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	Required for a MSCE degree
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	***Related Program Outcomes***
CLO1: Recognize the principles of direct stiffness method for truss and frame structures.	**K1**
CLO2: Recognize the Weighted Residuals; Energy Principles and Rayleigh-Ritz methods to solve simple boundary value problems	**K1**
CLO3: Recognize the fundamentals of domain discretization, interpolation functions and the finite element formulation in one, two and three dimensional domain	**K1**
CLO4: Recognize numerical integration and computer implementation of finite element method	**K1**
CLO5: Apply direct stiffness method to truss and frame analysis	**S1**
CLO6: Use approximate Weighted Residual and Rayleigh-Ritz methods to solve simple boundary value problems	**S1**
CLO7: Solve simple plane stress/plane strain problems using Finite Element method.	**S1**
CLO8: Evaluate and model some real structural problems and predict its behavior using MATLAB and available finite element software.	**C2**

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<tr><td>Student Outcomes related to this Course</td><td>K1. Recognize advanced engineering knowledge, concepts and techniques to identify, interpret and analyze complex and real-life engineering problems.
S1. Provide solution for complex and real-life engineering problems through critical thinking and using modern engineering tools and identify its impact on social and ethical issues.
C2. Design novel advanced Civil Engineering systems and evaluate its performance and effectiveness for engineering practice and its impact on society.</td></tr>
<tr><td>Topics Covered</td><td>
<table>
<tr><th>List of Topics</th><th>Related CLOs</th></tr>
<tr><td>1. Basic Concept of Finite Element Method</td><td>CLO4</td></tr>
<tr><td>2. Direct formulation of finite element – Stiffness Method</td><td>CLO1</td></tr>
<tr><td>3. Development of truss equations</td><td>CLO1</td></tr>
<tr><td>4. Development of beam equations</td><td>CLO1</td></tr>
<tr><td>5. Development of frame equations</td><td>CLO1</td></tr>
<tr><td>6. Applications on truss and frame structures</td><td>CLO5</td></tr>
<tr><td>7. Weighted Residual and Rayleigh-Ritz Methods</td><td>CLO2</td></tr>
<tr><td>8. Virtual Work and Energy Principles</td><td>CLO2</td></tr>
<tr><td>9. Shape Functions and Finite Element formulation - One-D FE formulation</td><td>CLO3</td></tr>
<tr><td>10. Analyzing plane stress/plane strain structures by FEM</td><td>CLO7</td></tr>
<tr><td>11. Isoparametric Elements and Numerical Integration</td><td>CLO6</td></tr>
<tr><td>12. Computer implementation</td><td>CLO8</td></tr>
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<tr><td>Textbook(s) and Other Required Material</td><td>Y. M. Desai, T. L. Eldho, A. H. Shah, Finite Element Method with Applications in Engineering, Pearson India., 2011.
J. N. Reddy, Introduction to the Finite Element Method, 3rd edition, McGraw-Hill Education, 2006</td></tr>
<tr><td>Grading System</td><td>Assignments and Homework 15%
Presentation of Project 10 %
Two Midterm Exams 35%
Final Exam 40%</td></tr>
<tr><td>Instructors</td><td>Dr. Yassir M. Abbas; Office 2A84/1; Email: yabbas@ksu.edu.sa</td></tr>
<tr><td>Date of Review</td><td>February, 2021</td></tr>
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