Agricultural and Biological Engineering
ABE 483: Engineering Properties of Food Materials

Course Syllabus

Instructor:	Mohammed Kamruzzaman, 376A AESB, mkamruz1@illinois.edu
Lecture / Discussion:	Monday and Wednesday 9:30 – 10:50, room 248 AESB
Laboratory:	Monday and Wednesday 9:30 – 10:50, room 104 AESB
Office hours:	set up an appointment (preferred), occasional hours as announced, or drop.
	You can also set a 30 min discussion session via Zoom (per week per student).
Credit:	3 hours

Course Philosophy: This course is to prepare you for finding, evaluating and using food properties in engineering practice and research in the "real world." You should learn where to find properties, how to estimate and measure properties, and then be able to use them. This course also emphasizes being able to *communicate* your understanding to other people.

Learning Objectives:

1. understand terminology of food properties used in the food and biological materials industries
2. find information on properties
3. estimate values of properties
4. understand and perform techniques to measure food properties
5. analyze and solve diverse problems through application of property data
6. think critically and apply problem solving techniques
7. create, develop, execute, and document a laboratory experiment on material properties

Activities: Several unique activities are used to accomplish the above objectives.

- Lecture/discussion sessions
- Preparatory reading
- Case studies, simulations, and group problem-solving sessions – this is where you process what you've learned.
- Laboratory assignments, problem sets, and design problems – test and further apply what you have learned firsthand.
- Exams – reinforce what you have learned.
- Individual projects – allow you to choose topics for further investigation. You will explore topics in detail and to learn about your classmates' topics.
- Present your findings – in written papers and in oral presentations to the class.
- Evaluate your own work and work of others.

Required Text:

Rahman, S. Food Properties Handbook. 2009. 2nd ed. CRC Press. Boca Raton, FL.

Stroshine, R. *Physical Properties of Agricultural Materials and Food Products*. 2000. Text available as a pdf.

Other Texts that are useful (many available on reserve at the ACES library):

Hayes, George D. 1987. *Food Engineering Data Handbook*. Longman Scientific & Technical, Essex, UK

Iglesias, Hector A. 1982. *Handbook of Food Isotherms*. Academic Press, New York.

Jowitt, Ronald, Escher, Hallstrom, Meffert, Spiess, and Vos. 1983. *Physical Properties of Foods*. Applied Science Publishers, London and NY.

Mohsenin, Nuri N. 1984. *Electromagnetic Radiation Properties of Foods and Agricultural Products*. Gordon and Breach Science Publishers, NY.

Mohsenin, Nuri N. 1986. *Physical Properties of Plant and Animal Materials*. Gordon and Breach Science Publishers, NY.

Mohsenin, Nuri N. 1980. *Thermal Properties of Foods and Agricultural Materials*. Gordon and Breach Science Publishers, New York.

Okos, Martin R. 1986. *Physical and Chemical Properties of Foods*. American Society of Agricultural Engineers, St. Joseph, Michigan.

Peleg, M. and E.B. Bagley. 1983. *Physical Properties*

of Foods. The AVI Publishing Company Inc., Westport, Connecticut.

Rao, M.A. and S.S.H. Rizvi. 1995. *Engineering Properties of Foods*. Marcel Dekker, NY.

Serna-Saldivar, S. O. 2010. *Cereal grains: Properties, processing, and nutritional attributes*. CRC Press: New York, NY. 747 pp. ISBN 978-1-4398-1560-1.

Sitkei, Gyorgy. 1987. *Mechanics of Agricultural Materials*. Elsevier Press.

Steffe, J.F. 1996. *Rheological methods in food process engineering.* Freeman Press. East Lansing, MI. 428 pp. Available free at: www.egr.msu.edu/~steffe/Freebooks/offer.html

Steffe, J.F. and Daubert, C.R. 2006. *Bioprocessing pipelines: rheology and analysis.* Freeman Press. East Lansing, MI. 173 pp. Available free at: https://moreira.tamu.edu/BAEN474/BAEN422_files/Bioprocessing%20Pipelines.pdf

Toledo, R. 1991. *Fundamentals of Food Process Engineering.* 2nd edition. Chapman and Hall. New York.

