

## NUMERICAL MODELING IN AGRICULTURAL AND BIOSYSTEMS (ABEN 377) COURSE SYLLABUS

### **BASIC INFORMATION**

**Number of credits:** 3

**Time and places:** MWF 11:00-11:50 a.m. @ Ladd 201

**Term and year:** Spring 2024

**Instructor's name:** Zhulu Lin

**Office location:** Ladd 104C

**Office hours:** Monday and Thursday 1:00-2:00 p.m. or by appointment

**Contact information:** Zhulu.Lin@ndsu.edu/231-7118

### **BULLETIN DESCRIPTION**

Numerical modeling using finite element and other numerical techniques. Engineering applications include modeling of stress/strain and heat/mass transfer in physical, natural resource, and biological systems such as grain and food products.

### **PREREQUISITES**

Before taking this course, students should have already completed the following courses:

- MATH 266 – Introduction to Differential Equations, and
- ME 223 – Mechanics of Materials

### **ABEN EDUCATIONAL OBJECTIVES AND ABET STUDENT OUTCOMES**

**Educational Objective 1:** Graduates are expected to have established themselves as practicing engineers who, within a few years of graduation, successfully address emerging engineering challenges in the design or evaluation of machine systems, processing systems, and natural resources and environmental systems affecting the production of food, feed, and other biobased products.

This objective addresses the following ABET student outcomes:

- ABET-(1): An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics, and
- ABET-(2): An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

### **COURSE OBJECTIVES**

After completing this course, students should be able to

1. Understand the fundamental concepts of finite element analysis methods. [ABET-(1)]
2. Apply the finite element methods to solve engineering problems involving stress analysis and heat transfer. [ABET-(1)&(2)]
3. Use general-purpose finite element software such as Ansys to obtain solutions to engineering problems in agricultural, biomaterial or environmental systems. [ABET-(1)&(2)]

### **REQUIRED STUDENT RESOURCES**

**Required textbook:**

- Lee, Hwei-Huang (2022). Finite Element Simulations with Ansys Workbench 2022: Theory, Applications, Case Studies. SDC Publications. Mission, KS. ISBN-13:978-1-63057-539-7.

**Other Resources:** A regularly checked e-mail account, data storage devices such as a USB drive, and a calculator are required. Departmental computers are available in Ladd 208 to complete homework assignments and the course project.

**COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS\***

Wk	Day	Date	Topics	HW	Lab	Exam or PRJ
1	W	1/10	Course introduction & Pre-test			
	F	1/12	<i>Lab 1 – Ansys introduction</i>		<i>Lab 1</i>	
2	M	1/15	MLK Jr. Day (no class, office closed)			
	W	1/17	FEA introduction I			
	F	1/19	<i>Lab 2 – Preprocessing</i>		<i>Lab 2</i>	
3	M	1/22	FEA introduction II	HW1		
	W	1/24	FEA introduction III			
	F	1/26	<i>Lab 3 – Meshing</i>		<i>Lab 3</i>	
4	M	1/29	Trusses I			
	W	1/31	Trusses II	HW2		
	F	2/2	<i>Lab 4 – Post-processing</i>		<i>Lab 4</i>	
5	M	2/5	Columns & beams I			
	W	2/7	Columns & beams II	HW3		
	F	2/9	<i>Lab 5 – Structure analysis</i>		<i>Lab 5</i>	
6	M	2/12	1D elements	HW4		
	W	2/14	1D elements applications I			
	F	2/16	<i>Lab 6 – Advanced named selection</i>		<i>Lab 6</i>	
7	M	2/19	Presidents' Day (no class, office closed)			
	W	2/21	1D element applications II	HW5		
	F	2/23	<i>Lab 7 – Remote BC</i>		<i>Lab 7</i>	PRJ
8	M	2/26	2D elements			
	W	2/28	2D elements applications	HW6		
	F	3/1	<i>Lab 8 – Parameter optimization</i>		<i>Lab 8</i>	
9	M	3/4				
	W	3/6	Spring Break			
	F	3/8				
10	M	3/11	<b>Sketching</b> – Section 2.1	Text		
	W	3/13	<b>Sketching</b> – Sections 2.2 & 2.3	Text		
	F	3/15	FEA Midterm Exam			Exam
11	M	3/18	<b>2D Simulations</b> – Sections 3.1 & 3.3	Text		
	W	3/20	<b>2D Simulations</b> – Section 3.5	Text		
	F	3/22	<i>Lab 9 – Fatigue analysis</i>		<i>Lab 9</i>	
12	M	3/25	<b>2D Simulations</b> – Section 3.5 (cont)	Text		
	W	3/27	<b>3D Solid Modeling</b> – Sections 4.1 & 4.4	Text		
	F	3/29	Spring Recess (no class, offices closed)			
13	M	4/1	Spring Recess (no class, offices open)			
	W	4/3	<b>3D Simulations</b> – Sections 5.1 & 5.3	Text		
	F	4/5	<i>Lab 10 – Thermal analysis</i>		<i>Lab 10</i>	
14	M	4/8	<b>Surface Models</b> – Sections 6.2 & 6.3	Text		

