Graduate Handbook

Department of Food Science

University of Massachusetts Amherst
**Contents**

Contents .................................................................................................................................................. 2

Getting Started ........................................................................................................................................ 3

Graduate Student Information .................................................................................................................. 4

M.S. with Thesis ......................................................................................................................................... 5

1-Year Professional M.S. Degree .............................................................................................................. 5

Ph.D. .......................................................................................................................................................... 6

Ph.D. Coursework ...................................................................................................................................... 7

  Written Comprehensive Exam ................................................................................................................... 8

  Oral Comprehensive Exam ....................................................................................................................... 9

  Dissertation Prospectus/Outline Exam ..................................................................................................... 10

  Final Dissertation Defense ....................................................................................................................... 12

Summary of Guidelines for NIH R21 Proposal .......................................................................................... 14

Summary of Guidelines for USDA NIFA Proposal .................................................................................... 15

Written Comprehensive Exam Guidelines .................................................................................................. 16

  Food Processing .................................................................................................................................... 16

  Food Chemistry ..................................................................................................................................... 17

  Food Microbiology ................................................................................................................................. 19

Travel Guidelines ....................................................................................................................................... 20

Annual Report ........................................................................................................................................... 21
Getting Started

- Order a building (Chenoweth) and lab key with the lab technician for your lab.
- International students: Visit International Programs Office (Hills South) and see Richard Yam. Link to the IPO website: [http://www.umass.edu/ipo/iss/](http://www.umass.edu/ipo/iss/)
- Get a campus ID card from Whitmore.
- Get an email address from OIT.
- Give Mary (mbell@cns.umass.edu) and your advisor the email address you check daily.
- Tell your advisor your expected regular lab hours.
- Sign up for and attend lab, fire, and biological safety trainings with environmental health and safety. A link to upcoming classes is here: [http://www.ehs.umass.edu/index.html](http://www.ehs.umass.edu/index.html).
- Check with your advisor to register for additional required safety course(s) that are required.
- If you are receiving a Graduate Fellowship stipend, sign paperwork with Stacy (sapostolou@umass.edu) so you can start getting paid.
- You may choose to order business cards from Print Services: [http://www.umass.edu/print/products/business_cards.html](http://www.umass.edu/print/products/business_cards.html).
- Learn how to use Science Citation, library resources, GraphPad/Origin/Sigmaplot data analysis software, and RefWorks/Endnote bibliography software.
- Some suggested reading to get you started with independent research and technical writing:
  - Chapters 1, 4, 5, and 6 of *At the Bench, A Laboratory Navigator*;
  - Purdue Online Writing Lab for *Avoiding Plagiarism*: ([http://owl.english.purdue.edu/owl/resource/589/01/](http://owl.english.purdue.edu/owl/resource/589/01/)). Generally speaking, you must ALWAYS cite any reference you use in a text, and you must NEVER write word-for-word what someone else has already published (on the internet, in a book, or in a journal article). You must rephrase it and cite the original source. If you have any questions on what plagiarism is, contact your PI. Our library has a subscription to Turnitin, a software to detect plagiarism. It is a good idea to submit papers to Turnitin to ensure you’re not ‘accidentally’ plagiarizing.
- Discuss planned courses and timing for your degree with your advisor.
- Other places on campus you may want to check out: Recreation Center for gym membership; Campus Center for campus store and Blue Wall Café; Peoples Market for snacks and coffee; Mullins Center for hockey and basketball games and shows; University Health Services for doctor appointments.
- Other useful University links:
  - Graduate Student Handbook from the Graduate School: [http://www.umass.edu/gradschool/policies-forms/graduate-student-handbook](http://www.umass.edu/gradschool/policies-forms/graduate-student-handbook)
  - Tuition and Fee information: [http://www.umass.edu/bursar](http://www.umass.edu/bursar)
Graduate Student Information

University Costs
UMass Amherst tuition, fees, room and board rates are established each spring for the following academic year. Learn more about university costs.

Eligibility
There are several requirements that you must meet in order to be eligible for financial aid. Learn more about eligibility.

