

▪ **Type of Course:**

Graduate course - Lecture format – 3 credits – Online Instruction.

▪ **Course Overview:**

An understanding of structural stability is a special branch of engineering mechanics of importance to structural engineers whose job is to design safe structures. In a structure, a small change in load could cause a large change in displacement. If the change in displacement is large enough, or is in a critical member of the structure, a local or member instability could lead to a total collapse of the entire structure. Instability failures are often catastrophic.

This course examines how and under what loading condition, a structure passes from a stable state to an unstable one. The stability of different structural members and systems is analyzed. The course also includes a practical look at how theory translates into design methods implemented in design specifications. All major international design specifications include provisions based on stability theory. Attention is especially focused on steel structures. Compared to structures designed using other construction materials, steel structures rely to a greater extent on stability limit states.

▪ **Prerequisites/ Required Skills:**

Knowledge of the basics and principles of engineering mechanics and structural analysis & design is required. Some mathematical skills in calculus and differential equations are also expected.

▪ **Required Text:**

Structural Stability of Steel – Concepts and Applications for Structural Engineers, by Theodore V. Galambos and Andrea E. Surovek, John Wiley & Sons, 2008.
(ISBN # 978-0-470-03778-2)

▪ **References:**

- Structural Stability – Theory and Implementation by W. F. Chen and E. M. Lui
Prentice Hall, 1987.
- Theory of Elastic Stability, 2nd Edition, by S. P. Timoshenko and J. M. Gere,
McGraw Hill, 1961.
- Stability of Structures under Static and Dynamic Loads, ASCE 1977.
- Principle of Structural Stability Theory, by A. Chajes, Prentice Hall, 1974.
- Strength of Metal Structures, by F. Bleich, McGraw Hill, 1952.

▪ **Course Requirements:**

Students are required to take two tests and a final exam in addition to a few homework assignments. Moodle will be used to deliver the online course and to submit tests and

assignments. The Moodle site is <http://moodle.njit.edu> . Students can login with their UCID and password.

Homework assignments will be posted on Moodle at the end of each major subject. A PDF file outlining the assignment will be posted, and a link will be created on Moodle for the students to upload the assignment file by the due date and time. Students must have access to a scanner to scan their homework solution pages. All pages must be combined into a single PDF and uploaded to Moodle. Students are not to post files in formats other than PDF. The instructor must be able to open and read the files. If the file is corrupt or illegible, and the instructor is unable to read the file for some reason, the student will receive an F grade for that assignment. Students are not to email the assignments directly to the instructor.

In addition to the formal assignments, some informal homework problems and test review problems will be posted by the instructor. It is important that students attempt to solve those problems before the solution is posted. Students do not have to upload any informal homework problems and test review problems. However, it is necessary for the students to solve these problems on their own first, because these informal problems are an integral part of the course material and are needed for a proper learning of the covered topics.

The two tests and the final exam will be given on Moodle. Tentative test dates are given below. Students need to login a few minutes before the test time (6:30 pm). The test sheet containing the problems to solve will be posted in PDF format. Students have 1.5 hours to solve the problems (2.5 hours for the final exam), an additional 30- minute time will be given to the students in order to scan their solution sheets and upload their test to Moodle as a single PDF. It is known that the general test time for traditional courses on campus is one full period or 1 hour and 25 minutes. The additional 30-minute time for scanning and uploading is rather generous, as scanning and uploading do not normally take more than 10 to 15 minutes.

Due to the nature of the material in this course which is not suited for multiple-choice test questions, and after discussing this matter with the program director at the civil engineering department, it was determined that the most logical and most suitable format for the tests in this course is to set a window of a couple of hours for the students to take the tests online, all students at the same time. The tests will consist of a few problems to solve. Students are supposed to show the work done in order to solve the problems.

Again, due to the nature of the test format and course material, and also for test security reasons, it is important that all students login at the same time to take the test online. Solution files must be uploaded within 2 hours for the two scheduled tests and within 3 hours for the final exam. Considering that some online students have a day job, the faculty was instructed by the department to schedule the tests in the evening hours. For this reason, both tests and the final exam are scheduled to start at 6 pm on the scheduled test dates.

Students who have a conflict with another course scheduled at the same time must contact the instructor to get a different test date and time. All excuses must be substantiated and only students with legitimate excuses can have a make- up test. Please note that business and vacation trips are not considered as legitimate excuses. Illnesses and other issues must be dealt with by the Office of the Dean of Students who will

determine whether those excuses are legitimate or not. Students who do not show up online as scheduled for a test will simply receive an F on that test.

Moodle will be set up to get locked at 8:30 pm (9:30 pm for the final exam) therefore it is important to upload the test solution by 8 pm. For the sake of fairness to students who respect the test time rules, and in order to preserve some discipline, nobody will be permitted to email the test or any part thereof directly to the instructor, especially past the end time of a test. The student work, tests and assignments, must be stored on Moodle and any emailed test files will be declined and deleted.

