**EGR 211 – Mechanics of Materials**

**Mechanical Properties of Materials**

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| **Stage 1 – Desired Results** | |
| **Established Goals:**  **Course (as stated in the Course Outline on file with the college)**   * To develop a clear insight into the relation between stress and strain for a wide variety of conditions and materials   **College-Wide Core Competencies (as stated in the 2011 – 2012 College Catalog)**   * **Communication:** Using listening, speaking, reading, writing and visual communication skills effectively. * **Information Literacy**: Recognizing when information is needed and locating, evaluating, and using information appropriately. * **Quantitative Reasoning**: Applying mathematical concepts appropriately to analyze and interpret quantitative information. * **Innovative and Critical Thinking**: Integrating knowledge to analyze problems using different modes of thinking (critical, creative and innovative). | |
| **Understandings:**  *Student will understand that…*   * Mechanical properties of materials are determined by experiments. * Multiple experimental methods exist for determining a mechanical property of a material. * Stress-strain diagrams are created based on the results of an experiment. * Stress-strain diagrams contain many mechanical properties (through locating key points and analysis particular features, such as linear portions of the diagram). * Stress-strain diagrams for ductile and brittle materials will have different general shapes and analysis of the shape is one way to determine if a material is ductile or brittle. | **Essential Questions:**   * How are mechanical properties for materials determined? * Where do you find material properties for existing (well-established) materials? * How can materials be compared using their mechanical properties? * Which mechanical properties are essential to know (define) prior to using a material in a real-world application? * How are mechanical properties established for new materials? * What properties are use to categorize a material as “ductile” versus “brittle”? Are there any in-between states? |
| *Students will know…*   * Key terms: modulus of elasticity/Young’s modulus, yield strength, 0.2% offset yield strength, ultimate strength, necking, rupture, fracture strength, strain hardening, percent elongation, resilience, toughness, brittle, ductile. * General procedures for basic mechanical test methods (tensile, compression, torsion, three-point bend, four-point bend). * For brittle and ductile materials, which tests are most reliably used to determine mechanical properties. | *Students will be able to….*   * Given typical ductile and brittle material stress-strain diagrams, identify/calculate key properties (such as the yield strength, ultimate strength, breaking strength, elastic region, and plastic region). * Given a set of load and elongation data from a tensile test, apply appropriate equations to calculate required values needed to create a stress-strain diagram. * Given a set of load and deflection data from a three-point bend test, apply appropriate equations to calculate required values needed to create a stress-strain diagram.   *(continued: Students will be able to….)*   * Use Microsoft Excel to create stress-strain diagrams. * Use the linear portion (the slope of the graph) of a stress-strain diagram to determine the modulus of elasticity for a material. * Provide examples of brittle and ductile materials (from engineering or from other “real world” experiences). |
| **Stage 2 – Assessment Evidence** | |
| **Performance Tasks:**  Homework – Internet assignment MecMovies (<http://web.mst.edu/~mecmovie>)   * M3.1 The tension test * M3.2 The stress-strain diagram * M3.3 Hooke’s Law – basic problems   Homework – traditional problem solving   * Given a set of force and deflection data, create a stress-strain diagram using Microsoft Excel. * Identify key properties from the diagram. * Complete related property calculations. * Categorize material as brittle or ductile. | **Other Evidence:**   * In-class discussion * Related questions on test(s) |
| **Stage 3 – Learning Plan** | |
| **Learning Activities:**   * Pre-lecture reading/on-line video viewing (W) * Lecture/discussion on importance of determining properties of materials prior to using materials in real-world applications (Introduce topic) (W,H) * Typical ductile material * Lecture/discussion of tensile test procedure and describe data to be taken (H,E) * YouTube video of tensile test (H) * Show resulting stress-strain diagram (E) * Lecture/discussion of key components on diagram and other related calculations (E,R) * Discussion of common materials that fit into this category (E,R) * Typical ductile material with no yield point * Lecture/discussion of key components on graph and other related calculations (E, R) * Show resulting stress-strain diagram (E) * Discuss similarities/differences between the two diagrams (E,R) * Discussion of common materials that fit into this category (E,R) * Typical brittle material * Discussion on difficulties with performing a tensile test on a brittle material (E,R) * Discuss alternative testing methods for determining mechanical properties – such as a three-point bend test (E,R) * Introduction to summer research work with dental composites (H) * Describe data to be taken (E) * Show YouTube video of test (H) * Show resulting diagrams (E) * Discussion of standards of testing methods established by ASTM and ISO (H) * Although not a “learning activity” handouts for the lecture will be made up in advance with the stress-strain diagrams and key lecture topics/bullets already drawn so that more time can be spent by the students listening and learning rather than trying to copy everything down from the board (O) | |