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Civil and Environmental Engineering Syllabi

NJIT Syllabi

Fall 2018

CE 630-101: Matrix Analysis of Structures

Matthew Bandelt

CE 630: Matrix Analysis of Structures

Section: 101

(3 credits)

Lectures:	Thursday 6:00pm – 9:05pm (with a 15-minute break mid-way) Colton Hall, Room 416
Instructor:	Matthew Bandelt, Ph.D. Colton Hall, Room 209 bandelt@njit.edu (973) 596-3011
Office Hours:	M. 11:00am-1:00pm W. 4:00-6:00pm *or by appointment whenever my office door is open, come in!*
Prerequisite:	An undergraduate course in structural analysis and computer programming.
Required Textbook:	McGuire, William, Richard H. Gallagher, and Ronald D. Ziemian. *Matrix Structural Analysis*. second ed. Middletown, DE: Wiley, 2015.

Course Description *(from NJIT's course catalog)*

A review of matrix operation and energy method, and development of flexibility and stiffness methods used in linear-elastic structural analysis. Behavior of continuous beams, plane trusses, space trusses, and frames will be studied

Course Themes

Structural design requires calculations of element forces, displacements, and support reactions of structural elements using analysis techniques. This course builds upon undergraduate structural analysis techniques to introduce students to the theoretical development and practical implementation of the direct stiffness (i.e. matrix method) of structural analysis. Topics covered include virtual work principles; flexibility and stiffness methods of analysis; computation of element stiffness matrices and load vectors; coordinate transformation; distributed, self-straining and thermal loads; numerical solution of systems of equations; modeling with symmetry; and static and kinematic condensation techniques. Advanced topics such as continuum finite element methods and nonlinear analysis techniques will be introduced.

Learning Objectives (General)

By the end of this course, the student will be able to:

Theoretical Background & Behavior: Define degrees of freedom as they relate to structural analysis; Develop an idealized structural model for analysis; Utilize the principles of virtual work (PVF and PVD) to calculate unknown forces and displacement.

Systematic Formulation of Direct Stiffness Methods: Calculate the element stiffness matrix of truss and beam-column elements; Describe how elements are transformed from local to global coordinates; Construct a global stiffness matrix from element stiffness matrices; Assemble load vectors from nodal, thermal, and distributed loads; Solve for unknown element forces, support reactions, and nodal displacements.

Special Procedures: Utilize condensation techniques to reduce the computational effort required to solve matrix structure analyses; Develop models using sub structuring methods to solve analyses for complex structures; Describe methods for solution of simultaneous equations and the implications of numerical accuracy.

Introduction to Advanced Concepts: Describe how results from second-order elastic analysis can differ from first-order elastic analysis; Solve for equilibrium on deformed structural geometry; Compare and contrast the uses of line and continuum structural models.

POLICIES & PROCEDURES

Academic Integrity: It is expected that NJIT's University Code on Academic Integrity will be followed in all matters related to this course. Refer to NJIT's Dean of Students website to become familiar with the Code on Academic Integrity and how to avoid Code violations.

Communication: All communication by the Instructor will be done through Moodle. It is your responsibility to check e-mail on a daily basis, and the course page on Moodle regularly.

Lectures/Class: Attendance at all lecture/class periods is expected. During class I will often ask you to work on a problem or brainstorm ideas with the person or people next to you and you will then be called on to provide one of more of your answers. The goal of this in-class work will be to get you started on a problem (not necessarily finish) that we will then discuss. Please turn all cell phones off during class and keep laptops closed.

Handouts: Copies of the notes used in class will be posted on Moodle throughout the semester at least one day before lecture. It is highly recommended that you print out a set of notes to follow along with during lecture, as notes will be filled on these handouts. A "filled in" version of these notes will be posted after class.

Prerequisites: It is assumed that you have a background in undergraduate structural analysis, mechanics of materials, and statics. Further, basic understanding of computer programming is expected. You will not necessarily be given every piece of information you need to solve a problem, but enough to be able to solve it with some looking up of expressions or conducting analyses.

Homework: Homework will be assigned to encourage further reading, to extend the material presented in lectures, and to provide practice in arriving at engineering solutions to problems. Completion of the homework is an essential part of the learning process. All homework is to be turned in individually unless specified otherwise on the assignment. If you collaborate with a classmate (or two) be sure to state that collaboration and their names at the top of your assignment.

Homework Format: It is expected that all homework be presented in an organized manner; use green, yellow or white engineering paper, one side of each page (clear side, not grid side); begin each problem on a new page and number all pages; staple all homework pages together and have your name written clearly on the front page. An example of an acceptable homework solution is available on Moodle.

Late Homework: Homework will be due at the beginning of class on the date it is due. Late Homework will be accepted up to two days after the due date with a 10% reduction for each day the assignment is late. After that time, assignments will not be accepted.

Homework Solutions: Homework solutions will be posted two days after the homework is due. It is your responsibility to make sure you understand how to solve the problems by attending office hours with the instructor and/or asking questions in class. As with many engineering problems, multiple solutions may be possible. This means that all rational solutions to the assignments will be accepted.

Exams: There will be one in-class exam held during class time and one exam as scheduled by the University Registrar. All exams count equally.

Calculation of Course Grade: A weighted average grade will be calculated as follows:

Homework	25%
Project	25%
Midterm Exam	25%
Final Exam	25%

The minimum requirements for final letter grades are as follows:

A = 90%, B+ = 85%, B = 80%, C+ = 75%, C = 70%, D = 65%, F < 65%

Your performance depends only on how you do and how much you learn, not on how everyone else in the class does. It is therefore in your best interest to help your classmates, while acting within the bounds of the stated academic integrity policy (i.e., NJIT's Code of Academic Integrity).

Instructor Commitment: You can expect the Instructor to be courteous, punctual, organized, and prepared for lecture and other class activities; to answer questions clearly; to be available during office hours or to notify you beforehand if he is unable to keep them; to provide a suitable guest lecturer when they are traveling; and to grade uniformly and consistently.

Students with Documented Disabilities: NJIT is committed to providing students with documented disabilities equal access to programs and activities. If you have, or believe that you may have, a physical, medical, psychological, or learning disability that may require accommodations, please contact the Coordinator of Student Disability Services located in the Center for Counseling and Psychological Services, in Campbell Hall, Room 205, (973) 596-3414. Further information on disability services related to the self-identification, documentation and accommodation processes can be found on the webpage at: (http://www.njit.edu/counseling/services/disabilities.php)