	W	4/10	<b>Surface Models</b> – Sections 6.2 & 6.3 (cont)	Text		
	F	4/12	<i>Lab 11 – Object generator</i>		<i>Lab 11</i>	
15	M	4/15	<b>Line Models</b> – Section 7.2	Text		
	W	4/17	<b>Optimization</b> – Section 8.2	Text		
	F	4/19	<i>Lab 12 – Advanced preprocessing</i>		<i>Lab 12</i>	
16	M	4/22	<b>Advanced Meshing</b> – Sections 9.1 & 9.3	Text		
	W	4/24	<b>Advanced Meshing</b> – Sections 9.1 & 9.3 (cont)	Text		
	F	4/26	<i>Lab 13 – Multistep analysis</i>		<i>Lab 13</i>	
17	M	4/29	<b>Modal Analysis</b> – Section 11.1	Text		
	W	5/1	Project presentations			PRJ
	F	5/3	<i>Lab 14 – Modal analysis (Snow day bonus)</i>		<i>Lab 14</i>	
18	T	5/7	Anslys Lab Exam (1:00 - 3:00 p.m.)			Final

\* Except for the examination dates (<https://www.ndsu.edu/registrar>), the above course schedule is subject to change, including 13 FEA lectures (M), 13 Ansys demos (W), and 15 Ansys labs (F).

**ATTENDANCE POLICY**

In accordance with NDSU Policy 333 (<http://www.ndsu.edu/fileadmin/policy/333.pdf>), class participation is expected at all regularly scheduled class and lab times as they are critical to every student’s success in this course. Students are expected to attend every class and remain in class for the duration of the session. Although students are expected to participate in the course in person, when needed occasionally students may request the instructor to record the lecture and review it at a different time. If you are unable to attend class at the regularly scheduled time due to health issues, contact the instructor prior to the class meeting time for alternate arrangements, including recordings of class sessions and accommodations needed for assignments.

**EVALUATION PROCEDURES AND GRADING CRITERIA**

**Assignment Policy:** Due dates for homework, computer lab assignments and course projects will be given with the assignments. Late assignments will be accepted with a 10% penalty per NDSU class day. All assignments must be submitted before 4 p.m. to be credited to the day it is received. Late assignments will not be accepted after solutions are posted/handed out/discussed or after 3 NDSU class days from the date they are due. If required electronic computer files for Ansys lab assignments and design projects should also be submitted before the due date.

You are encouraged to work together with others for your homework and lab assignments because that will help you learn. You are also encouraged to contact the instructor for assistance during office hours or by appointment. Although students are encouraged to work together and assist one another with assignments, all work submitted should be created by that individual. If it is apparent that work has simply been copied from other’s work, all students involved will receive zero point for that assignment.

**Exam Policy:** Missed exams will receive zero points unless missed for a valid justification *and* the instructor is notified prior to the date and time of the exam. Valid justification is a statement indicating illness, obituary notice (death in family or loved one), or co-curricular activities. For such justified reasons, a make-up exam may be given at a mutually acceptable time or the weight of the missed mid-term exam will be shifted to the final exam. Extracurricular activities, weddings, vacations, hunting and fishing trips, work, dentist’s appointments, and undocumented car-related

incidents are examples of unjustifiable reasons for missing the scheduled dates and times for exams. The instructor reserves the right to determine whether the excuse is legitimate or not.

