

## MAE 316 – Strength of Mechanical Components

Section: 316-001  
Time: 11:45 AM – 1:00 PM  
Lecture Room: 2213 EB 3

Instructor: Brendan O'Connor  
Office: Partners 2, Rm 1505, in suite 1500  
email: [btoconno@ncsu.edu](mailto:btoconno@ncsu.edu)

### Office Hours

I am available for in-person and remote office hours on Monday and Wednesday from 9 - 10 AM.

Note: If remote, please send an email letting me know that you have joined online.

Remote: <https://ncsu.zoom.us/j/7704681983>

### Preferred Method of Communication & Response Time

- **Preferred method of communication:** If you need to contact me directly, my preferred method of communication is email. You can expect to receive a response within two business days. If I email you directly, please strive to respond within two business days.
- **Asking questions about the course:** If you have a question about the course or its content, you can email me or post your question on the Student Help Forum in Moodle. You can expect to receive a response within two business days.
- **Email guidelines:** Always include a descriptive, specific but concise subject. Include your course number and section in your email, and provide adequate context for your question in order to ensure full understanding of your email. Be sure to use your NC State email account.

---

## Course Information

### Catalog Description

Analysis and design of mechanical components based on deflection, material, static strength and fatigue requirements. Typical components include beams, shafts, pressure vessels and bolted and welded joints. Classical and modern analysis and design techniques. Computer analysis using the finite element method. Material and manufacturing considerations in design.

### Structure

The majority of this course is **synchronous**, delivered through real-time, face-to-face class sessions. Additional materials and activities are delivered through **Moodle**, a secure and easy-to-use online learning platform. Learning activities in this course will include in-person lectures, reading assignments, videos, discussion forums, homework assignments, and exams. Assignments will be submitted through Moodle, and must be submitted by 5PM on the given due date. Classes may or may not be recorded on posted on Panopto. Assignments will be announced in class including due dates. There will be two in class exams during the semester. There will be a final exam during the designated final exam period or a final project.

### Prerequisites/Corequisites

Prerequisites: MA 214 with C- or better, co-requisite MA341

### Minimum Technical and Digital Information Literacy Skills

- Navigate and use Moodle, NC State's Learning Management System.
- Create and submit files in commonly used program formats (MS Word, Excel, PowerPoint, PDF).
- Download and upload attachments
- Use spreadsheets, presentations, graphics programs, and other applications in digital environments
- Use web conferencing tools including Zoom
- Post to discussion boards and forums on Moodle
- Perform online research using various search engines and library databases.
- Analyze digital information for credibility, currency, and bias
- Properly cite information sources. Prepare a presentation on research findings

---

## Learning Objectives

Be able to analyze and design mechanical components based on deflection, material, static strength and fatigue requirements. Typical components include beams, shafts, pressure vessels and bolted and welded joints.

---

## Course Materials

### Required textbooks

Required: Shigley's Mechanical Engineering Design, Budynas and Nisbett, McGraw Hill, 12e (11e, 10e OK).

### Recommended materials

Recommended: Mechanics of Materials, Beer, Johnston, DeWolf and Mazurek 8e (or 7e), McGraw Hill.

---

## Technology Requirements

### Computer

A computer is recommended for students taking this course. NC State's Office of Information Technology provides recommendations for [your computer at NC State.](#)

### Software and digitally-hosted course components

The following software and tools will be used in this course. All tools are available as part of NC State's enterprise tools. See [information about their purpose, how to access them, accessibility information, and privacy policies](#). MS Word, MS Excel, MP4 viewer, PDF reader.

---

## Communication Guidelines

### Respecting our learning community

The [NC State Code of Student Conduct](#) outlines expectations for behavior in the classroom (whether virtual or physical) and the consequences for students who violate these expectations. Any behavior that impacts other students' ability to learn and succeed will be addressed, but expressing diverse viewpoints and interpretations of course content is welcome.

Community guidelines for this course include:

- Use a respectful tone in all forms of communication (email, written, oral, visual).
- Maintain professionalism (avoid slang, poor grammar, etc.) in your written communication.
- Respect regional dialects and culturally embedded ways of oral communication.
- Stay home if you are exhibiting symptoms of a contagious illness (fever, chills, etc.).
- Enter our virtual and/or physical classroom community respectfully by refraining from lewd or indecent speech or behavior, helping to maintain a safe physical environment, not using your cell phone for voice or text communication except when explicitly given leave to do so.
- Treat each community member with respect by not recording others without their consent or engaging in any form of hazing, harassment, intimidation, or abuse.
- Respect cultural differences that may influence communication styles and needs.

### Expectations for learner participation and interaction

Some course activities, including synchronous class sessions, Moodle Forums, and group work, will require you to interact with other students in the course. Communication expectations, including frequency and content, are detailed in the information about each assignment or activity when it appears in the course.

---

## Grading and Feedback

Final course grades will be determined as follows:

|                   |      |
|-------------------|------|
| Homework          | 15 % |
| Midterm exams (2) | 50 % |
| Final Exam        | 35 % |

### *Grade distribution*

|              |               |               |                    |
|--------------|---------------|---------------|--------------------|
| A+ 97.5-100% | B+ 87.5-89.9% | C+ 77.5-79.9% | D+ 67.5-69.9%      |
| A 92.5-97.4% | B 82.5-87.4%  | C 72.5-77.4%  | D 62.5-67.4%       |
| A- 90-92.4%  | B- 80-82.4%   | C- 70-72.4%   | D- 60-62.4%, F<60% |

Grades may be adjust up at the discretion of the instructor.