Applying for Aid
You must apply for aid every year. Filing the Free Application for Federal Student Aid (FAFSA) is the first step. Learn more about applying for aid.

Types of Aid
Most aid for graduate students is in the form of loans. You must be taking at least six credits in a degree-granting program to receive federal loans. You may also receive an assistantship from the Graduate School or your department. Learn more about the types of aid you may qualify for.

Receiving Aid
After you complete your FAFSA, review your Student Aid Report for accuracy and to ensure that UMass Amherst is listed to receive your information electronically. You may need to respond to requests for documentation before your aid can be awarded. Learn more about receiving aid, including when you will be notified about your award and when you can expect your funds to disburse.

Summer Aid
If you plan to take courses over the summer, you may be eligible to receive financial aid to offset the costs. The financial aid programs available for the summer are Federal Direct loans, credit-based alternative loans, and summer work study (for some eligible graduate students). Learn more about summer aid.

Student Employment Office
Most graduate students at UMass Amherst are hired through the graduate appointment process as teaching assistants, research assistants, interns, etc. Your best option for finding a teaching or research assistantship is to contact your academic department. In some cases, departments hire graduate students on an hourly basis. Visit Student Employment for more information.

Procedure for handling problems arising between a graduate student and the faculty mentor
If a graduate student is dissatisfied with mentorship by his/her advisor, the student should bring this up with the GPD or department head. If either is not available/appropriate, graduate student can contact any members of Departmental Graduate Program Committee, which information can be obtained upon request to the Departmental Office (Chenoweth Room 240).
One-Year Professional Master Degree in Food Science

**One Year Professional Master Degree in Food Science:** Applicants for the Masters degree with a B.S. degree in a field other than Food Science may qualify for the 1-Year non-thesis professional Masters degree. *Please note that students in this program do not qualify for graduate teaching and research assistantships.*

SUGGESTED COURSES FOR 1-YEAR Professional Master Degree in Food Science  
(for applicants with non food science B.S.)

Choose 30 credits

<table>
<thead>
<tr>
<th>FALL</th>
<th>Credits</th>
<th>SPRING</th>
<th>Credits</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Chem 541</td>
<td>3</td>
<td>Food Chem 542 or Elective*</td>
<td>3</td>
<td>Independent study***</td>
</tr>
<tr>
<td>Food Microbiology 567</td>
<td>3</td>
<td>Food Processing 561 or</td>
<td>3</td>
<td>(Food Science 696),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elem Food Proc. Engin 575</td>
<td></td>
<td>under guidance of a</td>
</tr>
<tr>
<td>Graduate course **</td>
<td>3</td>
<td>Graduate course**</td>
<td>3</td>
<td>academic advisor,</td>
</tr>
<tr>
<td>Elective*</td>
<td>3</td>
<td>Seminar FS791A</td>
<td>1</td>
<td>up to 6 credits.</td>
</tr>
</tbody>
</table>

Assumes prerequisites: Chemistry (two semesters of General Chemistry plus a complete course in Organic Chemistry), Microbiology, Biochemistry, and Intro statistics

At least 12 credits must be earned (at this University) in the 600-800 series

Department notes: One course must be in each area of: food chemistry (Food Chem 541 or 542), food microbiology (Food Microbiology 567), and food processing (Food Processing 561 or Elem Food Proc. Engin). One credit of graduate seminar is required. A final oral exam is required.

* Suggested Electives: Food Analysis 581, Plant & Soil Science 661 (Biometry) or other outside-Dept. courses (400-level or above). One 400-level course will be accepted.

** 700-level food science graduate courses

*** Register for Spring semester
M.S. with Thesis

- The standard M.S. degree in Food Science involves the completion of at least 20 graduate course credits (500-level and above) and a maximum of 10 thesis credits. Not less than 6 credits of courses at the 600- or 700-level are required (not Independent Study). Of these one course (3 or 4 credits, 400-level or above) may be from courses outside the Department. One credit of seminar is required.

- A typical program would include:
  
  Food Chemistry (FS 541 and 542)
  Food Microbiology (FS 567)
  Food Processing (FS 561)
  Food Analysis (FS 581)*

  *an analytical chemistry course in the Department of Chemistry at the 400-level or greater may be used to satisfy this requirement

- Two 700-level Food Science courses are offered each semester. Each is offered every two years.

