in complex structures. |

## III. COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

| | | |
|---|---|---|
| CO 1 | **Recall** various types of arches and select appropriate arch in field applications. | Remember |
| CO 2 | **Make use of** energy principles in the analysis of two hinged arches for computing resultant thrust and evaluating secondary stresses due to thermal and rib shortening effects. | Apply |
| CO 3 | **Apply** the concepts of Castigliano's theorem for analyzing indeterminate trusses. | Apply |
| CO 4 | **Apply** the concepts of slope-deflection, moment distribution and Kane's methods for analyzing continuous beam with and without support settlement. | Apply |
| CO 5 | **Explain** the effect of rolling loads for thorough understanding of the variations in internal forces due to moving vehicular loads. | Understand |
| CO 6 | **Apply** the concept of influence line diagrams for analyzing beams, bridge girders and trusses in real time problems. | Apply |

## IV. SYLLABUS:

| MODULE – I | ARCHES | Classes: 09 |
|---|---|---|
| Introduction, types of arches, comparison between three-hinged and two hinged arches; Normal thrust and radial shear in an arch; Geometrical properties of parabolic and circular arch; Three hinged circular arch at different levels; Absolute maximum bending moment diagram for a three-hinged arch; Two hinged arches: Introduction, classification of two hinged arches, analysis of two hinged parabolic arches, secondary stresses in two hinged arches due to temperature and elastic shortening of rib. | | |
| **MODULE – II** | **ANALYSIS OF INDETERMINATE STRUCTURES** | **Classes: 09** |
| Indeterminate Structural Analysis –Determination of static and kinematic indeterminacies – Analysis of trusses with up to two degrees of internal and external indeterminacies using Castiglione's theorem. | | |
| **MODULE – III** | **SLOPE-DEFLECTION AND MOMENT DISTRIBUTION METHOD** | **Classes: 09** |
| Introduction- Derivation of slope deflection equation-Application to continuous beams with and without settlement of supports - Analysis of single-bay, single-story, portal frame including side sway. | | |

Introduction to moment distribution method - Application to continuous beams with and without settlement of supports - Analysis of single-bay, single-story, portal frame including side sway.

| MODULE – IV | KANI'S METHOD | Classes: 09 |
|---|---|---|

Introduction to Kani's method – Rotation factor- Application to continuous beams with and without settlement of supports.

| MODULE – V | MOVING LOADS AND INFLUENCE LINES | Classes: 09 |
|---|---|---|

Introduction maximum SF and BM at a given section and absolute maximum S.F. and B.M due to single concentrated load U.D load longer than the span, UDL load shorter than the span, two-point loads with fixed distance between them and several point loads – Equivalent uniformly distributed load – Focal length. Definition of influence line for SF, Influence line for BM – load position for maximum SF at a section – Load position for maximum BM at a section Point loads, UDL longer than the span, UDL shorter than the span.

**Text Books:**

1. B.C. Punmia, A.K Jain &A.K.Jain, "Theory of Structures", Laxmi Publications 12th Edition, 2004.
2. C.S.Reddy, "Basic Structural Analysis", Tata Mc. Graw Hill, 3rd Edition, 2010.

**Reference Books:**

1. Bhavikatti, "Analysis of Structures - Vol. 1&2",Vikas Publications.
2. VaziraniandRatwani, "Analysis of Structures–Vol.II", Khanna Publishers, 16th Edition, 2015.
3. Ramamrutham, "Theory of Structures", Dhanpat Rai Publications, 9thEdition, 2014.
4. C.K.Wang, "Intermediate Structural Analysis", Standard Publication, 1stEdition, 2010.

**Web References:**

1. https://nptel.ac.in/courses/105105166/
2. https://www.youtube.com/watch?v=qhEton-EEOw&list=PL83821B43A558F579

**E-Text Books:**

1. https://www.kopykitab.com/Structural-Analysis-I-by-S-S-Bhavikatti
2. https://www.pdfdrive.com/fundamental-structural-analysis-e25550099.html