**Grading Policy:** The course work consists of the following categories: FEA homework assignments, Ansys computer labs, course project, FEA exam, and Ansys computer exam. The design project is a team work and each team may consist of 2-4 members. The requirements for design projects include a written report and an in-class oral presentation. The possible points can be earned for all work categories are listed in the table below. Each student’s final letter grade in the course will be determined by the percentage of the total earned points over the total possible points using the following grading scale:  $A \geq 90\%$ ,  $80\% \leq B < 90\%$ ,  $70\% \leq C < 80\%$ ,  $60\% \leq D < 70\%$ ,  $F < 60\%$ .

Work category	Points	Snow Day Bonus Points
FEA homework (6)	120	
Ansys lab reports (13)	130	10 (Lab 14)
FEA midterm exam (1)	100	
Ansys computer exam – final (1)	100	
Ansys design project (1)	150	
Total	600	10

**AMERICAN DISABILITIES ACT FOR STUDENTS WITH SPECIAL NEEDS STATEMENT**

Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the [Center for Accessibility and Disability Services \(www.ndsu.edu/disabilityservices\)](http://www.ndsu.edu/disabilityservices) as soon as possible.

**FAMILY EDUCATIONAL RIGHTS AND PRIVACY (FERPA) STATEMENT**

Your personally identifiable information and educational records as they relate to this course are subject to FERPA.

**APPROVED ACADEMIC HONESTY STATEMENT**

The academic community is operated on the basis of honesty, integrity, and fair play. [NDSU Policy 335: Code of Academic Responsibility and Conduct](#) applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the [Office of Registration and Records](#). Informational resources about academic honesty for students and instructional staff members can be found at [www.ndsu.edu/academichonesty](http://www.ndsu.edu/academichonesty).

**VETERANS AND MILITARY PERSONNEL**

Veterans or military personnel with special circumstances or who are activated are encouraged to notify the instructor as early as possible.

**ADDITIONAL RESOURCES FOR STUDENTS**

As a member of the NDSU community, resources are available for you should you need help in dealing with adverse reactions to things happening in the world today. A variety of resources are listed below. For students on campus and remotely (telehealth):

- Counseling Services: 701-231-7671; <https://www.ndsu.edu/counseling/>
- Disability Services: 701-231-8463; <https://www.ndsu.edu/disabilityservices/>
- Student Health Service: 701-231-7331; <https://www.ndsu.edu/studenthealthservice/>
- Dean of Students Office: 701-231-7701; <https://www.ndsu.edu/deanofstudents/>

***In a crisis or emergency situation:***

- Call University Police: 701-231-8998
- Call 9-1-1
- Go to a Hospital Emergency Room
- Go to Prairie St. Johns for a Needs Assessment: 701-476-7216 (510 4th St. S.)
- Call the FirstLink Help Line: 1-800-273- TALK (8255) or 2-1-1
- Call Rape and Abuse Crisis Center: 701-293-7273

**IMPORTANT DATES**

Jan 1	Mon	HOLIDAY — New Year's Day (offices closed)
Jan 8	Mon	Classes begin at 4:00 p.m.
Jan 9	Tue	First full day of classes
Jan 15	Mon	HOLIDAY — Martin Luther King, Jr. Day (no classes, offices closed)
Jan 16	Tue	Last day to be added to Campus Connection Wait Lists
Jan 18	Thu	Last day to Add classes via Campus Connection
Jan 18	Thu	Last day for no-record Drop of classes @ 100% refund
Jan 18	Thu	Last day to Withdraw to Zero Credits @ 100% refund
Jan 24	Wed	Payments due for NDSU account balances
Jan 29	Mon	Last day to submit requests to Audit, Pass/Fail
Feb 19	Mon	HOLIDAY — Presidents' Day (no classes, offices closed)
Feb 19	Mon	Last day to Withdraw to Zero Credits @ 75% refund
Mar 4-8	M-F	Spring Break Week (no classes, offices open)
Mar 15	Fri	Late fee applied to unpaid account balances (11:59 p.m.)
Mar 21	Thu	Last day to Withdraw to Zero Credits @ 50% refund
Mar 29-Apr 1	F-M	HOLIDAY -- Spring Recess
Apr 5	Fri	Last day to Drop classes with 'W' record*
Apr 5	Fri	Last day to Withdraw to Zero Credits for Spring
Apr 15	Mon	Late fees applied to unpaid account balances (11:59 p.m.)
Apr 29-May 3	M-F	Dead Week
May 6-10	M-F	Final Examinations
May 11	Sat	Commencement ceremony

**SYLLABI ON WEB PAGES**

The course syllabus is available on Blackboard and ABEN Department webpages.