Students enrolled in this course are not to schedule vacation and holiday trips while the course is ongoing and on dates that coincide with test dates. The course will end after the final exam is given. Airline tickets must not be booked before the final exam date. The final exam week is from December 16 to December 22.

▪ **Grading Criteria:**

Test 1: 25% - Tentative Date: Monday, October 10th – 6:30 to 8:30 pm

Test 2: 25% - Tentative Date: Monday, November 21st – 6:30 to 8:30 pm

Final examination: 30% - During the final exam week. To be determined based on the final exam schedule of other courses.

Assignments: 20% - Due dates will be announced and posted.

▪ **Academic Integrity**

Academic integrity and honesty are of paramount importance. Cheating and plagiarism will not be tolerated. The NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students. All students are responsible for upholding the integrity of NJIT by reporting any violation of academic integrity to the Office of the Dean of Students (www.njit.edu/doss). The identity of the student filing the report will remain anonymous. The “University Code on Academic Integrity” can be found at: (www.njit.edu/academics/pdf/academic-integrity-code.pdf).

▪ **Instructor/ Contact Information & Office Hours:**

Rima Taher, PhD, PE, Senior University Lecturer

Office Number: Weston 521.

Office Hours: Tuesday and Friday from 12:00 to 1:00 pm

E-mail: rima.taher@njit.edu

Website : <http://moodle.njit.edu>

▪ **Course Content and Weekly Schedule**

Week 1: 9/5 to 9/9

Introduction, Course Requirements, Grading Criteria

Introduction to Stability Theory

New Jersey Institute of Technology
Department of Civil & Environmental Engineering

4

Review: External Work & Strain Energy – Principle of Virtual Work – Principle of Stationary Total Potential Energy

Brief Math Review: Differentiation and Integration

Week 2: 9/12 to 9/16

External Work and Strain Energy (Continued)

Fundamentals of Stability Theory: Spring-Bar System, Post-Buckling Behavior, Softening Spring-Bar Structure, Equilibrium Solutions, Virtual Work Method

Week 3: 9/19 to 9/23

Fundamentals of Stability Theory Continued: Spring-Bar System, Post-Buckling Behavior, Softening Spring-Bar Structure, Equilibrium Solutions, Virtual Work Method

Week 4: 9/26 to 9/30

Fundamentals of Stability Theory Continued
Snap-Through Buckling

Week 5: 10/3 to 10/7

Fundamentals of Stability Theory Continued:
Multi-Degree of Freedom Systems

Week 6: 10/10 to 10/14

Test 1: Monday, October 10 – 6:30 to 8:30 pm

Brief Math Review: Differential Equations

Elastic Buckling of Planar Columns: Large Deflection Solution of an Elastic Column

Week 7: 10/17 to 10/21

Elastic Buckling of Planar Columns (Continued): Differential Equation of Planar Flexure, Pin-Ended Columns, Fundamental Column Cases – Examples

Elastic Buckling of Planar Columns (Continued): Differential Equation of Planar Flexure,

Week 8: 10/24 to 10/28

Elastic Buckling of Planar Columns (Continued)

Pin-Ended Columns, Fundamental Column Cases – Examples

Inelastic Column Buckling

Week 9: 10/31 to 11/4

Stability of a Rigid Frame – End Restrained Columns - Boundary Conditions for Bracing Structures – Examples

Week 10: 11/7 to 11/11

Stability of a Rigid Frame (Continued) – End Restrained Columns - Boundary Conditions for Bracing Structures – Examples

Week 11: 11/14 to 11/18

Stability of a Rigid Frame – End Restrained Columns - Boundary Conditions for Bracing Structures – Examples

Week 12: 11/21 to 11/25

Test 1: Monday, November 21st – 6:30 to 8:30 pm

New Jersey Institute of Technology
Department of Civil & Environmental Engineering

5

Beam- Column Stability: Behavior of Beam-Columns, Elastic Limit Interaction Relationships, Amplification Factors – Examples

Tuesday, November 22nd: Thursday Schedule

Wednesday, November 23rd: Friday Schedule

11/24 and 11/25: Thanksgiving Recess – No class

Week 13: 11/28 to 12/2

Beam- Column Stability (Continued): Behavior of Beam-Columns, Elastic Limit Interaction Relationships, Amplification Factors – Examples

Week 14: 12/5 to 12/9

Beam- Column Stability (Continued): Behavior of Beam-Columns, Elastic Limit Interaction Relationships, Amplification Factors – Examples

Week 15: 12/12 to 12/16

Lateral / Torsional Buckling - Specification-Based Applications of Stability in Steel Design

Review for the Final Exam

Last Day of Class at NJIT: Wednesday, December 14

Reading Day: Thursday December 15

Final Exam Week: December 16 to 22nd.