FDSCTE 5400 – Unit Operations in Food Processing
FABENG 4410 - Unit Operations in Food Engineering
Spring 2017  3 Credits U G

Lecture Tu Th 8:00AM - 8:55AM
Recitation and Unit Operations lab Mo 9:10AM - 11:55AM & 3:00-5:45 PM

COURSE OBJECTIVES

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.

RATIONALE

Food industry is in need of knowledgeable food engineers and scientists with background in engineering, chemistry, microbiology, consumer acceptance among others.

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. This includes

(a) develop novel food processes,
(b) operate a food process equipment,
(c) evaluate microbial safety,
(d) formulate new products,
(e) food-packaging interactions
(f) reformulate existing products to meet changing consumer demand,
(g) test nutritional content of processed food,
(h) develop strategies for improving manufacturing and packaging operation,
(i) enforce certain federal and state regulations for making safe product,
(j) and study consumer acceptance of formulated products.

Thus, it critical to understand what are the different engineering unit operations, how are used in making different food process operations work, underlying physics behind these processes, and their advantage and limitation.
It is important to understand the process and packaging parameters that make the food safe and preserve food quality.

During the semester we will also learn to do simple process calculations that may help answer “what-if” type processing questions.

Hopefully our journey during the semester will help you to better appreciate the importance and benefits of integrating knowledge from engineering, chemistry and microbiology for controlling different food processes.

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

Instructor website: [http://go.osu.edu/foodsafetyeng](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 (330 Parker Food Science and Tech).**
- Shreya Kamat, Lab Manager, E-mail: kamat.10@osu.edu

**SUPPLEMENTAL READING**

The material covered during lecture and recitation will come from several sources including the following books. Some of these relevant text material is available as a reference via CARMEN as reading material prior to class. In addition, you may find journal articles as additional valuable resources. Class power point notes also posted through Carmen website.


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) 35%
- Attendance & class room discussion 5%

FABENG 4410 - Unit Operations in Food Engineering (undergraduate credit)
- Recitation Laboratory report 20%
- Midterm exams (2; 20% each) 40%
- Final Exam (cumulative) 35%
- Attendance & class room discussion 5%

FDSCTE 5400 – Unit Operations in Food Processing (Graduate credit)
- Individual Critical literature review (consult instructor for topics) 10%
- Recitation Laboratory report 15%
- Midterm exams (2; 20% each) 40%
- Final Exam (cumulative) 30%
- Attendance & class room discussion 5%

Bonus points for OPTIONAL QUIZ:
- (Optional) Quiz
  - At least 8 out of 10 quizzes completed 2 points
  - If scored at least 70% (average) in 10 quizzes 3 points

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

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-93</td>
<td>A</td>
</tr>
<tr>
<td>92.9-90</td>
<td>A-</td>
</tr>
<tr>
<td>89.9-87</td>
<td>B+</td>
</tr>
<tr>
<td>86.9-83</td>
<td>B</td>
</tr>
<tr>
<td>82.9-80</td>
<td>B-</td>
</tr>
<tr>
<td>79.9-77</td>
<td>C+</td>
</tr>
<tr>
<td>76.9-73</td>
<td>C</td>
</tr>
<tr>
<td>72.9-70</td>
<td>C-</td>
</tr>
<tr>
<td>69.9-67</td>
<td>D+</td>
</tr>
<tr>
<td>66.9-63</td>
<td>D</td>
</tr>
<tr>
<td>&lt; 63</td>
<td>E</td>
</tr>
</tbody>
</table>

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

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.

COURSE ORGANIZATION
The course consists of two lectures and one recitation session per week.

TENTATIVE LECTURE SCHEDULE
Lecture TuTh 8:00AM - 8:55AM

Class lectures will be posted on Carmen. You will be responsible for printing the lecture handout. Supplemental reading materials & references will also be provided. Bring a calculator for both lecture & recitation session

Jan 9 Classes begin
Jan 9- 13
- Role of food engineering in food preservation
- Importance of unit operations
- Importance of Kinetics models in ensuring food safety and quality
• Thermometry

Jan 16-20  
Food preservation by application of heat  
• Blanching  
• Pasteurization  
• Sous vide

Jan 16  
Martin Luther King Day observed--no class

Jan 23-27  
Heat Sterilization  
• Retort processing  
  o Retort types  
  o Key processing steps  
  o Least heated zone  
  o Heat penetration  
  o Process uniformity  
  o Thermal process calculations  
  o Extended shelf life foods  
• Aseptic Processing  
  o Residence time distribution  
  o Identifying least treated particle

Jan 30-Feb 3  
Heat processing by advanced thermal processes  
• Microwave heating  
  o Process description  
  o Key food properties  
• Ohmic heating  
  o Process description  
  o Key food properties

Feb 6-10  
Continue lectures  
• Review - midterm 1

Feb 9, 2017  
Midterm exam 1

Feb 13-17  
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  
  o Equipment
- Process description
- Microbial safety
- Food quality
  - Pulsed electric field processing
    - Equipment
    - Process description
    - Microbial safety
    - Food quality

Feb 20-24  
Dehydration,  
- Dehydration equipment  
- Spray drying  
- Freeze drying and misc drying

Feb 27- March 3  
Food irradiation, Combination process

March 6-10  
Extrusion processing

**March 9**  
2nd Midterm Exam

March 13-17  
Spring break

March 20-24  
Separation, concentration

March 27-31  
Evaporation

April 3- 7  
Cleaning and Sanitation  
Presentation & discussion

April 10-14  
Food Processing Sustainability  
Presentation & discussion

April 17-21  
Federal regulations pertinent to food processing

April 25  
Review

April 26- May 2  
Final exam week (exam date as per university registrar)  
**Final exam – Wednesday April 26 8-945 AM**

**TENTATIVE RECITATION SCHEDULE**

There will be two recitation periods (Monday morning and afternoon).
In an effort to provide reasonable hands on experience, on pilot plant experimental days, we divide the class into two sub groups. While one group is doing the pilot plant experiments, the other teams will work on recitation / analysis related to that lab.

The TAs will provide the raw data and the student teams will analyze and prepare a report. The report for laboratory-based recitation will be due one week after assignment. Recitation Sessions will meet Parker Conference Room 311. Bring calculator for both lecture & recitation sessions

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
</table>
| Jan 9 | Orientation  
Review of basic principles             |
| Jan 16 | Holiday. No Class                        |
| Jan 23 | Thermometry                               |
| Jan 30 | Canning                                   |
| Feb 6  | Problem solving (Thermal Processing )     |
| Feb 13 | Problem Solving (Aseptic processing)      |
| Feb 20 | Freezing                                  |
| Feb 27 | Problem solving (Ohmic and Microwave)     |
| March 6 | Minimal food processing                   |
| March 13 | Spring break week                        |
| March 20 | Dehydration                             |
| March 27 | Problem solving (Separation and Concentration ) |
| April 3 | Food filtration                           |
| April 10 | Problems solving exercise continue       |
| April 17 | Student presentation                     |
| April 24 | Review                                   |

LAB REPORT TEMPLATE
See separate file for instructions and template for lab report
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). There will be total of at least 10 quizzes. You will obtain 2 bonus points for attempting at least 8 quizzes. To obtain maximum 5 bonus points you should have scored 70% (average).

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 14 and prepare a presentation for the presentation during the assigned class time (week of April 17th).

PARTICIPATION

Your active participation in both class and laboratory activities is encouraged. Participation means you will

- attend lectures and **being on time**
- regularly submit lab reports
- equal partner in the activities of your lab group
- Participate in class discussion.