Course Number & Name: ENR 220 Mechanics of Materials

Credit Hours: 4.0  Contact Hours: 6.0  Lecture: 3.0  Lab: 3.0  Other: N/A

Prerequisites: Grade of “C” or better in ENR 110

Course Outline Revision Date: Fall 2010

Course Description: This course for technology students covers stresses and deformation in structural members due to axial, tensile and compressive loads, torsional loads on shafts and bending and shear loads on beams. Also included is the study of the basic design of structural members based on the analysis of stress and the deformation.

Course Goals: Upon successful completion of this course, students should be able to do the following:

1. calculate stresses on a member subjected to axial loads;
2. calculate stresses of a member subjected to shear force;
3. explain and compute the mechanical properties of materials;
4. calculate angular rotation of a shaft subjected to torsional moment;
5. compute forces, stresses, and bending moments in loaded beams; and
6. evaluate combined stresses and draw Mohr’s stress circle.

Measurable Course Performance Objectives (MPOs): Upon successful completion of this course, students should specifically be able to do the following:

1. Calculate stresses on a member subjected to axial loads:
   1.1 compute the tensile stress of a member;
   1.2 compute the compressive stress of a member;
   1.3 compute the deformation on a member;
   1.4 compute the strain on a member;
   1.5 compute the Modulus of Elasticity of a member; and
   1.6 compute the shear stress on inclined planes for a member
Measurable Course Performance Objectives (MPOs) (continued):

2. Calculate stresses of a member subjected to shear force:
   2.1 compute the shear deformation of the member;
   2.2 compute the shear strain in the member; and
   2.3 compute the shear stress in the member

3. Explain and compute the mechanical properties of materials:
   3.1 identify the proportional limit of various materials;
   3.2 compute the determine the yield stress of various materials;
   3.3 determine the ultimate stress of materials;
   3.4 draw stress/strain diagrams of various materials;
   3.5 determine the modulus of elasticity using the stress/strain diagram;
   3.6 determine factor of safety in design;
   3.7 determine stress concentration in members;
   3.8 operate the tensile testing equipment effectively;
   3.9 test various materials for their mechanical properties; and
   3.10 document the results of the tensile tests and report the findings in written form

4. Calculate angular rotation of a shaft subjected to torsional moment:
   4.1 compute the torsional shear stress of the member;
   4.2 compute the torque on the member;
   4.3 compute the angle of twist of the member;
   4.4 compute the torsional deflection of the member;
   4.5 compute the power developed in the member; and
   4.6 document the results of the torsion tests and report the findings in written form

5. Compute forces, stresses, and bending moments in loaded beams:
   5.1 draw shear force and bending moment diagrams for beams subjected to concentrated loads and/or distributed loads;
   5.2 calculate tensile and compressive stresses for a beam subjected to a bending moment;
   5.3 calculate longitudinal shear stress for a beam subjected to a shear force and a bending moment; and
   5.4 document the results of the bending tests and report the findings in written form

6. Evaluate combined stresses and draw Mohr’s stress circle:
   6.1 compute normal and shear stresses analytically; and
   6.2 using graphical methods (CAD), draw the Mohr’s Stress Circle, and use it to determine the normal and shear stresses

Methods of Instruction: Instruction will consist of lectures and problem solving.
Outcomes Assessment: Selected homework, quiz, test and exam questions are blueprinted to course objectives. A checklist rubric is used to evaluate lab reports for the presence of course objectives. Data is collected and analyzed to determine the level of student performance on these assessment instruments in regards to meeting course objectives. The results of this data analysis are used to guide necessary pedagogical and/or curricular revisions.

Course Requirements: All students are required to:

1. Maintain regular attendance.
2. Complete homework assignments and lab reports.
3. Sit for all quizzes, tests and exams that are scheduled.
4. Participate in all lab exercises.
5. Read all assigned textbook pages.
6. Participate in classroom discussions.

