**COURSE:** EN3112 Strength of Materials **INSTRUCTOR:** Pete Carroll, P.E.

**SEMESTER:** Fall 2022 210A Harrington

**ROOM:** TBD [pcarroll@maritime.edu](mailto:pcarroll@maritime.edu)

**MEETING TIME:** Monday, Wednesday, Friday, 1300 – 1350.

**ACADEMICS & LEADERSHIP:** I have a high expectations for the display of leadership, character, morals, ethics and respect. This is in regard to one another and between you and I. I expect all students to be on-time to classes, purchase Connect subscription for homework, and take notes during class. I expect all of you to pay attention to the lecture through eye contact and engaged with insightful questions. This will be a fast-paced, rigorous course and will require your understanding of the homework, quizzes, in class exercises and readings, in order to do well on the tests. **Attitude is everything**.

**COURSE DESCRIPTION:** This course studies the fundamental concepts of mechanics of materials, including stress, and deformation due to tensile and compressive forces, torsion, bending moments, transverse shear, and temperature changes. It also studies statically indeterminate problems, power transmission, stress concentration factors, beam design, columns, and buckling.

**PREREQUISITE:** EN-2211 Mechanics

**PRACTICAL EXERCISES:** Each class will do a practical problem for you to try and individually solve. I will give you hints to think about and methods to use to try and reach the answer. We’ll go over this practical problem in class.

**TEXT:** Mechanics of Materials, 8th Edition by Beer, Johnston, DeWolf, and Mazurek. The textbook is mandatory, but the e-book can be found here:  <https://www.mheducation.com/highered/product/mechanics-materials-beer-johnston/M9781260113273.html> or, I highly recommend buying a hard-copy text (used or rental) for the same price as an e-book.

**COURSE OBJECTVES:** At the completion of this course, the student should be able to:

* + Determine the normal and shear stresses due to forces and torques on simple structures
  + Understand and interpret a stress-strain diagram and Hooke’s Law
  + Predict and calculate thermal stress for simple structures
  + Apply the concepts of Factor of Safety and different failure modes
  + Predict and calculate the shear stress and angle of twist including stress concentrations for power transmission shafts
  + Draw and evaluate shear and bending moment diagrams for use in beam design
  + Design the most economical beam for a given load
  + Calculate principle stresses algebraically and through the use of Mohr’s circle
  + Calculate stresses in thin walled pressure vessels
  + Calculate the deflection of a beam for various loadings
  + Calculate the critical buckling load for simple columns

**HOMEWORK:** All homework will be completed on engineering graph paper and in the format specified at the beginning of class. See homework and test schedule attached to this syllabus and in Blackboard. All homework shall be completed on engineering graph paper.

**GRADING:** Homework – 20 %

2 Exams - 40 % (20 % each)

2 Team Projects - 40 % (20 % each)

**CALCULATORS:** No cell phones or **any electronics** are allowed on exams, quizzes or any other graded material. Only calculators approved by NCEES (National Council of Examiners for Engineering and Surveying) are allowed on exams and quizzes, (See <http://ncees.org/Exams/Examday_policies/Calculator_policy.php> for details)

**ATTENDANCE:** You are expected to provide advance notice and rationale for any absence; 4% will be deducted from your final grade for each unexcused absence. For excused absences, a legitimate excuse needs to be provided by text, phone or email before the beginning of class. There will be no make-up for unexcused absences during an exam or quiz.

**FOOD & DRINK POLICY:** Small portions of food and drink are allowed if the classroom is kept clean.

**CONTRIBUTION TO THE PROFESSIONAL COMPONENT:** Strength of Materials, a required course for Marine Engineering, Facilities Engineering and Energy Systems Engineering, requires that students use the fundamental knowledge from other courses in the program, such as: mathematics, physics, and mechanics. This course contributes 3 semester hours to the engineering topic requirement.

**STUDENT ACCOMMODATIONS:** The Academy offers, upon request, accommodations to students with documented learning disabilities. The ADA Coordinator, Asst. Dean Elaine Craghead, evaluates the documentation provided, determines appropriate services, and is available to discuss accommodations with students. The Disability Resources office is located in the Academic Resource Center, ABSIC 320. Students can drop in during normal business hours, M-F 0800-1600, or call x5120, or email [ADAcompliance@maritime.edu](mailto:ADAcompliance@maritime.edu).

Letter Grade Cut-Offs:

93 ≤ X ≤ 100 A 77 ≤ X ≤ 79 C+

90 ≤ X ≤ 92 A- 73 ≤ X ≤ 76 C

87 ≤ X ≤ 90 B+ 70 ≤ X ≤ 72 C-

83 ≤ X ≤ 86 B 67 ≤ X ≤ 69 D+

80 ≤ X ≤ 82 B- 63 ≤ X ≤ 66 D

X 63 F

There will be no D- grades given. You must have an average ≥ 63 in order to pass this class