- Students with a background in Food Science need not repeat these courses but may enroll in other 500-level or above courses.

1-Year Professional M.S. Degree

The 1-Year Professional Masters Degree in Food Science is designed for applicants who have earned a B.S. degree in a field of science other than food science and delivers a curriculum that provides students with the skills and knowledge to succeed in the food industry. Enrollment is highly selective and limited to applicants with a B.S. degree from a U.S. college/university and who have the necessary prerequisites: GPA of 3.0 or above; separate courses in general chemistry, organic chemistry, biochemistry, general microbiology and statistics.
Ph.D.

<table>
<thead>
<tr>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
<th>YEAR 4</th>
<th>(YEAR 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRITTEN COMP</td>
<td>ORAL COMP (1)</td>
<td>PROSPECTUS (2,3)</td>
<td>FINAL DEFENSE (4,5,6)</td>
<td></td>
</tr>
<tr>
<td>COMPLETE COURSEWORK ASAP</td>
<td>(7 months between prospectus and final defense)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Required Forms**

1. Nomination to candidacy for the doctoral degree form to graduate school
2. Advisor memo appointing dissertation committee to graduate school from GPD.
3. Signed prospectus/outline signature sheet to graduate school  
   *(At least 6 months before defense)*
4. Advisor memo announcing dissertation defense date to graduate school from GPD.  
   *(One month before defense)*
5. Signed dissertation signature sheet to graduate school
6. Advisor to request a memo for results of defense to GPD
7. Doctoral degree eligibility form to graduate school

**Notes**

- Forms #1, 2, 4, 6 are to be filled by GPD upon requests by the faculty advisor
- Specific timing depends on individual student progress.
- Full guidelines for Written and Oral Comprehensive Exams and course guidelines are available here: [http://www.umass.edu/foodsci/graduate/phdRequirements.html](http://www.umass.edu/foodsci/graduate/phdRequirements.html)
- Full guidelines for Dissertation Prospectus/Outline and Final Dissertation Exam, as well as a host of other requirements, are available here: [http://www.umass.edu/grad_catalog/doctoral.html](http://www.umass.edu/grad_catalog/doctoral.html)
- Prof. Yeonhwa Park, ypark@foodsci.umass.edu, (252 Chenoweth Lab) is the Food Science GPD.
- The Graduate school requires two consecutive semesters of residency for graduation, fulfilled by registering for 9 or more credits in two consecutive semesters.
Ph.D. Coursework

The following coursework should be completed to obtain a Ph.D. in Food Science. Specific classes are determined based on research interests and student needs, to be agreed upon by the student and advisor.

A total of 21 graduate course credits and 18 dissertation credits are required to complete the degree.

For 21 graduate course credits,

1. 9 credits from courses within the Department ≥600 level
   *Most one- or two-credit courses (e.g. journal club) do not count towards this requirement (except FS792A and FS796T).*
2. 2 credits Graduate Seminar (FS792A, 1 credit each, 2 separate semesters)
3. 1 credit Teaching Experience (FS796T)
4. 10 credits from within or outside the Department ≥500 level (including category 3 above, FS796T)

Transfer Credits:

- 6 credits can transfer from a BS degree, if they were not required for the BS degree
- Credits can be transferred from an MS degree to fulfill the 10 credits ≥500 level credits (category 4 above) and 1 credit of graduate seminar (category 2 above). Transferred credits should be a subject appreciably different from the courses taken at UMass.
- Your advisor must send a memo to the Graduate Program Director (GPD) with details of the courses to be transferred.

Graduate Seminar (FS792A)

All graduate students are expected to attend Graduate Seminar, usually held once per week every semester. Students who present a seminar receive one credit, while all others SAT. The topic of the seminar presentations will be detailed by the coordinator of the Graduate Seminar, currently Prof. McClements. In addition to its academic purpose it is also the one time each week that all graduate students gather together and an occasion for Department announcements/upcoming events, etc.

