

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

Midterm Exam	25%
Assignments (5 x 3% each)	15%
Group Presentation & Paper	15%
Final Exam	45%
TOTAL	100%

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 <
<http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,0,0>>.

Textbooks Resources for this course:

1. Singh, R.P. and D.R. Heldman. Introduction to Food Engineering. 4th Ed. Academic Press, Inc., 841 pp., 2009.
2. Earle, R.L. Unit Operations in Food Processing. 2nd Ed. Pergamon Press. 207 pp., 1983.
3. Henderson, S.M. and R.L. Perry. Agricultural Process Engineering. 3rd Ed. The AVI Publishing Co., Inc., 442 pp., 1976.
4. Toledo, R.T. Fundamentals of Food Process Engineering. The AVI Publishing Co., Inc., 409 pp., 1980.
5. Heldman, D.R. and R.P. Singh Food Process Engineering. 2nd Ed. Van Nostrand Reinhold, 414 pp., 1981.
6. Fellows, P. Food processing Technology: Principles and Practice 3rd Ed. Woodhead Publishing. 2000
7. Cutnell & Johnson. Physics. 8th Edition. John Wiley & Sons, Inc.

Course Schedule

	Sept. 3 L1- Course Introduction: Work, Energy and Power	Sept.5 L1- Work, Energy and Power
Sept. 8 L2- Measurements, Units & Dimensions .	Sept. 10 L3- Food Packaging: selection of appropriate packages.	Sept. 12 L4- Heat transfer and Mass Modes of heat transfer
Sept. 15 L5- Heat Exchangers in food processing	Sept. 17 L6- Principles for food preservation	Sept. 19 L7-Moisture content , Mass & Energy balances Assign. 1 due- involves critical thinking
Sept. 22 L8-Blanching of foods	Sept.24 L9-Heat pasteurization of foods	Sept. 26 L10- Heat sterilization of foods Assign. 2 due Oct. 1–includes L1-L6
Sept. 29 L11-Refrigeration/chilling systems	Oct. 01 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 Siyun Wang	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. 17 - Midterm - includes L1- L12
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	Oct. 29 L21-Food safety engineering concepts in food processing Dr Xiaonan Lu	Oct.31 L22-Concentration processes: Evaporation
Nov. 03 L23-Concentration processes: Dehydration	Nov. 05 L24- Freeze concentration	Nov. 07 L25- Dehydration equipments
Nov. 10 L25-Microwave heating	Nov.12 Water activity in foods	Nov. 14 Assign. 5 due-includes L19-26
Nov. 17 - L27 Psychometric chart	Nov. 19 G7)	P Nov. 21 G12)
Nov.24 Exam: L1-L9	R Nov.26 Exam: L10-L18	Review Nov. 28 -Review fo