

## **GRSC 820 Advanced Extrusion Processing**

**Fall 2007**

(12/07/07)

### **Instructor**

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**Lectures:** MWF 10:30-11:20 am; SH301

**Lab** : W 12:30-3:20 pm; SH301; Extrusion Labs (Waters 02G and BIVAP)

**Course Description:** 4 credits. This is a graduate level class, and will involve advanced study of the principles of extrusion forming and cooking with a detailed focus on traditional topics like screw and die design, drying and scale-up, and more current areas like polymer science applications to processing, low carb and/ or high fiber products, and recent innovations in extrusion technology.

The class will start from a basic intro on extrusion (there are students in the class with no prior extrusion experience) and go on to research-based topics (which can't be covered in an undergrad class like GRSC 720) for the rest of the semester. Students will be taken through the complete research cycle – from literature search and formulation of research hypothesis to experimental design, lab work, data analysis and manuscript writing. Depending on time available, the class might also involve one or two field trips to regional extrusion-based industries, and a few guest lectures from industry specialists.

Most of the class lectures will be informal and discussion-based. The class will involve a 3 hour lab component as well. A variety of extrusion systems (including pilot scale single and twin screw extruders, and a lab scale twin-screw extruder) and research problems will be studied in the laboratory with associated group projects. Considering, the nature of graduate level research projects, some of the lab work may to be done outside the regular lab hours.

**Required Text:** *Extruders in Food Applications* (2000). Ed. Mian N. Riaz. \$151.95. Copies are available at Varney's Bookstore in Aggieville and at the campus bookstore.

A substantial amount of reading material will be based on handouts given in class, mostly reproductions of research articles. A reproduction fee of \$30.00 is to be paid by each student to Ms. Addie Lynn in SH203 by August 29<sup>th</sup> (Wednesday).

## Other Useful Extrusion Texts:

### Introductory

*\*Extruders and Expanders in Pet Food, Aquatic and Livestock Feeds* (2007) Ed. Mian Riaz

*The Technology of Extrusion Cooking* (1994) Ed. N.D. Frame

*Extrusion Cooking. Technologies and Applications* (2001) Ed. Robin Guy

(Available online through KSU Libraries website)

### Graduate Level

*Food Extrusion Science and Technology* Eds. J.L. Kokini, C.-T. Ho, and M.V. Karwe

*Extrusion Cooking* Eds. C. Mercier, P. Linko, and J.M. Harper

All of the above text books are on reserve in the Swanson Resource Room (SH 303) and Hale Library, except for the one marked by \*.

## Basis for Evaluation/ Grades

Class discussion and general participation	= 200
Weekly lab work, reports, assignments	= 400
Term Project Work	= 200
Term Paper and Presentation	= 200
(First draft 25, Peer-review 25, Presentation 50, Term paper 100)	

Total 1000 points

Letter grades will be assigned according to the total number of points earned as follows:

A = 900-1000      B = 800-899      C = 700-799      D = 600 – 699

F < 600 points

## Lab Reports Format

The lab report should have a cover page, with an appropriate title, name of the individual submitting it, date of the lab and date of submission. The report should be styled after the standard format for submission of articles to any recognized peer-reviewed journal of the student's choice, preferably where they intend to eventually submit the term project work. The reports should be double spaced and preferably not be more than 6 pages in length, excluding the cover page but including all figures, tables and references.

## Term Paper Format

The term paper should be styled after the standard format for submission of articles to the peer-reviewed journal where the students intend to eventually submit their work, or after the standard format of patent disclosures to the Kansas State University Research Foundation (KSURF). The paper should have a cover page, with an appropriate title, name of the group members submitting it, journal name (or patent disclosure intent), and

a tentative date for final submission to the journal or KSURF. The paper should be double spaced and there are no page limits.

### **Statement Regarding Academic Honesty**

Kansas State University has an Honor & Integrity System based on personal integrity, which is presumed to be sufficient assurance in academic matters one's work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor & Integrity System. The policies and procedures of the Honor & Integrity System apply to all full and part time students enrolled in undergraduate and graduate courses on-campus, off-campus, and via distance learning. The honor system web site can be reach via the following URL: <<http://www.ksu.edu/honor>> .

A component vital to the Honor System is the inclusion of the Honor Pledge which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: "On my honor, as a student, I have neither given nor received unauthorized aid on this academic work." A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation.

Academic cheating and /or plagiarism (presenting part or whole of another person's work as your own) is considered a serious offence and a violation of the Honor Pledge. If you are caught cheating or plagiarizing, it will results in failure of the exam, report, or entire course.