Teaching Experience (FS796T)

All graduate students are expected to complete 1 credit teaching experience (FS796T). You will need to discuss with your advisor for this requirement and the class will be assigned by Graduate Program Committee.
Exams

Written Comprehensive Exam

Content

- The written comprehensive consists of three exams, each taken on a separate day: Food Chemistry, Food Microbiology, & Food Engineering.
- Each exam consists of 6 questions; you must answer only 5 and pass four to pass the exam.
- Guidelines for studying are in another section of this handbook but generally you should study based on the undergraduate curriculum of UMass Food Science for each of these areas.
- Past Comprehensive Exam questions are available (sent via email prior to exam).

Timeline

- The written comprehensive is typically offered twice a year, in early January and late May/early June. Exact dates are selected a month or two before the exam.
- If you have a Food Science BS or MS degree, plan to take the written comprehensive exam after 1 semester. If you have no food science background, or are not a native English speaker, plan to take it after 2 semesters.

Notes

- The written comprehensive exam is written and graded by the faculty in the Department of Food Science.
- Results of Written Comp Exam will be used as a part of evaluating your overall degree progression by the faculty.
- You will have maximum two (2) chances to take Written Comp Exam.
Oral Comprehensive Exam

Content

- The oral comprehensive exam consists of two parts: a written grant proposal and an oral examination in which you present and defend the written grant proposal.
- The topic of the grant proposal will be different from, but can be related to, your current research.
- The format of the written grant proposal will follow the guidelines of a government grant proposal (such as USDA or NIH R21, to be determined by your committee chair).
- The formal of the oral examination will be a ~20 minute prepared presentation and defense of the grant proposal. Expect to be interrupted with questions; total exam time 1 – 1.5 hrs.
- The oral comprehensive presentation will be closed, meaning only committee members may attend.

Timeline

- The oral comprehensive exam should be completed after the written comprehensive exam, recommended to be within the first two years of a Ph.D. program.
- Week 0: Your advisor gives you a topic for the grant proposal
- Week 1: Review your grant proposal outline with your advisor for comments and feedback.
- Week 3: At the end of the third week, you should submit an independently written grant proposal to your committee.
- Week 4 or availability of the Committee: Present an oral presentation of the grant proposal to the committee.

Notes

- The oral comprehensive exam committee will consist of your advisor and three additional members, one of which maybe from outside of the Food Science Department – but this is not required. Your advisor is not allowed to be a chair for Oral Comp Exam.
- After completing the oral portion of the Comprehensive Exam, the committee chair will tell the Graduate Program Director who will notify the Graduate School of successful completion of the Comprehensive Exam.
- After passing both comprehensive exams, complete the form: “Nomination to candidacy for the doctoral degree” and submit to the graduate school.
**Dissertation Prospectus/Outline Exam**

**Content**

- The Dissertation Prospectus/Proposal Exam consists of two parts: a written Dissertation Prospectus/Outline and an oral examination in which you defend your Prospectus/Outline.
- The format of the written Prospectus/Outline will follow that of the Dissertation. Plan to use “paper format” in which each of your publications is formatted into a chapter, with summarizing introduction/conclusion sections. Include a table of abbreviations. A sample outline follows:
  - Chapter 1 – introduction (if written, a review paper can serve as the introduction)
  - Chapter 2 – first publication
  - Chapter 3 – second publication
  - Chapter X – work yet to be completed

Note that the format can be different from the above. For example if there are no publications/manuscripts prepared at the time of the Dissertation Proposal presentation, the proposal can include sections comprised of Review of Literature, Specific Objectives, Materials and Methods, Preliminary Results and Future Work. This format is also acceptable to the Graduate School. **Your advisor will provide guidance specific to their expectations.**

- Details on formatting guidelines are available from the Graduate School.
- The format of the oral exam will be a 20-30 minute presentation of the Prospectus/Outline. Expect to be interrupted with questions. The entire exam should be 1 – 1.5 hrs.
- The prospectus presentation will be closed, meaning only committee members may attend.
- Your advisor may help with organizing the presentation outline, but will not thoroughly edit the presentation – the presentation itself is part of the exam.
- Be able to verbally defend HOW and WHY you did (or plan to do) every aspect of your research.

