College of Engineering

Department of Civil Engineering

CE 569 Finite Element Method in Structural Analysis

Credit and Contact hours	3 / 3 (Lectures), 0 (Tutorials), 0 (Laboratory)
Required, or Elective	Elective
Course Description	Introduction to Finite Element Method; Direct formulation of finite element in one dimension; stiffness method for truss, beam and frame analysis; Weighted residuals; Energy and Variational principles in elasticity; Rayleigh-Ritz method; Shape functions and finite element formulation; Lagrangian and Serendipity elements; Isoparametric elements and Numerical integrations; Finite Element Implementation to 2-D Plane Stress/Plane Strain and Axisymmetric problems.
Prerequisites or Co-requisites	CE 564 Advanced Solid Mechanics
Course Learning Outcomes	Students completing this course successfully will be able to:

Course Learning Outcomes (CLOs)	*Related Student Outcomes (SO)*
CLO1. Recognize the principles of the direct stiffness method for truss and frame structures. K1	**SO1**
CLO2. Recognize the Weighted Residuals; Energy Principles and Rayleigh-Ritz methods to solve simple boundary value problems. K1	**SO1**
CLO3. Recognize the fundamentals of domain discretization, interpolation functions, and the finite element formulation in one, two- and three-dimensional domains. K1	**SO1**
CLO4. Apply the direct stiffness method to truss and frame analysis. S1	**SO2**
CLO5. Use approximate Weighted Residual and Rayleigh-Ritz methods to solve simple plane stress/plane strain boundary value problems. S1	**SO2**
CLO6. Evaluate some real structural problems and predict their behavior using MATLAB/Octave. S1	**SO2**
CLO7. Manage work plans and assigned tasks in individual coursework and assignments, group projects, and research work. V2	**SO7**

Student Outcomes related to this Course	SO 1 Recognize advanced engineering knowledge, concepts, and techniques to identify, interpret, and analyze complex and real-life engineering problems. SO 2 Provide solutions for complex and real-life engineering problems through critical thinking and the use of modern engineering tools, and identify their impact on social, global, cultural, environmental, safety, and economic factors. SO 7 Effectively manage, individually or in groups, specialized tasks and activities in coursework, projects, assignments, and research work with a high level of autonomy and responsibility.

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<tr><td>Topics Covered</td><td>
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<tr><th>List of Topics</th><th>Related CLOs</th></tr>
<tr><td>1. Basic Concept of Finite Element Method</td><td>CLO1, CLO2, CLO3</td></tr>
<tr><td>2. Direct formulation of finite element – Stiffness Method</td><td>CLO4</td></tr>
<tr><td>3. Weighted Residual and Rayleigh-Ritz Methods</td><td>CLO2, CLO5</td></tr>
<tr><td>4. Virtual Work and Energy Principles</td><td>CLO2, CLO3, CLO5</td></tr>
<tr><td>5. Shape Functions and Finite Element formulation - One-D FE formulation</td><td>CLO3</td></tr>
<tr><td>6. 2—D and 3-D Lagrangian and Serendipity Elements</td><td>CLO3, CLO6</td></tr>
<tr><td>7. Isoparametric Elements and Numerical Integration</td><td>CLO3, CLO5, CLO6</td></tr>
<tr><td>8. Computer implementation</td><td>CLO6</td></tr>
<tr><td>9. A workshop on related topics</td><td>CLO6, CLO7</td></tr>
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<tr><td>Textbook(s) and Other Required Material</td><td>• Logan, D.L., 2016. A first course in the finite element method. Cengage Learning.</td></tr>
<tr><td>Grading System</td><td>Assignments and HWs 10%
Lecture Attendance —
Written midterm exam 40%
Computer Assignment 10%
Final exam 40%</td></tr>
<tr><td>Instructors</td><td>Prof. Yassir M. Abbas; Office 2A65; Email: yabbas@ksu.edu.sa</td></tr>
<tr><td>Date of Review</td><td>March 2025</td></tr>
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