### **Students with Disabilities**

Any student with a disability who needs an accommodation or other assistance in this course should make an appointment to speak with the instructor as soon as possible.

**GRSC 820 Advanced Extrusion Processing  
Fall 2007 Course Schedule**

<b>Week</b>	<b>Date</b>	<b>Topic</b>	<b>Comments/ Reading Assignments</b>
Week 01	Aug 20-24	Introduction; Basic extrusion principles	
	<b>Aug 18, Wed</b>	<b>Lab01 Tour of Extrusion Lab facilities; Lab Groups</b>	
Week 02	Aug 27-31	Trends in extrusion research - I	
	<b>Aug 29, Wed</b>	<b>Lab02 Lab-Scale Extrusion – all groups</b>	
Week 03	Sep 03-07	Basic extrusion principles	Group project draft proposals due 09/07/07
	<b>Sep 03</b>	<b>No Class (Labor Day Holiday)</b>	
	<b>Sep 05, Wed</b>	<b>Lab03 Pilot Scale Extrusion on TX-52 and X-20 – all groups</b>	Lab timings changed: 2-4:50 pm
Week 04	Sep 10-14	Trends in extrusion research - II	
	<b>Sep 12, Wed</b>	<b>Lab04 Lab-Scale Extrusion – Group 01</b>	
Week 05	Sep 17-21	No class whole week; Research Trends review assignment	
	<b>Sep 19, Wed</b>	<b>Lab05 Lab-Scale Extrusion – Group 02</b>	
Week 06	Sep 24-28	Extrudate measurements	
	<b>Sep 26, Wed</b>	<b>Lab06 Lab-Scale Extrusion – Group 03</b>	
Week 07	<b>Oct 01</b>	<b>No Class (Student Holiday)</b>	
	Oct 03, 05	Brian Plattner (Wenger) guest lectures - Mass and Energy Balance (Wed) - Scale-up (Fri)	
	<b>Oct 03, Wed</b>	<b>Lab07 Lab-Scale Extrusion – Group 04</b>	
Week 08	Oct 08-12	No class on Mon and Wed; Review of group projects	
	<b>Oct 10, Wed</b>	<b>Lab08 Pilot -Scale Extrusion – Group 01</b>	
Week 09	Oct 15-19	Extrusion process characterization; Kaleb Beyer (Wenger) guest lecture – aquatic feed (Fri)	Group project extended proposals due 10/17/07
	<b>Oct 17, Wed</b>	<b>Lab09 Pilot -Scale Extrusion – Group 02</b>	
Week 10	Oct 22-26	Extrusion process characterization; Review of group projects	
	<b>Oct 24, Wed</b>	<b>Lab10 Pilot -Scale Extrusion – Group 03</b>	
Week 11	Oct 29 – Nov 02	Screw and die design	

Week	Date	Topic	Comments/ Reading Assignments
	<b>Oct 31, Wed</b>	<b>Lab11 Pilot -Scale Extrusion – Group 04</b>	
Week 12	Nov 05 - 09	Screw and die design; Extruder performance Pierr Faa (Frito Lay) guest lecture – healthy snacks	
	<b>Nov 07, Wed</b>	<b>Lab12 Pilot -Scale Extrusion – Group 01</b>	
Week 13	Nov 12 - 16	Polymer science and phase transition applications in processing Lew Keller (Frito Lay) guest lecture – screw profile	Term paper first draft due; Nov. 16th
	<b>Nov 14, Wed</b>	<b>Lab12 Pilot -Scale Extrusion – Group 02</b>	
Week 14	Nov 19	Polymer science and phase transition applications in processing	
	Nov 21, 23	<b>No Class (Thanksgiving Holiday)</b>	
Week 15	Nov 26 - 30	Polymer science and phase transition applications in processing	
	<b>Nov 28, Wed</b>	<b>Lab13 Pilot -Scale Extrusion – Group 03</b>	
Week 16	Dec 03 - 07	Modeling of bubble growth dynamics	Term paper peer-review due; Dec. 5th
	<b>Dec 05, Wed</b>	<b>Lab14 Pilot -Scale Extrusion – Group 04</b>	
	<b>Dec 12, Wed 11:50 am – 1:40 pm</b>	<b>TERM PAPER PRESENTATION</b>	<b>TERM PAPERS DUE</b>

**THIS SCHEDULE IS SUBJECT TO REVISION BY THE INSTRUCTOR.**