**Timeline**

- Once the committee is selected by you and your advisor, the advisor emails the Graduate Program Director to appoint the committee through the Graduate School.
- Once your advisor approves your written prospectus/outline, it must be submitted to the committee before the oral exam (typically 1 week).
- Student must send reminder about location and date/time of exam a few days before the exam.
• The timing for the Dissertation Prospectus/Outline Exam varies widely, depending on students’ progress. It is recommended to have at least 1 publication and a significant amount of self-directed laboratory research by the time of the prospectus.

• The Dissertation Prospectus/Outline Exam should be passed 6 months prior to the Dissertation Exam (although this can be waived if needed by a memo from your advisor to the Dean of the Graduate School).

Notes

• The Dissertation Prospectus exam committee will consist of your advisor and at least two additional members, one each from within and outside of the Food Science Department.

• After passing the Prospectus exam, the cover sheet of the prospectus must be signed by all committee members and the department head or graduate program director, and submitted to the graduate school.
Final Dissertation Defense

Content

- The Final Dissertation Defense consists of two parts: a written Dissertation and an oral examination in which you present and defend your Dissertation.
- Plan to use “paper format” in which each of your publications is formatted into a chapter, with summarizing introduction/conclusion sections. Include a table of abbreviations. A sample outline follows:
  - Chapter 1 – introduction (if written, a review paper can serve as the introduction)
  - Chapter 2 – first publication
  - Chapter 3 – second publication
  - Chapter X – overall conclusions, and recommendation for future work on topic
- Details on formatting guidelines are available from the Graduate School. Templates can be downloaded from OIT: [http://www.oit.umass.edu/support/workshops-training/format-a-thesis-or-dissertation-microsoft-word](http://www.oit.umass.edu/support/workshops-training/format-a-thesis-or-dissertation-microsoft-word).
- The format of the Dissertation will be a 30-40 minute prepared presentation of the Dissertation. The presentation will be open, followed by general audience questions. After the open question period, the audience will leave and the committee will ask addition questions.
- Your advisor may help with organizing the presentation outline, but will not thoroughly edit the presentation – the presentation itself is part of the exam.
- Be able to verbally defend HOW and WHY you did every aspect of your research. It cannot be over-emphasized that you need to know what and why you did everything you present.

Timeline

- A memo requesting announcement of the defense must be submitted to the graduate school one month before the defense date. Please send following information to GPD:
  - Student’s full name & identification number, the degree, day of week/date/time/place of the exam, major, chair of committee and title of dissertation. Once submitted, the defense is announced in In the Loop, and the final checklists of degree requirements are emailed to the student.
- Once your advisor approves your written draft dissertation, it must be submitted to the committee before the defense (typically 1-2 weeks).
- Student must send reminder about location and date/time of exam a few days before the exam.
- The dissertation defense should be the last step in getting the Ph.D. This means that you should have submitted first drafts of each publication you intend to submit prior to defending your dissertation.
- There are three deadlines per year for awarding of PhDs (posted on the graduate school website). Generally, mid-December for a February degree; mid-April for a May degree; and the last working day of August for a September degree. These deadlines are firm.
However, you can defend your dissertation on any date – this just means if you submit your final paperwork in January, you will have a May date on your diploma. This doesn’t mean you have to stay in Amherst until May.

Notes

- **The Dissertation defense committee will be the same as your Prospectus/Outline exam committee members.**
- After passing the Dissertation defense, the signature page of the Dissertation must be signed by all committee members and the department head or graduate program director, and submitted to the graduate school. This must be on acid-free, 20 lb weight, white, 8.5 x 11” paper.
- The dissertation must be submitted electronically to the graduate school (see the graduate school website for details).
- The doctoral Degree Eligibility Form must be completed, signed by the Department Head and Graduate Program Director, and sent to the graduate school.
- A bound copy of your dissertation should be given to your committee chair. Binding can be done through Copy Cat, acmebook.com, UMI, or a number of book binderies.
Summary of Guidelines for NIH R21 Proposal

