FDSCTE 5400 – Unit Operations in Food Processing
FABENG 4410 - Unit Operations in Food Engineering
Spring 2019 (3 Credits)

Lecture: Tuesday: Thursday: **8:00 AM-8:55 AM**

Recitation and Unit Operations lab: Monday: **9:10 AM-11:55 AM & 3:00 PM-5:45 PM**

COURSE DESCRIPTION

Study of unit operations in preserving foods by thermal and alternative food processing methods. Recitation through problem solving and experimentation. Interdependence of food engineering, chemistry, and microbiology principles in food preservation

Prerequisites: FDSCTE 2400, FABEng 3481, and Micrbio 4000, or graduate standing. Cross- listed as FDSCTE 5400/FABEng 4410.

OUTCOMES OF INSTRUCTION / GOALS

By the end of the course, the students should:

1. *Understand basic unit operation principles associated with various conventional and emerging food processing methods.*
2. *Identify key components of different food process equipment, and discuss their purpose in food preservation*
3. *Identify key food processing and product parameters that can influence microbiological safety, and quality of the processed product.*
4. *Importance of kinetic models in food process design and development. Calculate selected key food process parameters such as D, z and process lethality.*

INSTRUCTOR

V.M. Bala Balasubramaniam, Professor of Food Engineering,
333 Parker Food Sci & Tech.
614-292-1732(voice)
E-mail: Balasubramaniam.1@osu.edu

Instructor website: http://go.osu.edu/foodsafetyeng

Instructor encourages interactions. You can meet with instructor immediately after the class (9-10 AM Tu &Th), during the recitation lab hours or by appointment. A note on instructor name- phonetically it can be spelled as "*ba-la-su-bra-money-um"*. But you are welcome to call him simply as "Bala".

TEACHING ASSOCIATES

- Dr. Alifdalino Sulaiman, Visiting Scholar, Email: sulaiman.19@osu.edu
- Shreya Kamat, Research Associate/Pilot Plant Lab Manager, Email: kamat.10@osu.edu
- Jerish Joyner Janahar, Graduate Research Associate, Email: janahar.1@osu.edu
- Vybhav Gopisetty, Graduate Research Associate, Email: gopisetty.4@osu.edu

RATIONALE

This class will help you to build background in food engineering principles and basic mathematical skills you need to face variety of challenges as a food engineer. Examples includes: food process development, equipment operation, evaluate microbial safety of a food process, formulate new products, understanding food-packaging interactions, reformulate existing products to meet changing consumer demand, test nutritional content of processed food, develop strategies for improving manufacturing and packaging operation, enforce certain federal and state regulations for making safe product, and study consumer acceptance of formulated products.

It is critical to understand what the different engineering unit operations are, how they are used in different unit food processes, underlying physics, their role in food safety, quality and nutrition. We will also learn to do simple process calculations that may help answer "what-if" type processing questions.

COURSE ORGANIZATION

We meet twice a week for lectures and once a week for recitation and/or pilot plant / laboratory session. Instructor encourage encourage active student discussion and questions.

Background reading material & powerpoint slides are posted via Carmen. *You are encouraged to read the available material from Carmen website prior to the class. Bring a calculator for both lecture & recitation session.*

SOCIAL MEDIA AND CELL PHONE USE

Use of cell phone or browsing social media during the class period is a distraction to your fellow students & the instructor. Thus it is highly discouraged. Instructor may ask the violators to remove the cell phone outside the class room.

You welcome to bring a laptop computer for the sole purpose of reviewing PowerPoint lecture slides and / or take class notes is acceptable.

TENTATIVE LECTURE SCHEDULE

Week	Lecture
Jan 7	**Classes begin**
Jan 7-11	Role of food engineering in food preservation ▪ Importance of unit operations ▪ Importance of Kinetic models in ensuring food safety and quality ▪ Thermometry
Jan 14-18	Food preservation by application of heat ▪ Blanching ▪ Pasteurization ▪ Sous vide
Jan 21	**Martin Luther King Day -- no class**
Jan 21-25	Heat Sterilization ▪ Retort processing ▪ Retort types ▪ Key processing steps ▪ Least heated zone ▪ Heat penetration ▪ Process uniformity ▪ Thermal process calculations ▪ Extended shelf life foods
Jan 28-Feb 1	Heat processing by advanced thermal processes Aseptic Processing ▪ Residence time distribution ▪ Identifying least treated particle Ohmic heating ▪ Process description ▪ Key food properties
Feb 4-8	Microwave heating ▪ Process description ▪ Key food properties Review - midterm 1 **Midterm Exam 1 (Thursday, Feb 7)**
Feb 11-15	Processing by heat removal Food freezing ▪ Freezing physics, equipment ▪ Freezing food properties ▪ Freezing time prediction

