STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK

MASTER SYLLABUS

CIVL 403 – Matrix Methods of Structural Analysis

CIP Code: 14.0803

Created by: Saeid Haji Ghasemali
Updated by:

School: Canino School of Engineering Technology
Department: Civil and Construction Technology
Implementation Semester/Year: Fall 2026

A. TITLE: Matrix Methods of Structural Analysis

B. COURSE NUMBER: CIVL 403

C. CREDIT HOURS (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity):

# Credit Hours per Week	**3**
# Lecture Hours per Week	**2**
# Recitation Hours per week	**2**
# Lab Hours per Week	
Other per Week	

D. WRITING INTENSIVE COURSE:

Yes	
No	x

E. GER CATEGORY:

Does course satisfy a GER category(ies)? If so, please select all that apply.

[1-2] Communication	
[3] Diversity: Equity, Inclusion & Social Justice	
[4] Mathematics & Quantitative Reasoning	
[5] Natural Science & Scientific Reasoning	
[6] Humanities	
[7] Social Sciences	
[8] Arts	
[9] US History & Civic Engagement	
[10] World History & Global Awareness	
[11] World Languages	

F. SEMESTER(S) OFFERED:

Fall	x
Spring	
Fall and Spring	

G. COURSE DESCRIPTION:

This course covers the formulation of truss, beam, and frame analysis using the stiffness method within matrix structural analysis. It includes the development of element properties, coordinate transformations, and the theory of global analysis. Special topics such as initial loads, member and joint constraints, and modification procedures are also explored.

H. PRE-REQUISITES:

CIVL 303 Structural Analyses, or permission of the instructor.

CO-REQUISITES:

I. STUDENT LEARNING OUTCOMES:

Course Student Learning Outcome [SLO]	Program Student Learning Outcome [PSLO]	GER	ISLO & Subsets
a. Use a physical interpretation of stiffness matrices to assemble stiffness matrices analytically.	SO 2, SO1		ISLO 5
b. Determine deflections and forces in statically determinate and indeterminate structures using the matrix stiffness method.	SO 2, SO1		ISLO 5
c. Apply the matrix stiffness method to model the behavior of planar trusses, beams, and frames;	SO 2, SO1		ISLO 5
d. Calculate deflections, reactions, and internal forces for planar trusses, beams, and frames using analytical and computer-based methods	SO 2, SO1		ISLO 5

KEY	Institutional Student Learning Outcomes [ISLO 1 – 5]
ISLO #	**ISLO & Subsets**
1	**Communication Skills** Oral [O], Written [W]
2	**Critical Thinking** *Critical Analysis [CA], Inquiry & Analysis [IA] , Problem Solving [PS]*
3	**Foundational Skills** *Information Management [IM], Quantitative Lit, /Reasoning [QTR]*
4	**Social Responsibility** *Ethical Reasoning [ER], Global Learning [GL],* *Intercultural Knowledge [IK], Teamwork [T]*
5	**Industry, Professional, Discipline Specific Knowledge and Skills**

J. APPLIED LEARNING COMPONENT:

Yes	x
No	

If yes, select [X] one or more of the following categories:

Classroom / Lab	x	Community Service	
Internship		Civic Engagement	
Clinical Practicum		Creative Works/Senior Project	
Practicum		Research	
Service Learning		Entrepreneurship [program, class, project]	

K. TEXTS:

Aslam Kassimali, Matrix Analysis of Structures - 3rd edition, Brooks/Cole Publishing Co., 2022.

L. REFERENCES:

ASCE 7, Minimum Design Loads for Buildings and Other Structures

M. EQUIPMENT:

Scientific calculator, scale/straight edge, engineering and Computer Laboratory.

N. GRADING METHOD: A-F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS:

Exams
Quizzes
Term Project
Homework
Laboratory Projects

P. DETAILED COURSE OUTLINE:

I. Introduction to Matrix Structural Analysis
- A. Overview of structural analysis methods
- B. Introduction to matrix notation and linear algebra concepts
- C. Comparison of classical methods vs. matrix methods

II. Direct Stiffness Method
- A. Basic principles of the stiffness method
- B. Matrix formulation for trusses, beams, and frames
- C. Development of stiffness matrices for different structural elements

III. Element Properties and Coordinate Transformations
- A. Derivation of element stiffness properties
- B. Local and global coordinate systems
- C. Coordinate transformation and assembly of global stiffness matrix

IV. Analysis of Statically Determinate and Indeterminate Structures
- A. Matrix formulation for statically determinate structures
- B. Introduction to statically indeterminate analysis using the stiffness method
- C. Boundary conditions and constraint handling

V. Displacement Methods
- A. Displacement-based methods for structural analysis
- B. Use of virtual work principles
- C. Application to frame and truss systems

VI. Computer-Based Structural Analysis

A. Introduction to structural analysis software (e.g., SAP2000)
B. Application of stiffness methods in software environments
C. Case studies of 2D/3D trusses, frames, and nonlinear analysis

VII. Final Project and Application

A. Comprehensive structural analysis project
B. Application of matrix methods to complex structures
C. Presentation and discussion of project results

Q. LABORATORY OUTLINE:

The 2 hour lab session will be used to engage the student in lengthy problem solutions associated with current lecture topics.

A. Matrix notation and linear algebra problems
B. Matrix formation for trusses and beams
C. Element properties and coordinate transformations
D. Analysis of statically determinate and indeterminate structures
E. Displacement methods
F. Computer-based structural analysis
G. Final project