Methods of Evaluation: Final course grades will be computed as follows:

<table>
<thead>
<tr>
<th>Grading Components</th>
<th>% of final course grade</th>
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<tbody>
<tr>
<td><strong>Quizzes and class participation</strong></td>
<td>5 – 10%</td>
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<tr>
<td>A perusal of quizzes and class discussion will indicate the extent to which students master course objectives.</td>
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<tr>
<td><strong>Homework</strong></td>
<td>10 – 15%</td>
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<td>A perusal of homework problems will indicate the extent to which students master course objectives.</td>
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<tr>
<td><strong>3 or more Tests</strong> <em>(dates specified by the instructor)</em></td>
<td>30 – 40%</td>
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<tr>
<td>Tests will show evidence of the extent to which students meet course objectives, including but not limited to identifying and applying concepts, analyzing and solving problems, estimating and interpreting results and stating appropriate conclusions using correct terminology.</td>
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<tr>
<td><strong>Lab Reports</strong></td>
<td>15 – 25%</td>
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<td>Lab reports will show evidence of applying course concepts to physical problems and to analyze errors and the ability to compose technical reports on topics related to course objectives.</td>
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<tr>
<td><strong>Term Project</strong></td>
<td>10 – 20%</td>
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<tr>
<td>The term project will show evidence of applying course concepts to real world problems and to design a solution and the ability to compose a technical report related to a course objective.</td>
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Methods of Evaluation (continued):

<table>
<thead>
<tr>
<th>Grading Components</th>
<th>% of final course grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Work</td>
<td>5 – 10%</td>
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<tr>
<td>Collaborative work among colleagues, an essential component of engineering practice in industry, will be practiced as students complete their lab and term projects.</td>
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<tr>
<td>Final Exam (comprehensive)</td>
<td>25 – 35%</td>
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<td>The same objectives apply as with tests, but it is anticipated that students will provide increased evidence of synthesizing a combination of concepts.</td>
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**NOTE:** The instructor will provide specific weights, which lie in the above-given ranges, for each of the grading components at the beginning of the semester.

**Academic Integrity:** Dishonesty disrupts the search for truth that is inherent in the learning process and so devalues the purpose and the mission of the College. Academic dishonesty includes, but is not limited to, the following:

- plagiarism – the failure to acknowledge another writer’s words or ideas or to give proper credit to sources of information;
- cheating – knowingly obtaining or giving unauthorized information on any test/exam or any other academic assignment;
- interference – any interruption of the academic process that prevents others from the proper engagement in learning or teaching; and
- fraud – any act or instance of willful deceit or trickery.

Violations of academic integrity will be dealt with by imposing appropriate sanctions. Sanctions for acts of academic dishonesty could include the resubmission of an assignment, failure of the test/exam, failure in the course, probation, suspension from the College, and even expulsion from the College.

**Student Code of Conduct:** All students are expected to conduct themselves as responsible and considerate adults who respect the rights of others. Disruptive behavior will not be tolerated. All students are also expected to attend and be on time for all class meetings. No cell phones or similar electronic devices are permitted in class. Please refer to the Essex County College student handbook, *Lifeline*, for more specific information about the College’s Code of Conduct and attendance requirements.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Concept of stress</td>
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<tr>
<td>2</td>
<td>Concept of strain</td>
</tr>
<tr>
<td>3</td>
<td>Modulus of elasticity, stress concentration, design stress, safety factors</td>
</tr>
</tbody>
</table>
| 4    | Tension tests  
  **Test 1** |
| 5    | **Tension Tests Lab Report due**  
  Deformation and thermal stresses |
| 6    | Deformation and thermal stresses (continued)  
  Brinell hardness and impact tests |
| 7    | **Brinell Hardness and Impact Tests Lab Report due**  
  Torsional shear stress and torsional deflection |
| 8    | Torsion tests  
  **Test 2** |
| 9    | **Torsion Tests Lab Report due**  
  Shear forces and bending moments in beams |
| 10   | Shear forces and bending moments in beams (continued), centroids and moment of inertia |
| 11   | Bending tests  
  **Test 3** |
| 12   | **Bending Tests Lab Report due**  
  Stresses due to bending |
| 13   | Shear stresses in beams |
| 14   | Combined stresses and Mohr's circle |
| 15   | **Comprehensive Final Exam** on all course material covered |