**19CE3205 - FINITE ELEMENT METHOD**

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| **Course Category** | Professional Core | **Credits** | 2 |
| **Course Type** | Theory | **Lecture-Tutorial-Practical** | 2-0-0 |
| **Prerequisite** | Structural Analysis | **Sessional Evaluation** | 40 |
| **External Evaluation** | 60 |
| **Total Marks** | 100 |

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| **Course**  **Objectives** | 1. To understand the basic principles of finite element method. 2. To know the concepts of finite element modelling and discretization, shape functions. 3. To analyze one dimensional elements using finite element methods. 4. To make use of the finite element approach in analyzing two dimensional elements. 5. To appreciate the concept of finite element formulation, plane stress and plane strain analysis. 6. To understand the principles iso-parametric elements. | |
| **Course Outcomes** | CO1 | Understand the basic principles of finite element method. |
| CO2 | Comprehend the concepts of finite element modelling and discretization, shape functions. |
| CO3 | Apply the finite element method in one dimensional elements. |
| CO4 | Utilize the finite element method in analyzing plane trusses. |
| CO5 | Make use of finite element formulation for beam elements and apply plane stress and plane strain concepts to plane elements. |
| CO6 | Apply the knowledge of isoperimetric elements for analysis. |
| **Course**  **Content** | **UNIT –I**  **INTRODUCTION:** Basic steps in Finite element method – Advantages and disadvantages –– Limitations.  **UNIT – II**  **FINITE ELEMENT MODELING AND DISCRETIZATION:** Finite element modeling and discretization – Interpolation and shape functions – Types of elements –Nodes and degrees of freedom.  **UNIT – III**  **ONE DIMENSIONAL FINITE ELEMENTS:** Introduction – Bar element – Beam element – Bar and beam elements of arbitrary orientation ––Element stiffness matrices – Assembly of element stiffness matrices –– Loads –– Boundary conditions –– Applications.  **UNIT – IV**  **TWO DIMENSIONAL FINITE ELEMENTS:** Plane trusses – Local and global coordinate systems – Direction cosines – element stiffness matrix – Assembly of global stiffness matrices – Stress calculation.  **UNIT – V**  **FINITE ELEMENT FORMULATION:** Introduction – Beam stiffness matrix– Assembly of beam stiffness matrices – Loads – Boundary conditions – Plane stress analysis – Plane strain analysis.  **UNIT – VI**  **ISOPARAMETRIC ELEMENTS:** Introduction – Mesh requirements – Material properties – Loads and reactions – Boundary conditions – checking the model – Analysis and design software (for practice purpose only). | |
| **Textbooks**  **& Reference books** | **TEXT BOOKS:**   * 1. C.S. Krishnamoorthy, *Finite Element Analysis*, McGraw–Hill Education, 2nd Edition, 2017.   2. S. S. Bhavikatti, *Finite Element Analysis*, New age international publishers, 3rd Edition, 2015.   3. Tirupathi R.Chandrupatla & Ashok D. Belegundu, *Introduction to Finite Elements in Engineering*, Pearson Education, 4th Edition, 2011.   **REFERENCE BOOKS:**   * + 1. O.C. Zienkiewicz, R.L. Taylor and J.Z. Zhu, *The Finite Element Method:Its basics and Fundamentals*, Butterworth-Heinemann publishers, 7th Edition, 2013.     2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, *Concepts and Applications of Finite Element Analysis*, John Wiley & Sons Publishers, 4th Edition, 2001.     3. Daryl L. Logan, *A First Course in the Finite Element Method*, CL Engineering, 5th Revised Edition, 2010. | |

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