TSM 455/555 Feed Processing and Technology

Instructor
Dr. Dirk Maier
3325 Elings Hall
294-0140
dmaier@iastate.edu

Textbook
Readings will be assigned from the Feed Pelleting Reference Guide. This is available online at http://www.wattagnet.com/feed-pelleting-reference-guide. It is free but requires an account to download.

Recommended (but not required) is Feed Manufacturing Technology V. The book is available directly from the publisher. The cost is $112.50 payable by check or money order to AFIA.

Additional readings will be assigned from various trade publications. These readings will be provided to you throughout the course.

Catalog Description
TSM 455/455: Feed Processing and Technology. (3-0) Cr. 3, S.
Prerequisite: junior classification or higher.
Introduction to formula feed manufacturing and the animal feed industry. Overview of feed ingredients and formulation, understanding and operation of feed production processing equipment including principles of conveying, grinding, mixing, conditioning, pelleting, and other processing techniques, and the formulation of concentrates, premixes, and rations. Students will become knowledgeable about the manufacturing of various animal feed types such as pelleted and extruded feed, aqua (fish) feed, liquid feeds, poured and pressed blocks, steam flaked feed, and pet food, and their effect on animal performance and health. TSM 555: Research project required for graduate credit.

Course Outcome
Students will become familiar with the global production animal feed industry, feed manufacturing equipment and processes, effect of feed manufacturing on animal performance, and elements of effective feed mill operations management, and be competent in critical roles of operating a feed mill.

To succeed in this course, expect to spend at least 6-9 hours per week outside of class completing the readings and lab reports.

Student Learning Objectives
1. To become familiar with the importance, scope, and trends of the global animal feed industry.
2. To understand the basic processes used to convert raw materials (ingredients) into finished animal feeds.
3. To understand the principles of design and operation of contemporary feed manufacturing equipment, including equipment maintenance and trouble-shooting.
4. To be able to relate the effect of each feed manufacturing process and ingredients to animal performance and health.
5. To apply knowledge of processing and process components to solve feed quality and/or production problems.
6. To understand feed mill operations management as it pertains to feed quality and safety, worker safety, and profitability.
7. TSM 555: to conduct literature reviews and write research papers in the field of feed processing and technology.

For ISU Students: AST/ITec Program Competencies addressed in this course
a) an ability to apply knowledge of mathematics, science, and applied sciences;
b) an ability to design and conduct experiments, as well as to analyze and interpret data
e) an ability to identify and solve applied science problems;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of solutions in a global and societal context
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice
n) an understanding of the complex systems that sustain our water, air, soils, and food.

Course Grading
Quizzes (15-20)
Short online quizzes (3-4 questions) will be given over the reading assignments. The instructor will proceed on the assumption that reading assignments have been completed.

Laboratory Exercises (5)
The laboratory section will be held during regular class time in Sukup Hall or Food Science building in the pilot plant of the Center for Crops Utilization Research (CCUR).

Exams (2)
There will be two midterm exams. Each exam will be worth 100 points.

Final Exam
The final exam (not comprehensive but over the third section of the semester) is scheduled for December 12th, 2017, from 9:45 a.m. to 10:30 a.m. in Elinggs 4223. The final is worth a total of 100 points.

Research Project/Presentation (TSM 555 - Graduate Students Only)
Students taking the class for graduate credit will research a topic related to feed processing or technology and present their final project to the class during finals week. Students must receive a C or better in the research project in order to pass the class.