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| # | **CLASS** |  | **READING** | **TOPIC** | **Homework** | **DUE** |
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|  | Thurs | 9/1/2022 |  | **Orientation Day – No Classes** |  |  |
|  |  |  |  |  |  |  |
|  | Mon | 9/5/2022 |  | **LABOR DAY - NO SCHOOL** |  |  |
| 1 | Wed | 9/7/2022 |  | Introduction, Statics Review |  |  |
| 2 | Fri | 9/9/2022 | 1.1-1.2 | Axial Loading & Average Normal Stress | 1.2, 1.10, 1.12 | 9/12/2022 |
|  |  |  |  |  |  |  |
| 3 | Mon | 9/12/2022 | 1.1-1.2 | Shearing Stresses & Bearing Stresses | 1.15, 1.16, 1.21 | 9/14/2022 |
| 4 | Wed | 9/14/2022 | 1.5 | Factor of Safety and Design Considerations | 1.37, 1.41 | 9/16/2022 |
| 5 | Fri | 9/16/2022 |  | Project Assignment-Tension/Compression/Buckling | - |  |
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| 6 | Mon | 9/19/2022 | 2.1 | Normal Strain under Axial Loading | 2.1, 2.3, 2.4 | 9/21/2022 |
| 7 | Wed | 9/21/2022 | 2.1 | Stress-Strain Diagram & Hooke's Law | 2.5, 2.6, 2.8 | 9/23/2022 |
| 8 | Fri | 9/23/2022 | 2.3 | Problems Involving Temperature Changes | 2.47, 2.50 | 9/26/2022 |
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| 9 | Mon | 9/26/2022 | 2.2 | Statically Indeterminate Problems | 2.33, 2.34, 2.39 | 9/28/2022 |
| 10 | Wed | 9/28/2022 | 2.4 | Poisson's Ratio & Multiaxial Loading | 2.61, 2.64 | 9/30/2022 |
| 11 | Fri | 9/30/2022 | 10.1-10.2 | Stability & Euler's Formula | 10.9, 10.11, 10.15 | 10/3/2022 |
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| 12 | Mon | 10/3/2022 | 10.3 | Centric Load Design | 10.57, 10.58, 10,59 | 10/5/2022 |
| 13 | Wed | 10/5/2022 |  | Project Workshop | - |  |
| 14 | Fri | 10/7/2022 |  | **Project #1 Due** | - |  |
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|  | Mon | 10/10/2022 |  | **COLUMBUS DAY** | - |  |
| 15 | Tues | 10/11/2022 | 2.7-2.11 | Shearing Strain & Stress Concentrations | 2.75, 2.79, 2.93, 2.97 | 10/12/2022 |
| 16 | Wed | 10/12/2022 | 3.1 | Circular Shafts in Torsion | 3.4, 3.13, 3.19 | 10/14/2022 |
| 17 | Fri | 10/14/2022 | 3.2 | Angle of Twist | 3.32, 3.33 | 10/17/2022 |
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| 18 | Tues | 10/17/2022 | 3.3 | Statically Indeterminate Shafts (1) | 3.51, 3.55, 3.56 | 10/19/2022 |
| 19 | Wed | 10/19/2022 | 3.4 | Statically Indeterminate Shafts (2) | - | - |
| 20 | Fri | 10/21/2022 | 3.5 | Stress Concentrations in Circular Shafts | 3.64 | 10/24/2022 |
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| 21 | Mon | 10/24/2022 |  | **Exam #1** | - |  |
| 22 | Wed | 10/26/2022 | 4.1-4.2 | Stress and Deformation in Pure Bending | 4.1, 4.3 | 10/28/2022 |
| 23 | Fri | 10/28/2022 | 4.3 | Stress and Deformation in the Elastic Range | 4.18, 4.24, 4.37 | 10/31/2022 |
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| 24 | Mon | 10/31/2022 | 4.7 | Project Assignment #2 | - |  |
| 25 | Wed | 11/2/2022 | 5.1-5.2 | Shear and Bending Moment Diagrams | 5.7, 5.9, 5.12 | 11/4/2022 |
| 26 | Fri | 11/4/2022 | 5.3 | Design of Prismatic Beams | 5.67, 5.72, 5.82 | 11/7/2022 |
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| 27 | Mon | 11/7/2022 | 6.1 | Horizontal Shearing Stress in Beams | 6.1, 6.5 | 11/9/2022 |
| 28 | Wed | 11/9/2022 | 6.3 | Longitudinal Shear in Arbitrary Cut | 6.11, 6.13, 6.18 | 11/14/2022 |
|  | Fri | 11/11/2022 |  | **VETERAN'S DAY** | - |  |
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| 29 | Mon | 11/14/2022 | 6.4 | Thin-Walled Members | 6.29, 6.35 | 11/16/2022 |
| 30 | Wed | 11/16/2022 | 9.1 | Equation of the Elastic Curve | 9.1, 9.2 | 11/18/2022 |
| 31 | Fri | 11/18/2022 | 9.2, 9.4 | Superposition | 9.65, 9.73 | 11/21/2022 |
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| 32 | Mon | 11/21/2022 | 9.4 | Statically Indeterminate Beams | 9.79 | 11/28/2022 |
|  | Wed | 11/23/2022 |  | **THANKSGIVING BREAK** | - |  |
|  | Fri | 11/25/2022 |  | **THANKSGIVING BREAK** | - |  |
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| 33 | Mon | 11/28/2022 | 9.1-9.4 | Superposition/Elastic Curve Workshop | - |  |
| 34 | Wed | 11/30/2022 |  | Project #2 Due + Presentation | - | - |
| 35 | Fri | 12/2/2022 |  | Project #2 Due + Presentation | - |  |
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| 36 | Mon | 12/05/22 | 7.1 | Stress Transformation - Plane | 7.1, 7.7, 7.11 | 12/7/2022 |
| 37 | Wed | 12/7/2022 | 7.3-7.5 | Mohr's Circle | 7.32 | 12/9/2022 |
| 38 | Fri | 12/9/2022 | 7.3-7.5 | Stresses in Thin-Walled Pressure Vessels | 7.99, 7.100, 7.109 | 12/12/2022 |
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| 39 | Mon | 12/12/2022 |  | Review Stress Transformations | - |  |
| 40 | Wed | 12/14/2022 |  | **Exam #2** | - |  |