FNH 300 - Principles of Food Engineering

Units and dimensions, mass balance, energy balance, steady state and transient heat flow, fluid handling and measurement. [3-0-1] Prerequisite: One of PHYS 101, PHYS 107.

Course Overview

Principles of Food Engineering addresses the fundamental scientific concepts and engineering skills needed to understand the outcomes of commercial food processes, as well as to design simple food process systems. This course provides breadth in that it considers heat, refrigeration, and fluid principles that apply to all food engineering. It also provides depth in the application of heat processing to sterilize and pasteurize foods. Because of the practical need for quantitative prediction of process outcomes, topics are examined in mathematical as well as descriptive terms. This course is intended to precede FNH 309 Food Process Science.

*All course content-related and homework-related questions to your instructor and/or T.A. should be posted to the Connect discussion board (for all to see and learn from!). In the event you need to send a message to your instructor directly/privately, please send to my above email address.

Evaluation

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<tr>
<th>Evaluation</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Midterm Exam</td>
<td>25%</td>
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<tr>
<td>Assignments (5 x 3% each)</td>
<td>15%</td>
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<td>Group Presentation &amp; Paper</td>
<td>15%</td>
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<td>Final Exam</td>
<td>45%</td>
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<td>TOTAL</td>
<td>100%</td>
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Learning Objectives

While detailed Learning Outcomes will be given at the beginning of each lesson, the overall Learning Objectives of this course can be summarized threefold:

The course introduces scientific knowledge, engineering skills, and professional values required to design (predict and validate) arrange of food processes for the purposes of food safety and quality.

Upon completion of this course, you will be able to describe / explain:

- Heat transfer principles including conduction, convection, radiation, and latent heat
- Risk factors of processed foods with respect to public health
- Thermobacteriological terms including D, z, and F-values
- Scientific methods by which mathematical models of food processes are derived and validated.
- Pasteurization and sterilization processes, applications, and equipment
- Blanching principles and methods
- Low-temperature food quality preservation methods
- Causes of food-borne illness and quality degradation associated with incorrect food handling, processing, and storage.

Upon completion of this course, you will be able to use the SI system of engineering units and apply fundamental food engineering equations to make numerical predictions about:
Food materials/mass balance
- Energy requirements or energy consumption
- Heating and cooling rates of packaged and bulk foods
- Total lethality of multi-step heat processes on defined microbial hazards

Upon completion of this course, you will be able to select appropriate predictive equation(s) to design food processes/handling procedures which consider:
- Loss of nutrient and sensory quality
- Cumulative impact of complex storage histories on shelf life

Finally, an important outcome of this course is the recognition and acceptance of the moral responsibility associated with food process design; as a professional food scientist, you will be expected to assess the risks of food borne illness associated with the product being designed or produced: In this course, risk assessment will be discussed for low-acid shelf-stable foods, acid foods, refrigerated pasteurized foods, and frozen foods.

Required Materials
Lesson slideshows, assignments, & links to required UBC Library e-readings will be posted on Connect. You are responsible for printing materials from Connect if you wish to bring them to class in paper format.

Plagiarism Notice
Direct copying and submission of other students' work constitutes plagiarism and is subject to the UBC Student Conduct and Discipline Policy. 

Textbooks Resources for this course:
Course Schedule

Sept. 3  
L1- Course Introduction: Work, Energy and Power  

Sept. 8  
L2- Measurements, Units & Dimensions  

Sept. 10  
L3- Food Packaging: selection of appropriate packages.  

Sept. 15  
L4- Heat transfer and Mass Modes of heat transfer  

Sept. 17  
L5- Heat Exchangers in food processing  

Sept. 19  
L6- Principles for food preservation  

Sept. 21  
L7- Moisture content, Mass & Energy balances  
Assign. 1 due- involves critical thinking  

Sept. 24  
L8- Blanching of foods  

Sept. 26  
L9- Heat pasteurization of foods  

Sept. 29  
L10- Heat sterilization of foods  
Assign. 2 due Oct. 1–includes L1-L6  

Sept. 30  
L11- Refrigeration/chilling systems  
Dr Siyun Wang  

Oct. 1  
L12- Freezing of Foods  

Oct. 3  
L13- Fluid flow in pipes: Laminar and Turbulent flows-Reynolds number  

Oct. 6  
L14- Food Microbiology: spoilage & pathogens Dr Xiaonan Lu  

Oct. 8  
L15- Thermobacteriology I  

Oct. 10  
L16- Thermobacteriology II  
Assign. 3 due-includes L7-12  

Oct. 13  
Holiday-Thanksgiving  

Oct. 15  
Revision for Midterm  

Oct. 20  
L17- Food irradiation  

Oct. 22  
L18- Thermodynamics and heat capacities of foods  

Oct. 24  
L19- Gas pressure & steam heat content (enthalpy) Assign.4 due-includes L13-18  

Oct. 27  
L20- Application of High Pressure processing of foods  
Dr Xiaonan Lu  

Nov. 03  
L21- Food safety engineering concepts in food processing  

Nov. 05  
L22- Concentration processes: Evaporation  

Nov. 10  
L23- Concentration processes: Dehydration  

Nov. 12  
L24- Freeze concentration  

Nov. 17  
L25- Microwave heating  
Nov. 19  
L26- Water activity in foods  
Nov. 23  
Psychometric chart  

Nov. 24  
Exam: L1-L9  

Nov. 26  
Review Exam: L10-L18  

Nov. 28  
Exam: L27-L26  

Nov. 30  
Review Exam: L25-L24  

Dec. 01  
Exam: L21-L18  

Dec. 08  
Exam: L19-L12  

Dec. 20  
Exam: L10-L9  

Dec. 21  
Exam: L1-L9  

Dec. 26  
Exam: L27-21