**Grading**

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<td>Lab exercises (5)</td>
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**Course Expectations**

- Attendance is **REQUIRED AND HIGHLY RECOMMENDED! NO CREDIT WILL BE GIVEN FOR MISSED ASSIGNMENTS OR EXAMINATIONS WITHOUT THE INSTRUCTOR’S PRIOR APPROVAL.** No credit will be given for missed assignments without the instructor’s prior approval.
- This course, as all courses in the ABE department, adheres to the [ABE Code of Classroom Conduct](http://www.abe.iastate.edu/abe-code-of-classroom-conduct/).
- Students are expected to be in class on time (i.e., at least 5 minutes before lectures or labs start).
- You are responsible for all information missed because of your absence, not the instructor.
- **Leaving spilled grain is a great way to get insects!** At the completion of each lab the counters and floors must be cleaned entirely of any grain or grain residue!
University and Department Policies/Information

Campus Resources

The following resources may be of assistance to you:

- Academic Success Center: [http://www.dso.iastate.edu/asc/](http://www.dso.iastate.edu/asc/). The Academic Success Center (ASC) is a collection of services and programs designed to help you reach your academic goals. ASC offers individualized and group experiences, course-specific and general academic assistance, and even credit and non-credit programs.
- Student Disability Resources: [http://www.sdr.dso.iastate.edu/](http://www.sdr.dso.iastate.edu/)
- Writing and Media Help Center: [http://www.dso.iastate.edu/wmc](http://www.dso.iastate.edu/wmc). Trained consultants assist with written, oral, visual and electronic communication.

Disability Accommodations

Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. All students requesting accommodations are required to meet with staff in Student Disability Resources (SDR) to establish eligibility. A Student Academic Accommodation Request (SAAR) form will be provided to eligible students. The provision of reasonable accommodations in this course will be arranged after timely delivery of the SAAR form to the instructor. Students are encouraged to deliver completed SAAR forms as early in the semester as possible. SDR, a unit in the Dean of Students Office, is located in room 1076, Student Services Building or online at [http://www.sdr.dso.iastate.edu/](http://www.sdr.dso.iastate.edu/). Contact SDR by e-mail at disabilityresources@iastate.edu or by phone at 515-294-7220 for additional information.

Academic Dishonesty

The class will follow Iowa State University’s policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.

Note that ISU identifies several forms of academic dishonesty including: A student uses or attempts to use unauthorized information in the taking of an exam; submits as his or her own work, themes, reports, drawings, laboratory notes, computer programs, or other products prepared by another person; or knowingly assists another student in such acts or plagiarism. Students found guilty of academic dishonesty in this class face suspension, conduct probation, or reprimand.

You should review this policy. See [http://www.studentconduct.dso.iastate.edu/academic/misconduct.html](http://www.studentconduct.dso.iastate.edu/academic/misconduct.html) and [http://catalog.iastate.edu/academic_conduct/#academicdishonestytext](http://catalog.iastate.edu/academic_conduct/#academicdishonestytext).
Harassment and Discrimination

Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact the course instructor, the ABE Associate Chair of Teaching (Dr. Amy Kaleita, kaleita@iastate.edu, 515.294.5167), Student Assistance (http://www.studentassistance.dso.iastate.edu/, dso-sas@iastate.edu, 515.294.1020), or the Office of Equal Opportunity (http://www.eoc.iastate.edu/, eooffice@iastate.edu, 515.294.7612).

Religious Accommodation

If an academic requirement of this class conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be submitted to the instructor in writing. You may also seek assistance from the Dean of Students Office (http://www.dso.iastate.edu/, dsoweb@iastate.edu, 515.294.1020) or the Office of Equal Opportunity (http://www.eoc.iastate.edu/, eooffice@iastate.edu, 515.294.7612).

Classroom Conduct

All students have the right to learn without interference from others. Instructors, teaching assistants, and staff members have the authority to protect this right by creating and maintaining an environment that is conducive to learning. Toward this end, the department of Agricultural and Biosystems Engineering (ABE) has developed the following Code of Classroom Conduct: http://www.abe.iastate.edu/abe-code-of-classroom-conduct/. The University’s Student Conduct Code can be found here: http://www.policy.iastate.edu/policy/SDR#4.0.

