MATRIX ANALYSIS OF STRUCTURES – CE 445/545 - Spring 2018

TIME AND PLACE: 2:30 P.M. - 3:20 P.M. MWF JEB 021

INSTRUCTOR:
Richard Nielsen, Ph. D., P.E.
Associate Professor, Civil Engineering
BEL 106
Phone: 208 885-8961 E-mail: rnielsen@uidaho.edu
Engineering Outreach students: 1-800-824-2889 ext. 8961

OFFICE HOURS: TBA

REQUIRED TEXT: Matrix Structural Analysis 2nd ed, by McGuire, Gallagher, and Ziemian, available for free download from: http://digitalcommons.bucknell.edu/books/7/

SOFTWARE:

- MASTAN2 is available for free download from: http://www.mastan2.com/
- RISA 2D and 3D, are available:
  - In the on-campus computer labs
  - Through the university on-line virtual lab: http://vlab.uidaho.edu/ (see also: https://www.uidaho.edu/infrastructure/its/departments/student-labs/vlab)
  - As educational/demo version downloads from Risa Technologies: http://risa.com/downloads.html.
- SAP 2000 is also available in the on-campus and virtual computer labs.
- Other software can be used for the graduate project, by arrangement with the instructor.

Mathcad will be used to reduce the computational effort required for matrix analysis. A license can be purchased for $35 by calling Linda Moser at the CEE Department at 208-885-6782.

WEB LINK: BBLearn.uidaho.edu

CATALOG DESCRIPTION:
Formulation of the analysis of trusses, beams and frames using the stiffness method of matrix structural analysis; development of element properties, coordinate transformations, and global analysis theory; special topics such as initial loads, member and joint constraints, modification procedures. Special project demonstrating mature understanding of materials required for graduate credit.

OBJECTIVE:
The student will learn the theoretical background behind modern structural analysis software. He or she will understand how to formulate the structural analysis in matrix form, and how virtual work concepts can expand the scope of problem that can be treated along with the associated approximations. The student will also perform nonlinear analyses and determine the stability of structures using matrix methods.

PREREQUISITE: CE 342 - Theory of Structure, or permission.

READING:
The reading assignments indicated in the course calendar correspond to sections in the text. Read the assigned section before each lecture.

HOMEWORK:
Homework sets are due on the dates shown on the course syllabus/calendar. Submit homework solutions and project submittals through BBLearn. Solutions and submittals must be either pdf or Mathcad files. (I cannot easily provide feedback for other types of files.) Homework problems and project documents cannot be submitted once the BBLearn link closes.

EXAMS:
There will be three midterm examinations as indicated in the course calendar.

PROJECT:
Students taking the course for graduate credit will complete a project involving the application of the material discussed in class.

UNDERGRADUATE GRADING:

Homework - 20%
Midterms - 80% (i.e., 26.7% each)

GRADUATE GRADING:

Homework - 20%
Midterms - 55% (i.e., 18.3% each)
Project - 25%

Disability Support Services Reasonable Accommodations Statement:

Reasonable accommodations are available for students who have documented temporary or permanent disabilities. All accommodations must be approved through Disability Support Services, located in the Idaho Commons Building, Room 306, in order to notify your instructor(s) as soon as possible regarding accommodation(s) needed for the course. Contact DSS at 208-885-6307, email dss@uidaho.edu, or www.uidaho.edu/dss

PRELIMINARY COURSE SYLLABUS AND TENTATIVE HOMEWORK ASSIGNMENTS

Session	Day	Date	Subject	Text Sections	Homework Due
1	W	1/10	Introduction - Review of Structures	1.1-1.2	
2	F	1/12	Degrees of Freedom & Coordinate Systems	2.1-2.3, 13.1	
	M	1/15	NO CLASS – Human Rights Day		
3	W	1/17	Axial Force Elements, Matrix Condensation, Matrix Condensation Example	2.4	2.12, 14 Submit assignments through Blackboard
4	F	1/19	Axial Force Elements - Global Equations	2.5-2.6	
5	M	1/22	Direct Stiffness Method	3.1	2.5-2.6
6	W	1/24	Mathcad Background – 2-member truss	3.2-3.4	
7	F	1/26	Stress & Strain - Work & Energy	4.1-4.4	
8	M	1/29	Axial Force & Torsional Elements	4.5.1-4.5.2	3.3, 4, 7 (See BBLearn for details)
9	W	1/31	Beam Elements	4.5.3-4.5.5	
10	F	2/2	Frame-Truss Example		
11	M	2/5	3D Coordinate Transformations	4.6, 5.1.1	3.15, 4.1b-e, 6
12	W	2/7	Coord. Transformation, Space Truss	5.1.2-5.1.4	
13	F	2/9	Member End Releases - Hinge Example		4. 10, 14, 16, 5.3
14	M	2/12	Virtual Displacements	6.1-6.5	5.10a
15	W	2/14	Displaced State of Elements - Shape Functions	7.1	
16	F	2/16	Element Stiffness from Virtual Displacements	7.2	
	M	2/19	NO CLASS – Presidents' Day		
17	W	2/21	Stiffness Matrices from Virtual Work		
18	**F**	**2/23**	**EXAM #1**		
19	M	2/26	Non-nodal Forces from Virtual Displacements	7.5	7.1, 6
20	W	2/28	Thermal & Prestrain Loads by Virtual Work	7.6	
21	F	3/2	Nonuniform Elements, Tapered Element Example, Tapered Element/Log Shape Function	7.3	5.8a, b, f, 10b, 13
22	M	3/5	Nonuniform Torsion	7.4	
23	W	3/7	Nonuniform Torsion		2D vs, 3D comparison
24	F	3/9	Uniform Torsion, 8-Element Nonuniform Torsion		Project Assignment
	M	3/12	Spring Recess		
	W	3/14	Spring Recess		
	F	3/16	Spring Recess		
25	M	3/19	Shear Deformations, Shear Deformation Example	8.1.1-8.1.2	7.12, 19
26	W	3/21	Nonlinear Analysis	8.1.3	
27	F	3/23	Nonlinear Examples	8.1.4	7.13
28	**M**	**3/26**	**EXAM #2**		Presentation Topic Proposal
29	W	3/28	Plastic Hinge Example	8.2-8.3	8.1, 4
30	F	3/30	Matrix Non-linear Analysis	9.1	
31	M	4/2	Geometric Stiffness Matrices for 2D	9.2	8.6, 8
32	W	4/4	Geometric Stiffness Matrix Example 1	9.3	
33	F	4/6	Geometric Stiffness Matrix Example 2	9.4	Presentation Outline
34	M	4/9	Nonlinear Material Behavior	10.1	
35	W	4/11	Nonlinear Material Example, Postscript	10.2	9.5, 9.10
36	F	4/13	Eigenvalue Buckling Analysis	10.3	
37	M	4/16	Eigenvalue Buckling Example	10.4	
38	W	4/18	Partially Restrained Joints	13.1-13.2	Presentation Progress Report
39	F	4/20	Member End Offsets	13.3	10.12, 9.2

40	M	4/23	Restraint/Offset Example	13.5	
41	W	4/25	Structural Optimization		
42	F	4/27	Structural Optimization		
43	M	4/30	Presentations		
44	W	5/2	Presentations		
45	F	5/4	Presentations		
	M	**5/7**	**Final Exam Week**	**3:00-5:00 P.M.**	**Exam #3**
	W	5/9			
	F	5/11			