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

BASIC INFORMATION

Number of credits: 3
Time and places: Lectures MW 11:00-11:50 a.m. @ABEN224
Computer labs F 11:00-11:50 a.m. @ABEN210B
(Lab notes and pre-recorded videos. See notes on remote desktop protocol to access computers in ABEN210B)
Term and year: Spring 2022
Instructor's name: Zhulu Lin
Office location: ABEN 104
Office hours: Monday and Thursday 1:00-2:00 p.m. or by appointment
Contact information: Zhulu.Lin@ndsu.edu/231-7118
Zoom Meeting Link: https://ndsu.zoom.us/j/2999001994

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: Moaveni, S. (2008 or 2015). Finite Element Analysis: Theory and Application with ANSYS (3rd or 4th Edition). Pearson Prentice Hall, Upper Saddle River, NJ.
Reference (optional): Logan, D.L. (2012). A First Course in the Finite Element Method (5th Edition). CENGAGE Learning, Stamford, CT. ISBN-13: 978-0-495-66825-1.
Other Resources: A regularly checked e-mail account, data storage devices, and a calculator are required. Departmental computers are available in ABEN Room 222 to complete homework assignments and the course project.

COURSE SCHEDULE/OUTLINE/CALENDAR OF EVENTS

Wk	Day	Date	Topics	Readings	HW	Tests
1	W	1/13	Introduction & Pre-test	Ch 1.1-1.4, 1.8-1.9		
	F	1/14	Lab – ANSYS introduction	Videos		
2	M	1/17	MLK Jr. Day (no class, office closed)			
	W	1/19	Formulation of finite element equations	Ch1.5-1.7		
	F	1/21	Lab – ANSYS project wizard	Demo 1		
3	M	1/24				
	W	1/26				
	F	1/28	Lab – Preprocessing	Demo 2		
4	M	1/31				
	W	2/2			HW1	
	F	2/4	Lab – Meshing	Demo 3		
5	M	2/7	Lecture – Trusses and direct formulation	Ch 3.1-3.3		
	W	2/9				
	F	2/11	Lab – Post-processing	Demo 4		
6	M	2/14	President's Day (no class, office closed)			
	W	2/16			HW2	
	F	2/18	Lab – Structure analysis	Demo 5		
7	M	2/21	President's Day (no class, office closed)			
	W	2/23	Lecture – Beams, minimum potential energy formulation	Ch 4		
	F	2/25	Lab – Advanced named selection	Demo 6	PRJ	
8	M	2/28				
	W	3/2			HW3	
	F	3/4	Lab – Object generator	Demo 7		
9	M	3/7	Review and help session			
	W	3/9	Mid-term Exam			Exam
	F	3/11	Lab – Parameter optimization	Demo 8		
10	M	3/14				
	W	3/16	Spring Break Week			
	F	3/18				
11	M	3/21	Lecture – 1D problems and Galerkin formulation	Ch 5 & 6		
	W	3/23				

	F	3/25	Lab – Remote BC	Demo 9		
12	M	3/28				
	W	3/30			HW4	
	F	4/1	Lab – Fatigue analysis	Demo 10		
13	M	4/4				
	W	4/6	Lecture – 2D heat transfer problems	Ch 7, Ch 9.1-9.4, 9.6-9.8		
	F	4/8	Lab – ANSYS Exam	Timed Lab		Exam
14	M	4/11				
	W	4/13				
	F	4/15	Recess (no class, offices closed)			
15	M	4/18	Recess (no class, offices open)			
	W	4/20	Lecture – 2D stress analysis problems	Ch 10.1-10.2, 10.6-10.7		
	F	4/22	Lab – Advanced preprocessing	Demo 11		
16	M	4/25				
	W	4/27			HW5	
	F	4/29	Lab – Thermal analysis	Demo 12		
17	M	5/2	Project presentations			
	W	5/4	Review and help session			
	F	5/6	Lab – Multistep analysis Lab – Modal analysis	Demo 13 & 14		
18	Th	5/12	Comprehensive Final Exam (8:00 - 10:00 a.m.)			Final

* Except for examination dates (https://www.ndsu.edu/registrar/dates/finals/#c467382), the above course schedule is subject to change.