Singh, R. P. and Heldman, D. 2013. Introduction to Food Engineering. 5th edition. Elsevier Press.

List of Assignments and Grading Policy

Grading (subject to minor adjustment):	%
Assignments	
Problem Sets (up to 8)	10
Laboratory Reports (up to 6)	10
Quizzes, *Class Assignments and Participation, PBL*	10
Hour Exams (HE), 3 will be given (each worth 10%)	30
Semester Individual Research Projects (SIRP)	40
Total	**100**

Approximate Grading Scale (+/-):

Overall Grade %	Letter grade
=>96.00	A+
91.00-95.99	A
86.00-90.99	A-
83.00-85.99	B+
80.00-82.99	B
77.00-79.99	B-
74.00-76.99	C+
71.00-73.99	C
68.00-70.99	C-
65.00-67.99	D+
62.00-64.99	D
60.00-61.99	D-
<60	F

Grades are not awarded based on a class curve. Grades are based on demonstrated understanding and mastery of the topic and are not affected by the performance of others in the class. For example, high performance of a PhD student will not lower the grades of undergraduates in the class.

Late Policy:

- Assignments will be due at the beginning of class on the assigned date.
- Assignments that are submitted late will NOT be accepted.
- Assignment deadlines should be treated as though your job depends on timely submission. An exception is when you have an excused conflict and let me know ≥24 hours in advance of class.
- In all other cases, obtain appropriate documentation from the Emergency Dean.

Computer crash and printer problems policy: all computers eventually crash and/or get viruses. Back up your work

on a routine, regular basis. Printers seem to have problems printing assignments at "crunch" time, so allow some time for delays. It is a good habit and your responsibility to backup assignments. Computer/network problems or viruses are not acceptable excuses for late work. Losing a file or having printer problems just before the due date is not an acceptable excuse.

Electronic submission: Assignments can also be submitted via email attachment. However, if you submit your assignment as an attachment, you must assume it was **not** received unless I have acknowledged its receipt.

Learning is an active process from the teacher's and from the learner's points of view. Teachers and students have a strong responsibility to one another.

My obligations as a teacher include
(a) being knowledgeable on subject matter,
(b) providing good learning experiences,
(c) making it worth your time to attend class,
(d) evaluating work fairly and
(e) assisting you to achieve course goals.

Student obligations include
(a) reading and completing assignments,
(b) participating actively and positively in the learning process, and
(c) expressing needs to the instructor

Assignment Requirements

- Ethical behavior is expected at all times of instructor and students alike. This includes coursework and exams, and in conducting verbal and written communication.
- When using data from a reference, briefly give the source and page number. If using an online source, provide web page author information and the link.

Problem Sets (PS)

- Must be turned in on green or beige "Engineering" paper. Solutions can be supplemented with printouts from spreadsheets and word processors.
- Write on the non-grid side of the page only.
- Each problem should include a short problem statement and given information.
- An organized, easy-to-read problem solution is a form of communication. A difficult to read solution will not receive the same grade as a disorganized one that is technically equivalent.
- Show your work in the solution.
- Reference all values and equations obtained found in literature.

Lab Reports

- The most difficult and practical exercise in the class!
- Focus on what was important, not every piece of information; no extra credit for report length.
- Clarity, conciseness and completeness must be balanced within the length limits of the report.
- Clarity and conciseness of communication should be emphasized in completing the assignment.

Hour Exams

- Two individual and one group exam will be given.
- Type of exam (group or individual) will be announced at the beginning of the exam.
- Individual exams: open book & notes
- Group exams: open book, notes & neighbors
- Group exams require a group effort and receive a single group grade.
- Exams will simulate real life problem solving.