	▪ Impact of freezing on food safety and quality ▪
Feb 18-22	Selected non thermal processing methods High pressure processing ▪ Equipment ▪ Process description ▪ Microbial safety ▪ Food quality Pulsed electric field processing ▪ Equipment ▪ Process description ▪ Microbial safety ▪ Food quality
Feb 25-March 1	Nonthermal Processing - Food irradiation Food preservation by removal of moisture (dehydration) ▪ Dehydration equipment ▪ Spray drying ▪ Freeze drying
March 4-8	Food dehydration lectures continued N
March 11-15	**Spring break (no classes observed)**
March 18-22	Midterm 2 review **Midterm Exam 2 (Thursday March 21)**
March 25-29	Evaporation, Separation, Concentration
April 1-5	Extrusion processing
April 8-12	Cleaning and Sanitation Food Processing Sustainability
April 15-19	Federal regulations governing food processing Presentation & discussion
April 22-26	Final exam review **Final Exam** (exam date as per university registrar) **April 24, Wednesday, 08:00 AM - 09:45 AM**

TENTATIVE RECITATION / PILOT PLANT SCHEDULE

There will be two recitation periods (Monday morning and afternoon). During recitation we will work on (a) pilot plant experiments (b) mathematical problem solving exercise for learning how to estimate pertinent food process parameters (c) combination of both. Students

work in assigned teams during both pilot plant periods as well as mathematical problem solving exercise.

Pilot plant experiments: Teams review and sign a team member agreement form as well as a pilot plant user agreement. During the pilot plant experiments, Tas will lead experimentation, and collect the data with the help of student teams. Then TAs share the data among all the members for subsequent analysis and report writing. Instructions (and template) for the preparation of lab reports will be provided during pilot plant orientation. Student teams submit single lab report one week after the lab session. Lab reports are electronically submitted via Carmen (by 5 pm). Late assignments/term papers are penalized at a rate of 10% loss in points per day late including weekends.

Problem solving Recitation: This section help you practice and develop mathematical problem solving skills. You are welcome to work in teams. Since midterm and final exams test your knowledge on such problem solving skills, you are encouraged to use the problem solving recitation to practice all the problems and ask the TAS and instructors in case you have questions.

Bring calculator for both lecture & recitation sessions

REPORT TEMPLATE

See separate file for instructions and template for lab report

Week	Topic
Jan 7	Orientation Review of basic principles
Jan 14	Thermometry
Jan 21	**Martin Luther King Day -- no class**
Jan 28	Canning
Feb 4	Problem solving (Thermal Processing)
Feb 11	Problem Solving (Aseptic processing)
Feb 18	Problem solving (Microwave and Ohmic)
Feb 25	Freezing
March 4	Minimal “nonthermal” food processing
March 11	**Spring break (no classes)**
March 18	Dehydration
March 25	Problem solving (Separation and Concentration)
April 1	Food filtration
April 8	Problems solving exercise continue
April 15	Student presentation
April 22	Review

READING MATERIAL

Pdf copies of PowerPoint & reference material for various lectures and recitations are available via CARMEN. You may also find the following optional reading material useful:

- R.P. Singh and D.R. Heldman. 2009. Introduction to Food Engineering. Elsevier.
- Earle, R.L. and M.D. Earle. Unit Operations in Food Processing. http://www.nzifst.org.nz/unitoperations/
- Zhang, H.Q., Barbosa-Canavas, Gustavo V., VM Balasubramaniam, C. Patrick Dunne, Daniel Farkas, and James T.C. Yuan. 2011. Nonthermal Processing Technologies for Food. IFT Press.
- P. Fellows. 2009. *Food Processing Technology, Principles and Practice*, Third edition. Woodhead Publishing Lmt, England.
- D.R. Heldman, R. W. Hartel. 1998. Principles of Food Processing Aspen.

