FSHN 411 Food Engineering, Fall 2008
(3 credits, Cross-listed as BE 411)

Instructor: Soojin Jun
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Office hours: TR 2:30 – 4:30 p.m.

Meeting time: M W 3:30 – 4:20 pm
Class room: Ag. Science 204
Lab: F 1:30 – 4:20 pm Ag. Science 118

Course description: Designed for undergraduate students in Food Science program, who want to learn the basic engineering principles of heat and mass transfer, fluid flow applied to food processing through problem solving and laboratory experiments

Course Objectives:

Upon completing this course, the student will be able to:	Level[†]	Outcome[‡]
i) apply principles of mass/energy conservation and force balance to derive differential equations for a system;	I	(a)
ii) formulate and apply appropriate boundary/ initial conditions;	I	(a)
iii) understand basic principles of how light and electromagnetic radiation interact with materials;	I	(b)
iv) formulate solutions relating pressure, pump power, flow rate, and conduit characteristics/ dimensions in pipe flow;	D	(c)
v) understand the relationship between free energy, entropy, internal energy, and enthalpy;	D	(c)
vi) understand the fundamental principles of thermodynamic machines;	D	(c)
vii) recognize and define the problem to be solved;	D	(d)
viii) have a fundamental understanding of the material and chemical properties of biological materials;	D	(d)
ix) have a fundamental understanding of accuracy and precision of a measurement, and how these relate to uncertainties in the performance of a design;	M	(e)
x) use appropriate statistical tools to determine the power/ reliability of an experiment;	M	(e)
xi) apply computational tools for the solution of multidimensional and partial differential equations;	D	(f)
xii) write structured code to simulate a system;	D	(f)

xiii) share responsibilities and duties with team members;	M	(g)
xiv) objectively discuss the problem and the merits of possible solutions;	M	(g)
xv) organize the content of a presentation according to the informational needs and technical background of audience;	D	(i)
xvi) effectively address questions and/or assimilate feedback from an audience;	D	(i)
xvii) effectively assimilate feedback from a reviewer/ audience;	D	(i)
xviii) develop independence in researching current literature, patents, and design standards;	D	(k)

† I = Introductory; D = Developmental; M = Mastery.

‡ UH Biological Engineering Course Outcomes:

(a) The graduate has the ability to solve problems involving differential equations.

(b) The graduate has the ability to solve physics problems involving mechanics, electromagnetics, and optics; chemistry problems involving inorganic and organic chemistry; problems involving general and micro-biology.

(c) The graduate has the ability to solve engineering problems related to statics, dynamics, fluid mechanics, and thermodynamics.

(d) The graduate has the ability to design a system, component, or process in which biology plays a significant role.

(e) The graduate has the ability to design and conduct experiments to gather information for engineering designs.

(f) The graduate has the ability to use modern engineering techniques, skills, and tools to define, formulate, and solve engineering problems.

(g) The graduate has the ability to function effectively on multi-disciplinary teams.

(h) The graduate has the ability to identify professional and ethical responsibilities when practicing engineering.

(i) The graduate has the ability to communicate effectively in large and small groups.

(j) The graduate has the background to understand the impact of engineering solutions on the surrounding context.

(k) The graduate recognizes the need to engage in life-long learning through participation in professional conferences, workshops, and courses, and by reading and writing in the relevant literature.

(l) The graduate has the ability to intelligently discuss contemporary issues.

Course policies:

1. Attendance is expected, not required and will not influence course grade. However, Lab attendance is required because it needs team play that every group member should participate in. You can rearrange the schedule with an instructor and other group members if you have to miss a lab.
2. Lab rules: **Keep your work area in the lab clean**. After your experiment turn all power off, unplug batteries, wires etc. Place electronic components in the right place (in a packet or box).
3. All graded assignments, lab reports, quizzes and exams will be returned to students.
4. The course is graded on an absolute grading policy.

5. **A team project** on a student-selected, instructor-approved topic will be conducted in groups of 2 or 3 students. The team projects are conceived to increase the involvement of the students in the learning process and to promote communications. Through group discussions, the team members will help consolidate the learning process, learn to negotiate, and yet make better decisions. Each group will make a professional presentation and submit a written report at the end of the semester. The topic may cover any food or processing method. Examples of topics are "Factors affecting the shelf life of salad dressings"; "Electrical conductivity of ohmically treated foods"; "Unsteady state heat transfer in microwaved foods"; "Advances in high pressure processing of foods".
6. **Homework:** Homework must be turned in before class by a due date. Late homework will receive a 15% penalty per day. Each assignment will be equally weighed throughout the semester.
7. **Quizzes:** In-class quizzes (typically 15 minutes) will be one problem or several conceptual questions given at the beginning of the lecture. The material covered on the quiz will come from the previous lectures, homework. The quiz will be closed books and notes. No make-up quizzes will be given.
8. **Exams:** Two exams will be given during the semester. The exams will be closed books and notes. No make-up exams will be given.
9. **Lab assignment:** Lab reports are due in lab before the beginning of the next lab exercise. Follow the format in the lab report sheet specified by followings;
   (1) Introduction: Brief description of the data or problem, type of equipment, and objectives of the study (10 pts)
   (2) Experimental apparatus and procedures: General procedures used for laboratory, diagrams of the experimental set up, and theoretical development (10 pts)
   (3) Results and discussion: Answers to specific questions, sources of errors, and figures and tables of analysis results (20 pts)
   (4) Conclusion: Suggestions or comments to improve the lab (5 pts)

   One report per group is requested. Late lab assignments will be accepted only if prior arrangements were made. Late lab assignments will be penalized 15% per day.

