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**


**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/OVERVIEW/CALENDAR OF EVENTS**

<table>
<thead>
<tr>
<th>Wk</th>
<th>Day</th>
<th>Date</th>
<th>Topics</th>
<th>Readings</th>
<th>HW</th>
<th>Tests</th>
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<tbody>
<tr>
<td>1</td>
<td>W</td>
<td>1/13</td>
<td>Introduction &amp; Pre-test</td>
<td>Ch 1.1-1.4, 1.8-1.9</td>
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<td></td>
<td>F</td>
<td>1/14</td>
<td>Lab – ANSYS introduction</td>
<td>Videos</td>
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<td>2</td>
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<td>1/17</td>
<td>MLK Jr. Day (no class, office closed)</td>
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<td></td>
<td>W</td>
<td>1/19</td>
<td>Formulation of finite element equations</td>
<td>Ch 1.5-1.7</td>
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<td></td>
<td>F</td>
<td>1/21</td>
<td>Lab – ANSYS project wizard</td>
<td>Demo 1</td>
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<td>3</td>
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<td>1/28</td>
<td>Lab – Preprocessing</td>
<td>Demo 2</td>
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<td>F</td>
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<td>Lab – Meshing</td>
<td>Demo 3</td>
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<td>5</td>
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<td>2/7</td>
<td>Lecture – Trusses and direct formulation</td>
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<td>F</td>
<td>2/11</td>
<td>Lab – Post-processing</td>
<td>Demo 4</td>
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<td>6</td>
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<td>HW2</td>
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<td>F</td>
<td>2/18</td>
<td>Lab – Structure analysis</td>
<td>Demo 5</td>
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<td>7</td>
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<td>2/21</td>
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<td>W</td>
<td>2/23</td>
<td>Lecture – Beams, minimum potential energy formulation</td>
<td>Ch 4</td>
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<td>Lab – Advanced named selection</td>
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<td>Lab – Object generator</td>
<td>Demo 7</td>
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<td>Mid-term Exam</td>
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<td>Lab – Parameter optimization</td>
<td>Demo 8</td>
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<td>3/16</td>
<td>Spring Break Week</td>
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<td>11</td>
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<td>Lecture – 1D problems and Galerkin formulation</td>
<td>Ch 5 &amp; 6</td>
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<td>Demo 9</td>
<td>HW4</td>
<td>Lab – Fatigue analysis</td>
<td>Demo 10</td>
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<td>Lecture – 2D heat transfer problems</td>
<td>Ch 7, Ch 9.1-9.4, 9.6-9.8</td>
<td>Lab – ANSYS Exam</td>
<td>Timed Lab</td>
<td>Exam</td>
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<td>Lecture – 2D stress analysis problems</td>
<td>Ch 10.1-10.7</td>
<td>HW5</td>
<td>Lab – Advanced preprocessing</td>
<td>Demo 11</td>
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<td>Lab – Thermal analysis</td>
<td>Demo 12</td>
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<td>Project presentations</td>
<td>Review and help session</td>
<td>Lab – Multistep analysis</td>
<td>Lab – Modal analysis</td>
<td>Demo 13 &amp; 14</td>
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<td>Final</td>
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*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 that 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%.

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<thead>
<tr>
<th>Work category</th>
<th>Points</th>
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<tbody>
<tr>
<td>Homework (5)</td>
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<tr>
<td>Computer labs and class participation (10)</td>
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<td>ANSYS Computer lab exam (1)</td>
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<td>Design project (1)</td>
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<tr>
<td>Midterm exam (1)</td>
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<tr>
<td>Final exam (comprehensive)</td>
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<td><strong>Total</strong></td>
<td>700</td>
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**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/](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](http://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](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/](https://www.ndsu.edu/counseling/)
- Disability Services: 701-231-8463; [https://www.ndsu.edu/disabilityservices/](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.

![Remote Desktop Connection](image)

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.