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

Prereq: 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, their role and use to preserve foods.
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. Typically you can meet with instructor immediately after the class (9-10 AM TuTh.) or during the recitation lab hours. 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 (054 Parker Food Science and Tech).

- Shreya Kamat, Lab Manager, E-mail: kamat.10@osu.edu
RATIONALE

This class will 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 critical to understand what are the different engineering unit operations, 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. Background reading material & powerpoint slides are posted via Carmen. You are encouraged to review the material in advance of the class. Bring a calculator for both lecture & recitation session. Your active involvement is encouraged.

TENTATIVE LECTURE SCHEDULE

Jan 8 Classes begin
Jan 8- 12
- Role of food engineering in food preservation
- Importance of unit operations
- Importance of Kinetics models in ensuring food safety and quality
- Thermometry

Jan 15-19 Food preservation by application of heat
- Blanching
- Pasteurization
- Sous vide

Jan 15 Martin Luther King Day observed--no class

Jan 22-26 Heat Sterilization
- Retort processing
  - Retort types
  - Key processing steps
  - Least heated zone
  - Heat penetration
- Process uniformity
- Thermal process calculations
- Extended shelf life foods
  
- Aseptic Processing
  - Residence time distribution
  - Identifying least treated particle

**Jan 29-Feb 2**  
Heat processing by advanced thermal processes
  
- Microwave heating
  - Process description
  - Key food properties

- Ohmic heating
  - Process description
  - Key food properties

**Feb 5-9**  
Continue lectures
  
- Review - midterm 1

**Feb 8**  
Midterm exam 1

**Feb 12-16**  
Processing by heat removal – Food freezing
  
- Freezing physics, equipment
- Freezing food properties
- Freezing time prediction
- Impact of freezing on food safety and quality

Selected nonthermal processing methods
  
- High pressure processing
  - Equipment
  - Process description
  - Microbial safety
  - Food quality

- Pulsed electric field processing
  - Equipment
  - Process description
  - Microbial safety
  - Food quality

**Feb 19-23**  
Continue nonthermal processing

Food preservation by removal of moisture (dehydration)
  
- Dehydration equipment
- Spray drying
- Freeze drying and misc drying
Feb 26- March 2  Continue dehydration lecture
March 5-9  Food irradiation, Combination process
March 12-16  Spring break
March 20  Midterm 2 review
March 22  **2nd Midterm Exam**

Other Unit Operations of interest
March 26-30  Extrusion processing
April 2-6  Evaporation
Separation, concentration
April 9-13  Cleaning and Sanitation
Food Processing Sustainability
April 16-20  Federal regulations pertinent to food processing

April 23  Presentation & discussion
Final Exam Review
April 25- May 1  Final exam week (exam date as per university registrar)
**Final exam – Wednesday Apr 25 8:00am-9:45am**

**TENTATIVE RECITATION / PILOT PLANT SCHEDULE**

There will be two recitation periods (Monday morning and afternoon). There are days we will meet in the pilot plant or lab to conduct some experiments. Students work in teams. The TA will pool and provide the raw data from experimentation and the student teams will analyze and prepare a report(s). Other days we meet in the class room (Parker 311) to analyze, solve mathematical problems.

The report for laboratory-based recitation will be due one week after assignment. Bring calculator for both lecture & recitation sessions
<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>Jan 8</td>
<td>Orientation</td>
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<td>Jan 15</td>
<td>Holiday. No Class</td>
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<td>Jan 22</td>
<td>Thermometry</td>
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<td>Jan 29</td>
<td>Canning</td>
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<td>Feb 5</td>
<td>Problem solving (Thermal Processing)</td>
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<td>Feb 12</td>
<td>Problem Solving (Aseptic processing)</td>
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<td>Feb 19</td>
<td>Freezing</td>
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<td>Feb 26</td>
<td>Problem solving (Ohmic and Microwave)</td>
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<td>March 5</td>
<td>Minimal food processing</td>
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<td>March 12</td>
<td>Spring break week</td>
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<td>March 19</td>
<td>Dehydration</td>
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<td>March 26</td>
<td>Problem solving (Separation and Concentration)</td>
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<td>April 2</td>
<td>Food filtration</td>
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<td>April 9</td>
<td>Problems solving exercise continue</td>
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<td>April 16</td>
<td>Student presentation</td>
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<td>April 23</td>
<td>Review</td>
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**REPORT TEMPLATE**

See separate file for instructions and template for lab report

**READING MATERIAL**

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


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)
- 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%

It is your responsibility to learn the material covered during lecture and recitation lab sections. You are encouraged to read the available material from Carmen website prior to the class. Regular attendance of lecture and recitation is mandatory. 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.

Laboratory team reports will be electronically submitted using Carmen. Late assignments/term papers are penalized at a rate of 10% loss in points per day late including weekends. During the first day of the class, we will discuss the grading policy and revise the grading breakdown and midterm exam dates if necessary.

Bonus points for OPTIONAL QUIZ:
(Optional) Quiz
i. Complete 80% of assigned quizzes (e.g., 8 quiz out of 10 quiz) 3 points
ii. Score 70% or above in each of 8 quizzes 2 points
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 AM and closes the following week by Wednesday 11:59 pm. It is your responsibility to take quiz within assigned time frame (no extensions will be provided). You will obtain 3 bonus points for attempting at least 80% of the assigned quizzes. If you score minimum 70% in each of these quizzes, additional 2 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.

*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 express. 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)

This is the first semester we are using Carmen Canvas dashboard. Instructor welcomes any suggestions and recommendations.

TERM PROJECT (Graduate credit only)
By first week of Feb, 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 16th)

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
• with the team members & submit lab reports on time
• 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.