NEW JERSEY INSTITUTE OF TECHNOLOGY

ME 315-002 STRESS ANALYSIS

Spring 2025

Instructor: Dr. Xing Liu (xing.liu@njit.edu)

Lectures: Tuesday and Thursday 4:00-5:20 pm at KUPF 118

Office hours: Monday 4:00–5:00 pm at 263 Fenster Hall

Prerequisites: ME 215 Engineering Materials and Processes; MECH 237 Strength of Materials; MATH 222 Differential Equations

Textbook:

- *Mechanics of Materials*, 3rd edition, by Roy R. Craig, JR. (Wiley)
- Advanced Mechanics of Material and Applied Elasticity, 5th edition, by Ansel C. Ugural and Saul K. Fenster (Pearson)

Course Description: This course provides an introduction to the mechanics of solids and the fundamentals of linear elasticity theory.

Course Learning Outcomes

- 1. Understand the concepts of stress and strain tensors.
- 2. Describe the stress-strain relationship in an isotropic, linear-elastic solid.
- 3. Analyze the stress/strain states in basic structural members.
- 4. Analyze general stress/strain states using transformation equations and Mohr's circle.
- 5. Define plane stress/strain problems, and understand the underlying assumptions.
- 6. Solve plane stress/plane strain problems.
- 7. Understand the concepts of strain energy and external work.
- 8. Solve linear elasticity problems using energy methods.
- 9. Understand the concepts of stable, unstable, and neutral equilibrium.
- 10. Solve column buckling problems through stability analysis.

| Jan. 21 | Review of Basic Concepts I | |
|---------|-------------------------------|--|
| Jan. 23 | Review of Basic Concepts II | |
| Jan. 28 | Stress-Strain Relationship I | |
| Jan. 30 | Stress-Strain Relationship II | |

Tentative Schedule and Topics

| Feb. 4 | Stress Analysis in Basic Structural Members | | |
|---------------------|---|--|--|
| Feb. 6 | Transformation of Stress and Strain I | | |
| Feb. 11 | Transformation of Stress and Strain II | | |
| Feb. 13 | Problem Session | | |
| Feb. 18 | Midterm Exam I | | |
| Feb. 20 | Elements of Linear Elasticity: Equilibrium Equations | | |
| Feb. 25 | Elements of Linear Elasticity: Compatibility Conditions | | |
| Feb. 27 | Plane Elasticity: Formulations | | |
| Mar. 4 | Plane Elasticity: Airy Stress Function Method I | | |
| Mar. 6 | Plane Elasticity: Airy Stress Function Method II | | |
| Mar. 11 | Plane Elasticity: Problems in Cartesian coordinates | | |
| Mar. 13 | Plane Elasticity: Problems in polar coordinates | | |
| Mar. 18 | Spring Recess. No Class. | | |
| Mar. 20 | Spring Recess. No Class. | | |
| Mar. 25 | Plane Elasticity: Advanced Topics | | |
| Mar. 27 | Problem Session | | |
| Apr. 1 | Midterm Exam II | | |
| Apr. 3 | Wellness Day. No Class. | | |
| Apr. 8 | Strain Energy and External Work I | | |
| Apr. 10 | Strain Energy and External Work II | | |
| Apr. 15 | Application of the Energy Method I | | |
| Apr. 17 | Application of the Energy Method II | | |
| Apr. 22 | Application of the Energy Method III | | |
| Apr. 24 | Stability of Elastic Structures | | |
| Apr. 29 | Buckling of Columns | | |
| May 1 | Problem Session | | |
| May 6 | Problem Session | | |
| May 13 or 15 | Final Exam | | |

Grading Policy

• Homework Sets (40%)

Homework will be assigned regularly. Students must upload a PDF copy of their solutions to Canvas by the due date. Submission by other means will not be accepted. In rare cases of illness or other justified reasons, homework should be uploaded before the solutions are posted.

Students will be required to self-evaluate their homework and submit their evaluation within 48 hours after the solutions are posted. The instructor will review both the homework and the self-evaluation to assign the grade.

• Midterm Exam I (20%), Midterm Exam II (20%), Final Exam (20%)

There will be no make-up exams. Students are advised to contact the Office of the Dean of Students if they have any questions or need additional guidance.

• In-class activities and pop quizzes: bonus credit up to 10%

In-class quizzes <u>will not be announced in advance</u> and student participation is <u>not</u> <u>mandatory</u>.

For all exams and quizzes, students are expected to take pictures of their solutions (using an electronic device, such as a smartphone, tablet, or laptop) and upload them to Canvas during class.

• Grading Scale

The final grade will not be curved.

| А | B+ | В | C+ | С | D |
|--------|-------|-------|-------|-------|-------|
| 90–100 | 85–89 | 80-84 | 75–79 | 70–74 | 60–69 |

Academic Integrity

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <u>NJIT Academic Integrity Code (https://www.njit.edu/sites/njit.edu.policies/files/NJIT-University-Policy-on-Academic-Integrity.pdf</u>).

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary

action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

Generative AI

This course expects students to work without generative artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, student use of generative AI (*e.g.*, ChatGPT) is not permitted throughout this course under any circumstance.

Student Absences for Religious Observance

NJIT is committed to supporting students observing religious holidays. Students must notify the instructor in writing of any conflicts between course requirements and religious observances. Students expecting to miss classes or exams due to religious observances must submit a written list of dates to their instructors, ideally by the end of the second week of class, but no later than two weeks before the anticipated absence. Academically reasonable accommodation will be provided, allowing students to complete missed assignments, exams, quizzes, or other coursework within the academic term.

This policy applies only to absences for religious observances. For other excused absences, students should refer to the policies from the Dean of Students. For any questions or additional guidance, please review the policy (<u>https://www.njit.edu/registrar/njit-policy-student-absences-religious-observances</u>) or contact the Office of Inclusive Excellence at <u>inclussiveexcellence@njit.edu</u>.