EVALUATION PROCEDURES AND GRADING CRITERIA

While the assignment submission policy for this course is outlined below, please note that I will be flexible regarding deadlines for students who are experiencing illness or other challenges related to COVID-19. Please contact me as early as possible if you think you may not be able to complete an assignment or participate in the course due to illness. Do not come to class if you are sick. You can view the Yuja lecture recordings afterward.

Assignment Policy: In this course Blackboard will be used for assignment submission for all students. The due dates for homework and 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 5 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. Any required electronic computer files for ANSYS lab assignments and design projects should be submitted through Blackboard, not via email.

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 five categories: homework assignments, computer labs, one course project, two midterm examinations, and one comprehensive final examination. The design project is a team work and each team may consist of up to four 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 ≥ 90%, 80% ≤ B < 90%, 70% ≤ C < 80%, 60% ≤ D < 70%, F < 60%.

Work category	Points
Homework (5)	100
Computer labs and class participation (10)	100
ANSYS Computer lab exam (1)	100
Design project (1)	100
Midterm exam (1)	100
Final exam (comprehensive)	200
Total	700

ATTENDANCE POLICY AND COVID-19 ACCOMMODATION

In accordance with NDSU Policy 333 (http://www.ndsu.edu/fileadmin/policy/333.pdf), class attendance and participation are expected at all regularly scheduled class 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 face-to-face (see below for face covering policy), when needed students are able to view the recording of the class afterward.

If you are unable to attend class at the regularly scheduled time due to illness, contact the instructor prior to the class meeting time for alternate arrangements, including recordings of class sessions and accommodations needed for assignments.

GUIDANCE REGARDING CLASSROOM MANAGEMENT AND MASKS

NDSU has implemented a mask requirement for all classroom settings whether such classes are credit, non-credit, training sessions, etc. Faculty members who are able to maintain social distance from students may remove their masks during the class for purposes of being more easily heard. Medical exemptions for mask wearing can only come from Disability Services (701-231-8463). Students asking for a medical exemption should be directed to that office. This guidance can be found here.

1. Faculty should set clear expectations about the required use of masks in their classes. In the event that the faculty member has not been strictly enforcing the mask requirement to date, the faculty member should indicate that, starting with the next class meeting, the policy will be strictly enforced.

2. In the event that one or more students do not wear a mask to a class, the faculty member should remind the student(s) of the mask requirement and indicate that the student(s) must comply.
3. It is optional but recommended that the faculty member offer non-complying student(s) a mask (a limited supply is available from Central Stores).
4. If a student continues to violate the mask requirement after being directed to comply, the faculty member may ask the student to leave the class. The faculty member is not required to either provide an alternative learning method or provide make-up opportunities for any missed class requirements.
5. In the event that a student is asked to leave the class on three or more occasions, the faculty member should contact her/his chair to discuss further action(s). A possible action may be an administrative drop of the class, but this will only be used after a meeting between the student and the chair. This meeting is intended to discuss the situation and gain compliance for mask wearing by the student.
6. If the student is disruptive in class beyond non-compliance on mask wearing, the faculty member should file a Concern and Complaint form with the Dean of Student's Office to determine if a violation of the Code of Student Conduct occurred. The form can be found here.

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 Disability Services Office as soon as possible. Assistance is also available from Disability Services in 212 Ceres Hall (231-8463). http://www.ndsu.edu/disabilityservices/

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.*"

All work in this course must be completed in a manner consistent with NDSU Policy, Section 335: Code of Academic Responsibility and Conduct https://www.ndsu.edu/fileadmin/policy/335.pdf.