Academic integrity:

"Professional conduct, especially with regard to honesty and integrity, is a lifetime requirement for those pursuing an engineering career."

Text:

R. Paul Singh, Dennis R. Heldman, 2000, Introduction of Food Engineering, 3rd edition, Academic Press Inc.

References:

Christie J. Geankoplis, 2003, Transport Processes and Unit Operations, 4th edition, Allyn and Bacon, Inc.

Romeo T. Toledo, 1991, Fundamentals of Food Process Engineering, 2nd edition, Van Nostrand Reinhold

Grade basis and scale:

A+	> 93%	C+	74 – 76.9%

Homework (10)	15%
Quiz (4)	10%
Midterm exam	20%
Final exam	20%
Team project	
Final report & Presentation	15%
Peer evaluation	5%
Lab reports (14)	15%

A	90 – 93%	C	70 – 73.9%
A-	87 – 89.9%	C-	67 – 69.9%
B+	84 – 86.9%	D+	64 – 66.9%
B	80 – 83.9%	D	60 – 63.9%
B-	77 – 79.9%	F	< 60%

Course plan:

Lecture	Topic	Reading (Chap.)	Lab/Homework
1	Introduction to food processing, format and scope of course, course expectations	1.1-1.2	Team organization
2	Units and dimensions, system and properties	1.3-1.5	**Lab1:** Internet resources in Food processing. computer basics, review of maths
3	Enthalpy, Thermodynamics, Conservation of mass & energy	1.12-1.17	**HW1: 1.1, 1.2, 1.3, 1.4**
4	Liquid properties, Viscosity measurement	2.1-2.3	**Lab2:** Viscometry
5	Mechanical energy balance, Flow measurement	2.5-2.7	Due - HW1 **HW2: 2.1, 2.2, 2.4, 2.8**
6	**Quiz1**, Generation of steam, Fuel utilization	3.1-3.2	**Lab3:** Estimation of pipe friction
7	Electric power utilization	3.3	Due - HW2 **HW3: 2.10, 3.2, 3.3, 3.5**
8	Heat transfer in food processing	4.1-4.2	**Lab4:** Pump characteristics
9	Steady state heat transfer	4.3-4.4	Due - HW3
10	Unsteady state heat transfer	4.5-4.6	**Lab5:** Steam quality
11	**Quiz2**, Thermal processing: D, Z, F values	5.1-5.4	**HW4: 3.10, 4.4, 4.7, 4.17**
12	Chemical kinetics and thermal parameters	5.5-5.6	**Lab6:** Thermal properties **Team project abstract Due**
13	Aseptic processing	6.1-6.2	Due - HW4 **HW5: 5.1, 5.4, 5.8, 5.10**
14	Mathematical formulation of aseptic process	6.2	**Lab7:** Convective heat transfer, Review

15	**Midterm exam**		
16	Components of refrigeration system COP refrigerant requirement, multistage systems	7.1-7.3	Due - HW5 **HW6: 6.1, 6.2, 6.3, 6.5** **Lab8:** Heat exchangers
17	Pressure-Enthalpy chart	7.4	Due - HW6
18	Mathematical expressions in analysis of vapor-compression	7.5-7.6	**HW7: 7.2, 7.3, 7.6, 7.9** **Lab9:** Refrigeration
19	Refrigeration Freezing system, frozen food properties	8.1-8.2	
20	Freezing time, storage, Types of evaporators	8.3-8.4 9.2	Due - HW7 **HW8: 8.1, 8.3, 8.5, 8.6** **Lab10:** Evaporation
21	**Quiz3**, Design of evaporator	9.3-9.6	
22	Properties of dry air, properties of water vapor	10.1-10.3	Due - HW8 **Lab11:** Pilot plant tour
23	Properties of air-vapor mixtures, psychrometric chart	10.4-10.5	**HW9: 9.1, 9.2, 10.2, 10.6**
24	Diffusion process	11.1-11.2	**Lab12:** Psychrometrics/ Food freezing
25	Membrane separation systems, food packaging	11.3-11.4	Due - HW9
26	**Quiz4**, Basic drying process	12.1-12.2	**Lab13:** Water content of corn meal **Team project progress (5-10 min discussion)**
27	Dehydration systems and designing	12.2-12.3	**HW10: 11.2, 11.4, 12.1, 12.2**
28	Introduction of data acquisition system (Power point slides)	Handout	**Lab14:** Simple data acquisition system
29	Digital control system (Power point slides)	Handout	Due - HW10
30	Review, Problem solving		**Lab15:** Team project presentations
31	**Final exam**		
32	**Last day of class – Team project report Due**		

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