- Specific aims (1 page)
  - Executive summary of whole project
  - Includes motivation, objectives, expected outcome
- Research proposal (6 pages, not including references)
  - Significance
  - Innovation
  - Approach
    - For each specific aim: introduction, justification, research design, expected outcomes, potential problems & alternate strategies
  - Timeline
  - Future Directions
- Format
  - Arial, 11 point or larger, 6 lines per vertical inch or fewer
Summary of Guidelines for USDA NIFA Proposal

- Project Narrative (18 pages, not including references)
  - Introduction
    Include a clear statement of the long-term goal(s) and supporting objectives of the proposed project. Summarize the body of knowledge or past activities that substantiate the need for the proposed project. Describe ongoing or recently completed activities significant to the proposed project including the work of key project personnel. Include preliminary data/information pertinent to the proposed project.
  - Rationale and Significance
    Concisely present the rationale behind the proposed project. The potential long-range improvement in and sustainability of U.S. agriculture and food systems should be shown clearly. Any novel ideas or contributions that the proposed project offers should also be discussed in this section.
  - Approach
    a) A description of the activities proposed and the sequence in which the activities are to be performed;
    b) Methods to be used in carrying out the proposed project, including the feasibility of the methods;
    c) Expected outcomes;
    d) Means by which results will be analyzed, assessed, or interpreted;
    e) How results or products will be used;
    f) Pitfalls that may be encountered;
    g) Limitations to proposed procedures;
    h) A full explanation of any materials, procedures, situations, or activities related to the project that may be hazardous to personnel, along with an outline or precautions to be exercised to avoid or mitigate the effects of such hazards; and
    i) A timeline for attainment of objectives and for production of deliverables that includes annual milestones with specific, measurable outcomes.

- Format
  o Times New Roman, 12 point, 6 lines per vertical inch or fewer
- See a recent USDA NIFA RFA for details (italicized portions are reproduced from the 2013 RFA)
Written Comprehensive Exam Guidelines
Updated 11/2012

Food Processing

Engineering Principles
- Units Conversion
- Mass and Energy Balances: steady state, continuous, steam tables, specific heat
- Viscosity: Newtonian and non-Newtonian, effect of processing (shear)
- Fluid Flow: mass and energy balance, friction
- Heat Transfer: conduction, convection, radiation, steady state, transient
- Psychrometric Charts, Steam Tables, Thermodynamic properties of refrigerants
- Moisture sorption & phase diagrams
- Pasteurization, Sterilization and Enzyme Inactivation, D-value, Z-value, nonlinear kinetics.

Unit Operations
- Drying: evaporation, freeze drying, drum drying, spray drying
- Refrigeration & Freezing: refrigeration cycles, ice crystal formation
- Thermal Processing: heat exchangers (plate and frame, tubular, scraped surface)
- Retorting: continuous, still, water/steam
- Mechanical Transport and Storage: conveyors, silos, pumps, tanks
- Mechanical Processing: size reduction, sieve analysis
- Mechanical Separation: filtration, centrifugation, reverse osmosis
- Extrusion: single/twin screw, puffing

Additional Concepts
- Process Development: process development cycle, scale-up
- Sanitation Principles: sanitary valves/fittings, materials, CIP, disinfection (e.g. chlorination, UV)
- Quality Control: fill heights, color, weight, pH, density, on-line measurements, specifications
- Packaging Equipment: Polymer packaging, cans (double-seam), aseptic processing, form-fill-seal machines
- Commodity Processing: oils, dairy, grains, meat and meat products, juices, fermented foods

Suggested Reading

Suggested Classes
- FS 575 – Elements of Food Processing Engineering
- FS 561 – Food Processing
- FS 265 – Survey of Food Science
**Food Chemistry**

**Water**
- **Molecular properties**: The water molecule; Hydrogen bonding; water organization
- **Physicochemical properties**: Phase changes (gas-liquid-solid); Water-solute interactions; Solution properties; pH and pKₐ values, Water activity; Moisture sorption isotherms; Glass transitions
- **Freezing of water**: Physical, chemical, and biological effects of freezing
- **Analysis**: Methods to determine the amount and type of water in foods