### **Requirements for earning a grade of “Satisfactory”**

If you are taking this course for credit only (S/U), your grade will be reported as S (Satisfactory) when coursework is equivalent to a C- or better or U (Unsatisfactory) when coursework is equivalent to less than a C-. For more information, see the [Credit Only Courses regulation](#).

Auditing this course is approved on a case-by-case basis. Please contact the course instructor to attain approval.

Refer to the [Audit regulation](#) for more information and links to required forms.

**Homework:** Homework will be assigned as the course develops, announced in class and posted on Moodle. All homework must be neatly prepared with your name, date and problem number on each homework problem. Each new problem must start on a new page. The homework will be posted on Moodle and submitted through Moodle. Submit homework assignments as ONE PDF file.

**Exams:** Test dates are shown in the calendar, but are subject to change. Each test will be 75 minutes long. The test will be in-class, closed-book, and open notes. Electronic notes on a laptop or tablet are allowed. The pdf notes must be the only files open and the computer wifi must be off. The format the exam may change as announced in class. All exams will be returned in class or can be picked up at my office. Exams will be discarded after 1 month from the initial return date.

Arrangements for missed tests will be made on an individual basis provided there is an acceptable, certifiable excuse (what constitutes an 'Excused Absence,' is at this link <http://policies.ncsu.edu/regulation/reg-02-20-03>). These arrangements must be made at least one week in advance and preferably as soon as possible (except in the case of emergency). If tests or exams are scheduled on days that the University is closed due to emergencies, those exams will be researched to occur at the earliest possible class period after the University reopens.

**Class Attendance Policy:** Attendance is not required, nor is it recorded. The University policy is given at [http://www.ncsu.edu/policies/academic\\_affairs/courses\\_undergrad/REG02.20.3.php](http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.3.php)

**Academic Integrity** (cheating): Evidence of cheating on exams or assignments will result in disciplinary action. Students are expected to adhere to the University policy on academic integrity found in the Code of Student Conduct Policy (POL11.35.1). An Honor Pledge is expected to be followed on all assignments. The Honor pledge is as follows: "I have neither given nor received unauthorized aid on this test, exam or special assignment. I have not discussed the contents of this test or exam prior to taking it."

**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 at 1900 Student Health Center, Campus Box 7509, 515-7653.

[http://www.ncsu.edu/provost/offices/affirm\\_action/dss/](http://www.ncsu.edu/provost/offices/affirm_action/dss/) For more information on NC State's policy on working with students with disabilities, please see the [Academic Accommodations for Students with Disabilities Regulation](#).

## Course Organization

| Per. | Date           | Topic                                       | Reading             | Homework |
|------|----------------|---------------------------------------------|---------------------|----------|
| 1    | Jan. 12        | Review of solid mechanics                   | 3.8-3.12, 3.14      |          |
| 2    | Jan. 14        | Review of solid mechanics                   |                     |          |
|      | <b>Jan. 19</b> | <b>No-class, MLK day</b>                    | 3.6-3.7             |          |
| 3    | Jan. 21        | Review of solid mechanics                   | 3.18                |          |
| 4    | Jan. 26        | 2D and 3D stresses                          |                     | HW 1 due |
| 5    | Jan. 28        | Curved beams                                |                     |          |
| 6    | Feb. 02        | Overview of material properties             | 2                   |          |
| 7    | Feb. 04        | Overview of material properties             |                     | HW 2 due |
| 8    | Feb. 09        | Beam with skew loads                        | Notes + 3.10        |          |
| 9    | Feb. 11        | skew loads and non-symmetric cross sections |                     |          |
| 10   | Feb. 16        | non-symmetric cross sections                | 3.14 + Notes        | HW 3 due |
| 11   | Feb. 18        | Test review                                 |                     |          |
| 12   | Feb. 23        | <b>Test 1</b>                               |                     |          |
| 13   | Feb. 25        | Thick-walled cylinders                      |                     |          |
| 14   | Mar. 02        | Press and shrink fits                       | 3.16                |          |
| 15   | Mar. 04        | Beam deflection review                      | 4.3-4.5             | HW 4 due |
| 16   | Mar. 09        | Beam deflection continued                   |                     |          |
| 17   | Mar. 11        | Castigliano's method                        | 4.7-4.10            | HW 5 due |
|      | <b>Mar. 16</b> | <b>No-class, spring break</b>               |                     |          |
|      | <b>Mar. 18</b> | <b>No-class, spring break</b>               |                     |          |
| 18   | Mar. 23        | Castigliano's method                        |                     |          |
| 19   | Mar. 25        | Castigliano's method                        |                     |          |
| 20   | Mar. 30        | Matrix method                               | Notes               | HW 6 due |
| 21   | Apr. 01        | Test 2 review/ Matrix method continued      |                     |          |
| 22   | Apr. 06        | <b>Test 2</b>                               |                     |          |
| 23   | Apr. 08        | Matrix method continued                     |                     |          |
| 24   | Apr. 13        | Matrix method continued                     | 3.19                |          |
| 25   | Apr. 15        | Failure theories                            |                     |          |
| 26   | Apr. 20        | Fracture mechanics                          | 5.3-5.8, 5.12, 5.14 |          |
| 27   | Apr. 22        | Fatigue                                     | 6.4, 6.7, 6.8, 6.11 | HW 7 due |
| 28   | Apr. 27        | Review for final exam                       |                     |          |
|      | May 04         | <b>Final exam – 12PM (EB3 Rm 2213)</b>      |                     |          |

*Note: The information in this document is subject to revision through communication on Moodle and in class.*