GRADING

Students will be graded based up on which section you enroll (FDSCTE 5400 (undergraduate & graduate), FABENG 4410(undergraduate). We use the following criteria:

FDSCTE 5400 – Unit Operations in Food Processing (Undergraduate credit)

- Recitation Laboratory report 20%
- Midterm exams (2; 20% each) 40%
- Final Exam (cumulative) 40%

FABENG 4410 - Unit Operations in Food Engineering (Undergraduate credit)

- Recitation Laboratory report 20%
- Midterm exams (2; 20% each) 40%
- Final Exam (cumulative) 40%

FDSCTE 5400 – Unit Operations in Food Processing (Graduate credit)

- Individual Critical literature review (consult instructor for topics) 10%
- Recitation Laboratory report 20%
- Midterm exams (2; 20% each) 40%
- Final Exam (cumulative) 30%

During the first day of the class, we will discuss the grading policy and revise the grading breakdown and midterm exam dates if necessary. *Random checks will be made. For each day you are not present (without prior approval), 1% will be deducted from your final grade at the discretion of instructor. Reasonable medical excuses are acceptable, provided you document them.*

For all the classes listed above, each class is graded on a straight scale:

100-93	=	A
92.9-90	=	A-
89.9-87	=	B+
86.9-83	=	B
82.9-80	=	B-
79.9-77	=	C+
76.9-73	=	C
72.9-70	=	C-
69.9-67	=	D+
66.9-63	=	D
< 63	=	E

It is possible (and desirable) for the entire class to receive ***A***.

QUIZ (Bonus points)

There will be optional quizzes assigned via Carmen (that can help you to learn & practice material covered in the class). You may also find the material useful for midterm and final exams.

Quiz will be available through CARMEN every **Thursday 9:00 AM and closes the following week by Wednesday 5:00 PM.** It is your responsibility to take quiz within assigned time frame (no extensions will be provided). You will obtain 2 bonus points for attempting at least 80% of the assigned quizzes. If you score minimum 70% in each of these quizzes, additional 1 bonus points will be added.

ACADEMIC MISCONDUCT

Academic misconduct is defined in the Code of the Student Conduct (3335-23-04, http://studentaffairs.osu.edu/csc/) and the Rules of the University Faculty (http://oaa.osu.edu/coamresources.html). Academic misconduct will not be tolerated. If you have questions on this point, please refer to the above web sites or ask an instructor. Some examples of misconduct are:

1. Using a report from a previous year as the whole or a portion of your report.
2. Copying another student's answers during a quiz.
3. Including material from internet without providing proper citations. Use of material (simple cut, copy/paste) from internet sites without making efforts to expressing in your own words is discouraged. We use tools to check such efforts.
4. Instructor may randomly check "lab reports" or other assignments using automated software system for ***plagiarism***. Violators will be reported to the university officials.

Team work is expected and required in this course. Students are allowed to work on their recitation reports and/or problem solving exercise together, but each student must use their own expression. Discussion and interpretation of results is encouraged.

CARMEN

Carmen is the primary web-based course management system supported by the Office of Information Technology (OIT) at the Ohio State University. To log into Carmen and see your online courses, first use your web browser to open a link to carmen.osu.edu. A login box is on the left side of the screen that appears. Type your username and password and click on the Log In button. In most cases, your Carmen username is the same as your OSU Internet username (the name you use for checking your e-mail, etc.). For example: doe.999. When entering your username, be certain your caps lock is off and that you type it all in lowercase. If you are having problems, please contact Carmen at (614)688-HELP (4357)

TERM PROJECT (Graduate credit only)

By first week of February, each graduate student will in consultation with the instructor identify a contemporary critical literature review topic. Turn in a 15-20 page term paper by April 12 and prepare a presentation for the presentation during the assigned class time (week of April 15th)

PARTICIPATION

For your own learning, active participation in both class and laboratory activities is encouraged. Participation means you will

- attend lectures and ***being on time***
- work with the team members & submit lab reports ***on time***
- be an equal partner in the activities of your lab group
- participate in class discussion and ask questions either during the lecture time or during the recitation time.