Safety Emphasis

Students in ABE/TSM classes work with systems that, if misused, can be extremely hazardous. Therefore developing an attitude of safety is crucial to all engineering and technology professionals. Instructors may take an array of actions when students fail to complete required safety training (for example by coming late to class and missing a safety briefing) or to adhere to procedures. These include but are not limited to (1) only allowing the student to observe the lab; (2) only allowing the student to observe the lab and deducting points from the associated lab report; (3) suspending the student from all lab activities until the student has successfully completed the required safety portion of the lab (this may mean attending another lab section where the student can arrive on time); (4) dismissing students – and particularly repeat violators of safety policy – from the course.
Dead Week

For each Fall and Spring semester, the last full week of classes before final examinations is designated as Dead Week. The intent of this policy is to establish a one-week period of substantial and predictable study time for undergraduate students. During the Dead Week period, regular lectures are expected to continue, including the introduction of new content, as deemed appropriate by the instructor. The restrictions established by this Dead Week policy includes:

- Due dates for mandatory graded submissions of any kind that fall within Dead Week must be listed on the syllabus provided at the start of the course.
- Mandatory final examinations may not be given during the Dead Week period except for laboratory courses or courses that meet weekly and for which there is no contact during the normal final examination week.

Contact Information

If you are experiencing, or have experienced, a problem with any of the policy or guideline issues described above, email academicissues@iastate.edu.

Emergency Information

Iowa State University is committed to providing a safe teaching and learning environment. You should familiarize yourself with the emergency action plan for your area or building so you will know what to do in the event of an emergency. The Emergency Procedures Guide: https://www.ehs.iastate.edu/prep/emergency-procedures has helpful information such as evacuation routes, severe-weather shelter areas, safety tips, and other helpful resources. Also, http://web.iastate.edu/students/safety is a helpful website with information for contacting medical, counseling, sexual misconduct and assault reporting, and other crisis resources.

In the event of an emergency, call 911.
For non-emergencies, call (515) 294-4428.
For urgent counseling, call (515) 294-5056. After hours, call (515) 290-3642.