Semester Individual Research Projects (SIRP)

- Are a significant portion of your grade
- Require time management for success
- See SIRP handouts for details
- SIRP projects replace the final exam

Official Final Exam Period

- Due to SIRP, there is no final exam
- The official exam period MAY be needed to present SIRP project.

Communication via e-mail:

- Call my office and leave a voicemail. I will get the message via email.
- I will do my best to respond to email in a timely manner, usually within 24 hr.
- Each student in ABE 483 is entitled to use the computer lab (220 AESB). If you need help,

see the computer attendant in 220 AESB.
- Assignments turned in via email should be considered "not received" unless you have an acknowledgement of receipt.

To be successful in ABE 483, you should:

1. *Prepare for class*. Skim the reading material and think about the subject matter. A few minutes invested before the material is covered in class is equivalent to hours of pre-exam cramming.
2. *Do* the assignments and submit them on time.
3. *Organize* class handouts, notes, and assignments so you can find them efficiently.
4. *Ask for help*. Consult the instructor, and classmates.
5. ***Be bold and creative***. Dare to try innovative approaches, think out loud, ask questions, and risk your pride in order to learn.

COURSE OUTLINE

This course investigates properties of food materials, specifically those properties used for
(1) sensing and control of bioprocesses
(2) characterization of food and biological materials
(3) design of processes and equipment

1. **Geometry and Physical Properties**
   - Size, shape, volume, surface area, density, porosity
   - Physical and chemical composition
   - Water in foods and water activity
2. **Optical/Electromagnetic Properties**
   - Basic concepts, optical properties, color, and measurement
   - Near-infrared and infrared applications
   - Hyperspectral imaging application
3. **Rheological Properties: Fluid Foods**
   - Introduction to rheology
   - Rheological properties and models
   - Newtonian and Non-Newtonian fluids
   - Viscometry
4. **Rheological Properties: Solid Foods**
   - Force-deformation, stress-strain, elastic-plastic
   - Time effects; viscoelastic characterization
   - Viscoelasticity: relaxation, creep, dynamic behavior
   - Texture measurement
5. **Particle Properties: Friction, Fractions, Fractals, & Flow**
   - Coefficient of friction, angle of repose, angle of internal friction
   - Particle size distribution
   - Flow through an orifice
   - Fractal analysis
   - Characteristics of powders
6. **Aerodynamic Properties**
   - Coefficient of drag
   - Terminal velocity
   - Particle orientation, separations, material handling
7. **Heat/Mass Transfer and thermal Properties**
   - Specific heat, thermal conductivity, and thermal diffusivity
   - Determination of thermal properties
   - Determination of mass diffusivity
   - Applications to heating, cooling, freezing, and drying of foods
8. **Engineering Properties of Starch**
   - Starch chemistry: a review for engineers and some others
   - Overview of modification processes
   - Waxy vs. dent starch

Other properties and topics as appropriate.

ABE 483 could be for you if…

1. You're looking for a useful technical elective.
2. Want to understand how to measure properties of complex biological materials (food) and how they are used in processes.
3. You'd like to work in the food/bioprocessing industry.

Academic Integrity

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/.
Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: https://studentcode.illinois.edu/article1/part4/1-401/. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or http://odos.illinois.edu/community-of-care/referral/). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe. Further, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at McKinley Health Center (https://mckinley.illinois.edu/). Or the Counseling Center (https://counselingcenter.illinois.edu/). For urgent matters during business hours, no appointment is needed to contact the Counseling Center. For mental health emergencies, you can call 911.

Students with Disabilities

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the as soon as possible. To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should contact Disability Resources and Educational Services (DRES) and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail disability@illinois.edu. http://www.disability.illinois.edu/.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (https://conflictresolution.illinois.edu; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Emergency Response Recommendations

Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency-preparedness/. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/.

Religious Observances

Students should complete the Request for Accommodation for Religious Observances form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, we request that students make requests for absence letters as early as possible in the semester in which the request applies.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu.