Matrix and Finite Element Structural Analysis I
CE720

Spring 2007

Instructor: Dr R. Seracino
214 Constructed Facilities Laboratory, Centennial Campus
513-1735 (office phone, CFL)
rudi_seracino@ncsu.edu

Lectures: 11:45 – 1:00 Tuesday 406 Mann Hall
11:45 – 1:00 Thursday 406 Mann Hall

Consultation: 2:00 – 4:00 Tuesday 326 Mann Hall (515-4345 Mann Hall office)
2:00 – 4:00 Thursday 326 Mann Hall
Consultation available at other times by prior appointment.

Prerequisites: CE425/525 (or similar course on structural analysis using stiffness method with matrix algebra)

Learning Resources:
http://courses.ncsu.edu/ce720
http://vista.ncsu.edu

Concepts and Applications of Finite Element Analysis
R.D. Cook, D.S. Malkus, M.E. Plesha and R.J. Witt

Course Objectives: Students will be able to use the finite element method in an informed manner to analyze solids and structures accurately and reliably, while recognizing the limitations of their analysis in relation to real physical problems. The course focuses on linear static analysis, but students will also be able to read literature and extend their knowledge related to dynamic and nonlinear finite element analysis.

Grading:

- Homework: 20% (approx. 5 assignments due on dates specified)
- Mid-term: 20% (Tuesday 13 March 2007)
- Project: 20% (Thursday 19 April 2007)
- Final Exam: 40% (8:00 – 11:00 Tuesday 1 May 2007)

Late homework assignments will not be marked.
Course Topics: Topics will be selected from:

*Review of matrix structural analysis:* degrees of freedom; bar, beam and frame elements; element stiffness matrix; assembly; global stiffness matrix and its properties; modeling and verification.

*Equations governing the deformation of 2-D solid continuum:* equilibrium equations; strain-displacement relations; stress-strain relations; boundary conditions; principle of virtual work.

*FEA of 2-D solids with simple elements:* need for approximation; interpolation of displacements; stiffness matrices and consistent load vectors; bar and beam elements revisited; constant strain triangle; stiffening effect of approximation; quadratic triangle; bilinear rectangle; quadratic rectangles; inter-element compatibility; improved rectangular elements for bending deformation; stress calculation; overview of isoparametric elements.

*Modeling Considerations:* sources of errors; discretization errors and their estimation; convergence considerations; stress smoothing; solution checking; good and bad practices.

*Isoparametric formulation:* bar element; bilinear quadrilateral element; gauss quadrature; higher order elements; selective reduced integration; convergence considerations; stress calculation.

<table>
<thead>
<tr>
<th>Grading Scale</th>
<th>A+</th>
<th>97-100</th>
<th>A</th>
<th>93-96.9</th>
<th>A-</th>
<th>90-92.9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B+</td>
<td>87-89.9</td>
<td>B</td>
<td>83-86.9</td>
<td>B-</td>
<td>80-82.9</td>
</tr>
<tr>
<td></td>
<td>C+</td>
<td>77-79.9</td>
<td>C</td>
<td>73-76.9</td>
<td>C-</td>
<td>70-72.9</td>
</tr>
<tr>
<td></td>
<td>D+</td>
<td>67-69.9</td>
<td>D</td>
<td>63-66.9</td>
<td>D-</td>
<td>60-62.9</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>&lt;60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Attendance Policy:**
On-campus students will be allowed access to the online lectures. However, regular class attendance is expected. Students are responsible for all materials presented in class.

**Academic Integrity Statement:**
Students will adhere to the academic policy set forth by the University Code of Student Conduct. Plagiarism and cheating are attacks on the very foundation of academic life, and cannot be tolerated within universities. Section 8 of the Code defines academic dishonesty and provides information on potential sanctions for violators of academic integrity.

**Students with Disabilities:**
Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with:

- Disability Services for Students  
  1900 Student Health Center  
  515-7653  
  [http://www.ncsu.edu/provost/offices/affirm_action/dss](http://www.ncsu.edu/provost/offices/affirm_action/dss)
Addendum to Syllabus for Online Students Only

This addendum applies only to those students registered for the online Section 601. The following procedures do not apply to on-campus students, namely those registered for Section 001.

**Homework:**
Please send all homework on or before the due date to Mike Myers in the NC State Engineering Online Office. He will accept homework as an email attachment, by fax, or by US mail. The homework will be forwarded to Dr Seracino and Mike Myers will return them to you after they have been graded. Following is the delivery information:

Engineering Online  
256 Page Hall  
21 Current Avenue  
Raleigh, NC 27695-7547

Email: mike_myers@ncsu.edu

Fax: (919) 515-8415

**Mid-term and Final Exam:**
The Mid-term Test and Final Exam must be proctored. Engineering Online students must submit the name of an individual to serve as a proctor to the EOL office. Proctors will receive and administer the Mid-term Test and Final Exam according to the schedule in the syllabus. For additional details, please see:

http://engineeringonline.ncsu.edu/onlinecourses/coursetimelogistics.htm