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

January 17	**Martin Luther King Jr. Holiday (no class, offices closed)**
January 20	Last day to add classes via Campus Connection
January 20	Last day for no-record drop of classes @ 100% refund
January 20	Last day to withdraw to 0 credits @ 100% refund
January 25	Financial Aid applied to Student Accounts
January 31	Last day to submit request to audit, pass/fail
February 21	**Presidents' Day Holiday (no classes, offices closed)**
March 4	Grades of Incomplete convert to F
March 14-18	Spring Break (no classes)
March 15	Undergraduate Spring graduation application due
March 15	Graduate student Intent to Graduate due
March 2nd week	Summer/Fall registration appointment times available
April 8	Last day to drop classes with record (W)
April 8	Last day to withdraw to 0 credits
April 8	Spring commencement participation deadline
April 15	**Holiday (no classes, offices closed)**
April 18	**Holiday (no classes, offices open)**
May 2-6	Dead Week
May 9-13	Final Examinations
May 14	Commencement

SYLLABI ON WEB PAGES

The course syllabus is also available at Blackboard.

Remote Desktop Protocol for Computers in ABEN 210B

Additional resources:
https://www.ndsu.edu/coe/faculty_staff/coe_tech_support/coelabremoteaccess/

1. You can see which computers are available here:

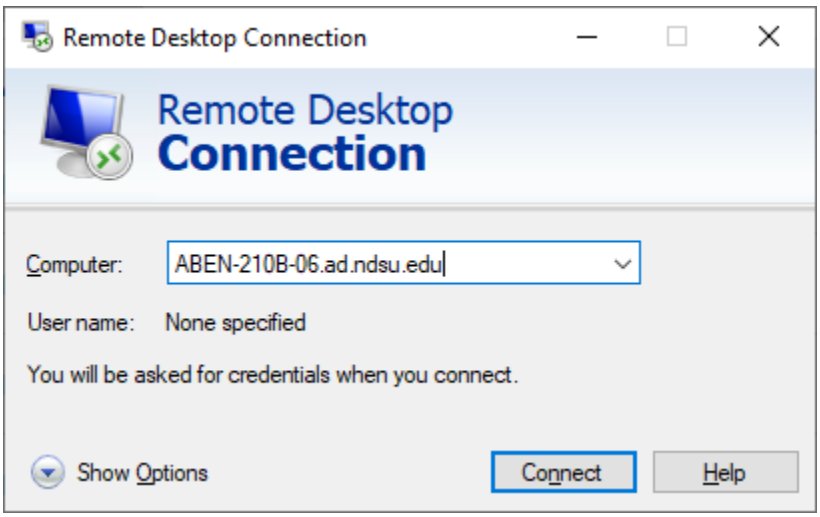
https://keyserver.ad.ndsu.edu/maps/std/c3aba96a4955d0bb165f6b78bf3d1698?list=1

2. Look at the Status column in the list of computers to see which are available and which are in use. Use the Refresh button in the upper right corner to update the list.

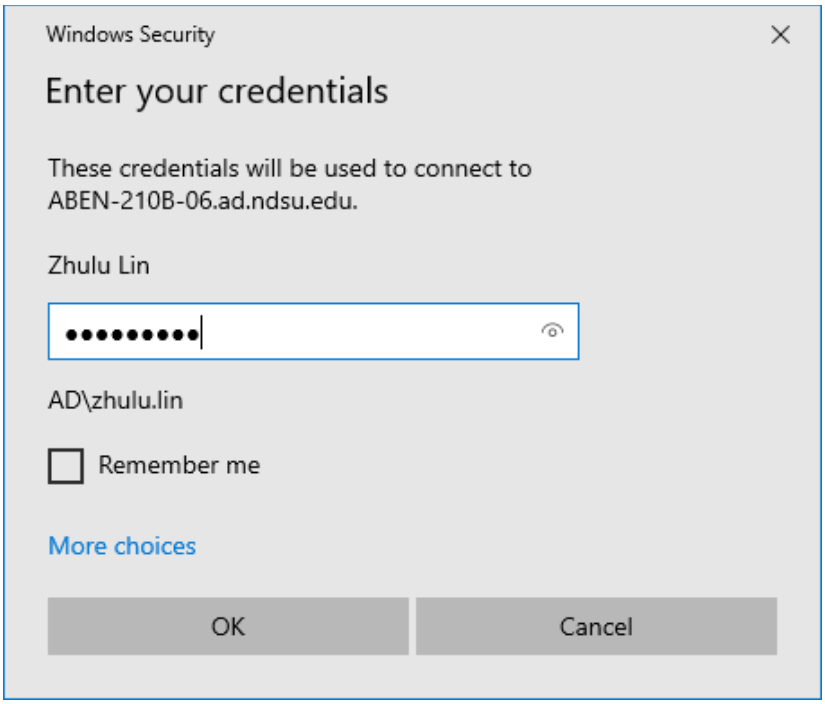
3. Start the Remote Desktop Connection tool on your local (home) computer.
   Start menu, Windows Accessories, Remote Desktop Connection

