

# CE 682 - ADVANCED STRUCTURAL ANALYSIS

## INSTRUCTOR

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## REFERENCES (required text is the first book in the list):

1. W. McGuire, R.H. Gallagher, and R.D. Ziemian, *Matrix Structural Analysis – Second Edition*, John Wiley and Sons, New York, NY, 1999. **ISBN Number 0-471-12918-6**
2. R.J. Melosh, *Structural Engineering Analysis by Finite Elements*, Prentice-Hall, Englewood Cliffs, NJ, 1990.
3. T.Y. Yang, *Finite Element Structural Analysis*, Prentice-Hall, Englewood Cliffs, NJ, 1986.

## COURSE GOALS AND OUTCOMES

CE 682 is designed to teach students matrix structural analysis for two- and three-dimensional frame structures. At the conclusion of the course, you should be able to:

- Apply and understand static structural analysis for both two- and three-dimensional frame structures in the context of finite element formulations.
- Use the flexibility method to produce exact stiffness equations for linear structural systems. Such systems include non-prismatic members, curved members, flexibly connected members, etc.
- Develop constraint equations that are utilized in most commercial structural analysis codes.
- Solve sclernomic structural systems, i.e., structural systems for which the nonlinear behavior can be modeled in a piecewise linear fashion.
- Generate the geometric nonlinear stiffness equations using a finite element approximation – TIME PERMITTING.
- Solve linear eigenvalue problems to determine the bifurcation load for framework structures – TIME PERMITTING.

Such knowledge and capabilities are highly valued in the aerospace, telecommunications, and up-to-date structural engineering offices.

## COURSE GRADE

The course grade will be decided using the following weights:

Homework	40%
Bridge Project Report	20%
Oral Presentation	5%
Semester Exam	35%
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Total	100%

## HOMEWORK POLICY

Homework assignments will be made periodically throughout the semester. Problem solving homework and written text summary homework assignments will be given. Homework will be graded using a letter grade system. The letter grade system is:

- a = 4 out of 4 points: correct procedure and calculations
- b = 3 out of 4 points: correct procedure with some calculation errors
- c = 2 out of 4 points: partially correct procedure and calculations
- n = 0 out of 4 points: insufficient knowledge or not submitted
- + = additional ½ point, e. g., b<sup>+</sup> = 3.5 out of 4 points

## BRIDGE PROJECT

Each student will belong to a team to analyze and design a three-dimensional steel bridge to meet the specifications of the AISC/ASCE National Steel Bridge Building Competition unless other arrangements are made with the instructor. Other arrangements are envisioned to accommodate non-structural engineering students. A commercial computer program will be used to perform the analysis. You must also run a geometric nonlinear analysis of your design. Follow standard design guidelines (e.g., ASD or LRFD), but eliminate any load factors or strength reduction factors. You can include a small factor of safety. A project report will be required. A preliminary project report is due Thursday, November 18 – other deadlines and project work will be announced during the course. An oral presentation will be required on Thursday, December 9 at 5:30 PM. Final project reports will also be due on December 9.

**For students pursuing the Plan B MSCE Degree, this project will provide 0.5 semester credit hours of independent study towards the three semester credit hour requirement.**

## SEMESTER EXAM

One seventy-five minute exam will be given during the semester. The exam will be open book and notes. No exam curve will be used. Lastly, it is the instructor's policy not to return exams in graduate courses. You are encouraged to come to the instructor's office and review your exam.

# CE 682 - ADVANCED STRUCTURAL ANALYSIS

TOPIC	TEXT MATERIAL
Review of Plane Truss and Frame Direct Stiffness Analysis	Chapter 2 & 3
Three-Dimensional Frame Stiffness via Flexibility-Stiffness Transformations	Chapter 4 and Handouts
Three-Dimensional Frame Analysis	Chapter 5 and Handouts
Self-Strain Analysis	Chapter 5
Energy Theorems	Chapter 6
Energy Principles in Framework Analysis	Chapter 7

## SEMESTER EXAM

Nonprismatic Frame Analysis	Handouts
Linear Flexible Connection Formulation	Handouts
Special Analysis Procedures	Chapter 13 and Handouts
Lattice Structural Members	Handouts
Scelernomic Structural Systems	Handouts
Introduction to Buckling Analysis (TIME PERMITTING)	Handouts

## COURSE DESCRIPTION

Theory and application of energy principles for plane and space frame solutions based on matrix methods of structural analysis. Course also includes coverage of flexible connections, condensation, constraint equations, skew coordinate systems and an introduction to nonlinear structural problems.

## COURSE LECTURE SCHEDULE:

T  $\Rightarrow$  5:15 – 6:30 PM in room 203 RGAN

R  $\Rightarrow$  5:15 – 6:45 PM in room 203 RGAN