

<p><b>COURSE NUMBER:</b> ME 5228, 4 credits</p>	<p><b>COURSE TITLE:</b> Introduction to Finite Element Modeling, Analysis, and Design</p>
<p><b>TERMS OFFERED:</b> Fall</p>	<p><b>PREREQUISITES:</b> IT upper div or grad, 3221, AEM 3031, CSci 1113, MatS 2001</p>
<p><b>TEXTBOOKS/REQUIRED MATERIAL:</b> Introduction to Finite Element Analysis by D. Logan</p>	<p><b>PREPARED BY:</b> Prof. K. K. Tamma <b>DATE OF PREPARATION:</b> May 29, 2007</p>
<p><b>COURSE LEADER(S):</b> Prof. K. K. Tamma</p>	<p><b>CLASS/LABORATORY SCHEDULE:</b> Two days per week Lectures of 2 hours each</p> <p><b>CONTRIBUTION OF COURSE TO MEETING PROFESSIONAL OBJECTIVES:</b> 100 % Engineering Topics, Mechanics and Computer Science</p>
<p><b>CATALOG DESCRIPTION:</b> Introduction to virtual simulation, verification and validation; Modeling and design through simulation based predictive analysis; Numerical Methods; Finite Elements and their role in Engineering; Conceptual, preliminary and detailed designs; 1-D models and comparison to analytical solutions in Stress analysis and heat conduction; Finite elements for bars, beams in general 3-dimensional space; Weighted residual methods and variational methods; two-dimensional finite elements with triangles and quadrilateral elements; Isoparametric formulations; Applications to Engineering analysis; extensions to axisymmetric and three dimensional finite elements for engineering computations; modeling issues, loads and boundary conditions.</p>	<p><b>COURSE TOPICS:</b></p> <ol style="list-style-type: none"> <li>1. Introduction to numerical methods</li> <li>2. Concept of degrees of freedom, and Interpolation</li> <li>3. Loads and boundary conditions</li> <li>4. Modeling and symmetry considerations</li> <li>5. 1-2-3 dimensional physics and 1-2-3 dimensional physical/geometric space</li> <li>6. Convergence of numerical results to exact solutions of PDE's</li> <li>7. 1-Dimensional elements</li> <li>8. Bars, beams with axial, bending, and torsion in general 3-D space</li> <li>9. Derivation and theory towards developing finite element discretized equations</li> <li>10. Variational methods and weighted residual methods</li> <li>11. 2-Dimensional elements</li> <li>12. Triangles</li> <li>13. Quadrilateral elements</li> <li>14. Isoparametric formulations</li> <li>15. Axisymmetric developments</li> <li>16. Three dimensional developments</li> <li>17. Engineering Applications</li> </ol>

<p><b>COURSE OBJECTIVES</b></p>	<p>For students to:</p> <ol style="list-style-type: none"> <li>1. Become familiar with the use and evaluation of numerical techniques with regards to applicability, verification and validation through convergence and stability.</li> <li>2. Use finite element techniques for analysis and leading to simulation based predictive design</li> <li>3. Gain experience in defining and solving problems through home works and computer implementation of numerical developments</li> <li>4. Compare results with analytic and other numerical and/or experimental results as available for simple problems.</li> </ol>
<p><b>COURSE OUTCOMES</b></p>	<p><b>(Letters shown in brackets are linked to program outcomes a-k)</b>  Successful completion of the course will indicate:</p> <ol style="list-style-type: none"> <li>1. Understanding of numerical methods enabling obtaining solutions to problems with complex geometries and boundary conditions and loads [a, c, e]</li> <li>2. Ability to obtain useful convergent results as solutions to engineering problems which otherwise are not easily tractable via analytic solutions [a, c, e, k]</li> <li>3. Awareness of finite element advantages, limitations and pitfalls.[e, f, k, i]</li> <li>4. Experience in numerical analysis for design [a, b]</li> <li>5. Practical experience in applying the theory and numerical skills learned in the course to a variety of engineering problems. [a, b, e, k]</li> </ol>
<p><b>ASSESSMENT TOOLS:</b></p>	<ol style="list-style-type: none"> <li>1. Homework</li> <li>2. Mid Term and Final Exams</li> <li>3. Implementation of selected numerical analysis techniques</li> </ol>

**ME 5228**

***Nature of Changes:***

***This is an entirely new document; no previous versions exist.***