For Mac, go to Apple Store and search for Microsoft Remote Desktop 10, and install it on your Mac. For more information, check out here:
https://www.ndsu.edu/its/help/index/remote_desktop_at_ndsu_rdp/

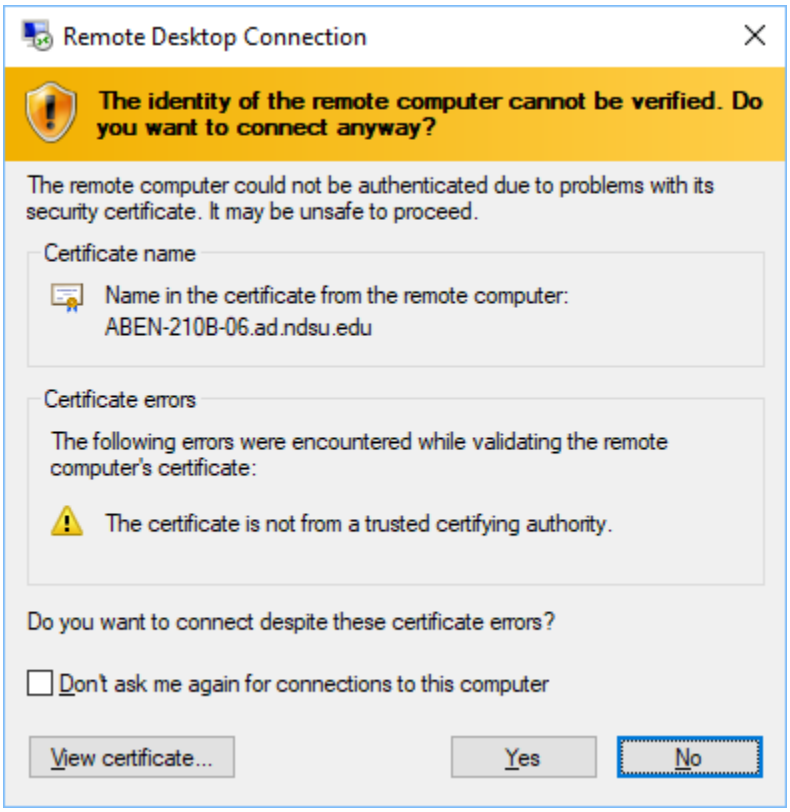
4. Select an available computer from the list in #2. Enter the computer name according to the format shown here for the computer ABEN-210B-06. Click Connect.



5. When Windows Security asks you to enter your credentials, enter firstname.lastname@ndsu.edu (if not already populated in the box) and the password that you use to log into NDSU computers (not your e-mail password). Press OK when done. An example is shown below.



6. Click "Yes" to the following screen (if appears):



7. Use your Duo Multi-factor authentication (text or call) to advance complete the log-in process.

8. You should now see the screen of the computer in room 210B.

9. Work on the computer as needed. To launch ANSYS program, Start menu, ANSYS 18.2, Workbench 18.2.

10. **When you are done, be sure to sign out of (log off) the computer as though you were physically present at the computer.** If you disconnect the remote connection, you may hang up the computer and it will not be available for others to use.