ISU Department of Public Safety Escort Service, call (515) 294-4444.
Car trouble while on campus? Call the Help Van: (515) 294-4444.
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<th>Subtopics</th>
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<th>Activity</th>
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<tr>
<td>1</td>
<td>8/22</td>
<td>Lec 1. Introductions, Syllabus, Lab safety</td>
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<td>SC</td>
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|    | 8/22 | Lec 2. Overview of US and World Feed Industry | • History  
• Scope and scale  
• Trends  
• Global trade | World Grain article | DEM |
|    | 8/24 | Lec 3. Feed Mill Equipment and Process Flows | • Basic process flow sheets  
• Feed mills are “recycling plants”  
• How gravity is used  
• Plant overview, inside and out | FT-V Ch. 5 pp. 43-57 | DEM |
| 2  | 8/29 | Feed Mill Tour - Ag Partners, Ellsworth, Iowa |  |  |  |
|    | 8/31 | Lec 4. Feed Mill Layout and Design | • In-depth ingredient flow process  
• Design considerations  
• Alternative layouts | FT-V Ch. 6 | Guest Lecture – T&S  
Guest Lecture |
| 3  | 9/05 | Lec 5. Feed Ingredients | • Major and Minor ingredients  
• Sourcing & supplier relationships | Article | Quiz  
Muddiest Points |
|    | 9/05 | Lec 6. Feed Additive Compendium & MFAs | • Current regulations  
• Walkthrough FAC | Article | SC |
|    | 9/07 | Lec 7. Receiving Process | • Approved Supplier relationships  
• SOPs | FT-V Ch 7 pp. 91-97 | Quiz |
|    | 9/07 | Lec 8. Inbound Ingredient Logistics | • Bulk vs Bagged |  | SC |
| 4  | 9/12 | Lec 9. Materials Handling | • Angle of repose  
• Flowability  
• Ingredient considerations | FT-V Ch 7 pp. 97-107 | Quiz  
Muddiest Points |
|    | 9/12 | Lec 10. Feed Formulation | • Nutritional Requirements  
• Least-cost Formulation  
• Ingredient availability  
• Nutritionist-Feed Mill relations | Article | Guest Lecturer |
|    | 9/14 | Lec 11. Particle Size Reduction – Hammer Mills | • Design  
• Operation | FT-V Ch 8 pp. 109-116 | Quiz  
SC |
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| 5    | 9/19 | Lec 12. Particle Size Reduction – Roller Mills | Design  
• Operation  
• Effect on performance/quality  
FT-V Ch 8 pp 116-126  
SC |
| 5    | 9/21 | Particle Size Reduction and Analysis Lab | Lab – meet in CCUR  
Pre-lab safety quiz completed  
Muddiest Points-Exam review  
Graduate Student (lead) |
| 6    | 9/26 | Exam 1 |  
Lec 13. Weighing, Proportioning, and Batching  
• Load cells, scales, balances  
• Sequencing  
FT-V Ch 9 & 15  
SC |
| 6    | 9/28 | Lec 15. Mixing |  
• Mixer designs  
• Operation  
• Effect on performance/quality  
FT-V Ch 10  
Quiz  
SC |
| 7    | 10/03 | Mixer Uniformity Analysis Lab | Lab – meet in CCUR  
Graduate Student (lead) |
| 7    | 10/05 | Lec 16. Boilers & Steam Systems |  
• Boiler design  
• Operation  
• Steam quality  
FT-V Ch 52  
Quiz  
DEM |
| 7    | 10/05 | Lec 17. Conditioning |  
• Design  
• Operation  
• Effect on performance/quality  
Muddiest Points  
DEM |
| 8    | 10/10 | Lec 18. Pelleting I |  
• Pellet mill design  
FT-V Ch 11  
Quiz  
DEM |
| 8    | 10/12 | Conditioning and Pelleting Lab | Lab – meet in CCUR  
Graduate Student (lead) |
| 9    | 10/17 | Lec 19. Pelleting II |  
• Pellet Mill Operation  
• Effect on performance/quality  
FT-V Ch 11 pp157-162  
DEM |
| 9    | 10/19 | Lec 20. Pellet Cooling |  
• Design  
• Operation  
Article  
Quiz  
DEM |
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<td>10/24</td>
<td>Pellet Durability Analysis Lab</td>
<td>Lec 21. Post-Pellet Liquid Application</td>
<td>Lab – meet in Sukup Muddiest Points Exam review</td>
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<td>Lec 22. Bagging &amp; Load-out</td>
<td>FT-V Ch 12 &amp; 14</td>
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<td>Lec 23. Feed Delivery &amp; Fleet Management</td>
<td>Lec 24. Warehouse Management</td>
<td>FT-V Ch 13</td>
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<td>11/02</td>
<td>Lec 25. Specialty Feeds</td>
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<td>Read NGFA article</td>
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<td>11/07</td>
<td>Lec 26. Specialty Processing Equipment</td>
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<td>Read Grain Journal article</td>
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<td>Lec 27. Preventive Maintenance &amp; Troubleshooting</td>
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<td>11/14</td>
<td>Lec 28. Automation and Control Systems</td>
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| 11/30  | Lec 30. Predictive/Preventive Maintenance   | • Supplier relations
• Day-to-day
• Scheduling maintenance
• Record keeping
• Prioritizing maintenance schedule | FT-V Ch 48          | Quiz          | Guest Lecturer |
|        | Lec 31. Process Optimization                | • Just-in-time receiving/delivery
• Identifying constraints/bottlenecks
• Measuring efficiency | Article          |              | Guest Lecturer |
| 12/05  | Lec 32. Out-of-Spec, Rework, and Real-World | • Real-world situation problem solving                                 | FT-V Ch 37 & 38 | Quiz          | Guest Lecturer |
|        | Situations                                   |                                                                         |                  |              | Guest Lecturer |
| 12/07  | Lec 33. Safety and Regulatory Compliance    | • Governing bodies
• Relevant legislation/regulations
• Compliance | Guest lecture | Quiz          | Guest Lecturer |
|        | Lec 34. Quality Assurance/Quality Control   | • Relevant parts of QA/QC manuals
• Examples | Article          | Exam review     | Guest Lecturer |
| 12/12  | Final Exam                                   |                                                                         |                  |              |                  |
|        | Graduate Student Presentations              |                                                                         |                  |              |                  |