**Carbohydrates**
- **Origin and Use**: Biological origin; Food Applications
- **Molecular properties**: Monosaccharides, Oligosaccharides, Polysaccharides; Structure and Nomenclature; Glycosidic bonds; Polymer structure
- **Chemical Reactions**: Oxidation, Reduction, Effect of pH, Maillard Reaction, Caramelization
- **Modification**: Enzymatic and chemical reactions to modify functional properties
- **Physicochemical properties**: Conformational changes; Interactions & Aggregation; Surface Activity
- **Functional properties**: Sweeteners; Humectants; Thickeners; Enzymes; Emulsifiers
- **Examples**: Monosaccharides, Disaccharides, Starch, Cellulose, Pectin, Alginate, Carrageenan, Xanthan, Guar
- **Analysis**: Methods to determine the amount and type of carbohydrates in foods

**Proteins**
- **Origin and use**: Biological origin; Food Applications
- **Molecular properties**: Amino acids (polar, non-polar, ionic); Peptide bonds; 1⁰, 2⁰, 3⁰ & 4⁰ Structure of proteins
- **Modification**: Enzymatic and chemical reactions to modify functional properties
- **Physicochemical properties**: Denaturation; Interactions & Aggregation; Surface Activity
- **Functional properties**: Enzyme activity; Thickening agents; Gelling Agents; Emulsifiers; Foaming Agents; Water holding properties
- **Examples**: Dairy, Egg, Meat, Plant Proteins
- **Analysis**: Methods to determine the amount and type of proteins in foods

**Lipids**
- **Origin and Use**: Biological origin; Food Applications
- **Molecular properties**: Fatty acids; Acyl Glycerols; Phospholipids; Cholesterol/Phytosterols; Structure, nomenclature
- **Chemical Reactivity**: Oxidation; Hydrogenation; Interesterification, Free radicals
- **Physicochemical properties**: Crystallization; Fractionation; Rheology; Emulsion formation
- **Functional properties**: Organoleptic; Health; Structural (plasticity)
- **Examples**: Plant, Meat, Fish, Dairy
- **Analysis**: Methods to determine the amount and type of lipids in foods, and lipid oxidation
Minor Components and Food Additives
- **Minerals**: Calcium, sodium, potassium, iron, copper, selenium, health aspects, physicochemical aspects
- **Vitamins**: Health aspects, physicochemical aspects
- **Nutraceuticals**: Carotenoids, Flavonoids; Health aspects
- **Colors**: Natural and artificial pigments
- **Flavors**: Natural and artificial flavors
- **Preservatives**: Chelating agents, antimicrobials, antioxidants
- **Texture Modifiers & Stabilizers**: Thickening, Gelling, Foaming and Emulsifying Agents

Food Tissue and Component Chemistry
- **Muscle, Plant, Egg, Dairy**: Composition, structure, organization, post-mortem or post-harvest changes, effects of processing

Suggested Reading
- Belitz, Grosch and Schieberle (2009). Food Chemistry, Springer, Germany

Suggested Classes
- Food Chemistry 1 (FS 541)
- Food Chemistry 2 (FS 542)
- Analysis of Food Products (FS 581)
- Survey of Food Science (FS 265)
- Biology of Food in Human Health (FS 270)
**Food Microbiology**

**Methods**
- **Staining Methods:** Simple stain, Gram stain, Fluorescent antibody stains, Dead/live cell stain
- **Detection and Enumeration of Microbes in Foods:** Microscopic counts, Plate counts, MPN, Fluorescent MPN counts
- **Rapid and Automated Microbial Methods:** Traditional Methods, Immunological methods, Molecular methods, Sub-species characterization of bacteria

**Microorganisms**
- **Indicator microorganisms:** E. coli, Clostridium perfringens
- **Characteristics of Foodborne Pathogens and their Toxins:** Clostridium botulinum, E. coli O157:H7, Clostridium perfringens, Vibrio parahaemolyticus, Vibrio vulnificus, Staphylococcus aureus, Vibrio cholera, Campylobacter, Listeria monocytogenes, Salmonella enterica, Bacillus cereus, Aflatoxin producing molds
- **Fermentative Microorganisms:** Lactic acid bacteria, Yeasts
- **Spoilage Organisms:** Bacterial spoilage genera and species, Yeasts, Molds

**Food Preservation**
- **Chemically- and biologically –based preservation**
  - Antimicrobials: Nisin and other bacteriosins, Benzoic acid, Parabens, Acetic acid and other organic acids, sorbates, propionic acid, nitrates
- **Principles of fermentation to preserve food products:** Dairy, vegetable fermentation
- **Physical methods of food preservation:** Retort, pasteurization, refrigeration, freezing, high pressure processing

**Additional Concepts**
- **Effect of intrinsic/extrinsic environmental factors on microorganisms growth and survival in foods:** Temperature, Oxygen, Aw, pH
- **Strategies of ensuring safe food:** e.g. HACCP, Hurdle technology
- **Principles of use of enrichment/selective media**
- **Microbial Growth:** Growth rate equation, Microbial growth curve

**Suggested Reading**
- Food Microbiology: An Introduction, T. Montville et al., ASM Press
- Food Microbiology: Fundamentals and Frontiers, M. Doyle, ASM Press

**Suggested Classes**
- Microbiology 310  General Microbiology
- Microbiology 312 Microbiology Laboratory
- Microbiology 390B  Introduction to Microbiology Laboratory
- FS 466 - Hygienic Principles of Food Handling
- FS 567 - Food Microbiology
- FS 580 - Foodborne Disease Agents
Travel Guidelines

- Ph.D. students are encouraged to present their research at scientific conferences and meetings. Examples of meetings include Experimental Biology, PittCon, Institute of Food Technologists, American Chemical Society, American Oil Chemists’ Society, Gordon Research Conferences among many others. Deadlines for abstract submissions vary and must be sought out by the student. Students must give their advisor ample time (~1 week) to review their abstract prior to approval and submission.
- Travel to a conference is considered part of work – you must behave professionally and participate in the conference beyond your individual presentation. It is not a paid vacation.
- Guidelines for what research can be presented (ie: published? submitted? about to be submitted?) must be agreed upon with your advisor.
- Guidelines for what type of presentation is supported must be agreed upon with your advisor. Generally, junior graduate students can present posters, but senior graduate students are encouraged to present oral presentations (except at conferences that don’t have an oral option, e.g. Gordon Research Conferences).
- Forms: Prior to travel, fill out a pre-travel authorization form: https://travelregistry.umasscs.net/
- Funding: The Department of Food Science will support Ph.D. student travel for accepted abstracts in the amount of ~$300 per student per year. The student’s advisor is expected to fund an additional $300 toward the travel costs. Travel costs exceeding $600 are expected to be covered by the student – it is therefore recommended to be thrifty. All receipts must be submitted to Mary immediately after the trip.
- Travel Scholarships: Many national conferences offer travel grants to students who are finalists in graduate research competitions (IFT, ACS, and others). Students are encouraged to seek these out. In addition, there are limited funds by the Graduate School to support student travel. Your advisor may nominate you for one of these awards, usually $300 per award, with preference to students who are finalists in a competition, near the end of their program, and who have not yet received a Graduate School travel award.
Annual Report
(Period of July 1 to June 30)

NOTE: Not all advisors require an annual report.

Student: _________________________ Starting Semester: ________________ Degree: _____

Committee Members: ____________________________________________________________________

Expected Degree Completion Date: ________

PhD Exam Timeline:

- Written Comprehensive
  Expected Date: ______ OR Completed Date: ______
- Oral Comprehensive
  Expected Date: ______ OR Completed Date: ______
- Dissertation Proposal
  Expected Date: ______ OR Completed Date: ______
- Dissertation Defense
  Expected Date: ______

Information to be provided by student (no more than two pages):

1. List of accomplishments (publications submitted/accepted/published, courses completed, seminars/research presentations, awards received (including being a finalist), involvement in on and off campus activities). Use the following citation format:

   Publications


   Presentations


2. BRIEF summary of research progress (i.e. what has worked; what has not worked; what would make it work better; equipment that would help your project?)

3. BRIEF summary of plans for the coming year, both in terms of your research and your intended "accomplishments."

Please email the electronic document by June 30th to your advisor